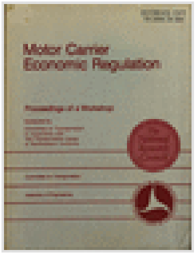

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MOTOR CARRIER ECONOMIC REGULATION

Proceedings of a Workshop

April 7-8, 1977
National Academy of Sciences
Washington, D.C.

Conducted by

Committee on Transportation
Assembly of Engineering
National Research Council
in cooperation with
The Transportation Center
at Northwestern University

NATIONAL ACADEMY OF SCIENCES
Washington, D.C. 1978

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PREFACE

This report consists of the proceedings of the workshop on Motor Carrier Economic Regulation held at the National Academy of Sciences in Washington, D.C., April 7-8, 1977. The workshop was conducted by the Committee on Transportation, Assembly of Engineering, National Research Council, in cooperation with The Transportation Center of Northwestern University. The U.S. Department of Transportation's Program of University Research sponsored the workshop.

Created by the National Academy of Engineering in 1970, the Committee on Transportation (now operating under the Assembly of Engineering of the National Research Council) advises the federal government on matters of transportation policy and technology.

The purpose of the workshop was to encourage contributions of research dealing with motor carrier economic regulation that could add substantially to the body of knowledge in that field. The committee is responsible for the preparation of these proceedings.

Following the introduction, the workshop was conducted over a two-day period during which scholarly papers were presented in the areas selected for discussion: The Structure of the Motor Carrier Industry: Empirical Findings About Cost and Demand; The Effect of Regulation Under the Current Regulatory Scheme; Cross Subsidy Issues; and Policy Alternatives and the Effects of Regulatory Changes. The papers were critiqued by recognized experts in the regulatory field, and, in addition, an evening session was held at the close of the first day where officials from labor, government, trade associations, and user organizations presented their views on motor carrier economic regulation.

These proceedings provide the individual views of the speakers and workshop participants. They do not necessarily represent the views or policies of the National Research Council, its Committee on Transportation, Northwestern University, or the U.S. Department of Transportation.

A list of participants and their affiliations is included in this report on pages 637-643.

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WELCOME

C.D. Perkins
President
National Academy of Engineering
and
Chairman
Assembly of Engineering
National Research Council

I would like to take this opportunity to welcome the participants to this important meeting on behalf of the National Academy of Sciences and the National Academy of Engineering, as well as the National Research Council, in which the Committee on Transportation is a very important element.

We are very happy that the Committee on Transportation has been able to arrange this workshop on Motor Carrier Economic Regulation in cooperation with the Northwestern University and the Department of Transportation.

We have great interest and some experience in various problems of transportation. Just recently we dealt with some of the aspects of air transportation, which is, as you all probably know, involved with regulatory problems that are unresolved at the moment. The question of what the airline industry is -- whether it should be treated as a public utility or as free enterprise -- is being argued right now in the Congress. I gather that the motor carriers have some of the same problems.

We look forward to your participation during the next days. To say that it is a timely subject is obviously an understatement. I am confident that this outstanding group of speakers and discussants will add substantially to the body of knowledge that deals with motor carrier economic regulation.

INTRODUCTION

James P. Romualdi
Director
Transportation Research Institute
Carnegie-Mellon University

I can really think of few subjects as difficult to deal with as that of motor carrier regulation. I suppose we could argue, if we want to be quite accurate about it, that if we were here to grapple with right-to-life, capital punishment, or strategic arms limitation treaties, we possibly could find issues that are more complex and deeper rooted. I doubt, though, that they would have more data. But deal with it we must.

There are thousands of miles of highways, railways, and waterways upon which countless thousands of vehicles move every day. Hundreds of thousands, even millions of people, are affected by this enormous network either directly or indirectly. We like to think that we understand it, but no doubt we fool ourselves. We know that if we alter one piece of it, all of the other segments are affected, and I doubt that we know very much about what those effects really are. Yet alter it we will, because it is a man-made system, operating under man-made rules, and as long as men rule, the system will be tampered with, either through technology or legislation.

There is an old saying: "May my enemies live in interesting times," and controversy is interesting. But how we long for a well-ordered, linear world where progress is measured in simple terms. Clear a field of trees and we see progress. We use the trees to build a barn and we see more progress. We use our talents and training to erect bridges, to build cities, or to heal bodies, and most people affected applaud progress, but in a complex, interconnected society all things are not that simple. They are, unfortunately, interesting.

Furthermore, we have an abundance of two troublesome ingredients. We have colleagues who frequently disagree with our definition of progress, and we have data, a magic substance that can be molded apparently to fit different viewpoints, and these two ingredients rob us of our definition of progress, and that is interesting. But the system we are dealing with touches upon the daily welfare of almost everyone in this country and quite a few abroad, and that is not just interesting -- it is serious.

All we can do, then, in the face of this seemingly intractable problem is to try as much as we can to understand it, and by understanding it, we mean to determine as well as we can what happens to all parts when one part is altered. In short, who is affected, who benefits, and who pays?

In answering those questions we might get down to the fundamental reasons for which political decisions are made, but at the very least we can provide those who make the decisions some understanding of the costs of consequences of making those decisions, whatever they may be.

This, then, is the purpose of this workshop or conference. It is a research conference--not a forum. The Committee on Transportation of the Assembly of Engineering, in cooperation with the Department of Transportation, has joined with the Northwestern University to develop a presentation that will enable us to better understand the consequences of more or less economic regulation. We hope that it is going to be a successful conference. We hope that your time is well spent.

Now, to start the conference off, I would like to introduce Dr. Leon Moses of Northwestern University, who is our program chairman and the man who made this conference really possible.

REMARKS BY PROGRAM CHAIRMAN

Leon N. Moses
Director
The Transportation Center
Northwestern University

A number of people made this conference possible. I would like to mention those people at Northwestern to whom I am personally indebted and who worked very hard at reading and reviewing papers, as well as making arrangements so that this conference could occur. They are Ms. Dian Younker, Professor Robert Baesemann of the Graduate School of Management, and Professor Ronald Braeutigam of the Department of Economics. All three are on the staff of The Transportation Center at Northwestern.

My involvement with this conference began at the National Academy of Sciences Summer Studies Center in Woods Hole, Massachusetts, in August 1976, with a planning session of the Committee on Transportation concerning this motor carrier economic regulation workshop. I found that the committee was, and continues to be, interested in the problems of intercity freight. Its members recognize that these problems involve much more than technology. They involve the nature of competition and of government regulation.

It is not my place to advocate either increased reliance on competition or greater regulation in transportation. My job was to help organize this conference and to encourage more thinking about the extent to which market forces can be relied on to achieve greater efficiency and perhaps even greater equity in transportation. It may be that government regulation, subsidization, etc. are inescapable in transportation. The issue remains to be resolved. The papers in this conference do not achieve the objective of finding a solution, but they do provide more insight than we have had, and even raise some questions that have not been raised before.

I wish to express my gratitude for the very great support I have received from the staff of the Committee on Transportation and from others in the National Research Council in arranging for the conference. The experience has been highly worthwhile. We all learned that a good deal of excellent work had already been done but that much more was needed. We hope that this workshop stimulates new people to write and do research in this vital area of competition and regulation in transportation.

SUMMARY

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INTRODUCTION

Recent developments in the United States transportation industries occasion reflection on their regulation. New legislation, energy considerations, and promising new findings in the transportation technical literature make it a propitious time for a workshop on the basis of public policy relating to motor carriers. The papers presented include some of the most recent research on motor carrier regulation and also identify unfilled research needs. In preparing this summary of the papers, three goals have been adopted. They are to:

(1) present the motivation and purposes of the conference;
(2) encourage readers of all kinds to use the papers in this volume to develop their views on motor carrier regulation; and
(3) make the technical papers accessible to readers who are not professional economists.

Before discussing the material covered during the workshop, it is considered useful to review some of the basic concepts that are used in several of the papers. Although the various authors present diverse views on public policy, they do rely generally on a common set of principles to develop their arguments. It is hoped that this brief review of the underlying basic economic concepts will be of assistance to the reader.

Regulatory reform is currently of concern in the motor carrier industry. A variety of concepts and issues characterizes the debate over the advisability and extent of reform. Such issues can be better understood by the recognition that some general principles are used implicitly by the advocates of different positions.

Monopoly occurs when only one firm serves a market. When a monopolist controls the entire quantity available in the market, he is in a position of power to influence the market price and quantity of the product or service to his advantage. Thus, in theory, a monopolist may use his dominant position to act against the interests of society as a whole. Many remedies, including regulatory rules and antitrust laws, can be applied when a monopoly imposes on society's interests. In some cases, the appropriate remedy reflects the fact that a monopoly arose by virtue of historical accident, extraordinary circumstances, or pure chance. When cases like these arise, antitrust measures, like forced divestiture, suspension of patent rights, or mandatory sharing of technological information, have been used to restore competition in the market. The possibility that these measures may be implemented could create an environment in which markets allocate society's resources well. In other circumstances, the actual use of these measures may be required to create such an environment. In either case, the success of antitrust policy usually obviates further government intervention into the process of resource allocation. When policy makers determine that the free market, notwithstanding assistance by antitrust measures, cannot be relied on to allocate society's resources well, direct government intervention may be employed.

Unfettered competition in these cases may lead to a monopoly, the dominance of a cartel that causes the same kinds of problems that a monopoly does, and chronic and costly instability. When nature and technology combine to assure monopolization, cartelization, or intolerable instability, the market's failure forms the basis for a "natural monopoly" and is frequently relied upon.

Much of the discussion at this conference concerned the relevance of the concept of natural monopoly to motor carrier regulation. Typically, economists define two kinds of natural monopoly. The first arises when technological conditions permit only one firm to produce a service where there are no close substitutes. For example, if the only harbor for an island can accommodate only one docking operation, then nature prevents competition among many firms, and the one feasible firm is a natural monopoly.

A second kind of natural monopoly occurs when more than one firm could provide service, but competition among a number of firms could have consequences that policymakers find undesirable. Perhaps only one firm will survive because of technological advantages relating to size. Alternatively, a number of firms might coexist by colluding with one another, instead of by competing independently. Colluding firms may charge prices that are higher than unit production costs; furthermore, the unit costs under a collusive agreement may be higher than the unit costs that would be incurred by a single firm serving the whole market when there are technological advantages that depend on size.

As this second notion of natural monopoly suggests, one possible basis for regulation occurs when a firm's cost per unit of output declines as the level of output increases. Economists refer to this condition as "economies of scale."

In the case of trucking, the concept of natural monopoly, defined in the strictest sense, applies to the industry only if all motor carriers can be regarded as providing the services of the same quality, if there are no close substitutes for those services, and if scale economies are present up to a level of output that satisfies the quantity demanded at any price such that the firm earns at least normal return on its investment.

OVERVIEW OF THE FOUR SESSIONS

The workshop was organized into four successive, related, discrete sessions. The issue of economies of scale appears to be central to the formulation of appropriate public policy in the motor carrier industry. The papers in the first session of these proceedings focus on this issue.

If other transport modes can profitably provide their services at prices which might induce many shippers to employ those modes, then the motor carrier industry does not satisfy the definition of a natural monopoly. If there are no economies of scale in trucking, or if any economies of scale that do exist for a single firm are exhausted at output levels that are much less than the level of output demanded for the whole market, then the natural monopoly argument based on economies of scale would also lack support.

In the second session the papers examine some effects of the current scheme of regulation. Frequently, economists measure the effects of regulation in terms of economic efficiency and equity. Resources are allocated efficiently when an additional unit of output (or service) is supplied whenever those who want to purchase the incremental output place a value on it that at least equals the additional cost incurred in its production. The value consumers place on the additional unit of service is represented by the price they are willing and able to pay for it. If policymakers decide that certain consumers do not have sufficient purchasing power, given their income, they may attempt to redistribute income so that these consumers have more purchasing power.

If policymakers find distribution of income acceptable, then resources are allocated efficiently whenever all consumers who are willing and able to pay an amount at least as large as the cost of the additional unit (the marginal cost) do in fact get service. Those who do not value the service as much as the marginal cost would not receive service when resources are efficiently allocated.

A second criterion used in evaluating regulation concerns some notion of fairness or equity that a regulatory authority wishes to impose in certain markets. A regulatory agency may wish to regulate the level of profit earned by a firm, to prevent it from earning too much or too little profit. This would be an equity constraint. As another example, a regulator may feel that it is unfair for shippers on a low density route (i.e., one which has low volumes of freight transport) to pay more than a shipper on a high density route of the same length, even if an economically efficient allocation of resources would require that different prices be charged. This practice, called rate averaging, is common in transportation as well as in other regulated industries.

Efficiency and equity considerations are closely related to one another as was mentioned in the papers. While equity considerations are usually imposed on the basis of social judgments, the extent to which resources can be efficiently allocated can be crucially affected by the presence of equity constraints. In some cases equity constraints may not lead to a decrease in economic efficiency. However, equity constraints may impose costs in terms of economic efficiency. For example, the implementation of rate averaging may mean that along one route not all consumers willing and able to pay a price at least as large as the marginal cost will get service, while on another route, some customers may receive service even though the marginal cost exceeds any price they are willing and able to pay. Other examples of the interaction between equity objectives and economic efficiency will be cited below.

After the general questions of natural monopoly, costs, and regulation are dealt with in the first two sessions, the papers in the third session consider some equity issues in more detail. Government intervention into markets often reflects a concern that some economic agents possess considerable power over the market's outcome. In the case of freight transportation, this issue concerns the possibility that the residents of small towns, small shippers, and the shippers of small shipments might encounter large (and perhaps unfair) disadvantages under either the present or some reformed system of regulation. It is sometimes argued that their size might prevent them from acquiring adequate service at reasonable rates in an unregulated environment in which large, powerful carriers and shippers operate.

In the final session, the prospects for regulatory change are surveyed. Since the first three sessions deal with the reasons for and against regulatory reform, some of the alternatives for reform and the possible effects that might develop are discussed. As part of the background, a somewhat detailed look at the motor carrier industry and at the Motor Carrier Act of 1935 is included.

Historically, the presence of numerous potential entrants into the motor carrier industry motivated the regulation of both tariffs and entry. If minimum rates are imposed in the absence of entry controls, the number of firms entering the industry could exceed the number required to satisfy demand at regulated tariffs. Chronic excessive supply causes some firms to fail. At times, the resulting potential instability has been used to justify entry restrictions in conjunction with rate regulation.

Similar reasoning reflects unfavorably on the use of entry controls without rate regulation. In the absence of potential entrants, firms that enjoyed the privilege of operating without rate regulation extract monopoly profits. As a consequence, it is often argued that firms securing route certificates should be subject to rate controls to prevent earning excess profits. Kolins argues that "Entry control is irretrievably related to the commensurate control of rate levels which together are designed to respond to the 'privilege-duty' theory of regulation."[1]

In summary, Kolins notes that four of the possible explanations for the decision to regulate motor carriers include:

(1) the protection of traditional pricing schemes, which include high prices for high-value service and low rates for bulk commodities;

(2) more gnerally, the protection of the railroads' financial position;

(3) imposition of stable prices and firm sizes in order to benefit both shippers and carriers; and

(4) a final explanation for the regulation of motor carriers that rests on the simple premise that systems of regulation are subject to inertia.

According to Pegrum (1975):

> The alternatives, as seen by the Coordinator (of transportation) at this time, were to abandon the regulation of transportation to the antitrust laws or to subject all of the agencies to the same type that had been developed for the railroads. No analysis was made of the fundamentally different economic characteristics of the various agencies, nor was any consideration given to a program of regulation that might be in accordance with these differences. Instead, legislation was recommended that would regulate common carriers by motor essentially in the same way that railroads were controlled and force the other motor carriers as much as possible into the same mold. This became the basis of the Motor Carrier Act of 1935, which has survived with minor modifications to the present time.[2]

Questions concerning the present system of regulation are currently the focus of considerable controversy, and the remainder of the papers address recent work relevant to the discussion of regulatory reform. The topics include the structure of the motor carrier industry and some of the economic factors arising as a result of existing regulation.

Under the current structure many different kinds of freight motor carriage and regulation exist in the United States. Some carriers are virtually unregulated, while others are subject to control of entry and exit, rates, some financial transactions, and conditions of ownership. Professor Paul Roberts, in his paper, describes some of the structural characteristics of the industry, and his estimates indicate that approximately 45 percent of the ton-miles of motor carrier intercity freight travels under ICC regulation. He provides data showing the extent of the activity for each of the three basic kinds of carriers regulated by ICC: (1) regular route common carriers that haul general commodities over well specified routes; (2) irregular route carriers that transport special commodities under an authority that allows haulage from a point to some defined area; (3) contract carriers that provide specialized service, typically under a long term contract which specifies origin and destination.

Professor Roberts notes that an additional 12 percent of intercity freight is regulated by state or local commissions. This means that about 58 percent of intercity freight traffic is regulated by some kind of agency. Of the remaining 42 percent, exempt agricultural haulers generate 11 percent of the total, and private carriers (those that may only haul their own product) account for 31 percent. He also points out that more than 20 percent of the intercity ton-miles are generated by owner-operators.

In 1976, there were 2,634 firms providing motor carrier service under ICC regulation. Of these, 971 were regular route common carriers.[3] Professor Roberts suggests that owner-operators and private carriers are exerting increasing competitive pressure on regulated rail and motor carriers. Owner-operators appear to have high rates of equipment utilization and relatively low wage rates. The low wage rates result from the fact that, while some independent operators are Teamster members, no union represents the operators in their dealings with those to whom they sell service. As a result, their costs per ton-mile are much lower than Class I and Class II motor carriers and only slightly higher than for rail carriers.[4] Because service times for trucks are typically shorter than for rail carriage, unregulated motor carrier rates slightly higher than rail rates may draw traffic to motor carriers, which would have gone by rail in the absence of owner-operators. Professor Roberts also notes that owner-operators occasionally operate under ICC special commodity rates. Because such rates are likely to be lower than regular common carrier rates, some traffic might be diverted to owner-operators. Since 1965, intercity ton-miles for regular route carriers have grown by only 19 percent, while specific commodity carriers as a whole have increased their ton-miles by 183 percent.[5]

It is not surprising that regulated carriers are also alarmed at the growth of private carriage. Frequently, shippers find development of their own private fleet less costly than reliance on common carriage. As Professor Roberts states, "A typical strategy is to (privately) haul the higher rated commodities and the regular hauls, but to leave the lower-rated commodities and overflow for the regulated carrier."[5]

THE STRUCTURE OF THE MOTOR CARRIER INDUSTRY: EMPIRICAL FINDINGS ABOUT COST AND DEMAND

Diverse and sometimes contradictory findings characterize the literature on economies of scale in trucking. In the first session, Chow's review of a number of these studies describes the extent of the disagreement. Because of the significance of the issue of scale economies, it is important to incorporate the newest techniques developed in production theory and econometrics into empirical research on motor carriers.

Among the papers presented in Session I, three studies deal with scale economies: "The Cost Structure of the Regulated Trucking Industry" by Klem, "Hedonic Costs and Economies of Scale in the Regulated Trucking

Industry" by Friedlaender, and "The Cost of Trucking Revisited" by Chow. Each of these papers addresses the existence and extent of scale economies in the regulated motor carrier industry.

Chow attempts to ascertain the dependence of total operating costs on the total number of shipments, the average weight of a shipment, and the average length of haul per ton. The data were collected from the Class I carriers in nine operating regions of the country. Each carrier in the sample earned at least 75 percent of operating revenues from intercity general freight operations. Chow suggests that economies of scale are present in the less-than-truckload (LTL) segment of the general freight motor carrier industry, and that constant returns to scale are present in the totally loaded segment. In LTL operations, scale economies appear to be strongest in the short and medium haul, and weakest, if they exist at all, in the long haul.[6]

Klem attempts to find a relationship between the total cost for a trucking firm in 1971 and the following determinants: the number of shipments carried in the year, the average length of haul for the firm in the year, and the average weight of the shipment. Like Chow, Klem includes a set of variables to identify geographic area, and concentrates on Class I carriers that had at least 75 percent of their revenue generated from intercity freight movement. Although he examines many variations of this basic line of investigation, his central conclusion is "the trucking industry exhibits economies of scale only at the size range that corresponds to the smallest Class I carriers...[and that] diseconomies of scale are evident for firms with revenues above approximately $10 million per year."[7]

While the approaches of Klem and Chow are quite similar, the paper by Friedlaender is markedly different in two respects. First, she recognizes that the prices paid for inputs (called factor prices) should be included explicitly as determinants of cost. Her model includes factor prices for labor, fuel, capital, and purchased transportation (mainly rental vehicles). Second, she attempts to account for different technologies of production, truckload [TL and LTL, average length and weight of haul] in a manner that is consistent with recent work in the theory of production. Rather than adopting simplistic specific forms for production functions, she uses a very general representation (called the translog formulation). Use of the data with this general specification enables her to test empirically the validity of simpler models. She specifically rejects the proposition that the ratio of the level of one input to the level of another will be constant over a wide range of output when the prices for the inputs remain constant.

The major conclusions of her work are summarized in her statement:

> Because diverse operating rights permit firms to utilize equipment more efficiently and undertake longer hauls per trip, it is likely that any observed economies of scale are of a regulatory rather than a technological nature. In particular, larger firms have lower costs because they have more diverse operating rights than their smaller

> competitors. Consequently, in the absence of entry and operating restrictions it is likely that small firms would be able to enjoy the same economies of haul enjoyed by large firms. Thus it is unlikely that the cost structure of different-sized firms would be significantly different.[8]

Friedlaender concludes that with deregulation motor carriers "could be expected to face U-shaped average cost curves in which the minimum average costs would be reached at a low level of output, [and that] it is likely that the trucking industry would be competitively organized, with the efficiently sized firm being quite small relative to the relevant market."[9]

The importance of including factor prices in cost estimation was emphasized in the discussion of the three papers by Duncan.[10] He pointed out that the tests for scale economies conducted by Chow and Klem are difficult to interpret because: (1) they assume that the systematic influence of factor prices on total costs can be completely described by accounting for regional variations, and (2) they use a very simple specification of the cost function (Friedlaender's paper rejected, on a statistical basis, the reasonableness of such a specification).[11]

As was pointed out at the workshop, the more sophisticated technique of Friedlaender requires more data which are sometimes inaccessible. For example, she calculates a single wage rate from total wage bill data, and it is not clear that this statistic is an adequate summary of the various wages firms pay for different kinds of labor.

The difficulty in interpreting regulatory cost data is emphasized in the paper by LaLonde entitled "An Analysis of the Functional Costs of Motor Carrier Operations." LaLonde argues that rates ought to be related more explicitly to costs. However, he points out that "true" costs are not easy to identify, given the kinds of cost allocation schemes often used by the ICC. The LaLonde paper provides some interesting insight as to just how complicated cost accounting has become in this regulated industry.[12] Friedlaender's paper is particularly important, because it works within the confines of regulatory data and uses well developed theory to strip away certain effects of regulation to infer how an unregulated industry might function.[13]

THE EFFECT OF REGULATION UNDER THE CURRENT REGULATORY SCHEME

Do Firms Minimize Costs?

In Session II, Russell Cherry's paper, "The Operating Ratio Effect and Regulated Motor Carriers," contributes to a body of economic literature concerned with the relationship between efficiency at the level of the firm and regulation. Economists have often noted that regulated firms may have an incentive to combine factors of production (i.e., inputs) inefficiently in producing output. Specifically, they use the standard of "cost-minimizing behavior," which is attributed to a firm that produces any given level of output in the least costly manner. Although economists usually assume that unregulated firms behave in this way, there are theoretical arguments that suggest that firms may respond to regulation by using resources inefficiently. The operating ratio form of regulation may provide the basis for this kind of concern about motor carriers. In particular, the operating ratio ties revenues to operating expenses (including labor costs), suggesting that this kind of regulation provides firms with an incentive to hire too much labor relative to other factors of production in providing any level of output. As a result, firms that maximize profits subject to an operaitng ratio constraint may not minimize costs.

Cherry derives such a theory and tests it empirically using a cross section of regulated carriers. He rejects the hypothesis that motor carriers are cost minimizers and offers evidence to support the proposition that the carriers use too much labor to be cost minimizers in their operations.

In a discussion between Braeutigam and Friedlaender during Session II, it was claimed that Cherry is not able to prove that failure to minimize cost is the consequence of operating ratio regulation. His empirical finding is simply an observation consistent with the proposition. Friedlaender pointed out that failure to minimize costs could arise from the operating ratio constraint or from a host of other possible causes associated with regulared industries. Among other things, this concern arises with Cherry's work because of his description of motor carriers as firms that maximize profit subject to an operating ratio constraint. In reality the operating ratio is applied to rate bureaus rather than individual firms. In other words, the operating ratio applies to a whole set of firms instead of to any one firm. Thus, individual firms may not respond directly to the operating ratio and this is inconsistent with Cherry's theoretical model.[14] However, the relationship between the regulatory agency, rate bureau, and individual carriers gives rise to many open research problems. A study analyzing the relationship between operating ratio constraints, rate bureaus, and the cost structures of individual firms would make an important contribution to an understanding of motor carrier costs and economies of scale.

Does Regulation Lower Rates?

One important hypothetical question about motor carrier regulation is: How has the regulated motor carrier industry performed under regulation in contrast with what its performance would be like without regulation? While the question is difficult to answer for the United States, consider the case of Canada.

The Canadian trucking industry may offer some evidence in this regard because each of the ten provinces has established a different regulatory scheme. In his paper, "Regulation and the Level of Trucking Rates in Canada," Maister questions the earlier work by McLauchlan (1972), Palmer (1973), and Sloss (1970, 1975), which concludes that regulation in Canada has raised rates. Maister argues that each of these studies involves the regression of "revenue per ton-mile" on, among other variables, one that represents regulation in a dichotomous fashion. Maister argues that this characterization is too simplistic for Canada, since some provinces regulate both rates and entry, others regulate rates but not entry, and one province regulates neither. He uses a set of variables to characterize the different forms of regulation. He then tests the effects of regulating only rates and of regulating both rates and entry. He concludes that the tests do not resolve the issue as clearly as the earlier papers would have us believe. In fact, his results are "somewhat inconclusive but seem to suggest that there is no strong relation between rate regulation and rate levels."[15] Non-price competition and interregional differences in service quality may be the cause of this ambiguity.

The Interface Between Regulated and Deregulated Zones

One provision of the Motor Carrier Act of 1935 specified that freight movements by motor carriers within a certain area including and adjacent to a municipality (known as a commercial zone) are exempt from federal regulation. In Allen's paper "The Need for Redefining the ICC Commercial Zone: The Case of Philadelphia," the interaction between the exempted zone and the surrounding regulated zones is examined. Allen discusses many aspects of the existence of a commercial zone and the possible effects of expanding the zone in the specific context of Philadelphia. He uses survey data to ascertain the reasons that shippers would like to take advantage of an expanded commercial zone area. Many shippers responded that they would like the increased flexibility in carrier selection, better service, lower rates, direct delivery to more distant points, and potentially lower costs to customers, although some shippers claimed the current service is satisfactory as it is. Allen suggests that the specific definition of the commercial zone in Philadelphia is outmoded, because, in reality, primary commercial activities for the metropolitan area cover a much greater area than the zone itself. In arguing for an expansion of the zone, Allen discusses some interesting historical facets symptomatic of the meeting of regulated and unregulated activities. With regard to the broad question of regulation, Allen's work reflects on the issue of service quality in the absence of regulation.

CROSS SUBSIDY ISSUES

The relationship between pricing and industry structure is especially important in regulated industries where there are numerous potential entrants. In Session III, the paper by Roberts and Simmie, "Profits, Price Discrimination, and Entry: The Motor Carrier Industry in Differing Regulatory Environments," describes theoretical principles relevant to pricing and efficient resource allocation in conjunction with different kinds of industry structure. Some background for their paper deserves mention here.

A paper by Baumol and Bradford (1970) addresses the case of a multiproduct firm with economies of scale and a monopoly in each of its markets. For the sake of argument, assume rail transport services are supplied by such a firm. Basic economic principles show that resources would be allocated most efficiently when prices are set equal to marginal costs. At these prices (sometimes called "first best" prices), scale economies imply that total revenues will not cover total costs, causing the firm to operate at a loss. As a result, economists have introduced the notion of "second best" pricing, where prices are set as efficiently as possible so long as the firm earns at least a normal economic profit. Second best prices deviate from marginal costs. This deviation is characterized by the "Baumol-Bradford inverse elasticity rule." The basic principle is stated here for the case in which all of the demands for the products provided by the firm are independent of one another, i.e., a change in the price of one product does not affect the quantity demanded for any other product. Then the size of the deviation of second-best prices from marginal costs should vary inversely with the elasticity of demand in each market.

Roberts and Simmie pursue this line of investigation and raise questions about the tenability of entry controls (especially when a portion of the motor carrier industry is unregulated). Their work also makes a point about scale economies in trucking. If there are no such economies, optimal regulation would generally allow motor carriers to earn rates of return on capital in excess of the normal rate. On the contrary, if there are scale economies in trucking, motor carriers should only earn a normal return on their investment.

Roberts and Simmie also argue that the theoretical basis for rate and entry controls for motor carriage does <u>not</u> provide a defense for the prevailing regulatory scheme. Present ICC policy is not, in all likelihood, based on techniques developed from second-best pricing rules. Informational requirements (e.g., elasticities and cross-elasticities of demand) for efficient pricing exceed the present data base of the ICC, and, in fact, it is difficult to believe that those requirements can ever be fully met. The paper in the same session by Daughety and Inaba, however, develops a theory and a data base for determining some of these elasticities.

In her comments as a discussant in Session III, Friedlaender pursued this point further. She noted that the notion of cross subsidy is ambiguous in the motor carrier industry, particularly since trucking firms are actually multiproduct firms. No clear definition of average cost for each kind of service is possible in this case, because some motor carrier costs are incurred simultaneously in the provision of two or more services. Friedlaender would like to say that, "a cross subsidy exists if the price-marginal cost markup of type A shipment relative to type B shipment is different from that ratio or relationship that would exist in a deregulated environment."[16] She observed that if marginal costs are higher over more lightly traveled routes (as her own paper in these proceedings suggests) and if the elasticity of demand is low for those shipments (as at least casual empiricism may suggest) then with deregulation it would be plausible to expect efficient prices to be higher for low density routes. The real question is not whether low density routes would be served in the absence of cross subsidy, but rather at what prices.

These basic points are consistent with some of the observations in the paper by Stuart and Sweeney entitled,"Shippers of Small Shipments Look at Motor Carrier Economic Regulation." The authors argue that the term cross subsidy is often used without definition. They explain two of the implicit meanings frequently intended when the term is mentioned. These are: (1) that larger shipments often subsidize small shipments over a given route, and (2) shipments along high density (heavy traffic) routes subsidize shipments over low density routes. In their terminology, as long as rates and charges at least cover the variable costs of handling, then a shipment is not being subsidized. Using this definition of cross subsidy, they argue that there is no conclusive evidence to support the proposition that larger shipments subsidize small shipments. Regarding their second point, the authors argue that the present ICC accounting procedures improperly inflate the operating ratios on small shipments. Consequently, low density routes, which are often characterized as low in profit, may actually be quite profitable when the proper cost descriptions are used.[17]

Some Effects of Entry Restrictions

Given its authority, the ICC determines when entry into regulated interstate markets is allowed and which of the applicants may enter. A prospective entrant must obtain a Certificate of Public Convenience and Necessity from the commission. In the paper by Kolins, "The Regulatory Program: The Effect on Entry, Backhaul and Energy Consumption," some of the results often attributed to the control of entry are examined. Kolins describes the review of applications for certificates as a tenuous judgmental exercise in which the commission clings to the notion that an application should be denied if an existing carrier is able to perform the service. He describes a number of effects.

(1) Entry contol has made it difficult and expensive to obtain a certificate. The authority to operate represents a valuable piece of property, and Kolins cites examples of the high prices paid by some firms for operating rights. Small firms are likely to be at a distinct disadvantage when attempting to purchase operating rights from other firms.

(2) The commission is inflexible and slow in acting on applications for certificates. When a shipper changes the product it ships by a regulated carrier, the carrier may be required to post a new rate and endure substantial bureaucratic delay in order to continue carrying the modified product.

(3) Motor carriers are often unable to provide service as cheaply as possible, because entry restrictions prohibit carriage over the most direct route by a single carrier or because a firm is not able to carry certain kinds of freight on its backhaul.

The extent of the backhaul problem is addressed in the paper by Tye, et. al., "Load Factors of Motor Carriers on the Interstate Highway System: Consequences for Regulatory Policy." The authors constructed a data set from ICC data for intercity motor carriers, including vehicle miles, load factors, and length of haul by equipment type and by type of operator. Among other things, they note that private carriers tend to operate with lower load factors (representing the percentage of available shipping floor space used) than ICC regulated carriers and exempt carriers. This appears to be true for all types of equipment, including vans, refrigerated loads, flats, and tanks. The authors suggest that these low load factors (ranging from 60 to 70 percent) could be raised if private carriers were allowed to lease their services to common carriers. They believe that this would increase load factors for common carriers as well.

While these conclusions seem plausible, Noll, in his comment on the paper, questioned the prediction that relaxed restrictions for private carriers would increase load factors, because no statistical tests have been performed with the data to show that the differences in load factors are statistically significant for various carrier types, and no underlying theoretical model is provided to support the predictions. Nevertheless, a data base has been collected that would be useful for future work.

In summary, the existence of the high market values attached to operating rights undoubtedly indicates the presence of extranormal profits resulting from entry control and regulated rates. Some discussion about the distribution of these extranormal profits between labor and the firms occurred in Session IV and in the evening session, particularly in the comments of Mr. Fitzsimmons. These comments are included in the next section of this summary. The role of entry control in conjunction with rate regulation in the achievement of certain equity objectives, such as rate averaging, is also addressed in the next section.

POLICY ALTERNATIVES AND THE EFFECTS OF REGULATORY CHANGES

What Does Regulation Accomplish, And What is the Cost?

Previous sections included discussion of some of the plausible and important reasons for imposing ICC regulation on motor carriers. Among the traditional justifications for regulation were protection of the railroads, maintenance of stability, and concern for society's welfare. Historically, these may have been the reasons for initiating regulation, but their relevance to present public policy rests on their validity under prevailing and expected future economic conditions.

Regulation and Monopoly Power

As mentioned earlier, the issue of scale economies is important because of its bearing on whether firms might be able to exercise monopoly power without regulation. Although there is considerable controversy over this point, Chow, Nelson, and Paul Roberts seem to agree that if economies of scale exist anywhere in the motor carrier industry, they occur in less-than-truckload shipments over short distances. The statistical results of Klem and Friedlaender do not support a finding of scale economies over the observed operating levels of output and support the prediction of workable competition in an unregulated trucking industry. None of the papers presented at the conference suggests that such economies are associated with long hauls and/or full truckload carriage. Muskin questions these findings on the grounds that demand considerations and managerial virtuosity might produce the same result as would economies of scale.

Without economies of scale in the industry, however, it is difficult to imagine how monopoly power would be exercised without regulation. As Noll points out in his comments on the papers from Session IV, even if economies of scale exist, this does not by itself indicate that monopoly power would be exerted in any case. The important question concerns the ability of two firms, or 25, or 50, or 1500, to survive at levels of output large enough to enable unregulated motor carriers to exhaust all potential for scale economies. If the relevant market can support 25 firms, monopoly power would probably not cause a problem. Relevant market is, of course, a difficult concept to make operational. For some purposes, a relevant market may include transport services from a specific origin to a specific destination. In other cases, a specific origin (e.g., a grain exporting state) and a widely scattered set of ports (e.g., Baltimore, New Orleans, and Houston) may constitute a relevant market. (See the paper by Daughety and Inaba in these proceedings for a study of this kind of market). The objective of the analysis is shipper welfare, and, in each case, the relevant market must be defined in terms of the shippers and the destination they seek to reach.

Questions about scale economies may never be answered to the satisfaction of some policy analysts. As noted in a previous section of this summary, many of the participants mention numerous problems with ICC data that limit the credibility of cost studies. Given these reservations about the data, statisticians are perhaps approaching the point beyond which further work can only refine, but not revolutionize, the basic findings already reported in the literature.[18] Unquestionably, the task of separating the effects on costs introduced by regulation from the nature of the underlying technology is difficult. Nevertheless, Friedlaender's paper makes a valiant effort to do so. If an unregulated industry were tested for economies of scale, then direct observation of the nature of costs might be possible. However, since motor carriers are already regulated, the observed costs are influenced by the mechanism of regulation as well as by market forces. To some extent this obscures the underlying technology.

If further cost research is pursued, there are at least two potentially important extensions. One follows Friedlaender in separating the effects of regulation and technology as cost determinants. The potential for a competitive marketplace without regulation depends on technology, not regulation. Another extension involves an analysis of unregulated motor carriers directly, a task that would be difficult no doubt because of the lack of central data source.

Stability, Equity, and Efficiency

One possible motivation for continued regulation is minimization of price fluctuations and bankruptcies. In relatively competitive unregulated industries, prices may vary substantially over a business cycle, and some inefficient firms may fail, particularly during times of economic contraction. Many of the industry leaders at the conference argued that stability is important for certain parts of the economy (see e.g., Fitzsimmons). Some shippers may desire reduced uncertainty in the prices they pay for transport. Existing carriers may realize a higher probability of survival, although in recent years some carriers have gone bankrupt even with regulation.[19]

At the same time, a program aimed at achieving stability may be costly. There are the direct costs of the regulatory process, including the expenses of regulatory agency operations, and also those of the regulated firms. Beyond that, some economists are concerned that regulation might protect inefficient firms from the normal forces of competition, so that some firms with higher costs are not driven out of business by more innovative firms. Regulation can be thought of as a kind of insurance against instability, where the premium paid consists of direct costs associated with the regulatory mechanism and probably some costs associated with inefficiency. No quantitative estimates of that tradeoff were presented at the conference. In fact, it remains to be argued persuasively that any stability purchased as a result of regulation does indeed represent an unambiguous benefit to society. Both Muskin and Noll raise the question.

As noted earlier, several kinds of equity constraints might be imposed by regulators. Equity constraints, virtually by definition, have the effect of redistributing income. Welfare economics indicates at least in principle, that one could redistribute income without incurring economic inefficiencies if the incomes of the needy group were supplemented by a direct transfer of income to that group, carried out, for example, by an appropriate scheme of taxation.

In practice, however, policymakers frequently resort to redistributing income by directly controlling prices, for example, by rate averaging.[20] Supporters of this practice note that it would be impossible to sustain rate averaging for motor carriers without regulation. As several participants from industry indicated, many proponents of regulation fear that the abolition of rate averaging would have undesirable implications for the distribution of income.

Proponents of regulation often point to the considerable accomplishments of the transport industry in the U.S. and argue that so elegant and productive a system should not be tampered with. Fitzsimmons, Morton, and Sollenbarger share this view. Other participants disagree with this position by questioning the current performance of the industry relative to its potential under other policies. The substance of the debate can be summarized as follows: advocates of change claim that even if the U.S. motor carrier industry is the best in the world, it is worthwhile to ask whether improvement might be possible. After all, a continuing effort to improve efficiency is a guard against complacency. Others find the industry's current performance admirable, and some are opposed to experimentation with change and the associated tasks.

Alternatives for Regulation

Three policy alternatives have been suggested during the course of the conference: (1) continuation of the status quo, (2) modifications of the present system, and (3) some form of deregulation.

The Status Quo

The central features of the status quo are the maintenance of controls on entry and rates for motor carriers. As discussed in the last section, regulation may enhance pricing and structural stability in the industry. Regulators might preserve forms of transportation crucial to economic growth which may otherwise fail. See Muskin for some discussion of this point.

A decision to continue the status quo must be based on arguments that include a recognition of intermodal competition as a pervasive feature of transportation. On a theoretical level, the Roberts and Simmie paper suggests that costless information gathering and other regulatory mechanics could make a system of entry and rate controls more efficient than a partially or totally deregulated system where some mode (such as railroad or motor carrier transport) has economies of scale. The phrase "could make" is important here, for if rates are not set according to the rules specified in that paper, and if entry is not carefully controlled, then there is no guarantee that regulation will lead to an efficient use of resources.

Perhaps more important in an evaluation of the qualitative conclusion of the Roberts and Simmie paper is the point that it <u>is</u> costly to gather the right kind of information and to operate the regulatory mechanism. A simpler system of regulation in which some of the controls are relaxed might lead to increased efficiency in resource allocation. In reality, regulation may fail to control entry and set rates in the manner specified by Roberts and Simmie, and the operating costs of the regulatory mechanism alone are large.

While the Roberts and Simmie paper addresses certain theoretical aspects of regulation with intermodal competition, several other papers presented at the workshop deal with the problem using different approaches. Rhetorically, Nelson questions the possibility of effective regulation of the motor carrier industry. He does not emphasize the normative problem: Is regulation desirable? Rather he asks whether or not any regulatory program requiring substantial coordination of regulatory levers (pricing, entry, exit, and so on) could possibly be carried out effectively. He argues that both the markets in which motor carriers purchase their factors of production and the markets into which they sell are structured so that regulation can have only a very limited effect. The presence of unregulated motor carriers and other modes, limits to some extent, the potential market power for motor carriers in most markets. The most likely exception, if one exists, is the less-than-truckload market, where intermodal competition is not as pervasive as elsewhere. Nelson asserts that:

> The motor carrier industry is, in fact, such a singularly poor candidate for regulation that, in the United States at least, it is, to most economic intents and purposes, not, in fact, regulated. The very extensive portion of the motor carrier industry which is totally unregulated even by legal standards must exert enormous pressure toward relaxation in the supposedly regulated area; and there is no sign that ICC pleas to Congress for extensive new regulatory authority will achieve any substantial change in this situation.[21]

Nelson also argues that motor carrier regulation cannot help the railroads in their financial plight.

> Whatever the American public finally decides to do about the financial and operating problems of the American railroads, with respect to any geographical area or any service, it will not expect to achieve any significant or useful results from either the continuation or stiffening of motor carrier regulation.[22]

In sum, Nelson asserts that the regulation of motor carriers does not prevent the exercise of monopoly power--intermodal competition has already eliminated all market power. Moreover, intermodal competition eliminates any opportunity for a regulatory authority to protect the railroads. Only an extension of regulatory powers to include the unregulated motor and water carriers would accomplish this, and an increase in the extent of regulation is unlikely, since it would be politically unpalatable, economically inadvisable, and operationally unfeasible.

As a discussant in Session IV, Noll addresses the problems of regulating intermodal competition from a legislative perspective. He concurs with Hillman that the "Quad-R" Act, designed to give railroads more freedom in the range of rates they charge,

> ...does not seriously circumscribe the ability of the ICC to continue to promulgate largely anticompetitive policies in setting minimum railroad rates...... The problem is twofold: the 1976 act, in the long-standing tradition of regulatory legislation, is vague and self-contradictory, and the courts, in keeping with legal precedent established in Nebbia vs. New York, are unlikely to overturn any ruling by a regulatory agency as long as some subsection of the law contains a mandate consistent with it and the administrative procedures surrounding the ruling were consistent with established practices of law.[23]

Noll lists some of the unanswered questions regarding regulation and, particularly, the difficult kind of regulation required in controlling intermodal competition. These include: "(1) how vague legislative directives are translated into specific regulatory policies (2) whether statutory or nonstatutory controls are more important in determining regulatory outcomes, and (3) why Congress behaves as it does in legislating and overseeing regulatory law."[24]

A broad spectrum of viewpoints must be considered in evaluating the status quo. Some of the theoretical problems have been addressed by Roberts and Simmie who point out the large informational requirements for efficient regulation.[25] The paper by Boyer describes the need for better data on the cross elasticities of demand, lest the effects of regulation be incorrectly estimated.[26] Spychalski notes that there is substantial room for improvement in data about costs for various modes, and that improved data are crucial to effective implementation of existing legislation (such as the Quad-R Act) and evaluations of alternative regulatory policies.[27] Muskin cautions against a rush away from the status quo until more is known about the tendency toward concentration if regulatory restrictions were relaxed, and the effects that a change in the structure of the motor carrier industry might have on the rest of the economy. This view conflicts with Noll's assertion that transportation research is a "well-ploughed field," and that, given the limitations of the ICC data, we have already performed the basic research needed to establish the potential for workable competition in the industry.

Some Modifications of the Status Quo

During the workshop, several suggestions were made for limited changes in the existing pattern of regulation. Kolins argues that the ICC should retain most of its regulatory options, since sudden change on a large scale might be disruptive. He proposes three moderate revisions in present practice designed to increase shipment load factors and reduce current inefficiencies. First, he suggests gradual relaxation of entry restrictions for regulated carriage. Rather than focusing on the adequacy of service provided by existing carriers, the ICC should consider the implications of efficiency in operation, fuel use, load factors, and service to the public. While Kolins does not specify an operational prescription, the intent is clear. The criteria for allowing entry should involve decreases in operating efficiencies rather than concern for the well being of existing carriers.

In the same spirit, Kolins proposes that certificates defining operating authorities should be broadened so that carriers are not so constrained to narrowly defined markets in terms of the geography and commodity type. He believes that the same purpose would be served by authorizing intercorporate hauling for private carriers, which might significantly improve load factors for private haul reported by Tye who makes the same recommendation. Both Kolins and Tye recommend that trip leasing be allowed where it is now proscribed.

"Complete" Deregulation

The relaxed restrictions just described could be viewed as limited forms of deregulation. The term "deregulation," like the term "cross subsidy," has many meanings. The paper by Paul Roberts examines the probable impacts of a scheme of "complete" deregulation, which he defines as the removal of controls from entry, rates, routes, publication of tariffs, and financial management.[28] Only safety regulations would be maintained. Railroads would remain regulated, and in his scenario he assumes that the limitations on ownership of trucklines by railroads would not be relaxed.

Roberts believes that the motor carrier industry would be comprised of four basic segments within five years of such a deregulation. These would include (1) less-than-truckload consolidators, (2) specialized carriers, (3) truckload brokers, and (4) private and contract carriers. The first group would probably arise, as it has in the unregulated motor carrier industries in Great Britain and Australia, because single-truck,direct-firm-carriers would not be efficient in less-than-truckload markets. "Operations must be broken down into pickup and delivery, terminal consolidation operations, and intercity line-haul operations." Specialized carriers would haul particular commodities, such as refined petroleum products and chemicals, much as they do today. Truckload brokers would enable irregular route carriers to locate and assemble shipments in a competitive environment. Finally, once the regulatory restrictions are relaxed, the distinction between private and contract would disappear for all practical purposes.

With deregulation some firms might act as combinations of the above. Roberts sees no reason why a full range of options might not emerge, given the compatibility of underlying technology with competitive market structure.

There are some problems which might arise with such a scheme. First, deregulation would undoubtedly cause some firms to suffer a loss on the capitalized value of their entry certificates. "Grandfather clauses," which spread out the deregulation process over several years, might be used to diminish the impact.

Industry leaders and a group of sympathetic academics are skeptical of deregulation. Morton, Fitzsimmons, and Sollenbarger argue that the prevailing regulatory scheme maximizes social welfare given the set of attainable institutional arrangements. They do not view competition as a feasible alternative to regulation. Sollenbarger predicts that monopolistic price discrimination will be endemic if the ICC is abolished. Fitzsimmons fears excessive uncertainty and concomitant costs for shippers. Morton feels that the instability of an unregulated trucking industry would end in government ownership.

All of these industry spokesmen feel that transport is essential to the survival of consumers and firms alike and necessary for economic growth. They view the common carrier obligation as inevitable for this reason and tie this obligation to a need for a broad regulatory scheme. They are proud of the industry's accomplishments under ICC regulation and cite safety and national defense as areas where the industry provides non-market benefits to society (e.g., See Fitzsimmons and Muskin).

Industry opinion regarding deregulation, as expressed at this workshop, is virtually uniform and very strong. As a result, the question of deregulation promises to be one of the "hottest" public policy debates of this decade. Rarely do staunch advocates so disagree, and these proceedings are an invitation to learn about the issues and possibly enter the debate.

NOTES

1. Kolins, R.K. The regulatory program: The effect on entry, backhaul and energy consumption, in this volume.

2. Pegrum (1975), p. 315.

3. Roberts, P.O. Some aspects of regulatory reform of the U.S. trucking industry, in this volume, Figure 3, derived from Trinc's Blue Book of the Trucking Industry, 1976 Edition.

4. This observation is based on, D. Wyckoff and D. Maister. 1975. The owner-operator. Lexington, Mass, Lexington Books.

5. Roberts, P.O. Some aspects of regulatory reform of the U.S. trucking industry, in this volume.

6. Chow, G. The cost of trucking revisited, in this volume, see Table 4 for a summary of the regression results.

7. Klem, R. The cost structure of the regulated industry, in this volume, see the first paragraph of his section on "Policy Implications."

8. Friedlaender, A.F. Hedonic costs and economies of scale in the regulated trucking industry, in this volume, see the first paragraph of Section V.

9. Ibid., Section V, paragraph 4.

10. Duncan, G. Discussant comments, in this volume.

11. Specifically, Friedlaender rejects the proposition that the production function is homothetic, a property which is assumed in the forms estimated by Klem and Chow.

12. To pursue the connection between rates and costs a bit further, economists would note that prices which efficiently allocate resources depend both on cost and demand data. LaLonde emphasizes only the cost side of this in his paper. Nevertheless, good cost data, which strip away the confusion introduced by the relatively arbitrary allocation of common costs often introduced in the accounts, are very important in determining efficient tariffs.

13. In her comments in the discussion during Session I of the conference, Professor Friedlaender indicates that she is in the process of expanding

the investigation begun with the paper presented at this conference. The new work includes an even wider range of motor carrier sizes, and Professor Friedlaender indicates that the substantive conclusions of the analysis will remain unchanged in light of her newest empirical results which have not yet been reported.

14. In the Discussion, Session I, Professor Friedlaender responded to a question about the impact of the operating ratio, and more generally other possibilities which might lead to a failure of firms to minimize costs, on the existence of a cost function which can be meaningfully estimated using statistical techniques. This paragraph represents the essence of her response.

15. Maister, D.H. Regulation and the level of trucking rates in Canada, in this volume. See the concluding paragraph of the paper.

16. See Friedlaender's remarks in Discussion, Session III. Of course, the definition of cross subsidy described here is only one of many possible ones that could be suggested. It is interesting because it does contain the idea that prices should bear some relationship to marginal cost, whereas many other possible definitions of cross subsidy do not.

17. Stuart, R.A., and Sweeney, D.J. Shippers of small shipments look at motor carrier economic regulation, in this volume. Authors argue strongly for a new platform study that would correct the improper inflation of costs presently assigned to low density routes.

It should also be noted that these authors do not claim that no cross subsidy exists anywhere in motor carriage. In fact, they use the single line and joint line shipment example as a case in which cross subsidy is "clear". The rate structure makes no difference between these operations. Yet, at equal distances the joint line shipment requires two extra platform handlings at a consequent higher cost. The authors do not provide enough information to show that a cross subsidy occurs, using their own definition that indicates a subsidy when rates and charges fail to cover variable costs. However, they implicitly suggest that some joint line shipments are being subsidized according to this definition.

18. Noll, R. Discussion, Session IV, in this volume. Noll argues this point in his comments.

19. See the comments of Mr. Moritz, a representative of the Regular Common Carrier Conference in the discussion, Session IV. In a response to one of his questions, Noll emphasized the importance of distinguishing between the monopoly power rationale for regulation and the rationale based on the possible desirability for stable prices and fewer bankruptcies.

20. One reason sometimes given for this is that it is "too costly" to identify who the "needy" persons are, and to effect an appropriate

transfer payment. Difficulties with existing programs (e.g., the food stamp program) are often cited to support such a case.

21. Nelson, J.R. Can the motor carrier industry be regulated, in this volume. See the concluding comments of section three of the Nelson paper.

22. Ibid., section three.

23. See section three of Noll's comments as a discussant in Session IV of the workshop. The "Quad-R" Act refers to the Railroad Revitalization and Regulatory Reform Act of 1976, PL 94-210, 94th Congress, S.2718, February 5, 1976. See Hillman, Session IV, for a detailed discussion of the provision of this legislation.

24. See Noll, section three of his comments in Session IV.

25. For example, cross elasticity of demand data are difficult to acquire, particularly since so many estimates may be needed. The papers by Boyer, and Daughety and Inaba, discuss how some of these data might be obtained, and point out many of the difficulties encountered in the process.

26. For example, a study of the benefits of deregulation which concentrates only on the cost savings that shippers might realize by using a lower cost mode will incorrectly ignore the fact that some shippers may choose a higher cost mode because it offers service more suitable to their needs. Product variety is valuable to shippers, and must be included as an important part of any assessment of alternative policies.

27. See the discussant comments by Spychalski from Session IV of the conference. Stuart and Sweeney note that the present platform study which is used as a basis for ICC rate making procedures is outdated even for the present system; and they strongly argue for better information even if no reform is contemplated.

28. See Roberts, P.O. in this volume, the section of the paper entitled "Possible Impacts of One Pattern of Deregulation."

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SESSION I

THE STRUCTURE OF THE MOTOR CARRIER INDUSTRY: EMPIRICAL FINDINGS ABOUT COST AND DEMAND

Chairman: Michael Lawrence

HEDONIC COSTS AND ECONOMIES OF SCALE IN THE REGULATED TRUCKING INDUSTRY

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INTRODUCTION AND OVERVIEW

Economists generally believe that the trucking industry would be competitively organized in the absence of regulation. Since the trucking industry is characterized by low capital requirements, they feel that there is nothing inherent in the structure of technology that would indicate the existence of barriers to entry or economies of scale. Thus, in the absence of regulation, one would expect the trucking industry to be characterized by a large number of small firms, each operating at the minimum point of its average cost curve. In this case, the costs and service levels available to firms serving light-density regions would be the same as those available to high-density regions. Consequently, small shippers in the small, rural communities should expect to face the same rate structure and receive the same levels of service as large shippers in large, urban areas. Thus, most economists believe that there is nothing inherent in the structure of the industry to indicate that the general public interest is served by regulation.

Advocates of regulation take a diametrically opposed view. According to them, the trucking industry is not only characterized by economies of scale but also economies of density. Thus, average costs not only fall with the size of the firm, but also with the volume of traffic over the network. Since small rural communities do not have sufficient traffic volumes to support a large number of efficiently sized firms, advocates of regulation feel that in the absence of regulation these communities could expect to experience a reduction in service and higher rates as they faced either efficient monopolistic carriers or small, inefficient carriers.

The recent merger movement in the trucking industry has lent considerable support to the regulationists' view. In recent years, the industry has been marked by a large number of mergers and acquisitions, in that large firms have either acquired or merged with smaller firms to extend their operating rights. Thus, the industry has become more concentrated, and large firms have become significantly larger. Since trucking firms essentially face a regulated price, this indicates that they perceive the existence of rather marked economies of scale; for a given regulated rate structure, a larger scale of operations should yield lower costs and thus higher profits. But if larger firms are in fact more efficient than smaller firms, small rural communities could suffer substantial reductions in service and increases in rates in the advent of deregulation.

It may be possible to reconcile these conflicting views by distinguishing between technological and regulatory economies of scale. Technological economies of scale refer to economies of scale that are inherent in the structure of technology, while regulatory economies of scale refer to economies of scale that are caused by the structure of regulation.

Because regulated trucking firms are typically limited in the commodities they can carry or the routes they can cover, by acquiring firms with different operating rights, regulated trucking firms can obtain longer hauls, higher load factors, fewer empty backhauls, and thus lower operating costs. Consequently, larger firms may not be more profitable because their costs are inherently lower, but because they can obtain higher utilization of equipment through diversified operating rights. Since many of the recent mergers have been characterized by the extension of operating rights and authorities, this indicates that if economies of scale do in fact exist, they may be of a regulatory rather than a technological nature. This implies, of course, that economies of scale would not exist if any carrier were free to carry any commodity to any place along any route. Thus, in a deregulated environment, the presently observed cost differentials among firms of different sizes and different kinds of operating authorities would not exist.

The question of whether the observed economies of scale are of a technological or regulatory nature is of crucial importance for policy. If technological economies of scale exist, in the absence of regulation one would expect the industry to be characterized by relatively few carriers and oligopolistic behavior in that small shippers in rural areas would probably face higher rates and lower standards of service than large shippers in urban areas. If, however, regulatory economies of scale exist, in the absence of regulation one would expect the industry to be characterized by a large number of carriers and competitive behavior in that small shippers in rural areas would face essentially the same rates and service levels as large shippers in urban areas.

This paper presents evidence that if any economies of scale exist in the trucking industry, they are of a regulatory rather than technological nature. By using a hedonic cost function (Spady and Friedlaender 1976a, b) that relates costs to the nature of trucking operations as well as to conventional measures of output such as ton-miles, we are able to distinguish between technological and regulatory economies of scale and show that while there do appear to be substantial regulatory economies of scale, there do not appear to be any technological economies of scale. Thus, our econometric evidence suggests that in a deregulated environment, the trucking industry would be competitively organized; there is nothing inherent in the technology of the industry to place small shippers in rural regions at a competitive disadvantage.

The second section of this paper outlines the nature of the hedonic cost function while the third presents the econometric results concerning trucking technology. The fourth section explicitly considers the question of economies of scale, and the fifth presents a brief summary and conclusions.

A HEDONIC COST FUNCTION FOR THE TRUCKING INDUSTRY

Because the nature of trucking operations is highly variable, it is important to take differences in trucking operations into account in estimating trucking costs. Not only do different firms carry different commodities but also, different firms utilize widely different shipment sizes and lengths of haul. Moreover, firms vary widely in the share of less-than-truckload (LTL) traffic they carry. Thus, two firms, each carrying an equal number of ton-miles over a year can have very different types of output. One could concentrate on short-haul, small-load, LTL traffic, while the other could concentrate on long-haul, large-load, truckload traffic. In view of the differences in the composition of their output, it would be surprising if they would have the same costs, although this would be predicted by conventional econometric studies of the trucking industry that measured output in terms of ton-miles alone (Ayala-Oramus 1975).

Basically, there are two sources in differences in output for any given measure of ton-miles. First, the nature of commodities carried may differ and second, the way in which the commodities are carried with respect to length of haul and size of shipment may differ. Ideally, econometric estimates of trucking costs should take both of these factors into account.

By limiting our analysis to regulated common carriers of general freight, we are largely able to take the first factor into account. These firms typically carry manufactured commodities whose characteristics with respect to handling, etc. should be similar.[1]

Within regulated carriers of general freight there are significant inter-firm differences with respect to size of shipment, load factor, length of haul, and the share of LTL traffic. Fortunately, data are available to take these factors into account, and this paper reports on efforts to relate costs to differences in the composition of output with respect to length of haul, size of shipment, load factor, and the share of LTL traffic. An understanding of the cost effects of these differences is important for evaluating alternative policies, not only because some alternatives (such as the relaxation of backhauling prohibitions) directly affect shipment sizes, load factors, and lengths of haul, but also because these factors affect firms' responses to the economies (or diseconomies) of increased firm size.

Duality theory indicates that every specification of a cost structure corresponds to a specification of a production structure. One can therefore interchangeably specify a cost function or a production function (Shephard 1970). Because, however, it is possible to specify more econometrically testable hypotheses concerning the structure of technology by using cost functions than by using production functions, it is generally agreed that econometric estimation of cost functions is more useful than econometric estimation of production functions (Varian 1975).

The simpliest specification that might reasonably be expected to take account of shipment size, load factor, length of haul, and share of LTL traffic is the hedonic cost function given by:

$$\text{Cost} = C[\psi(y,q_1,q_2,q_3) \quad ; \quad w_1,w_2,w_3,w_4] \tag{1}$$

where $\psi(y, q_1,q_2,q_3)$ is a function that measures output, with y = ton-miles;

q_1 = either average size of shipment or average load (tons per truck);[2]

q_2 = average length of haul;

q_3 = percentage of tons shipped in LTL lots; and w_1, w_2, w_3 and w_4 represent prices of labor, fuel, capital, and purchased transportation (primarily rental vehicles).

We call this cost function "quality-separable" because the effect of quality variations upon the output measure ψ, and therefore on costs, is independent of relative factor prices. The technology implied by such a specification can be envisioned as combining the four input factors to produce one abstract output, "trucking capacity," measured by $\overline{\psi}$, that can then be divided into any (y,q_1,q_2,q_3) combination that satisfies $\overline{\psi} = \psi(y,q_1,q_2,q_3)$.[3]

As indicated above, the value of the function $\psi(y,q_1,q_2,q_3)$ serves as the output measure in this specification of the cost function. This assumes that a continuum of different "quality" ton-miles exists, that can be consistently aggregated by the function $\psi(\cdot)$ (Spady and Friedlaender 1976b). By analogy with convetional theory of aggregation (Diewert 1974 and Samuelson Swamy 1974), it is natural to require that $\psi(\cdot)$ is separable into ton-miles and qualities. Thus:

$$\psi(y,q_1,q_2,q_3) = y\cdot\phi(q_1,q_2,q_3) \tag{2}$$

This implies that a doubling of ton-miles at a given quality level doubles ψ, the measure of output. No restrictions need be placed on $\phi(\cdot)$.

Because the translog approximation to a cost function permits us to test a wide range of hypotheses concerning the structure of technology, we use it here (Spady and Friedlaender 1976a). Since trucking firms presumably are able to adjust capacity easily, either by selling trucks or by rental agreements, it seems sensible to estimate a long-run cost function, that takes the following general form:[4]

$$\ln C(\psi,w) = \alpha_0 + \alpha_\psi(\ln\psi - \ln\bar{\psi}) + \sum_{i=1}^{4} a_i\ (\ln w_i - \ln\bar{w}_i)$$

$$+ \tfrac{1}{2} \sum_{i}^{4} \sum_{j}^{4} \beta_{ij}(\ln w_i - \ln\bar{w}_i)(\ln w_j - \ln\bar{w}_j)$$

$$+ \tfrac{1}{2}\ \beta_{\psi\psi}(\ln\psi - \ln\bar{\psi})^2$$

$$+ \sum_{i=1}^{4} \beta_{\psi i}(\ln\psi - \ln\bar{\psi})(\ln w_i - \ln\bar{w}_i) \qquad (3)$$

In addition, we estimate the factor share equations, which take the following form:[5]

$$\frac{w_i x_i}{C} = \alpha_0 + \sum_j \beta_{ij}(\ln w_j - \ln\bar{w}_j) + \beta_{\psi i}(\ln\psi - \ln\bar{\psi})$$

$$i = 1,\ldots,3 \qquad (4)$$

From Equation (2) we know that:

$$\ln\psi = \ln y + \ln\phi(q_1,q_2,q_3). \qquad (5)$$

We thus utilize a translog approximation of $\phi(\cdot)$ and write:[6]

$$\ell n\phi(q_1,q_2,q_3) = a_0 + a_1(\ell nq_1 - \ell n\bar{q}_1) + a_2(\ell nq_2 - \ell n\bar{q}_2) + a_3(\ell nq_3 - \ell n\bar{q}_3)$$

$$+ \tfrac{1}{2}\, b_{11}(\ell nq_1 - \ell n\bar{q}_1)^2 + b_{12}(\ell nq_1 - \ell n\bar{q}_1)(\ell nq_2 - \ell n\bar{q}_2)$$

$$+ b_{13}(\ell nq_1 - \ell n\bar{q}_1)(\ell nq_3 - \ell n\bar{q}_3)$$

$$+ \tfrac{1}{2}\, b_{22}(\ell nq_2 - \ell n\bar{q}_2)^2 + b_{23}(\ell nq_2 - \ell n\bar{q}_2)(\ell nq_3 - \ell n\bar{q}_3)$$

$$+ \tfrac{1}{2}\, b_{33}(\ell nq_3 - \ell n\bar{q}_3)^2 \qquad (6)$$

In the most general case, therefore, we substitute Equation (6) into Equations (3) and (4) and jointly estimate these equations,[7] subject to the following constraints, that ensure linear homogeneity of $C(\psi,w)$ in w and the symmetry restrictions implied by cost minimization.[8]

$$\sum_{i=1}^{4} \alpha_i = 1$$

$$\sum_{j=1}^{4} \beta_{ij} = 0 \qquad i = 1,\ldots,4; \quad \beta_{ij} = \beta_{ji} \qquad (7)$$

$$\sum_{i=1}^{4} \beta_{\psi i} = 0$$

ECONOMETRIC ESTIMATES OF TRUCKING COSTS

Having specified a general quality-separable hedonic cost function, with the appropriate restrictions needed to ensure cost-minimization, we now consider a number of alternative specifications and their associated restrictions, that have definite implications concerning the role of quality differentials and economies of scale in the trucking industry.

Data

The sample used in this study consists of 171 firms in 1972, located in the Central, Middle Atlantic, and New England trucking regions, as defined by the ICC, that roughly corresponds to the ICC's Official Railroad Territory.[9] As indicated above, we use the following variables in the cost functions:

y = ton-miles

q_1 = average size of shipment (tons/shipment) or average tons per truck

q_2 = average length of haul

q_3 = 1 + percentage of tons shipped in LTL lots[10]

w_1 = price labor

w_2 = price of fuel

w_3 = price of capital

w_4 = price of fuel

C = total costs

$w_i x_i / C$ = share of factor i

All of these data were taken from Trinc's Blue Book (1973), which summarizes the individual firm reports to the ICC. The firms' total costs were divided into labor costs, fuel expenditures and fuel taxes, purchased transportation, and other. "Other" expenditures (that included depreciation) were assumed to be payments for capital services. Each firm's "carrier operating property - net" was taken as a measure of the quantity of capital (and thus of capital services), so that "other expenditures" divided by "carrier operating property net" gave a firm-specific price of capital. A firm-specific price of labor was obtained by dividing labor expenditures by the average number of employees. Since direct quantity measures of purchased transportation and fuel were not available, regional prices for these commodities were estimated by a method whose assumptions and results are given in Spady and Friedlaender (1976b) (See also Christensen and Greene 1976, and Nerlove 1963).

The sample of 171 firms included all firms without missing data in five regions (Central States East, Central States West, Middle Atlantic, North Middle Atlantic, New England) that met the following conditions:

1. They purchased some of all four factors, but no more than 10 percent of their costs were for purchased transportation. (If a firm does not purchase any of a particular factor, this indicates a corner solution that the specification is incapable of modeling.) Firms that rent most of their vehicles do so from subsidiaries set up for tax and regulatory purposes, due to an ICC ruling that allows the deduction of such expenses as current costs. This has the effect of artificially lowering their operating ratio, that is a primary regulatory target.
2. They reported an average salary of $8000/year or more per employee. (Some firms implicitly reported salaries as low as $2000, presumably because they counted owner/operators whose trucks they rented as employees, even though they did not directly pay them any wages.)
3. They had a calculated price of capital of less than 10. (Due to reasons related to (1) above, a few carriers report almost no operating property, as it is (presumably) owned by subsidiaries. Note that carrier operating property is the value of the property that the firm owns, <u>not</u> its equity in that property.) The mean price of capital in the sample is 2.725 with a standard deviation of 1.287.
4. They had no other "obvious" error in the data. (For instance, one firm reported an average load of 92 tons.)

Econometric Estimates

In specifying the cost functions, it is useful to consider that quality variables should be influenced by regulatory policy affecting operating rights. The average size of shipment and the percentage of LTL traffic are largely determined by shipper characteristics and should not be related to the granting of operating authorities or other regulatory behavior. Consequently, we would expect the characteristics of small and large firms to be essentially the same with respect to these variables. Since, however, firms with diverse operating rights should have greater opportunities to utilize equipment over large geographical areas and maintain full backhauls, insofar as diverse operating rights are obtained by large firms, these firms should have longer hauls and higher average loads than small firms. Since trucking ton-miles characterized by long hauls and large loads are cheaper to produce than those characterized by small loads and short hauls, insofar as large firms are able to obtain long hauls and large load factors, we would expect their costs per ton-mile to be lower than those of smaller firms. However, to the extent that their costs differentials are due to differentials in length of haul and load factor, we would expect their average costs to be comparable to those of smaller firms when output is standardized for the characteristics of the trucking operators.

Since size of shipment and percentage of LTL are not particularly sensitive to the granting of operating rights, measures of output that include these variables should be good indicators of technological economies of scale.

To recapitulate briefly, insofar as large firms obtain diverse operating rights that permit them to have larger load factors and larger hauls than smaller firms, we would expect the average costs to be lower for large firms than for small firms. However, when we standardize for length of haul and load factor, we would expect these cost differentials to disappear. Finally, since average shipment size is shipper determined and is essentially exogenous to the firm, in the absence of technological economies of scale we would expect to observe no economies of scale when output is standardized for size of shipment.

These hypotheses can be tested by specifying the following cost functions.

Equation (1) is a conventional translog cost function that ignores the nature of the firm's operations. Thus $\ell n\phi(q)$ is set equal to zero and output is measured by ton-miles alone.

Equation (2) adjusts for the percentage of LTL shipments in the firm's operations and thus only includes LTL in the hedonic $\phi(q)$ function.

Equation (3) adjusts for average length of haul and the percentage of LTL and thus includes these variables in the hedonic $\phi(q)$ function.

Equation (4) also adjusts for average shipment size and thus includes LTL, average length of haul, and average shipment size in the hedonic $\phi(q)$ function.

Equation (5) adjusts for average load instead of average shipment size and thus includes LTL, average length of haul, and average load in the hedonic $\phi(q)$ function.

Because these equations separate the effects of the different quality variables, it should be possible to isolate the source of any observed economies of scale and thus determine whether they are due to regulatory or technological factors. In particular, if larger firms do indeed have lower average costs, we would expect to see economies of scale in the nonhedonic cost function, Equation (1). Moreover, if the share of LTL is not related to size, we would also expect to observe economies of scale when we adjusted for LTL alone in Equation (2). If, however, larger firms are able to obtain more diverse operating rights and thus have longer hauls, we would expect to observe fewer economies of scale when we adjust output for length of haul in Equation (3).

Equations (4) and (5) respectively introduce shipment size and load factor into the hedonic cost equations. Since shipment size should be independent of regulatory policy, adjustments for shipment size should encompass any technological impacts of economies of scale. Since average load may be related to broad operating rights, however, adjustments for average load should encompass any additional regulatory impacts of economies of scale over and above those associated with average length of haul. Thus, since Equation (4) includes average shipment size but not average load, if there were economies of scale associated with average load, the omitted variable, we would expect to observe economies of scale in Equation (4). Similarly, if technological economies of scale exist due to size of shipment (or other reasons), we would expect to observe them when we adjusted for average load, but not for average shipment size, the omitted variable.

In sum then, to the extent that economies of scale are due to regulation, we would expect to observe them in the equations that omit length of haul and average load, that is, Equations (1), (2) and (4). To the extent that economies of scale are due to technological factors, we would expect to observe them in Equations (3) and (5).

Before turning to the question of economies of scale, it is useful to consider explicitly the role of the hedonic adjustment. Since Equations (4) and (5) include all of the quality variables, the significance of these variables can best be observed by considering the hedonic $\phi(q)$ function estimated in these equations. These are given in Table 1, while the joint estimates of the cost function and the factor share equations are given in Table 2. Although the $\phi(q)$ function was also jointly estimated with the cost and factor share equations, it is useful to present it separately for comparisons with cases in that restrictions are imposed to describe economies of scale.

A constant does not appear in Table 1, since its effect in this specification would be merely to change the units of measurement of ψ ϕ. The estimates of Table 1 accord well with a priori expectations. The significant negative signs in the linear size and haul terms indicate that ton-miles characterized by larger shipment sizes, larger loads, and longer lengths of haul are easier to produce than ton-miles characterized by smaller loads and shorter lengths of haul.[11] Conversely, the significantly positive coefficient in the linear LTL term indicates that ton-miles characterized by a large percentage of LTL shipments are harder to produce than those characterized by small percentage of LTL shipments. Stated alternatively, these findings indicate that LTL shipments, small loads, and short hauls are more costly to produce than LTL shipments, large loads, and long hauls, for any given amount of ton-miles.

Table 1 indicates that the squared and interaction terms with respect to average shipment size and LTL are generally statistically significant, while those with respect to average load and average length of haul are generally statistically insignificant. Thus, increases in average shipment size and LTL will increase the elasticity of effective output with respect to average shipment size and LTL, but will reduce it with respect to average length of haul.

Table 2 presents the joint estimates of the cost and factor share equations under the different specifications of the cost function.[12] Since Equations (1), (2) and (3) omit hedonic variables that occur in

TABLE 1

Estimates of $\phi(q_1,q_2,q_3)$ by Direct Estimate of

$C(\psi,w)$ with $\psi = y\cdot\phi(q_1,q_2,q_3)^{\dagger}$

		Equation (4) q_1 = tons/shipment		Equation (5) q_1 = tons/truck	
Coefficient	Variable	Value	Stand.Error	Value	Stand.Error
a_1	(Size) q_1	-.1501	-.042	-.3186	-.0549
a_2	(Haul) q_2	-.7070	-.055	-.5041	-.0513
a_3	(LTL) q_3	1.2029	.233	.9784	.1566
b_{11}	$\frac{1}{2}\,q_1^2$	.1286	.056	-.0130	-.1229
b_{12}	q_1q_2	.0749	.061	.0731	.1330
b_{13}	q_1q_3	.7418	.185	.9137	.3147
b_{22}	$\frac{1}{2}\,q_2^2$	.1121	.092	-.0190	-.1738
b_{23}	q_2q_3	-.2816	-.342	-1.1030	-.2963
b_{33}	$\frac{1}{2}\,q_3^2$	7.5114	1.813	4.1890	1.3403

† 171 observations. The function was jointly estimated with the cost function, given in Table 2. Hence R^2 and other summary statistics are given in Table 2.

TABLE 2
JOINT ESTIMATES OF UNRESTRICTED COST AND FACTOR SHARE EQUATIONS

		Equation 1 (Nonhedonic)		Equation 2 $\psi = \phi(LTL)$		Equation 3 $\psi = \phi(LTL, Haul)$		Equation 4 $\psi = \phi(LTL, Haul, Shipment\ size)$		Equation 5 $\psi = \phi(LTL, Haul, Load)$	
Coefficient	Variable	Value	Standard Error	Value	Standard Error	Value	Standard Error	Value	Standard Error	Value	Standard Error
α_0	1	5.6858	.0457	8.6911	.0491	8.7954	.0351	8.6639	.0479	8.768	.0345
α_ψ	ψ (output)	.7665	.0352	.7798	.0363	1.0274	.0334	1.0408	.0275	1.0271	.0312
α_1	w_1 (labor)	.5871	.0049	.5876	.0049	.5928	.0049	.5928	.0046	.5916	.0049
α_2	w_2 (fuel)	.6416	.0013	.0415	.0013	.0399	.0013	.0597	.0012	.0402	.0013
α_3	w_3 (capital)	.3341	.0040	.3339	.0040	.3315	.0040	.3323	.0037	.3321	.0040
α_4	w_4 (Purch.Trans.)	.0372†	na†	.0371†	na†	.0358†	na†	.0352†	na†	.0361†	na†
β_{11}	w_1w_1	.0230	.0149	.0220	.0151	.0350	.0164	.0324	.0167	.0404	.0155
β_{12}	w_1w_2	-.0149	.0062	-.0141	.0063	-.0248	.0069	-.0235	.0073	-.0315	.0061
β_{13}	w_1w_3	-.0109	.0085	-.0107	.0085	-.0122	.0089	-.0147	.0087	-.0109	.0087
β_{14}	w_1w_4	.0028†	na†	.0028†	na†	.0010†	na†	.0058†	na†	.0070†	na†
β_{22}	w_2w_2	.0176	.0066	.0169	.0067	.0257	.0072	.0296	.0075	.0354	.0064
β_{23}	w_2w_3	-.0068	.0020	-.0070	.0026	-.0072	.0022	-.0073	.0024	-.0082	.0019
β_{24}	w_2w_4	.0041†	na†	.0042†	na†	.0063†	na†	.0012†	na†	.0043†	na†
β_{33}	w_3w_3	.0119	.0076	.0119	.0076	.0137	.0075	.0159	.0074	.0130	.0076
β_{34}	w_3w_4	.0058†	na†	.0058†	na†	.0057†	na†	.0061†	na†	.0061†	na†
β_{44}	w_4w_4	-.0127†	na†	-.0070†	na†	-.0130†	na†	-.0070†	na†	.0124†	na†
$\beta_{\psi 1}$	ψw_1	-.0005	.0035	.0003	.0036	.00095	.0045	.0128	.0045	.0071	.0045
$\beta_{\psi 2}$	ψw_2	-.0008	.0009	.0008	.0094	-.0017	.0012	-.0027	.0012	-.0010	.0012
$\beta_{\psi 3}$	ψw_3	-.0045	.0028	-.0050	.0029	-.0101	.0036	-.0115	.0036	-.0092	.0036
$\beta_{\psi 4}$	ψw_4	.0175	na†	.0039†	na†	.0024†	na†	.0014†	na†	.0031†	na†
$\beta_{\psi\psi}$	$\psi\psi$	.1117	.0320	.1076	.0340	.0659	.0430	.0644	.0390	.0662	.0378
R^2											
Cost Equation		.7596		.7653		.9043		.9286		.9065	
Labor Equation		.0315		.0307		.0645		.0847		.0577	
Fuel Equation		.0313		.0295		.0186		.0418		-.0131	
Capital Equation		.0367		.0389		.0657		.0778		.0553	
SSR											
Cost Equation		37.6612		36.7589		14.9972		11.1824		14.6485	
Labor Equation		.4981		.4985		.4815		.4708		.4864	
Fuel Equation		.0341		.0342		.0035		.0337		.0357	
Capital Equation		.3240		.3232		.3142		.3101		.3177	
Log of Likelihood Function		1075.80		1076.36		1136.55		1157.08		11161.55	

+Coefficient value implied by satisfaction of homogeneity restrictions that were implicitly imposed.
Standard errors were not calculated.

other equations, this is akin to imposing the restriction that the relevant hedonic coefficient is zero. Thus, by comparing the log of the likelihood functions of the various equations, we can determine whether the hedonic quality variable affects costs.[13] Thus, by comparing the log of the likelihood functions in Equations (1), (2), (3) and (4) and Equations (1), (2), (3) and (5), we can clearly see that all of the quality variables significantly affect costs. Note, however, that since Equations (4) and (5) contain different quality variables, we cannot compare them directly. Nevertheless, the difference in the log of the likelihood functions between Equations (3) and (4) and between Equations (3) and (5) clearly indicates that size of shipment and load factor have a significant impact upon costs. This implies, however, that a hedonic cost function should include all of these quality variables. Thus cost functions that omit these variables are mis-specified and are likely to lead to biased cost estimates.

EVIDENCE OF ECONOMIES OF SCALE

It is difficult to interpret the estimates of the translog cost function's coefficients directly, since the elasticities of substitution and returns to scale generally depend upon the output level and factor prices at which they are calculated. In particular, nonzero $\beta_{\psi i}$'s, that we generally estimated in Table 2, indicate that the cost function is *not* separable,[14] and therefore, that the structure of production is *nonhomothetic*. This means that factor intensities will generally vary with the level of outputs.

While it is not possible to strictly characterize returns to scale for a nonhomothetic production structure, it is possible to gain some intuition concerning this issue if we limit the analysis to situations where relative factor prices are constant, since in this case we can infer the shape and location of the average cost curve from the $\beta_{\psi\psi}$ and a_{ψ} coefficients. Specifically, at mean factor prices, a positive $\beta_{\psi\psi}$ indicates that the firm faces a U-shaped average cost curve (a negative $\beta_{\psi\psi}$ indicates an inverted U-shaped cost curve; $\beta_{\psi\psi} = 0$ indicates an average cost curve that is either exponentially falling, rising, or constant, depending on α_{ψ}); if $\alpha_{\psi} = 1$, then the bottom of the U, the point of minimum average cost, occurs at $\psi=\bar{\psi}$, the mean output level. If $\alpha_{\psi} < 1$, the point of minimum average cost occurs at $\psi > \bar{\psi}$, since expanding output beyond $\bar{\psi}$ would steadily decrease average costs if $\beta_{\psi\psi}$ were 0, but for $\beta_{\psi\psi} > 0$ additional costs grow with $(\ell n\psi - \ell n\bar{\psi})^2$ until they dominate the effects of the α_{ψ} term. Similarly, if $\alpha_{\psi} > 1$ then the point of minimum average cost occurs at $\psi < \bar{\psi}$.

Examination of Equations 1 and 2 indicates that $\beta_{\psi\psi}$ is statistically significantly different from zero, indicating that the average cost curve derived from these equations should be U-shaped. Moreover, since α_{ψ} is less than one in these equations, the minimum point of their implied average cost curve is greater than the mean output level. Thus, Equations 1 and 2 indicate the existence of economies of scale. In contrast, in Equations 3, 4, and 5, $\beta_{\psi\psi}$ is marginally significantly different from zero and α_ψ is greater than one, indicating that, if anything, firms are subject to diseconomies of scale rather than economies of scale.

These findings can be given more precision by imposing the specific coefficient restrictions to ensure that the cost function is homogeneous of degree one in output so that production is subject to constant returns to scale. Thus, let us set $\alpha_\psi = 1$, $\beta_{\psi\psi} = 0$, and $\sum_{i=1}^{4} \beta_{\psi i} = 0$ and estimate Equations 1-5 with those additional restrictions (for a derivation of these restrictions, see Spady and Friedlaender 1976a). By imposing the log of the likelihood function of the restricted and unrestricted equations, we can determine whether we can accept or reject the hypothesis of constant returns to scale.

Table 3 represents the log of the likelihood functions of Equations 1-5 in their unrestricted and restricted forms. This indicates that when Equations 1 and 2 are restricted for constant returns to scale, the log of the likelihood functions are significantly different at the .001 level. Thus Equations 1 and 2 clearly indicate an absence of economies of scale. However, the log of the likelihood functions in Equations 3, 4, and 5 are not significantly different from each other, indicating that we cannot reject the hypothesis of constant returns to scale in these equations.

Even though we cannot reject the hypothesis of constant returns to scale in Equations 3, 4, and 5, it is likely that their unrestricted forms gives a better picture of their implied costs than their restricted form. Thus, by evaluating the unrestricted forms of Equations 1-5 at mean factor prices and at mean qualities, we can calculate the average costs implied by these equations at various levels of output. These are plotted in Figure 1, and show the following:

- The cost structures of Equations 1 and 2 are virtually identical and indicate marked economies of scale.
- The cost structure of Equations 3, 4, and 5 are virtually identical and indicate a total absence of economies of scale and, in fact, rather substantial diseconomies of scale.

These results clearly indicate that average length of haul is the primary determinant of any observed economies of scale. In particular, since larger firms have longer hauls,[15] and since larger hauls are cheaper to produce than shorter hauls, larger firms enjoy lower costs. Nevertheless, it is the longer length of hauls enjoyed by larger firms rather than their size per se that permits them to enjoy lower costs.

The lack of responsiveness of the shape of the average cost curves when additional adjustments are made for size and load is striking and indicates that there are no economies of scale associated with either average shipment size or average load. Stated alternatively, Equations 3, 4, and 5 indicate that all of the observed economies of scale can be attributed to length of haul and that there are not additional economies of scale that can be obtained from average load or average shipment size.[16]

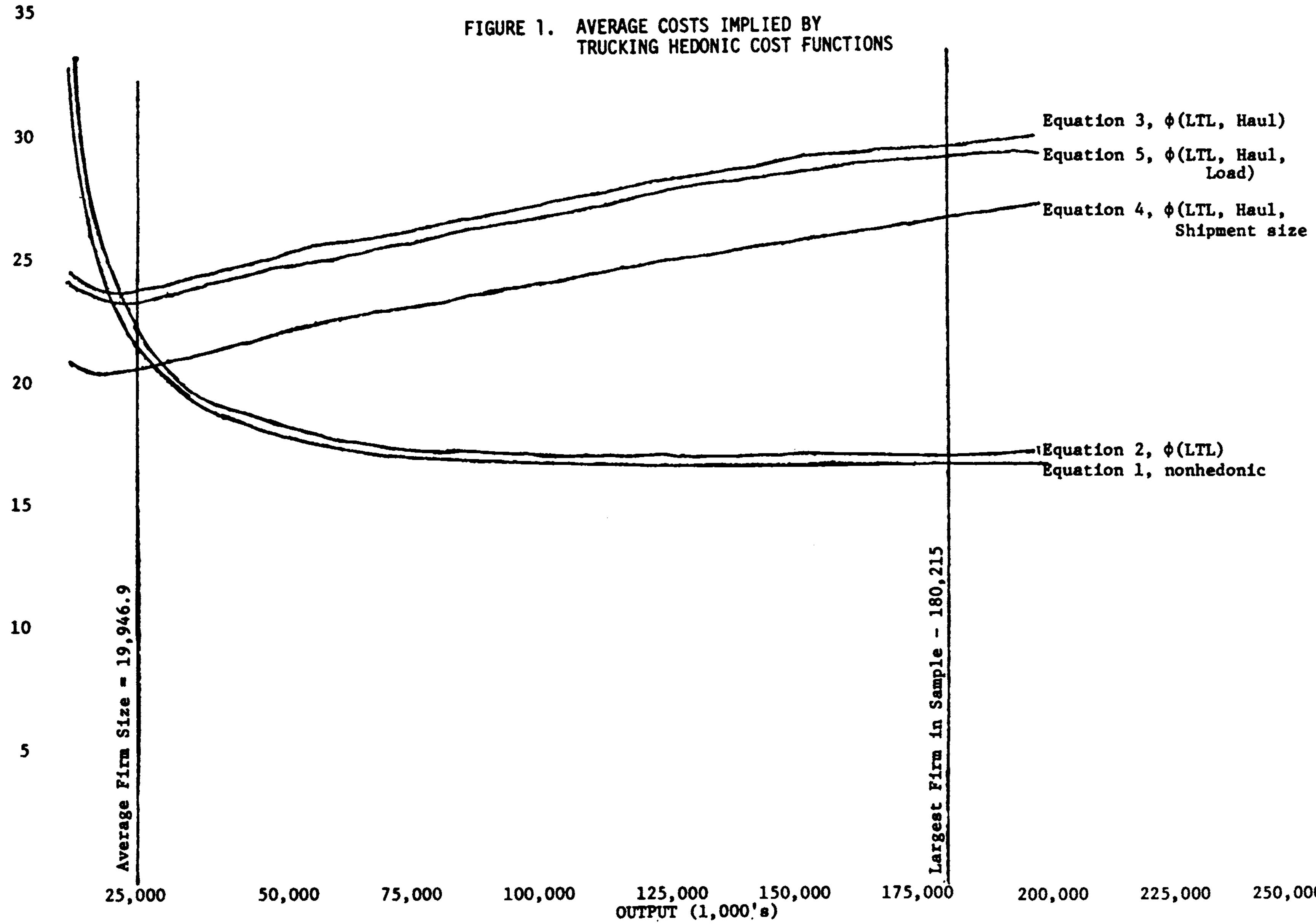
TABLE 3
Likelihood Ratio Test for Economies of Scale

	Log of the Likelihood Function: Unrestricted for CRS	Restricted for CRS	CRS Hypothesis (a)
Equation 1 (non-hedonic)	1075.80	1034.07	Reject (b)
Equation 2 ϕ(LTL)	1076.32	1045.59	Reject (b)
Equation 3 ϕ(LTL, Haul)	1136.56	1135.45	Accept
Equation 4 ϕ(LTL, Haul, shipment size)	1157.08	1155.46	Accept
Equation 5 ϕ(LTL, Haul, Load)	1161.55	1160.16	Accept

(a) The variable given by minus 2 times the ratio of the log of the likelihood function of the restricted equation to the unrestricted equation is distributed according to a χ^2 distribution with the degrees of freedom given by the number of restrictions.

(b) Significant at .001 level.

FIGURE 1. AVERAGE COSTS IMPLIED BY TRUCKING HEDONIC COST FUNCTIONS



The absence of any economies of scale associated with average load is interesting and indicates that large firms do not enjoy higher load factors than small firms. Since one would expect a diversity of operating rights to permit firms to enjoy higher load factors, this result is rather surprising.

Because it is generally believed that size and diversity of operating rights permit large firms to enjoy high load factors, it is interesting to analyze the relationships among average load, average haul, and firm size by regressing average load against average shipment size, average length of haul, and firm size. These results are given in Table 4 for a translog and a linear specification. Both equations indicate that average load is primarily determined by average length of haul and that size of firm has no influence whatsoever on average load. Thus if larger firms appear to have larger load factors, this is due to the relationship between average length of haul and average load rather than size per se. This relationship explains why adjusting for average load did not affect the existence of economies of scale. Thus, again, we are lead to the conclusions that any observed economies of scale in the trucking industry are due to the fact that larger firms enjoy longer average lengths of haul.

CONCLUSIONS AND POLICY IMPLICATIONS

Because diverse operating rights permit firms to utilize equipment more efficiently and undertake longer hauls per trip, it is likely that any observed economies of scale are of a regulatory rather than a technological nature. In particular, larger firms have lower costs because they have longer lengths of haul, and it is likely that they have longer lengths of haul because they have more diverse operating rights than their smaller competitors. Consequently, in the absence of entry and operating restrictions it is likely that small firms would be able to enjoy the same economies of haul enjoyed by large firms. Thus, it is unlikely that the cost structure of different size firms would be significantly different.

Nevertheless, these findings clearly indicate the importance in length of haul in determining costs. Those firms concentrating on short haul traffic are likely to have higher costs than firms concentrating on long hauls or transcontinental traffic. The important policy issue, however, is not whether transcontinental carriers would have lower costs than local carriers, but whether small carriers serving small shippers in rural communities would have significantly higher costs than large carriers serving large shippers in urban areas. Since there is no evidence of economies of scale associated with average load, small firms would appear to be at no disadvantage relative to large firms. Nevertheless, our results do indicate that low load factors and low shipment sizes will cause costs to rise at any level of output.

While the existing route and commodity restrictions almost certainly limit the ability of small rural carriers to achieve the same economies of load and haul as their larger intercity counterparts, it is

TABLE 4
RELATIONSHIP BETWEEN LOAD FACTOR AND
OTHER OPERATING ATTRIBUTES

		Translog:		Linear	
Variable	Coefficient	Value	Standard Error[a]	Value	Standard Error[b]
Const.	α_0	2.11870	0742	3.02527	.5021
AVZIZE	α_1	.09102	.0509	.04196	.0851
AVHAUL	α_2	.58458	.0928	.03714	.0038
Ψ	α_3	$.34E^{-6}$	$.42E^{-6}$	$.89E^{-6}$	$.12E^{-5}$
Size, Size	α_{11}	-.16595	.0564	-	-
Haul, Haul	α_{22}	-.11695	.1571	-	-
$\Psi\Psi$	α_{33}	$.11E^{-10}$	$.9E^{-10}$	-	-
Size, Haul	α_{12}	-.11620	.0627	-	-
Size, Ψ	α_{13}	$.32E^{-6}$	$.29E^{-6}$	-	-
Haul, Ψ	α_{23}	$-.29E^{-6}$	$.32E^{-6}$	-	-
R^2		.563		.413	

a) Dep variable =log AVLOAD; indep. variables in logs

b) Dep variable = AVLOAD; indep variables in conventional form difficult to see why they could not achieve their same economies in a deregulated environment. In particular, if all carriers were free to carry all commodities over any route, a full backhaul should generally occur. Moreover, in the absence of route and gateway restrictions, firms should be able to achieve the relevant economies of haul. Thus, there seems little reason to believe that the cost structure of carriers concentrating in rural areas would be substantially different from those concentrating in urban areas if they had comparable load factors and hauls; in the absence of route and commodity restrictions, there is little reason to believe that their load factors and hauls would not be comparable.

This paper supports the view that any observed economies of scale in the trucking industry are of a regulatory rather than a technological nature. Thus, in a deregulated environment, trucking firms could be expected to face U-shaped average cost curves in that the minimum average costs would be reached at a low level of output. Since many firms are now operating beyond this minimum point, in the absence of economies of density provided by operating rights, it is likely that they would find themselves at a disadvantage with respect to costs rather than at the advantage, that they presently enjoy. Consequently, in the absence of the severe route, commodity, and entry restrictions currently imposed by regulation, it is likely that the trucking industry would be competitively organized with the efficiently sized firm being quite small relative to the relevant market.

In conclusion then, this paper has highlighted the need for hedonic adjustment for quality in transportation cost functions and the importance of a general specification that will not impose unnecessary restrictions upon technology. In particular, it has illustrated that conventional econometric estimates of trucking cost functions are not very reliable and hence not very useful for policy purposes for two fundamental reasons: First, because the output of the trucking firm is heterogeneous by its very nature, simple measures of output such as ton-miles will fail to capture the true relationships between cost and output. Second, because the trucking firm is subject to nonseparable joint production, efforts to describe technology by a simple homothetic production function, such as the Cobb-Douglas or the CES production functions, may lead to serious biases of estimation.

To test these hypotheses, we developed a general quality-separable hedonic cost function that permitted nonhomothetic production and quality adjustments, and estimated it using a cross section of 171 firms in the Eastern United States in 1972. This (and similar) hedonic regressions indicated the following results, that have important policy implications.

(1) There are substantial nonhomotheticities in the structure of trucking firms' production. Consequently, any attempt to model their technology using a homothetic cost or production function (such as the Cobb-Douglas or the CES) is a serious misspecification. The nonhomotheticities make global generalizations about returns to scale impossible,

though they are not so large that the general character of scale returns is seriously altered for reasonable (with an order of magnitude of the mean) relative prices.

(2) The level of service in terms of length of haul, size of shipment, and share of LTL traffic does affect costs. In particular, evidence of increasing returns to scale exists when ton-miles are used as an output measure, but fails to exist when output is adjusted for length of haul and other quality differentials. This implies that any economies that exist are economies of haul or of service, not economies of scale of output _per se_.

(3) Since there is little reason to believe that these economies of haul or service are related to the technological structure of the industry, it is likely that any observed economies of scale are of a regulatory nature rather than a technological nature.

(4) When measured in terms of quality-adjusted output, trucking firms face U-shaped marginal cost and average cost curves for a _very_ wide range of factor prices. Because average costs at large output levels are substantially greater than minimum average costs, in the absence of the economies of regulation, large firms would find themselves at a competitive disadvantage. Hence large firms should be discouraged from further expansion, _ceteris paribus_.

Of course, the preliminary nature of the findings must be stressed. At the very least, we must extend the sample to other regions and other years to see if our findings are robust. In addition, we should extend the hedonic output function to incorporate the effects of traffic density and the composition of output to obtain more information about the extent of economies of scale in the trucking industry.

Nevertheless, these results clearly indicate the perils of conventional econometric estimates of trucking costs. If production is joint and if output is heterogeneous, we clearly want to take these facts into account in specifying cost functions. Otherwise, we may make the wrong policy decisions based on biased estimates of misspecified cost functions.

NOTES

1. Nevertheless, to the extent that firms specialize with respect to certain types of manufactured commodities, biases may still exist. If, for example, one firm specialized in computer components and another specialized in fabricated steel products, it is likely that their costs would differ for any given number of ton-miles. Unfortunately, however, data are unavilable to take these differences into account.

2. Because of size limitations in our nonlinear regression package, we can presently only use three quality variables. We hope to relax this restriction in the near future.

3. This specification is moderately restrictive since it implies, for example, that the price of fuel does not affect the combinations of ton-miles and average size of shipment that can be produced at equal cost with equal lengths of haul and LTL ratios. Nevertheless, our econometric results are consistent with this specification.

4. Note that we take the sample mean as the point of approximation.

5. Note that we only need to estimate three factor share equations explicitly, since the fourth is implied by the previous three. The results are invariant to the equation dropped. See Barten (1969) or Berndt and Savin (1975).

6. Note that we have collected similar terms in this expression and thus imposed the necessary symmetry conditions.

7. The LSQ procedure in TSP was used for all regressions reported here; it provides a minimum distance estimation whose properties are discussed in Berndt, Hall, Hall, and Hausman (1974). Estimating the factor share equations jointly with the cost functions improves the efficiency of the resulting estimates; see Christensen and Greene (1976) on this and related points concerning returns to scale estimation to be covered below. For a development of the homogeneity and symmetry restrictions, and a number of other restrictions useful in testing hypotheses concerning the technology represented by $C(\phi,w)$, see Spady and Friedlaender (1976a).

8. Since the regulated trucking industry is not subject to rate of return regulation, it should not be subject to the factor distortions caused by the Averch-Johnson effect that prevent cost minimizations. Moreover, although the industry as a whole may be subject to some sort of operating-ratio regulations, it seems unlikely that any given firm

would face a binding operating ratio constraint. Hence, there appear to be no regulatory distortions that could keep firms from minimizing costs.

9. This sample is currently being extended to include all carriers of general commodities operating in 1972. Preliminary analysis indicates that although the cost structure of regional carriers in the eastern and central regions, the regional carriers in the rest of the country, and the transcontinental carriers are somewhat different in all cases, there is no evidence of economies of scale beyond a very low level output.

10. The variable q_3 was defined as 1 + % LTL since some firms had no LTL shipments.

11. Specifically, the linear coefficients can be taken to represent the change in output occasioned by a change in quality. Thus, a positive sign in the linear terms implies that cet.par., an increase in the quality will increase the effective output, and thus increase costs. Similarly, a negative sign in a linear coefficient implies an increase in the quality will reduce effective output and hence costs.

The signs in the interaction terms are somewhat harder to interpret. Basically, they represent the impact of a given quality in the rate of change in output. For example, a positive b_{13} coefficient implies that for any given size of load, an increase in the share of LTL will lead to greater increase in effective output and thus higher costs. Thus, for any given size of load, costs increase with the share of LTL.

12. The low R^2's associated with the factor share equations indicate a low interfirm variability among factor shares.

13. The variable given by minus two times the difference between the log of likelihood functions of the restricted and the unrestricted cost functions should be distributed according to a χ^2 distribution with the degrees of freedom given by the number of restrictions.

14. A separable cost function can be written $C(\psi,w) = f(\psi)\cdot\phi(w)$, and corresponds to a production function that can be written $f(\psi) = g(x)$, where x is a vector of factor quantities.

15. The partial correlation coefficient between firm size and average length of haul was 0.57.

16. Figure 1 also indicates that the calculated average costs differ in Equations 1, 2, and 3. This indicates that the distributions of average lengths of haul, average load, and average shipment size are not the same among the sample. Hence the mean average load is relatively lower than the mean average shipment size or average length of haul, indicating that average costs evaluated at the mean average load are greater than those evaluated at the mean shipment size or length of haul alone.

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THE COST OF TRUCKING REVISITED

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INTRODUCTION

The evidence on the effect of scale on the cost of trucking is mixed. The results of Roberts (1956), Nelson (1956), and Dailey (1973), suggest that economies of scale do not exist in U.S. trucking. Patton (1970) concludes that diseconomies of scale exist in the California intrastate trucking industry. Studies by Emery (1965), Warner (1965), Ladenson and Stoga (1974), and Lawrence (1976) suggest an opposite conclusion. Koshal (1972) concludes that returns to scale exist in the Indian Trucking Industry. None of these studies is really conclusive. (Dicer 1971; Smykay 1958, 1959; Wyckoff 1974, pp. 6-7). Adding to the ambiguity of these results are those observers who accept the premise of constant returns to scale but add that firm size and quality of service are correlated. (Wilson 1960; pp. 388-89; Locklin 1972, pp. 648-49). In the second section of this paper, the basis for potential economies of scale are put forth. The third section will survey the literature on the motor carrier long run cost relationship. It is argued that a multivariate approach to empirical measurement of the cost-scale relationship is the most appropriate means. The Warner (1965) study took that approach. In sections four and five, the Warner analysis is expanded. Limitations and conclusions of the analysis are discussed in the two concluding sections.

BASIS FOR ECONOMIES OF SCALE

The most generally accepted reason for falling costs is indivisibilities in both men and capital equipment (Walters 1963, p.40). Many take the view that,

> . . .firms in this industry are small because of the relatively low cost of the basic operating unit -- truck, or tractor and semitrailer. Way and structure are paid for largely through gasoline taxes, and therefore their cost is almost entirely in proportion to use. The only investment of any magnitude is for terminals. However, terminals are relatively simple structures even when equipped with modern handling devices. Furthermore, for many carriers, terminals are not essential. (Nelson 1956, p. 33. See also Pegrum 1975, p. 176; Nelson 1974, pp. 436-40)

This is a rather myopic view of trucking if it is generalized to the general freight carriers that concentrate on less than truckload (LTL) size shipments. The investment in terminal land and structures often represents from one-third to one-half of these carriers' operating investment. (Annual report to stockholders, 1973). More importantly, ". . . these firms operate integrated and often geographically vast networks, and the movement of less-than-truckload shipments through such networks requires substantial investment in numerous terminals and intermediate point freight handling facilities." (Spychalski 1975, p. 5. See also Waters 1972, p. 1149). It is not merely the investment necessary for a single terminal that introduces some lumpiness in capital investment but rather the potential requirement that a carrier must operate a system of facilities and the requisite vehicle capacity between each facility in order to be efficient (Lawrence 1976, p. 169).

A second reason for returns to scale is the spreading of risks and reduction of costs of uncertainty. (Walters 1963, p. 40). This may be the most important basis for returns to scale in trucking, because the output of trucking is a nonstoreable service. From the point of view of the carrier, the output is ". . .a capacity to carry certain types of goods, at a certain point of time between points of origin and destination." (Studnicki-Gizbert 1970, p. 335). In the presence of fluctuating demand, the larger carrier may have advantages in traffic solicitation and greater control over equipment movements leading to better equipment utilization. In addition, Robinson's "economies of mass reserves" would be applicable. (Robinson 1958, pp. 25-26). A larger carrier would require less reserve equipment capacity to guard against shortages of equipment or fluctuations in demand because the random peaks and valleys in the individual customer's demand tend to cancel out as the carrier serves a larger number of shippers. (Scherer 1973, p. 73; Lawrence 1976).

REVIEW OF PREVIOUS STUDIES

The Evidence

The major studies of economies of scale in the U.S. motor freight industry are summarized in Table 1. Two methodological approaches are used. The early studies conducted by Roberts (1956), Nelson (1956), and Emery (1965), compared average costs for different size groups. The more recent studies fit a statistical curve representing the cost or production function. The studies further differed with respect to type of data used, location of carriers, range of scale examined, measure of scale, and specific non-scale variables considered. The most common characteristics explicit or implicit in all but one study were the unanimous focus on general freight carriers, and consideration of length of haul.

A major problem in economies of scale studies is dealing with heterogeneity. The "proper" measures of size and of cost are complicated by differences in product mix and product quality. There is certainly a recognition that trucking service is heterogeneous and that there will be substantial cost differences due to differences in products and to operating

TABLE 1
SUMMARY OF EXISTING ECONOMIC STUDIES OF MOTOR FREIGHT ECONOMIES OF SCALE IN THE U. S.

Author	Type of Study	Data Used, Population Size & Geographic Territory Considered	Additional Homogeneity Properties of Sample	Measure of Scale and Approximate Range of Scale (1) Largest (2) Smallest	Dependent Variable	Independent Variables	Representative Conclusion
Roberts 1956	Approximation of long run average cost curve relationship by size groups	1952 cross section of 114 Class I motor carriers operating in Central Territory for primary analysis. 1952 cross section of 92 Class I transcontinental carriers for supplementary analysis.	General Freight, Regular route, inter-city assumed (criteria not specified)	Tangible Assets-Central Territory Sample: (1) about $2,000,000 (2) less than $300,000 Interterritorial Sample: (1) Greater than $8,000,000 (2) not given	Average cost per vehicle mile (excluding terminal expenses)	Average length of haul Precent of truckload freight to total freight. Route to average haul Vehicle miles per route mile	"...small companies who were not disadvantaged in utilization and haul characteristics performed as efficiently as bigger ones."
Nelson 1956	Approximation of long run average cost curve relationship by size groups using rank correlation	1954 cross section of 102 Class I motor carriers domiciled in New England and 66 Class I carriers but domiciled outside of New England.	General Freight Intercity (criteria not specified)	Revenue - New England Sample (1) $8,400,000 (2) not given Non-New England Sample (1) $47,800,000 (2) not given	Average cost per vehicle mile, Average cost per ton-mile	Average length of haul Average load	"...size of firm bears little relation to operating cost."
Emery 1965	Approximation of long run average variable cost curve relationship by size groups	1960 cross section of 233 Class I and II motor carriers operating in Middle Atlantic territory.	General Freight, inter-city. Intercity carrier must receive at least 70% of revenue from intercity service	Revenue (1) greater than $12,401,300 (2) averaged $226,000	Average cost per ton-mile	Percent of truckload to total freight	"Relating the carriers total expenses to their ton-miles of output a perfect progressively declining expense per ton-mile from 21.67¢ for the smallest to 8.98¢ for the largest carrier size group was found."
Warner 1965	Log linear long run total cost function estimated	1953-1960 pooled cross section-time series of 72 Class I motor carriers operating in the U.S.	General Freight, inter-city (criteria not specifind) no ownership entanglements and continuous data available from 1953-1960	Number of shipments, statistics not given; however, largest carrier by revenue was about $14,000,000 and by assets $10,000,000	Total Operating Cost	Average length of haul Average weight of shipment	"...the results clearly suggested economies of scale....the economies suggested are not overpowering in the sense that such differences as there are cannot be overcome by a favorably situated small firm.
Bailey 1973	Log linear long run average cost function estimated	1960 cross section of 80,86,62 and 32 Class I and II motor carriers operating in TRINCS regions: New England, Pacific-Southern, Central States, and Southwest, respectively.	General Freight, Intercity (criteria not specified)	Revenue - New England (1) $9,861,000 (2) $374,000 Pacific-Southern (1) $69,902,000 (2) $374,000 Southwest- (1) $46,386,000 (2) $351,000 Central States - (1) $262,662,000 (2) $320,000	Average cost per ton-mile	Average length of haul Average load Annual miles per power unit	"Our results for our cost function suggest that the primary determinants of variations in motor common carrier costs are average length of haul, average load per vehicle, and, to a lesser degree, size of firm.... there are actually diseconomies of scale once route structure is held constant."
Ladenson and Stoga 1974	Log linear Cobb-Douglas production function estimated	1971 cross section of 116 randomly picked motor carriers in the U.S.	General Freight, intercity Intercity carrier must receive at least 50% of revenue from intercity service	Number of employees (1) greater than 2,000 employees (2) 1-80 employees	Ton-miles per unit of labor input Ton-miles per unit of capital input	Labor--Ratio of total wages and salaries to average hourly wage of drivers and platform workers, or ratio of the sum of total wages of drivers and platform workers to their average wage ratio. Capital--Net Carrier Operating Property or the sum of depreciation and amortization, road and property taxes paid and 5 percent of net worth. Ratio of labor to capital.	"With one exception, our estimates... indicate that once the firm has attained a size of fifty employees or more it is subject to increasing returns to scale."
Lawrence 1976	Log linear long run total cost function estimated	1973 cross section of 134 Class I motor carriers.	General freight carriers subgrouped by revenue size and length of haul	Total tonnage, Statistics not given but Revenue sizes were: Group 1 - (1) $10,000,000 (2) $1,000,000 Group 2 - $50,000,000 (2) $10,000,000 Group 3&4-(1) Not given (2) $50,000,000 Group 5 - (1) Not given (2) $10,000,000	Total Operating Cost	Average length of haul Average load Ratio of less-than-truckload (LTL) tonnage to total tonnage. Average tons per LTL shipment. Percent of business in large metropolitan areas	"The research reported here generally reveals the same type of results reported by Warner...these same regression coefficients for output, if valid, generally reflect highly significant economies of scale."

conditions. In practice, the methods employed to isolate cost-scale relationships from non-scale factors are to 1) compare carriers with similar operating and product characteristics except for size (i.e., use homogeneous study samples), 2) deduce the effect of non-scale variables on cost and adjust the observed cost-scale relationship accordingly, and 3) adjust the cost-scale relationship directly through statistical methods.

Sample Homogeneity

All of the previous studies sought to obtain some minimum degree of homogeneity by carefully selecting the sample. All of the studies used general commodity carriers. This purportedly assures a minimum similarity in the types of vehicles and handling techniques employed. However, a carrier may transport both general commodities and specific commodities and still be classified as a general commodity carrier by the ICC as long as 50 percent of its revenues are earned from general freight traffic.

Cost bias can arise from the amount of local cartage performed by intercity carriers. Local cartage costs tend to be higher than intercity costs per traffic unit because of the short distances moved and the typically congested areas served. Local cartage expenses are not separable from intercity expenses in a carrier's annual report. A carrier with a significant portion of local cartage traffic should show a higher cost per intercity ton-mile or vehicle-mile of shipment than a comparable carrier with less local cartage. In the previous studies, the degree to which this was accounted for varied.

Both the variability in the commodities carried and the amount of local cartage should be minimized by requiring higher percentages of traffic to be intercity and general freight. The ICC requires all common carriers who derive an average of 75 percent or more of their revenues from the intercity transportation of general commodities (for the latest three years) to furnish supplemental statistics on schedule 9003 of their annual report filed to the commission. The objective of homogeneity can be furthered by limiting the present study to these carriers, the I-27 carriers.

All of these studies utilized cross-section data for a reasonably large number of carriers at some given point in time. This rules out the possibility of temporal variations in factor prices distorting the cost-scale relation, but it does not rule out spatial variation in factor prices and in operating disabilities.

Roberts (19^5^6), Emery (1965), and Dailey (1973), isolated carriers by geographic territory as defined by the ICC (1974) or Trinc's Blue Book of the Trucking Industry (1969). By doing so, each study carrier would face reasonably similar operating conditions with respect to such cost influences as terrain, population and traffic density, and factor and supply prices. (Roberts 1956, p. 228; Dailey 1973, p. 88; Emery 1965, p. 286). Due to the nature and goals of Nelson's study (1956), he chose two study groups -- carriers domiciled in New England and carriers domiciled outside of New England but operating in New England. Smykay's critical remarks of Nelson's methodology were (1959, p. 186):

> Apparently no attempt was made to separate the costs of these carriers according to their New England and

> non-New England business. This, of course, may very well be impossible to do. The result of not taking this factor into account would result in a mixing of cost characteristics of the carriers studied so that it represents some sort of average cost for the territories and markets served by these carriers. The Interstate Commerce Commission studies of the cost characteristics of motor carriers indicates that there are cost differences in different territories.
>
> According to the cost studies, the linehaul out-of-pocket costs per vehicle mile, for example, are found to be ¢14.651 for the East-South territory, ¢18.438 for the Eastern Central territory, and ¢16.817 for the South Central territory. These are indeed significant differences which are usually attributed to the different transport and market characteristics of the regions.

While Smykay's criticism is valid in principle, his evidence is slightly misleading. Costs per traffic unit differ between ICC cost regions, but these differences are a function of the type of traffic as well as spatial variations in factor prices and operating conditions. To the extent that regional cost variations are a function of the latter, some accounting might be made. But if the major cost variations are accountable to different size shipments, haul lengths, etc., and they are accounted for separately, no adjustment for spatial differences (based on cost variations ascertained by the ICC) is necessary. It is not readily apparent if the cost regions of the ICC or Trinc's is defined fine enough to account for geographic differences in costs. For example, carriers in the Middle Atlantic territory may or may not operate in the mountainous western portion of that region (Western Maryland, Pennsylvania, New York, and all of West Virginia). Congested cities are not evenly distributed in a territory either.

Thus, it would be difficult to judge past studies as to whether an attempt should have been made to account for spatial differences or not. But it is best to shield new studies in the area from criticism by seeking geographical homogeneity. This can be achieved by sampling, as Roberts (1956), Emery (1965), and Dailey (1973) did or by the use of dummy variables if there is a sufficient sample size and a regression technique is being utilized.

The Lawrence study increased comparability by segmentation of the general freight carriers into revenue and length of haul groups. (Lawrence 1976, p. 172). This is explicit recognition that carriers of significantly different sizes and length of hauls are operating on different long run cost curves. The smallest motor carriers (by revenue) generally serve a limited area or limited number of origin-destination points, while the largest carriers generally operate over an extensive geographic area requiring intermediate consolidation faciliites. Long haul carriers design their operations to minimize driver layover costs that short haul carriers have a greater potential of avoiding. Delivery time requirements constrain the flexibility of the short haul carrier to a larger extent than the long haul carrier. Obviously the TL and LTL segments of the general freight sector use different technology. Where the number of observations are sufficient, efforts should be made to achieve further homogeneity through further segmentation of the industry. (See the section entitled "Design of Experiment" for additional justification).

Methodological Approaches

Once a reasonable degree of commodity and geographic homogeneity is achieved, the cost-scale relation is identified and the effect of non-scale influences on that relationship are determined. In the Roberts (1956) study, the initial relationship observed was decreasing unit costs for larger firms. However, he also observed an inverse relationship (which he judged as significant) between average haul and unit costs and between route utilization and unit costs for small carriers. From these relations, he deduces that large firms do not necessarily have any cost advantage over small firms, because the factors associated with high costs (short average haul and low route utilization) are not necessarily a feature of small carriers. However, if there are multiple cost effecting variables associated with each firm, a valid conclusion about the relationship between a single variable and cost efficiency can be made only when the effect of other factors are held constant. (The analogy in statistics is the partial rather than the simple correlation coefficient describing the relationship between two variables.)

Emery's (1965) methodology closely paralleled Roberts' (1956), except he used ton-miles instead of vehicle miles. His initial observation was a perfect progression of declining expense per ton-mile from the smallest to the largest size groups of carriers. Through separate analyses similar to Roberts' he validated his initial observation, i.e., the other factors affecting costs were not biased toward economies of scale. The same criticisms with regard to methodology expressed before apply. Emery also seems to have looked at the wrong relationships. A negative relationship between <u>profits</u> and average load or average haul is not the same as between <u>costs</u> and average load or average haul, as he seems to imply. (Emery 1965, pp. 286-289).

The Nelson (1956) study avoided the methodology criticism but failed to be conclusive for different reasons. His basic approach was similar to Roberts' except he used a more sophisticated technique for judging the strength of various relationships (the use of rank correlations). Unlike Roberts (1956), his initial initial results were that there was no relationship between vehicle-mile costs and size and a minor relationship between ton-mile cost and size. (Furthermore, Nelson's (1956, p. 38) results show an absence of significant correlation between average haul and cost per vehicle mile.) To validate the observed output-cost relationship, Nelson had to show that other cost-effecting variables were not bias against economies of scale (as opposed to Roberts' situation where he had to show a bias toward the appearance of economies of scale). To do so, Nelson studied carrier samples that were homogeneous to narrow ranges of average haul and average load and observed the same weak relationships between output and costs. This essentially held constant the "other factors" and validated Nelson's initial conclusion of no economies of scale.

Several questions remain on Nelson's analysis. With average haul and average load held constant, the sample sizes for the New England and non-New England carriers were 10 and 12, respectively. The results may have been sensitive to the particular range of average load and average haul chosen, and much doubt can be expressed over the appropriateness of average load as an independent variable. Were the relevant cost-effecting variables accounted for? If route utilization was judged significantly by Roberts, why not here?

A remedy for the first two criticisms of Nelson's technique is to use multiple regression analysis such as employed by Dailey, Warner and Lawrence. Such a technique estimates the relationship between the dependent variable (average or total cost) and each independent variable, with the effect of all other independent variables held constant. In effect, it achieves what a great number of samples, a la Nelson, would achieve (if it were feasible) with a much smaller number of observations. This appears to be the ideal methodological technique.

Variables Used

What about the appropriateness of certain variables used to isolate the effect of scale on costs? Average haul is consistently included as a cost-effecting variable. The length of haul of a shipment is clearly a characteristic of the shipment and contributes to heterogeneity on the cost side. A variable representing shipment size is less frequently utilized. Warner (1965) used average weight per shipment and Lawrence (1976) used average weight per less-than-truckload shipment while Roberts (1956) and Emery (1965) considered the effect on cost of truckload to total traffic (or, conversely, the amount of less-than-truckload to total traffic). (Roberts indicates that size of shipment was not available for his analysis, 1956, p. 229). There is much evidence suggesting that shipment size is a major determinant of cost variability but it is doubtful that a variable that does not discriminate between a 10,000 pound and a 1,000 pound shipment is very helpful. (Neither Warner nor Roberts found the variable very significant). Ladenson and Stoga (1974) mistakenly assume ton-miles are homogeneous and use no non-scale variables.

The remaining variables employed to isolate the cost-scale relationship are capacity utilization measures. Average load was considered by Nelson (1956), Emery (1965), Dailey (1973), and Lawrence (1976). Roberts used a route utilization ratio, and Dailey, in addition to average load, considered annual miles per power unit, a measure of vehicle utilization in her analysis.

The use of capacity utilization factors is questioned because such a variable does not represent a product dimension nor an operating disability that is exogenous to the firm. The average load, vehicle utilization, or route utilization can be a result of management decision to produce a certain quality product or a sign of efficiency due to size.

Carriers do not encounter average load of X level; carriers produce an intermediate output, characterized by average load. It is to be expected that as capacity is utilized more fully, costs per traffic unit would decrease. The use of capacity utilization variables in a cost equation, therefore, can mask the differences in service produced or the cost advantages due to size. (A supporting argument is made by Johnson 1973, pp. 21-22).

The cost of achieving higher average loads is a function of average shipment size. At the extremes, the truckload carrier of full consignments achieves the highest average loads without incurring any terminal or consolidating expenses. To obtain equivalent loads, the LTL carrier must consolidate. As the average shipment weight goes up (down), the probability of bypassing terminal handling goes up (down). Furthermore, larger shipments require less handling or can be handled by mechanical means such that even if a shipment does not bypass the terminal, the costs of terminal handling decrease as shipment size increases.

The cost relations just described create a built-in bias against economies of scale when revenues or assets are used as a measure of size and average shipment weight is <u>not</u> accounted for. Assume two carriers have:

(1) equal lengths of haul
(2) equal tons of freight moved
(3) carrier A is an LTL carrier with a low average shipment weight; carrier B is a TL carrier with a high average shipment weight.

If size is measured by revenues or assets, carrier A could be expected to be larger because LTL traffic is rated higher, costs more to move, and requires more assets to move than the TL traffic. For each carrier to achieve equal average loads, it is reasonable to expect that carrier A will incur greater expenses than carrier B. Thus, average total expense per ton-mile, ton, or vehicle mile (if average loads are equal between A and B and both carriers transport equal tons over the same length of haul, this is true) will be less for B than A unless the effect of average shipment weight on cost is held constant. If not, in this equality situation there are actually diseconomies of scale shown. (This is exactly the result obtained by Dailey 1973).

Summary

This review indicates that all of the major studies on economies of scale can be faulted in one way or another. The Warner (1965) study, however, seems to raise the least objections. It uses a multivariate approach to maintain ceteris paribus conditions lacking in the early studies. It avoids the use of utilization measures while including two important dimensions of the carriers' output. The major deficiency relative to other studies appears to be the potential lack of geographic homogeneity between the study carriers.

This is significant because Warner's (1965) results suggest that economies of scale exist in trucking, and there is hardly any reference to this work in motor carrier literature.[1] The studies by Roberts (1956) and Nelson (1956) suggest that economies of scale do not exist, and these conclusions are the most generally accepted and frequently cited.[2] Of course, none of these past results may have any relevance to policy decisions affecting trucking today. Shipper demands have changed and so have the operating methods employed by motor carriers. (Waters 1972, p. 1149). The lesson of this review is that a study expanding the methodology of Warner would be the most productive use of more recent data.

DESIGN OF EXPERIMENT

The Model

Warner utilized the following regression:

$$(1)\ \text{Log } C = b_o + b_1 \log S + b_2 \log W + b_3 \log H$$

where C = Total Operating Cost
S = Total Number of Shipments
W = Average Weight per Shipment
H = Average Length of Haul per Ton
(All quantities are per period of time, i.e., a year.)

In this model, the regression coefficient associated with the scale variable S is interpreted as the elasticity of total cost to scale. A one percent increase in scale, holding average shipment weight and average haul constant, will result in a b_1 percent in total cost. If b_1 is statistically less than one, then statistically significant economies of scale exist. If b_1 equals one, constant returns to scale are implied and if b_1 is greater than one, diseconomies of scale are implied. An advantage of this model is that it transforms what is potentially a curvilinear relationship into a linear relationship. It also presents a clear alternative to scaling or deflating for eliminating the bias effects of extremely large and extremely small observations. (Griliches 1972, p. 34).

The average weight per shipment and average length of haul represent two important determinants of costs. A dummy variable representing ICC cost regions is employed to account for geographic differences in congestion, operating terrain, and input costs. Reservations are raised over how well such an aggregate dummy variable would distinguish between fine spatial differences within a region.

The model with the dummy variables is:

$$(2)\ \log C = b_0 + b_1 \log S + b_2 \log W + b_3 \log H + b_4 R_1 + b_5 R_2 + b_6 R_3 + b_7 R_4 + b_8 R_5 + b_9 R_6 + b_{10} R_7 + b_{11} R_8 + b_{12} R_9$$

The new variables are defined as follows:

R_1 = 0, New England Region,

R_2 = 1, if Middle Atlantic Region, 0 if not,

R_3 = 1, if Central Region, 0 if not,

R_4 = 1, if Southern Region, 0 if not,

R_5 = 1, if Northwestern Region, 0 if not,

R_6 = 1, if Midwestern Region, 0 if not,

R_7 = 1, if Southwestern Region, 0 if not,

R_8 = 1, if Rocky Mountain Region, 0 if not,

R_9 = 1, if Pacific Region, 0 if not.

In addition to regional cost variables, seven additional variables are tested for their effect on cost. They are:

(1) Single Line Tonnage to Total Tonnage (SL),
(2) Pickup and Delivery Hours per Shipment (PDS),
(3) Renter Power Units to Total Power Units (RENTP),
(4) Rented Vehicle Miles to Total Vehicle Miles (RENTM),
(5) Tons Transported by Owner Operators to Total Tons Carried (00),
(6) Tractor Miles to Total Vehicle Miles (TRACTOR), and
(7) Linehaul Miles by Pickup and Delivery Equipment to Total Vehicle Miles (PEDDLE).

By no means do the above variables exhaust all of the potential determinants of trucking cost. Warner (1965) suggests that the average shape and dimension of shipments handled, dispersion of shipment origins and destinations, and trip speed are important determinants of cost, but, unfortunately, data are not readily available to represent them. On the other hand, this analysis avoids the inclusion of variables that measure productivity or capacity utilization. Average load, vehicle utilization, and actual cost per employee data are readily available; but in the section, "Basis for Economies of Scale," it was argued that a plausible source of economies of scale is the ability of the larger enterprise to organize and utilize capacity efficiently. To include measures of utilization would mask this advantage of size.

The effect of short run utilization is only relevant if the "regression fallacy" bias is significant or if smaller carriers are not able to achieve capacity utilization levels as a result of regulatory bias. In the first case, "The firms with the largest output are unlikely to be producing at an unusually low level; on the average, they are clearly likely to be producing at an unusually high level, and conversely for those that have the lowest output"(Walters 1963, p. 48). This criticism is certainly valid when comparing firms with similar plant capacity. In this analysis, the range of carrier sizes by any measure is substantial enough to minimize this bias. The second case is more difficult to handle. It is clear that entry controls cause certain inefficiencies in carrier performance (Nelson, 1965). It is unclear beyond the broad assertions commonly made whether the magnitude of the inefficiencies are significant and if the distribution is primarily on small carriers, on large carriers, or randomly distributed according to the type of service.[3] Until these questions can be answered, it must be assumed that deviations from the optimal point of each carrier's short run cost curve are randomly distributed with respect to size.

Data Sources and Sample Homogeneity

The examination of economies of scale in this inquiry will utilize the annual report data submitted by Class I carriers of general freight to the ICC for the year 1973.[4] In order to achieve greater homogeneity, the carriers analyzed were limited to Class I, I-27 carriers. An I-27 carrier is classified as such only if it earns at least 75 percent of its operating revenue from intercity general freight operations. This minimizes the influence of local traffic, non-general freight traffic, and contract service. The data were rechecked to eliminate any carriers that were not Class I carriers although classified as such or classified as I-27 carriers but their revenue statistics indicated otherwise.

Warner (1965) chose carriers with an objective of comparability through time so that a pooled cross-section of data could be used. In the present approach, one year's data are utilized so that the requirement that no merger occurs is irrelevant. Instead of a sample of carriers, the whole population of I-27 carriers are available for analysis, large as well as small. (Since most of the larger carriers grew from a combination of traffic growth, mergers and acquisitons, Warner's criteria eliminated the largest carriers.)

Offsetting this advantage is the possibility that observations from a single year are biased by spurious short run relationships. For example, Meyer et al. (1959, p. 44) used averages of several years' observations to minimize this bias. See also Griliches (1972, p. 31). In Warner's analysis the empirical results were consistent between the year-to-year samples as well as between any single year and the pooled sample (1965, p.20). This suggests that a single period observation is appropriate if that period could be considered "normal." While 1973 is characterized as a period when heavy inflation and the energy crisis began, these events gained their impetus in the last quarter of 1973 and their impact was greatest in 1974. (Kruger 1975). The year as a whole continued the trend in revenue, tonnage and mileage growth for major segments of the industry and no major strikes occured. (Horne 1974).

Griliches recognized in his railroad cost analysis, ". . .it is inappropriate to estimate on logarithmic relationship for the whole sample, imposing a constant elasticity on two halves having very significantly different elasticities."(1972, p. 34). His comparison of two size groups of railroads revealed significantly different statistical fits, different shaped lines and different elasticities. Similarly, motor carriers are classified into several groups classified by revenue. The results of estimating the basic log equation on various size groups is shown on Table 2. The revenue levels used at this point as classificatory criteria are essentially arbitrary. The results suggest that is it not appropriate to combine very large and very small carriers. Quite different results between the aggregate carrier and the divided carrier populations are evident. The same justification applies to dividing carriers by average weight per shipment and average haul. An average shipment weight of 5,000 pounds is used to distinguish between TL and LTL carriers, and an average length of haul of 400 miles is used to distinguish between long haul and short haul carriers. The results of estimating the basic cost equation on carrier groups classified by each of these two criteria separately are also shown on Table 2. The results should be interpreted like the preceding analysis of size to see if it is appropriate to combine carriers of different characteristics rather than for the values of b_1, because of the confounding efforts of alternative criteria, size, average shipment weight, and average haul.

Eight possible combinations can be identified,

(1) LTL, Long Haul, Large

(2) LTL, Long Haul, Small

(3) LTL, Short Haul, Large

(4) LTL, Short Haul, Small

(5) - (8) Same as (1) through (4) except for LTL.

However, achieving such homogeneity leads to some problems of sample size. There will be deficiency in observations in the TL markets. The data contained only 75 carriers with average shipment weights above 5,000 pounds reporting as I-27 carriers. The analysis will concentrate on the LTL segment where the population size permits further breakdown.

The segmentation of the industry is an inexact but not wholly arbitrary process. By using a cutoff between TL and LTL carriers of 5,000 pounds, we safeguard the segment of interest, the LTL carriers, from possibly including carriers with essentially TL operations. A load of 30,000 (20,000) pounds could require six (five) pickups at the origin area and six (five) deliveries of 5,000 pounds. Platform handling time for loading or unloading a 5,000 pound shipment is about .463 minutes per hundredweight. (U.S. Interstate Commerce Commission 1973, p. 39). The loading or unloading time required for six (five) pickups or deliveries is 6 X .463 X 50 (5 X .463 X 50) or 138.9 (115.7) minutes or 2.3 (1.93) hours. If all pickups (or deliveries) were to be made during popular business hours (say 8:00 a.m. to 6:00 p.m.), a substantial amount of time remains for stem time and contact time. It is not improbable that

TABLE 2
ESTIMATES OF SIZE ELASTICITY COEFFICIENT BY SUBGROUPS[1]

CLASSIFICATION[2]	N	R^2	b_1	S_b [3]
All	538	.9597	.9767	.0107
R < 10	349	.8202	.8194	.0214
R $\geq$ 10	189	.9498	.9812	.0209
10 < R < 50	140	.8209	.8483	.0366
R $\geq$ 50	49	.9315	.9478	.0428
W $\leq$ 5,000	463	.9643	.9895	.0116
W > 5,000	75	.9167	.9273	.0343
H < 400	439	.9352	.9560	.0135
H $\geq$ 400	99	.9901	1.0028	.0113

1 Log $C = b_0 + b_1 \log S + b_2 \log W + b_3 \log H$

2 R = Revenue in millions \$, W = Average Shipment Weight in Pounds, H = Average Length of Haul in Miles

3 Standard Error

a carrier with an average shipment and weight between 5,000 and 10,000 pounds would have little need for shipment rehandling at a terminal. On the other hand, it is equally undesirable to include LTL carriers with TL carriers. To minimize this possibility, the TL group can be defined as carriers with average weight of shipment greater than or equal to 10,000 pounds.

The length of haul like weight of shipment is nearly a continuous variable and the cutoff between long haul and short haul service is not the same in all situations. The objective of subclassification is to separate carriers with significantly different cost structures (occasioned by the type of service provided). A popular definition of a short haul carrier is one that can provide overnight service to its customers. The distance involved, however, can vary from relatively short distances, i.e. 200 miles to relatively long distances such as 500 miles depending on road conditions, stops, etc.[5] Furthermore, the single distinction between the long and short haul may be further refined to recognize regional carriers whose average length of haul falls between the long and short. Since there is no absolute answer as to the proper cutoff for defining carriers by length of haul, several cutoffs will be tested. Short haul carriers will be successively defined as less than 200 miles, 250 miles, and 400 miles. Medium length carriers are defined as between 199-500 miles. Long haul carriers are defined as greater than or equal to 400 and 500 miles.

The carriers are further classified by revenue. Revenue provides a rough measure of geographic extensiveness but it or any true measure is likely to be highly correlated with the number of shipments and length of haul. Within a given length of haul group, we would expect a carrier with larger revenues to be generally servicing a larger number of points. Since extensiveness as measured by revenues is a continuous variable, the following convention was used to separate the less extensive from the more extensive. The carriers in each length of haul group are divided into two groups, one with above average revenues and one with below average revenues. If this classificatory scheme reduces the sample size below 25, the median value of revenues will be used.

At this juncture, it is appropriate to highlight the differences between Warner's analysis (1965) and the present one. Both use a model of the same functional form but the present analysis explores a number of additional non-scale factors. The present analysis uses cross-sectional data for a single year while Warner used a pooled cross-section over five years. A result of the differences in types of data is that the present analysis can study a larger number of carriers over a wider range of characteristics such as size. The larger population of carriers enables the present effort to obtain additional homogeneity through segmentation of the carriers. At the same time, a large number of explanatory variables can be accommodated because of the large sample sizes.

REGRESSION RESULTS

Initial Observations

Table 3 presents the results of regression model (1). Table 4 presents the results of regression model (2) with the addition of those variables that were found to be consistently significant. A comparison of the R^2 from each table indicates that the greatest reduction in unexplained variance occurred in the short and medium haul populations. In both regressions, the total carrier population exhibits significant economies of scale but the LTL subpopulation did so only in the final model. The TL group even has a lower scale coefficient which leads one to suspect that there may be small economies of scale that are not statistically evident because of the small population size.

Examining the various classifications of LTL carriers, the estimates suggest significant economies of scale in nearly all of the short and medium haul groups. It appears that any evidence of economies of scale dissipates as the length of haul and size definition of the subpopulation increases.

Spatial differences appear to be more significant for short and medium haul carriers. This is to be expected since such carriers are more likely to have their route systems confined to a single region while the longer haul carriers operate in several regions causing an averaging of regional cost effects. The signs of the regional variables for the total LTL group indicate that, relative to the New England Region, the Central, Southern, Northwestern, Middlewest, Southwestern, Rocky Mountain, and Pacific Regions are the cheapest regions to operate in, and it costs about the same to operate in the Middle Atlantic Region relative to the New England Region.

A positive coefficient for SL was expected. Interline requires either the pickup or delivery to be performed by an interline carrier. In some unusual cases, a carrier will deliver its outbound interline to a connecting carrier as well as pickup inbound interline traffic. However, the prevalent situation requires each carrier participating in an interline to perform either the pickup of shipments only or delivery of the shipments only which means that the cost per shipment is decreased (as is the revenue). Carriers prefer to interchange loaded equipment rather than individual shipments (if they must interchange at all). To the extent that loaded equipment involves single truckload lots or presorted LTL shipments, there is a reduction in terminal handling costs per shipment. The coefficient of the variable is significant and positive for all but one short and medium haul LTL subgroup regardless of revenue size. No effect is found for the long haul LTL carriers. This would be expected since most of the long haul carriers possess enough route authority and extensiveness of service that it does not have to interchange a great deal to reach many points, and even if one did, it would probably perform the greater part of the movement thus incurring most of the cost of transportation even if the pickup (or delivery) is performed by another carrier. I have no explanation as to why the TL and one of the LTL groups had significantly negative values for SL.

TABLE 3
REGRESSION RESULTS WITH BASIC MODEL[1]

REGRESSION SUBPOPULATION[2]	N	R^2	INDEPENDENT VARIABLES[4]		
			S	W	H
1. Total	538	.9597	.9767* (.0107)	.6355 (.0142)	.3492 (.0138)
2. LTL ($W \leq 5{,}000$)	463	.9643	.9895 (.0116)	.5999 (.0231)	.3483 (.0149)
3. TL ($W \geq 10{,}000$)	45	.8645	.9288 (.0620)	.6434 (.1176)	.2691 (.0563)
4. LTL Short Haul ($H<200$) Small ($R<6$)	180	.7330	.7783* (.0373)	.4128 (.0379)	.1973 (.0309)
5. LTL Short Haul ($H<200$) Large ($R \geq 6$)	69	.7719	.8116* (.0572)	.5148 (.0813)	.1821 (.0642)
6. LTL Short Haul ($H<250$) Small ($R<8$)	221	.7723	.7970* (.0308)	.4493 (.0364)	.2392 (.0284)
7. LTL Short Haul ($H<250$) Large ($R \geq 8$)	79	.8257	.8943* (.0508)	.5816 (.0649)	.2534 (.0584)
8. LTL Short Haul ($H<400$) Small ($R<10$)	268	.8203	.8358* (.0257)	.5073 (.0309)	.2542 (.0225)
9. LTL Short Haul ($H<400$) Large ($R \geq 10$)	110	.8755	.9164* (.0358)	.6102 (.0466)	.2314 (.0454)
10. LTL Medium Haul ($200 \leq H<500$) Small ($R<19$)	110	.9310	.9233* (.0248)	.5820 (.0415)	.2220 (.0806)
11. LTL Medium Haul ($200 \leq H \leq 500$) Large ($R \geq 19$)	49	.9175	.9881 (.0456)	.6698 (.0562)	.3427 (.0802)
12. LTL Long Haul ($H \geq 400$) Small ($R<60$)	54	.9823	.9910 (.0190)	.6740 (.0423)	.5957 (.0585)
13. LTL Long Haul ($H \geq 400$) Large ($R \geq 60$)	31	.9760	1.0486 (.0349)	.7363 (.0657)	.5683 (.0483)
14.[3] LTL Long Haul ($H \geq 500$) Small ($R<59$)	28	.9808	.9738 (.0283)	.6691 (.0808)	.6534 (.0958)
15.[3] LTL Long Haul ($H \geq 500$) Large ($R \geq 59$)	27	.9814	1.0337 (.0337)	.7013 (.0731)	.5949 (.0558)

1 $\text{Log } C = b_0 + b_1 \log S + b_2 \log W + b_3 \text{ Log } H$ (Variables defined in text)
2 R = Revenue in millions \$
3 Median revenue used as cutoff to maintain sample size
4 Constant (b_0) omitted

Standard errors in parenthesis; *indicates statistical significance at the 5 percent level for scale variable, S. A one tail test of the null hypothesis $H_0: B_1 \geq 1$ is used. All coefficients for W and H were found to be significantly different from zero at the 5 percent level using a two tail test.

TABLE 4
REGRESSION RESULTS WITH ADDITIONAL INDEPENDENT VARIABLES[1]
(A)

REGRESSION SUBPOPULATION[2]	N	R^2	INDEPENDENT VARIABLES					
			CONSTANT	S	W	H	SL	PDS
1. Total	485	.9757	-2.8097* (.1814)	.9805* (.0094)	.5757* (.0152)	.3606* (.0121)	.0039* (.0005)	.0400* (.0094)
2. LTL (W≤5,000)	421	.9827	-2.5127* (.1911)	.9883* (.0090)	.5163* (.0217)	.3684* (.0121)	.0040* (.0004)	.0476* (.0120)
3. TL (W≥10,000)	36	.9318	-3.356* (1.4614)	.9793 (.0646)	.8457* (.1270)	.1723* (.0573)	-.0085* (.0041)	.0034 (.0235)
4. LTL Short Haul (H<200) Small (R<6)	143	.8874	-.07547 (.5224)	.8937* (.0314)	.4094* (.0331)	.2474* (.0257)	.0038* (.0006)	.04111* (.0142)
5. LTL Short Haul (H<200) Large (R≥6)	68	.9490	-.4944 (.7612)	.9431* (.0353)	.4838* (.0576)	.1428* (.0363)	.0027* (.0010)	.1163* (.0436)
6. LTL Short Haul (H>250) Small (R<8)	182	.9113	-.6534* (.0432)	.9297* (.0242)	.4293* (.0305)	.2557 (.0223)	.0042* (.0006)	.0499* (.0140)
7. LTL Short Haul (H<250) Large (R≥8)	77	.9629	-1.3748* (.5994)	.9388* (.0276)	.5169* (.0455)	.2533* (.0346)	.0048* (.0010)	.0990* (.0378)
8. LTL Short Haul (H<400) Small (R<10)	227	.9249	-1.0835* (.3618)	.9414* (.0203)	.4611* (.0268)	.2672* (.0175)	-.0043* (.0005)	.0509* (.0133)
9. LTL Short Haul (H<400) Large (R≥10)	109	.9622	-2.0789* (.4558)	.9629* (.0221)	.5696* (.0394)	.2712* (.0305)	.0038* (.0009)	.0713* (.0336)
10. LTL Medium Haul (200<H≤500) Small (R<19)	106	.9698	-2.1491* (.5137)	.9653* (.0193)	.5356* (.0422)	.3218* (.0631	.0039* (.0008)	.0590 (.0312)
11. LTL Medium Haul (200≤H≤500) Large (R≥19)	49	.9746	-2.364* (.7334)	.9460* (.0329)	.5712* (.0590)	.3626* (.0583)	.0042* (.0017)	.0723 (.0485)
12. LTL Long Haul (H>400) Small (R<60)	54	.9875	-4.1083* (.6697)	.9735** (.0194)	.5460* (.0559)	.6145* (.0584)	.0014 (.0013)	.1622* (.0549)
13. LTL Long Haul (H>400) Large (R≥60)	31	.9802	-4.9756* (1.6031)	1.0039 (.0531)	.6377* (.1253)	.5858* (.0773)	.0024 (.0033)	.0238 (.0888)
14.[3] LTL Long Haul (H>500) Small (R<59)	28	.9923	-5.3047* (1.0005)	1.0164 (.0275)	.4989* (.0756)	.7711* (.0878)	0	.3055* (.0738)
15.[3] LTL Long Haul (H>500) Large (R≥59)	27	.9886	-3.775* (1.739)	.9811 (.0463)	.5024* (.1196)	.5875* (.0944)	-.0027 (.0032)	.1781 (.1011)

1 $\log C = b_o + b_1 \log S + b_2 \log W + b_3 \log H + b_{13} SL + b_{14} PDS + b_4 R_1 + b_5 R_2 + b_6 R_3 + b_7 R_4 + b_8 R_5 + b_9 R_6 + b_{10} R_7 + b_{11} R_8 + b_{12} R_9$. (Variables defined in text)

2 R = Revenue in millions $

3 Median revenue used as cutoff to maintain sample size.

Standard errors in parenthesis; *(**) indicates statistical significance at the 5(10) percent level for the scale variable S. A one tail test of the null hypothesis $H_o: B_1 \geq 1$ is used.

*Indicates statistical significance from zero for non-scale variables at the 5 percent level.

TABLE 4
REGRESSION RESULTS WITH ADDITIONAL INDEPENDENT VARIABLES[1]
(B)

REGRESSION SUBPOPULATION	INDEPENDENT VARIABLES							
	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9
1. Total	.0401 (.0373)	-.0893* (.0374)	-.1886* (.0393)	-.1238* (.0496)	-.0975* (.0464)	-.1884* (.0526)	-.1125* (.0564)	-.0950* (.0442)
2. LTL (W≤5,000)	.0461 (.0347)	-.0976* (.0351)	-.1970* (.0362)	-.1441* (.0441)	-.1247* (.0420)	-.2144* (.0470)	-.1494* (.0506)	-.0907* (.0419)
3. TL (W≥10,000)	.1161 (.2177)	.1062 (.2164)	-.0465 (.2388)	0	.5376 (.3513)	0	0	-.5821* (.2861)
4. LTL Short Haul (H<200) Small (R<6)	.0827 (.0542)	-.0640 (.0550)	-.1748* (.0570)	-.1572 (.0852)	-.0847 (.0659)	-.2062* (.0768)	-.1512 (.0908)	-.0389 (.0651)
5. LTL Short Haul (H<200) Large (R≥6)	.0994 (.0546)	-.1686* (.0622)	-.3451* (.0607)	-.3042 (.0898)	-.1100 (.0875)	-.3983* (.0973)	0	-.1758 (.0979)
6. LTL Short Haul (H<250) Small (R<8)	.0659 (.0448)	-.0931* (.0449)	-.2191* (.0481)	-.2041* (.0676)	-.1229* (.0547)	-.2353* (.0659)	-.2162* (.0868)	-.1028 (.0566)
7. LTL Short Haul (H<250) Large (R≥8)	.0297 (.0518)	-.0987 (.0553)	-.2829* (.0606)	-.1817 (.0975)	-.0289 (.0855)	-.3542* (.0751)	-.1668 (.1234)	.1624* (.0740)
8. LTL Short Haul (H<400) Small (R<10)	.0514 (.0418)	-.0722 (.0425)	-.2038* (.0451)	-.1543* (.0607)	-.1040* (.0519)	-.2652* (.0613)	-.2358* (.0786)	-.1081* (.0520)
9. LTL Short Haul (H<400) Large (R≥10)	.0322 (.0456)	-.1380* (.0466)	-.2852* (.0484)	-.1283* (.0544)	-.1196 (.0634)	-.2867* (.0615)	-.0769 (.0940)	.0493 (.0599)
10. LTL Medium Haul (200<H≤500) Small (R<19)	-.0783 (.0628)	-.0986 (.0616)	-.2319* (.0735)	-.1469* (.0719)	-.0881 (.0690)	-.2647* (.0786)	-.1187 (.0836)	-.0994 (.0727)
11. LTL Medium Haul (200<H≤500) Large (R≥19)	-.0179 (.0556)	-.1010 (.0669)	-.2152* (.0664)	-.0864 (.0654)	-.0791 (.0809)	-.2220* (.0910)	0	.0547 (.0765)
12. LTL Long Haul (H≥400) Small (R<60)	.1341 (.0777)	.0210 (.0585)	0	0	.0148 (.0556)	-.0555 (.1065)	-.0781 (.0601)	-.0998 (.0809)
13. LTL Long Haul (H≥400) Large (R≥60)	.0595 (.0938)	.0339 (.0719)	-.0073 (.0689)	-.0374 (.0966)	0	0	-.0339 (.0901)	.0355 (.0877)
14. LTL Long Haul (H>500) Small (R<59)	.0581 (.1338)	0	-.0260 (.0686)	0	.0282 (.0871)	-.2264* (.1108)	-.2371* (.0846)	-.2377* (.1004)
15. LTL Long Haul (H>500) Large (R≥59)	-.1013 (.0841)	-.0064 (.0575)	0	-.2632* (.1251)	0	-.0358 (.0618)	-.0798 (.0746)	.0074 (.0713)

1 See notes for Part A of this table

The PDS variable represents the cumulative effect of several forces. First, as geographic extensiveness increases, the carrier may be able to pickup and deliver a larger number of multiple shipments and decrease PDS. (The principle is amply demonstrated in Blatner (1974)). As average shipment weight increases, larger PDS would be expected. Carriers performing pickup and delivery service in congested cities would encounter larger PDS. The PDS coefficient was positive and proved to be significant in all LTL short and medium haul subpopulations and the small long haul carrier groups. The large long haul carriers exhibit the smallest variability but the highest P&D hours per shipment as shown in Table 5. We would expect the opposite observation in view of the extensive route structure of most of these carriers but this seems to be more than offset by the other factors, particularly the emphasis on service to major cities where driving conditions such as congestion lead to high pickup and delivery costs.

Additional Variables

Rented power units to total power units (RENTP), rented vehicle miles to total vehicle miles (RENTM), tons transported by owner operators to total tons carried (OO), tractor miles to total vehicle (TRACTOR), and line haul miles by P&D equipment to total vehicle miles (PEDDLE), were also tested for their affect on total cost. OO was used to represent the effect of special commodity freight traffic on relative cost. To move such products, general freight carriers commonly employ owner operators, the carrier acting as a broker (Wyckoff and Maister 1975). No coefficients for OO were significant. RENTP and RENTM represent an operating alternative of the firm. In cost analysis, it is usually assumed that each firm makes the optional decision with regard to the manner in which equipment resources are secured. RENTP and RENTM were significant for the small long haul carriers. It is significant that slight economies of scale are now exhibited by these carriers as indicated in Table 6. Apparently the smallest carriers in these groups rely more on rental equipment, and this is verified by simple correlation coefficients of about -.30 between RENTP or RENTM and the Log of Total Shipments. This implies that without the ability to rent vehicles, the smaller carrier may be at a cost disadvantage. (This conclusion must be tempered by the recognition that vehicle resources rented from affiliates are not distinguished from those rented from non-affiliates.)

TRACTOR was significant for two groups and the signs were expected, i.e., the larger the percentage of TRACTOR to total miles, the lower the total cost. PEDDLE is a surrogate variable for PEDDLE type operations. As expected, there is a positive relationship between the degree of PEDDLE operations and the total cost. The implications for economies of scale remain the same. None of these additional variables were consistently significant over the range of subpopulations. Table 6 does indicate that different explanatory variables may be relevant in certain segments of the industry and not in others. For example, the replacement of SL by RENTM in the regression model used to produce Table 4 reduces the scale coefficient in all of the long haul groups as shown in Table 7.

TABLE 5
PICKUP AND DELIVERY HOURS PER SHIPMENT

SUBPOPULATION[1]	MEAN	STANDARD DEVIATION
1	.9090	1.0533
2	.7826	.7521
3	1.9624	2.5156
4	.6243	1.1115
5	.7707	.4287
6	.6604	1.0148
7	.8425	.4327
8	.7237	.9545
9	.8486	.4154
10	.9114	.5278
11	.8822	.3798
12	.8031	.3733
13	.9464	.3435
14	.8083	.4026
15	.9377	.3262

1 Subpopulations defined in Tables 3 and 4.

TABLE 6
SENSITIVITY OF BASIC RESULTS TO ADDITIONAL COST VARIABLES[1]

COST VARIABLE	LTL SUBPOPULATION [2]	N	R^2	COEFFICIENT b_1	b
RENT P	Long Haul (H ≥ 400) Small (R < 60)	54	.9837	.9804 (.0191)	-.4418* (.2150)
RENT P	Long Haul (H ≥ 500) Small (R < 59)	28	.9836	.9569* (.0280)	-.6620* (.3318)
RENT M	Long Haul (H ≥ 400) Small (R < 60)	54	.9854	.9731** (.0183)	-.1573* (.0488)
RENT M	Long Haul (H ≥ 500) Small (R < 59)	28	.9876	.9479* (.0243)	-.2315* (.0651)
RENT M	Medium Haul (200 < H < 500) Small (R < 19)	110	.9327	.9244* (.0247)	-.0813* (.0499)
TRACTOR	Medium Haul (200 < H < 500) Small (R < 19)	108	.9332	.9323* (.0256)	-.3599* (.2199)
TRACTOR	Short Haul (H < 200) Small (R < 6)	173	.7397	.7883* (.0382)	-.1560* (.0917)
PEDDLE	Short Haul (H < 250) Large (R ≥ 8)	79	.8318	.9101* (.0512)	1.1049* (.6707)
PEDDLE	Short Haul (H < 400) Large (R ≥ 10)	110	.8872	.9194* (.0342)	1.5819* (.4799)
PEDDLE	Medium Haul (200 < H < 500) Small (R < 19)	110	.9372	.9168* (.0239)	1.899* (.5899)

1 $\text{Log } C = b_0 + b_1 \log S + b_2 \log W + b_3 \log H + b\,(Z)$

Where Z = non-log variable, RENT P, RENT M, TRACTOR, or PEDDLE.

2 Notation and significance tests identical to Table 4.

TABLE 7
MODIFIED COST MODEL (WITH RENTM IN PLACE OF SL)[1]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
SUBPOPULATION	N	R^2	b_1	b_2	b_3	RENT M	PDS
LTL Long Haul (H ≥ 400) Small (R < 60)	54	.9897	.9647* (.0172)	.5993* (.0449)	.6449* (.0538)	-.1578* (.0489)	.1434 (.0495)
LTL Long Haul (H ≥ 400) Large (R ≥ 60)	31	.9802	1.0074 (.0508)	.6543* (.1116)	.5378* (.0675)	-.0487 (.0643)	.0444 (.0887)
LTL Long Haul (H > 500) Small (R < 59)	28	.9950	.9964 (.0246)	.5616* (.0754)	.7956* (.0780)	-.1807* (.0635)	.2382* (.0678)
LTL Long Haul (H ≥ 500) Large (R ≥ 59)	27	.9682	.9842 (.0432)	.5198* (.1166)	.5354* (.0702)	-.0264 (.0646)	.1750* (.0808)

1 Coefficients for dummy variables omitted.

Examination of Product Coefficients

We first examine the elasticity of total cost to average weight per shipment (W) and the elasticity of total cost to average length of haul (H) as the subpopulation moves from one that is dominated by LTL carriers to one that is dominated by TL carriers, e.g. lines 2 and 3 in Table 4. The weight elasticity increases from .5163 to .8457 and the haul elasticity decreases from .3684 to .1723. Each change between subpopulations is statistically significant as well as consistent with the technical operations of TL and LTL motor carriers. Holding number of shipments and average haul constant, an increase in average shipment weight results in fuller utilization of vehicles and when the normal vehicle capacity is reached, results in additional trips. The TL carrier has a greater propensity toward the latter. Furthermore, a majority of the TL carriers costs are variable with the number of trips per period. The computed weight elasticity for TL carriers is, in fact, not statistically different from one. Measures of vehicle utilization shown on Table 8 indicate that vehicle capacity of LTL carriers are generally less utilized. A LTL carrier whose traffic mix shifts from a lower to a higher average weight per shipment can either maintain the present average load but increase the frequency of trips, or maintain the present service frequency but increase average load. While there is not evidence as to which strategy is generally followed, the LTL carrier has a lower propensity to add vehicle trips for the reason of overfilled trucks. The LTL carrier also utilizes relatively more inputs, i.e. labor and capital resources in terminals, whose amounts are not or are less variable with the number of vehicle trips taken. The preceding observations of cost sensitivity to weight is consistent with Wilson's empirical conclusions, ". . .that costs rise slowly with respect to weight increases from low levels but the rate of increase rises as weight changes from successively higher levels" (1959, p. 274).[6]

An increase in the length of haul, all other things equal, would result in longer trips. For any motor carrier, the cost of a longer trip is a combination of truck and driver expenses proportional to distance, overnight lodging and meal expenses, and added facilities cost to consolidate and distribute LTL shipments at origin-destination points. The TL carrier largely avoids the latter source of cost by the nature of its shipment size. The elasticity coefficients indicate that LTL carriers' costs are about twice as sensitive to an increase in haul than TL carriers' costs.

The sensitivity of cost to changes in shipment characteristics is now analyzed as the mix of LTL carriers moves from short to long haul. The average weight elasticity ranges from .4 to just over .6. The magnitude of a few of the standard errors do not permit rigorous conclusions, although the weight elasticity tends to be lowest in the short haul groups and highest in the long haul groups. This relationship is expected if short haul LTL carriers tend to have lower average loads than long haul LTL carriers, much like LTL carriers have lower average loads than TL carriers. Table 8 indicates that this is the case.

TABLE 8
AVERAGE LOAD COMPARISONS

SUBPOPULATION	AVERAGE LOAD (TONS)		
	N	MEAN	WEIGHTED AVERAGE
LTL ($W \leq$ 5,000)	463	10.53	13.67
TL ($W \geq$ 10,000)	45	13.14	15.37
LTL Short Haul ($H <$ 200)	249	8.14	8.34
LTL Short Haul ($H <$ 400)	378	9.68	10.87
LTL Medium Haul ($200 \leq H <$ 500)	159	12.79	12.70
LTL Long Haul ($H \geq$ 400)	85	14.28	15.07
LTL Long Haul ($H \geq$ 500)	55	14.82	15.31

SOURCE: See Note 4.

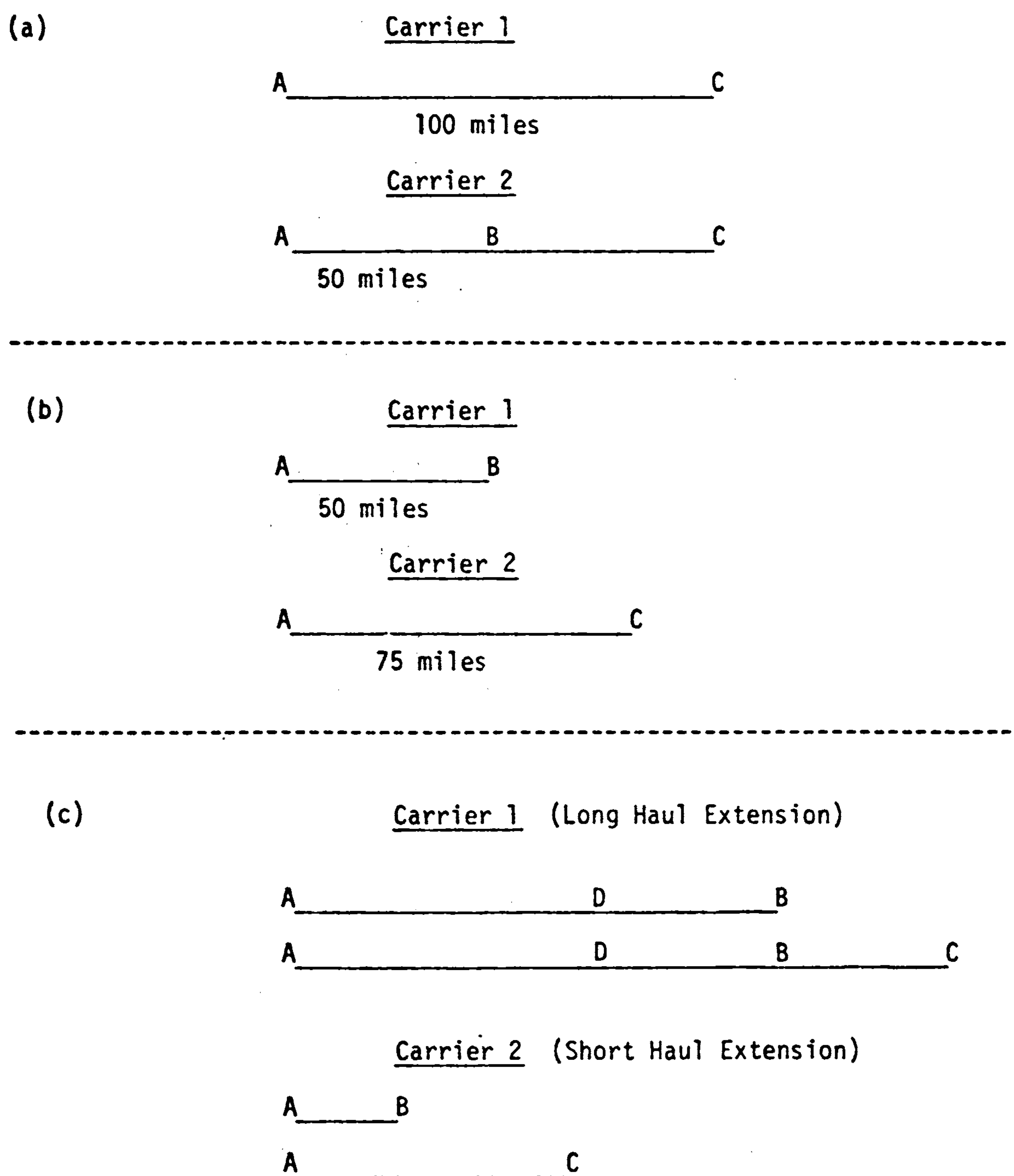
The sensitivity of cost to length of haul increases significantly from less than .25 to over .75 as length of haul group increases. As indicated earlier, as the length of haul increases, ceteris paribus, the average trip length increases, and three types of costs would be incurred; the direct cost of operating the truck, the layover costs incurred if the length of the trip requires layover, and increased terminal expenses to service origin-destination points. Why should the costs increase at a faster rate for long haul carriers than short haul carriers?

Differences in length of haul between two carriers can be attributable to two sources. In the first case, two carriers may have the same maximum haul distance, but one carrier may serve a large number of intermediate points (between extreme points in a route system) while the other moves most of its shipments between the extreme ends of its authority. This is illustrated in Figure 1(a) for a linear route system. Both carriers originate the same amont of tonnage from A (lets say 100 tons) but carrier 2 delivers 50 tons to B and 50 tons to C. The average haul of carrier 1 is 100 miles and for carrier 2 it is 75 miles $\left(\frac{50 \times 100 + (50 \times 50)}{100} = 75\right)$. In the second case, a carrier may simply have more long haul route authority than another as illustrated in Figure 1(b). Of course, many route systems are an infinite combination of these two situations in more complicated form (few are linear).

In caption (a), if vehicle operating costs are variable with miles operated, carrier 1 would incur about 33 percent (25 ÷ 75) more vehicle costs than carrier 2. Assume line haul costs are about 40 percent of total LTL costs so that total cost increases by 13.2 percent (.40 X .33) for a 33 percent increase in length of haul, hardly compatible with the lower estimated cost elasticities for short haul carriers or the higher elasticities of the long haul carriers. The structure of labor compensation for general freight carriers may explain the low elasticities for short haul carriers. Current Teamster contracts include minimum daily wage guarantees.[7] In effect, such guarantees make total driver costs constant regardless of length of haul (until the length of haul at which a mileage rate wage compensation exceeds the guaranteed compensation). While many carriers plan their vehicle journeys to maximize driver utilization through multiple turnaround trips and intermediate stops for pickup and delivery, the longer haul carrier can inherently utilize its driver manpower more efficiently than its shorter haul bretheren. This results in increases in non-labor trip cost proportional to the length of haul increase but increases in labor trip cost that is less than proportional to length of haul increase when the initial length of haul is short.

Long haul vehicle trips normally exceed the breakeven mileage point between guaranteed and mileage wages, so that nearly all of the costs associated with each vehicle journey are proportional to trip length. Also, as length of haul increases, the proportion of total cost that is attributable to line haul increases. Consequently, the weight given to line haul costs increases which, in turn, increases the sensitivity of total cost to changes in the length of haul.

FIGURE 1
EXAMPLES ROUTE-NETWORK SYSTEMS



As the length of haul increases, the penalty for underloading trailers is magnified by distance. The long haul carrier seeks the highest loads consistent with the frequency of service demanded. To do so, the long haul carrier has a tendency to serve more origin-destination points so as to generate a flow of traffic that maximizes equipment use. For example in Figure 1(c), carrier 1, in extending its authority, maintains facilities at A, D, B and C. A short haul carrier such as carrier 2 would have a greater tendency to simply maintain facilities between A and C and serve B as an intermediate stopoff it at all. An agency station (requiring low added fixed costs) might be maintained particularly by carrier 2 since B is likely to be a small traffic generating point. The long haul carrier is also more likely to maintain intermediate facilities not only because traffic generation is essential but because judicious spacing of the facilities will help reduce layover expenses by dividing long trips into several segments, each segment requiring a turnaround rather than a through run.

In summary, the rising sensitivity of total cost to length of haul as the carrier subpopulation changes from a set of short haul to medium to long haul carriers is consistent with expectations. The short haul carriers actually increase their efficiency as length of haul increases by adjusting the trip distance to fully utilize constant driver cost per trip. Driver costs consequently do not increase as fast as when driver wages fully reflect distance traveled as they do for the medium and long haul carriers. Layover costs in the form of out-of-pocket overnight expenses and facilities maintained to house layover drivers are incurred as longer trip lengths are involved. Line haul costs are more important in the total cost structure as length of haul increases and facilities costs tend to be incurred with greater length of haul in the long and medium haul classes of carriers.

Again, these conclusions are consistent with Wilson's empirical findings where he concludes, ". . .that costs rise slowly with distances as length of haul increases from low levels but the rate of increase rises as distance increases from higher levels" (Wilson 1959, p. 274).

LIMITATIONS AND EXTENSION OF RESULTS

Homogeneity Again

Cost analysis in economic theory assumes a homogeneous unit of output, but empirical endeavors seldom achieve this theoretical ideal. In the cost model, several dimensions of the motor carrier product were explicitly accounted for but by no means have all dimensions of service received treatment. In this section, we shall examine other aspects of service and the implications for the economies of scale conclusions obtained earlier.

Geographic Coverage

Larger carriers, in terms of revenue, generally service more destinations from any particular point. Authorities observe that many carriers are expanding on the assumption that shippers favor the carriers with the most extensive single line service. (Lawrence 1976, p. 171; Wyckoff 1972, p. 94). Evidence supporting this premise is meager but consistent. (Locklin 1972, p. 649; Saleh, Robeson and Grabner 1970, pp. 5-13). The best available measure of geographical extensiveness is revenues. Because it is highly correlated with other independent variables in the basic cost model it was explicitly excluded from the model. (A similar problem was encountered by Lawrence (1976, p. 173) who used the number of terminals operated by a carrier as a measure of geographic coverage.) Segregation of LTL Carriers into large and small groups served to achieve homogeneity in the LTL subpopulation defined, but it is likely that the larger carriers within each group provide a higher level of service with respect to this dimension.

If geographic coverage has an effect on total costs, the true total cost model would be:

$$C = a + b_1 S + B_2 W + b_3 H + b_4 G$$

Where G is a measure of geographic coverage. (The log transformation and operating characteristic variables are omitted.) However, we utilized the model of the specification:

$$C = a + b_1 S + B_2 W + b_3 H$$

The cost model is underspecified and the coefficients b_1, b_2 and b_3 are bias. The direction of the bias depends on the sign of b_4 and the direction of the correlation between G and S, W, and H respectively. (Kementa 1971, pp. 329-95).

The two captions in Figure 2 illustrate the effect of greater route coverage by an LTL carrier. In both cases, carrier 1 has less coverage but the average weight, number of shipments and length of haul are identical for both carriers. The only difference between the two carriers is in the number of nodes that are assumed to require terminal facilities. The total cost incurred by carrier 2, the more extensive carrier, is higher than that of carrier 1 because:

(1) Carrier 2 operates more facilities than carrier 1. The terminal capacity of each system is equal but ceteris paribus, carrier 2 must incur higher overhead cost. For example, carrier 2 may require 3 terminal managers while carrier 1 requires 2. (McCormick 1974, pp. 147-64).

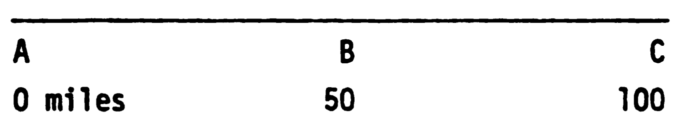
(2) The dispersion of facilities and routes of carrier 2 requires additional communication and coordination inputs.

(3) Carrier 2 performs more terminal consolidation and dispersion than carrier 1. For example, carrier 1 never has to sort packages since all freight is destined to a single destination.

(4) Carrier 2 picks up and delivers over a wider geographic area causing underloading or empty hauling possibilities. In caption (b) for example, in the course of one day, carrier 2 by assumption can only consolidate 1/2 a truckload since half of its traffic moves to one point and half to another. Furthermore, pickup and delivery vehicles at the

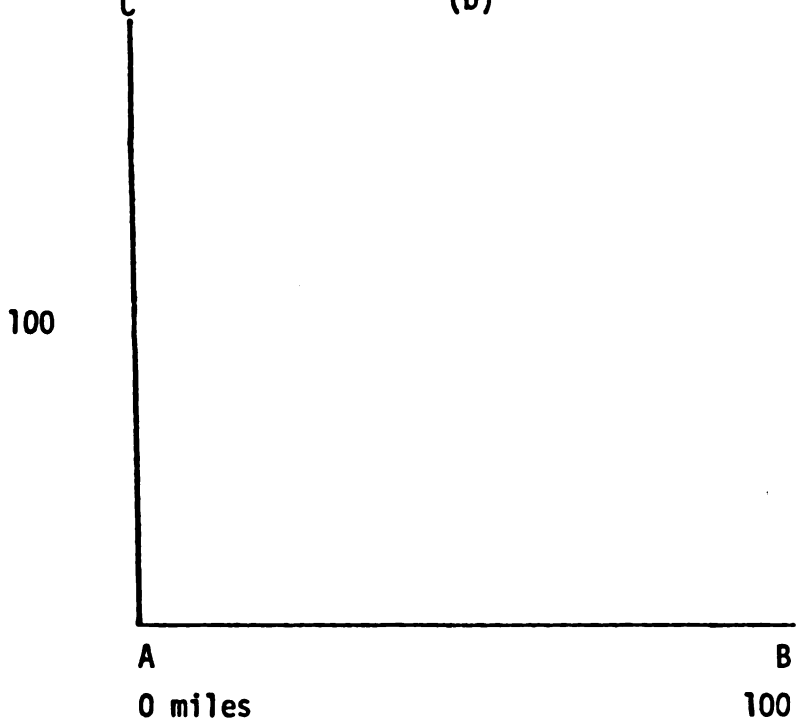
FIGURE 2
EXAMPLES ROUTE-NETWORK SYSTEMS

(a)



Carrier 1, all traffic from A to C.
Carrier 2, 50% of traffic from A to B,
50% from A to C.

(b)



Carrier 1, all traffic from A to B
Carrier 2, 50% of traffic from A to B,
50% from A to C.

extremes of carrier 2's route system are picking up (or delivering) half of what carrier 1's pickup and delivery vehicles are moving. It is concluded that b_4 is positive. Of course, it would be difficult to actually observe two carriers with differential coverage under these ceteris paribus conditions. Larger carriers, by and large, are carriers with a wider geographic network of terminals. As Harrison points out, (1963, p. 300):

> To expand means, primarily, to expand geographically, for even in a given centre, demand for transport in any particular direction is only a fraction of the total demand originating in that centre, so it may be easier for a firm to expand away from its base rather than by winning the whole of the market where it is based, . . ., geographic expansion implies multiplication of bases,. . . .

And, as noted previously, it seems reasonable that the ability to provide extensive single line coverage increases the total demand for the carriers service on any particular traffic lane. Consequently, the correlation between G and S is positive implying an upward bias in b_1, the elasticity of total cost to scale.

Long haul carriers will have the greatest tendency to own fixed facilities at all points in their coverage than short haul carriers. Since many short haul carriers are in essence performing distribution service, multiple stops are often made at points where nothing more than a call station or direct line represents the carrier. Increased coverage by a short haul carrier may simply be in the form of additional routes, intermediate stopoffs, and longer PEDDLE runs. Greater coverage by long haul carriers normally means a greater number of keypoints served directly, each keypoint generating the volume requisite for a terminal operation.

It is concluded that the absence of a variable measuring geographic coverage leads to a bias against economies of scale. The bias is greatest for long haul carriers. Further efforts to portray the motor carrier cost function should address this problem.

Logistics Information

The feasibility of installing advanced electronic data processing (EDP) equipment and software packages that can provide timely and accurate shipment and equipment information to shippers is related to the size of the carrier. While small carriers are not prohibited from utilizing EDP for batch jobs, the on-line systems have so far been limited to use by the larger carriers. Smaller carriers with limited route authority and providing short haul service do not necessarily need EDP hardware to produce timely logistics information. However, to the degree that such a small carrier produces long haul service directly or through interlining or interchange, the large long haul carrier has a distinct advantage through its instantaneous control of shipments throughout its system.

Loss and Damage

Interviews with representatives of a number of carriers indicate that the most important factor affecting the loss and damage performance of a company is the quality and policy of management. Exploratory analysis conducted by the author on the relationship between scale and loss and damage experience does not refute this assertion.

Temporal Aspects of Service

Shippers value transit time, frequency and availability of service, and consistency of transit time. (Milgrim 1972, p.35; Das 1974, p. 184; Evans and Southard 1974, p. 147). Direct measures of the performance of carriers with respect to these characteristics are not available in this study, so no inter-firm comparisons can be made. However, the following deductions are logical. If two carriers are identical with respect to the mix of shipments they move, i.e., equal average shipment weight and equal average haul, the larger of the two carriers is carrying more shipments (any other traffic unit will do since weight and haul are equal) per period of time. This greater volume enables a carrier to accumulate full loads faster and more frequently and also more consistently. This is true even if freight demand is irregular and subject to the same influences. Ceteris paribus, larger freight volume and carrier size permit the realization of better resource utilization.

An Extension

The logical result of better fleet or labor utilization is lower costs, but such were not exhibited in all carrier subpopulations. In particular, economies of scale were not found in the long haul carrier groups. One explanation for this cost behavior is that a carrier provides the highest level of service it can afford. That is, the larger carriers should be able to provide equal levels of service with respect to transit time, frequency, etc. at lower cost if they possess scale advantages. However, the cost advantage is profitable to a carrier only if it can attract customers who would be indifferent to any carrier's service (large or small) if the prices charged were equal. To do this, the carrier with the cost advantage may opt for either a price advantage or differentiate its service through improvement, which it can afford to do and still be as profitable as the less efficient and smaller carrier. Not only does this attract larger traffic volume to the larger carrier but also more higher rated traffic that tends to be more valuable and, therefore, benefits the most from high quality service. The ability of large carriers to attract this 'quality' freight is an important determinant of profitability.[8]

The theorem, "Each carrier offers the level of service he can afford . . ." was brought out by Lawrence who concludes(1976, p. 171):

> The implication of this analysis is that marginal revenue from improving service is greater than the marginal cost of providing the service.

To verify this assertion, he estimates regression models of both cost and revenue. "If the regression mechanism has adequately controlled the quality of service and related factors (i.e., if the output variable, all other factors equal, measures a homogeneous service) then the regression coefficient of the output variable in a multiple regression model to explain revenues should be 1.0." (Lawrence 1976, p. 174). However, Lawrence found the revenue coefficient to be greater than the comparable cost coefficients and larger than one for the large and long haul carriers that exhibited the least, if any, economies of scale as shown in Table 9.

To verify the results obtained by Lawrence, a revenue model was calibrated for regression model (2) substituting revenues for total costs. The regression results are displayed along with the difference (revenue coefficient minus the cost coefficient) in Table 10. The results are fairly consistent with Lawrence's results. It is notable that the largest differences were produced by the high coverage long haul carriers and the small long haul carrier group differences are negative or very small. This lends support to the hypothesis that the long haul carriers are pursuing a strategy of attempting to achieve market intensiveness (defined as the share of the market that a carrier has in a given geographic territory, lane, etc.) through market extensiveness, but the smaller carriers in this group have not yet achieved a balance between the two (Lawrence 1976, p. 171). These carriers are expending resources to provide extensive service, but demand has not yet responded, leading to unutilized excess capacity. One indication of this situation is fewer shipments picked up or delivered per stop. Table 4 shows that Pickup and Delivery Hours per Shipment (PDS) are significant for the small long haul carrier groups but not for the large long haul carriers. The simple correlation coefficients between PDS and log of shipments was +.12824 and -.02055 for the two small long haul carrier groups (having greater than 400 and 500 miles respectively) and -.40030 and -.36185 for the respective large long haul carrier groups. The large negative relationship for the larger carriers suggests a successful balance between extensiveness and intensiveness for the very large long haul carriers and, as yet, an unachieved balance for the smaller long haul carriers.

The preceding line of reasoning is summarized as follows. There are a number of a priori reasons supporting the existence of economies of scale particularly with regard to capacity utilization. However, a carrier can use its cost advantages to produce a superior service if it is more profitable to do so. This strategy would reduce observable economies of scale if the cost model does not account for the additional costs incurred to produce a superior product. The generally larger elasticity coefficients for revenue found here and in other research tentatively verify this.

There are a number of objections to the preceding argument. First, it is possible that the type of route authority possessed by larger carriers enables them to achieve the observed revenue elasticity. This can only be verified by a detailed comparison of route and commodity of authority of large and small carriers providing comparable service in terms of length of haul, shipment weight, etc. Second, the economies of scale and/or service may only exist for a limited rise in scale, for

TABLE 9
REGRESSION COEFFICIENTS FROM LAWRENCE MODEL[1]

SIZE RANGE (REVENUES)	REVENUES (1)	EXPENSES (2)	DIFFERENCE (1) - (2) (3)
1 MM - 10 MM	.984	.982	.002
10 MM - 50 MM	.991	.986	.005
Over 50 MM	1.009	.988	.021
Over 50 MM (Distance > 500 Miles)	1.034	1.019	.015
Over 10 MM	.995	.984	.011

1 Log (Total Cost or Revenue) = b_0 + b_1 (Tonnage) + b_2 (Distance) + b_3 (Load Average) + b_4 (Percent LTL Tons) + b_5 (Average Weight Per LTL Shipment)

SOURCE: Lawrence (1976). Col. 3 computed by author.

TABLE 10
ELASTICITY OF TOTAL REVENUE TO SCALE[1]

REGRESSION SUBPOPULATION[2]	N	R^2	b_1'	$b_1' - b_1$[3]
1	485	.9783	.9891 (.0090)	.0086
2	421	.9846	.9982 (.0086)	.0099
3	36	.9456	.9906 (.0581)	.01 3
4	143	.8949	.9000 (.0301	.0063
5	68	.9512	.9402 (.0351)	-.0029
6	182	.9149	.9344 (.0237)	.0047
7	77	.9694	.9535 (.0254)	.0147
8	227	.9308	.9523 (.0196)	.0109
9	109	.9680	.9685 (.0205)	.0056
10	106	.9750	.9768 (.0177)	.0115
11	49	.9812	.9576 (.0274)	.0116
12	54	.9887	.9618 (.0179)	-.0117
13	31	.9858	1.0257 (.0447)	.0218
14	28	.9944	1.0167 (.0261)	.0003
15	27	.9896	1.0079 (.0452)	.0268

1 Log Revenue $= b_0 + b_1 \log S + b_2 \log W + b_3 \log H + b_{13}\,SL + b_{14}\,PDS + b_4R_1 + b_5R_2 + b_6R_3 + b_7R_4 + b_8R_5 + b_9R_6 + b_{10}R_7 + b_{11}R_8 + b_{12}R_9.$

2 Subpopulations defined on Tables 3 and 4.

3 b_1 from Table 4

example, enough shipments per day to justify daily service between two points that may only be one or two truckloads. Such a volume may be forthcoming between many of the major population centers connected by the interstate system, but the exact quantitative answer is not known. The large amount of freight rehandled and reconsolidated at break bulk terminals of large and small, short haul and long haul carriers attests to either the lack of sufficient volume to fill and dispatch vehicles frequently and quickly enough to meet shipper service requirements or that there is too much competition and the traffic is being split up needlessly. To the extent that volume between a large number of origin-destination points is not sufficient to provide a given level of service, for example daily service, a carrier may utilize an operating system of successive reconsolidation through originating, relay and break bulk terminals that implies a carrier of large size and extensiveness than a carrier operating between limited origin-destination pairs.

A third objection concerns rate regulation that promotes service competition over price competition. If a shipper must pay an equal rate for different services, the shipper will naturally choose the best service available. Given the choice of lower rates or better service, the shipper may choose the former. However, this does not detract from the basic argument that the larger carriers can produce the same quality service as their smaller competitors at lower costs and, therefore, still hold a stronger competitive position. Furthermore, shippers may prefer premium service and continue to pay premium rates. The analysis of shipper demand for high quality service, particularly with respect to frequency and consistency of service remains relatively unexplored on an empirical basis.

SUMMARY AND CONCLUSIONS

The results of the statistical model suggest that economies of scale are present in the LTL segment of the general freight motor carrier industry and constant returns to scale are present in the TL segment [a result consistent with observations of Australian trucking (Wyckoff 1974b, p. 1)]. The small population size of the TL segment prevented further analysis of that group. The LTL segment was broken down into length of haul groups and size groups within each length of haul. Economies of scale were found to be strongest in the short and medium haul groups and weakest in the long haul groups.

As noted elsewhere a scale elasticity coefficient as high as .98 still implies a decreasing long run average cost curve. (Lawrence 1976, pp. 174-75). Warner notes, however, that these scale advantages can be more than offset by a favorable situation that may be interpreted to mean higher average weight or longer hauls. (Warner 1965, p. 43). This, however, confuses the meaning of economies of scale because by definition, the smaller carrier is producing a different product. The proper interpretation of a scale elasticity less than one is that given any combination of shipment size, haul and other non-scale factors, a larger carrier can potentially produce a shipment with those characteristics more efficiently than a small carrier.

A large number of quality of service dimensions were considered in order to isolate the cost-scale relationship. Attributes such as geographic coverage, transit time and dependability could not be included in the cost model. Much evidence suggests that the result of under-specifying the cost model results in a bias against economies of scale, and particularly for the long haul carriers. In fact, the revenue elasticity with respect to scale suggests that shippers are willing to pay the larger long haul carriers higher rates for shipments of equal average weight and equal average distances.

The immediate implications of this study for regulatory policy must be tentative. Whether the evidence strongly or weakly supports the existence of economies of scale in trucking, it is still necessary to ascertain the magnitude of the traffic density existing in each geographic freight market. High density markets may support a large number of optimal size carriers while a low density market may only support one or very few carriers. A stronger implication is that the trucking industry is really several industries. Economic and regulatory analyses must soon recognize this reality.

The limitations of the model point to areas that would be most productive in the effort to achieve more accurate conclusions on motor carrier cost relationships. More variables need to be developed to control non-scale factors. Of particular importance are measures of geographic coverage, transit time and dependability. The dummy variables representing spatial operating conditions were surprisingly significant and consistent with a priori expectations. Possibly the dummy variable approach could be further defined by rate bureau membership or TRINCS regions. An analysis duplicating this study but using another year's observations would serve to indicate whether 1973 was a "normal" year. The results can be highly sensitive to the method of grouping as Table 2 indicates. The criteria by which the carriers were segmented were not arbitrary; but on the other hand, future analysis could use alternative criteria. Finally, a variable explicitly measuring the effect of regulation might be inputed into the model. Attempting to achieve all of these improvements may be equivalent to searching for the Holy Grail. To be sure, there is much that needs to be done in the area of motor carrier cost research.

NOTES

1. Since the Warner study (1965) was in book form, its availability was limited. The study was referenced several times in a companion volume which interpreted the results as indicating a constant long run cost relationship (see Oi and Hurter 1965, pp. 160-61). This is a misinterpretation of the results (see Lawrence 1976, pp. 174-75). This study is properly cited in Kneafsey (1975, p. 341).

2. For example, see Adams and Hendry (1956), Meyer et al. (1959, p. 95), and more recently, G. Hilton (1973, p. 711). The conclusions by Adams and Hendry and Meyer et al. were made prior to the availability of most of the other studies but authorities continue to quote them as substantive evidence. For example, see Moore (1972, p. 1093).

3. For example, what amount of empty back hauls and underloading by general freight carriers is a result of natural traffic imbalances, and the carriers desire to provide fast dependable service vis-a-vis regulatory restrictions. Small carriers tend to be short haul and distribution type operations that face both of these problems.

4. The data source is the Motor Carrier Annual Report Form A for Class I carriers of general freight submitted to the Interstate Commerce Commission (1975). A magnetic tape containing the relevant accounts for the year 1973 was obtained. There are many criticisms of the ICC data and reporting practices, but these statistics are certainly the best available. Following the receipt of the annual reports, the commission goes through a checking process to make the reports useable for the construction of the annual Transport Statistics, Part 7.

5. Another researcher (Hilton 1973, p. 43) defined short haul carrier as one that has: (a) no two major points in its operating authority more than 500 direct miles apart or, (b) most points served within 300 miles of point of domicile or, (c) all operating authority within a maximum of two states.

6. Wilson does not refer to long run or short run cost behavior but the comparison of his results to Roberts (1956) long run cost analysis implies that it is the former (1959, p. 275).

7. For example, in 1973, the Central States agreement required a minimum payment of eight hours at $5.72 per hour for a driver performing a turnaround run exceeding a 60-mile radius or 120 miles round trip, but less than 190 miles round trip (National master freight and central states agreement 1970, p. 119).

8. The quality of a firm's traffic is sometimes approximated by its revenue yield, viz revenue per traffic unit. Publicly held carriers that are generally large long haul or regional carriers with extensive service areas are noted for their high revenue yields (see Pincavage 1975, p. 15).

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AN ANALYSIS OF THE FUNCTIONAL COSTS OF MOTOR CARRIER OPERATIONS

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Investigations of motor carrier costs can be conducted on either a macro or a micro level (Shrock 1975). To date, most published studies have utilized a macro approach. The typical format utilized by economists has involved estimation of how some measure of gross industry output varies with changes in the levels of gross inputs. Typical output measures have included ton-miles, total costs, operating ratios or some combination of these variables. Input measures utilized have included numbers of shipments, average length of haul, average shipment weight, and others. The typical economic study has worked with aggregated data and has not been concerned with anything other than overall cost performance. Seldom have attempts been made to measure cost variability by specific operating function or to determine the specific factors that affect the functional cost variability. Typical of macro level studies are those by Meyer, Peck, Stenason, and Zwick (1959),[1] Warner (1965),[2] and Oi and Hurter (1965).[3]

Micro cost analysis concentrates on attempting to determine how the cost of performing specific operating functions (line-haul, shipment handling, pickup and delivery, etc.) vary with changes in input variables such as shipment volume, shipment density, shipment sizes, etc. Typical of such studies are the A.T. Kearney study on platform handling (1969,1970)[4] and Shrock's dissertation on the allocation of indirect costs to specific traffic segments (1974).[5]

The most widely known motor carrier cost data presently available are those prepared by the Interstate Commerce Commission. The I.C.C. arrives at the average cost of performing various operating functions by starting with the total cost of performing a function and disaggregating the total cost according to a complex set of averaging procedures. The result is the average cost of performing a specified operating function for various sizes of shipments in specific geographic regions defined for cost finding purposes (U.S. I.C.C., 1970).

Both the macro and micro cost approaches have deficiencies that limit the usefulness their results produced through their use. The research results obtained by the macro approach suffer since they provide aggregate data which are useful only in gauging broadly based situations. On the other hand, the usefulness of the micro approach has been limited by the lack of adequate data bases to provide a truly representative picture of functional costs on an industry-wide basis. The I.C.C. studies have suffered from a variety of methodological problems (Schuster 1977). However, the I.C.C. costs are the only ones currently available by shipment size, geographic region, and function.

The purpose of this paper is to demonstrate how the methodological rigor of the typical macro type cost analyses can be applied to micro level data to obtain more precise estimates of the actual variation in both functional costs and total operating costs that motor carriers can expect under varying geographic conditions, shipment sizes, and lengths of haul. A better understanding of cost behavior at the micro level should enable analysts to make more meaningful assessments of the cost impacts of specific managerial or public policy decisions.

THE STATISTICAL COST APPROACH TO MOTOR CARRIER COST FINDING

For purposes of brevity, we will refer to our methodology as the statistical cost approach. It is similar in concept to the approach suggested by Shrock (1975). It is similar, on the surface, to the I.C.C. cost finding approach. However, there are key differences between our methodology and that used by the I.C.C. Specifically, our approach makes no attempt to allocate common costs among operating functions. It also starts from the level of the individual shipment and builds up to total costs for handling a class of shipments rather than starting with fully allocated costs at the functional level and disaggregating to arrive at average cost per shipment as is done in the I.C.C. approach.

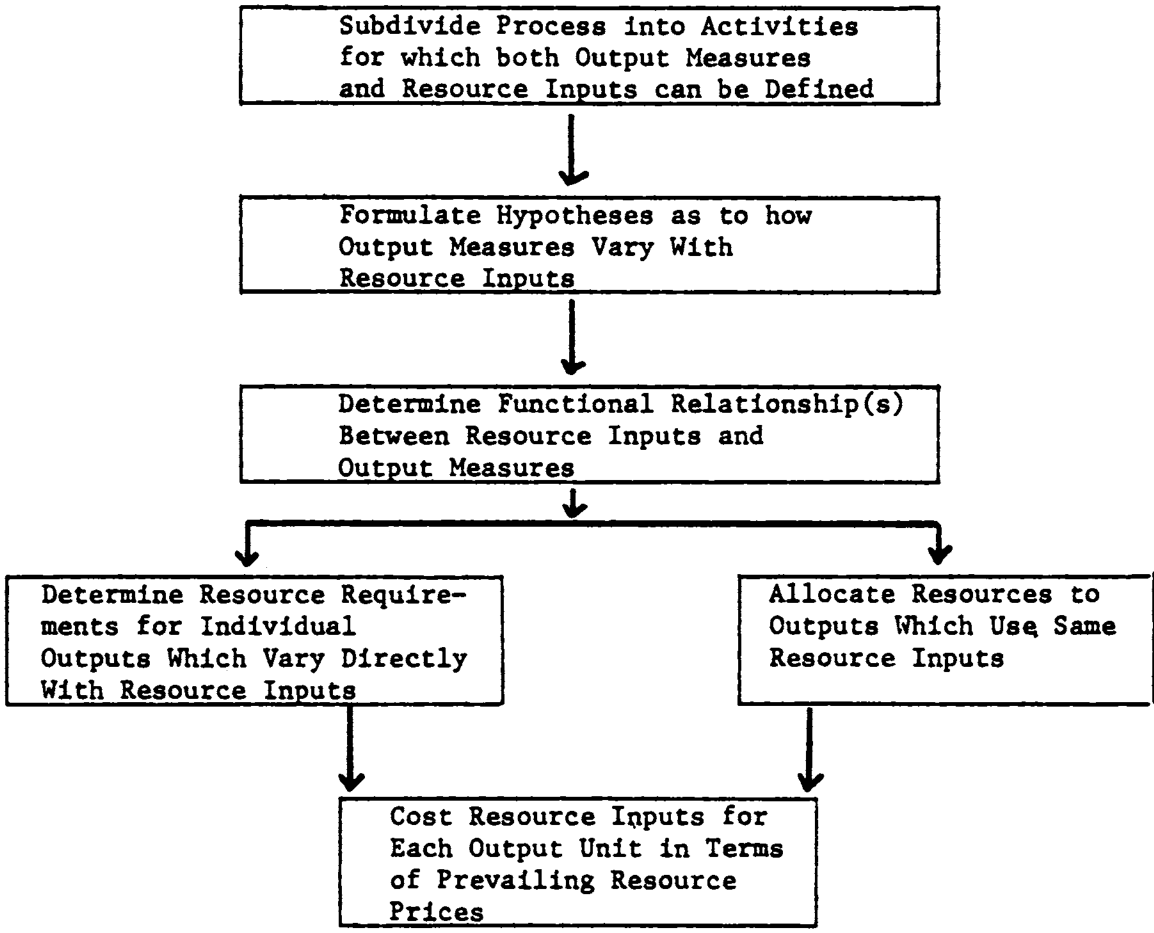
The statistical cost approach is based upon the fact that transportation costs consist of two elements: the number of units of various resources, or factor inputs, required to produce a given transportation service and the price, or prices, paid per resource, or factor, unit. Since it is common for factor unit prices to vary on a geographical basis, transportation costs can be determined in terms of resource units. The resulting costs are not biased due to geographical factor price differences.

The essence of the statistical cost approach has been stated by Shrock (1975). He says

> . . .relating costs first to functional areas and then to individual shipments through definition of resource use requirements necessitates some use of averaging techniques, but to a lesser degree than has been the custom in motor carrier cost analysis. It requires a willingness to look at small segments of the transportation process as units complete within themselves, the costs of which must be combined to define the costs of moving individual shipments. It requires the development of "standard" costs for each phase of operations which are related to shipment movement through the use of sets of shipment attributes rather than one or two, such as weight or density. It requires that all costs which cannot be directly assigned to individual shipments be held in "overhead" accounts and entered into calculation only after all direct costs have been assigned. This will provide the capability for more accurate estimation of the full costs of moving individual shipments. It also will permit comparisons of the direct costs prior to inclusion of indirect costs. Without the presence of indirect costs to cloud results, this will provide the capacity for a clearer view of such problem areas as the "small shipment" and "small shipper" controversies.

The major steps of the statistical cost approach are shown in Figure 1. The first step, or action, is to divide the process under study into sets of activities for which both output measures and resource inputs can be defined. The formulation of hypotheses as to how output measures vary in accordance with resource inputs is the second step. The third step is to use an appropriate set of analytical and/or statistical techniques to determine the form of the functional relationship between the output measure(s) and the resource input(s). The assignment of resource inputs to individual output units is accomplished for those resource inputs whose use levels can be related directly to individual output unit levels. The last step is to allocate resource inputs which vary with the level of output, but which cannot be directly attributed to individual output units, on some rational basis. This five step process provides the analyst with measures of output levels in terms of resource input units. The individual output units can be costed in terms of the prevailing resource prices to determine the direct, or variable, cost. The indirect costs of the process under study can either be allocated to individual output units in some manner or viewed as costs which the product's pricing must cover at some total output level of the firm. Thus, products are costed in terms of their individual direct costs, and decisions on the allocation, if accomplished, of indirect costs to individual product units are left to some other decision mechanism.

FIGURE 1. STEPS OF THE STATISTICAL COST APPROACH



Data Bases

In order to implement the costing procedure described above, it was necessary to obtain a data base which contained demand and operational information under a variety of conditions from a representative sample of motor common carrier firms. Data from only one firm would not have permitted valid conclusions to be drawn that would be generalizable to the universe of motor carrier firms.

Fortunately, such information was available from studies performed by the Interstate Commerce Commission. Two major I.C.C. data bases were acquired. Information on the nature of the demand for motor carrier service and the labor and equipment time and mileage requirements for pick up and delivery service and line haul operations was obtained from the raw data used by the Commission in compiling its 1971 territorial cost studies. This data base was confined to the New England I, New England II, Central, and Eastern-Central cost territories.

A second data base was from a special study of platform handling times made in 1969 and 1970 (U.S. I.C.C. 1973a). This study involved 40 carriers' terminals in 18 different cities throughout the United States. Thus, the two data bases provided the means for determining the characteristics of the freight tendered to carriers (including the weight of shipments and the number of shipments tendered at one time or delivered at one time) as well as the basic resources required to pick up, deliver, handle, and transport the freight.

Characteristics of the Demand Sample

The I.C.C.'s Form 2 sample of motor carrier shipments provided the needed information on the nature of the traffic carried by the industry in 1971. The sample was obtained from a total of 225 carriers participating in the 1971 territorial costs studies for the four cost territories included in this study. The data were drawn throughout the year using stratified systematic sampling with paired selections. If the carrier reported its shipment data to a rate bureau for use in a Continuing Traffic Study, the sampling was performed by the rate bureau. If the data were not provided to the rate bureau, the carrier performed the sampling itself following procedures prescribed by the I.C.C. These data were reported on a firm-wide basis rather than on a terminal by terminal basis as was true for the operational data obtained from the other data base used in this study.

The Form 2 sample provided data on 1) the total billed weight of shipments in each of 13 weight brackets and 2) the total number of shipments sampled. The shipment data in each weight bracket were classified as to whether the shipment was 1) a single-line movement, 2) an interline movement originated by the reported carrier, or 3) an interline bridge movement between originating and terminating carriers. The weight brackets used in stratifying the sample and the sampling rate for each weight bracket are listed in Table 1.

TABLE 1
FORM 2 WEIGHT BRACKETS AND SAMPLING RATES

Weight Bracket (Pounds)	Sampling Rate
0-149	1 out of 2,000
150-299	1 out of 2,000
300-499	1 out of 2,000
500-999	1 out of 1,000
1,000-1,999	1 out of 1,000
2,000-4,999	1 out of 200
5,000-5,999	1 out of 200
6,000-9,999	1 out of 200
10,000-11,999	1 out of 40
12,000-19,999	1 out of 40
20,000-29,999	1 out of 40
30,000-39,999	1 out of 40
40,000 and over	1 out of 40

One problem with the use of the Form 2 data sample is its use of summary data. Although unbiased estimates of the mean number of shipments and shipment weight can be obtained, the sampling variability can only be estimated rather than accurately computed. Therefore, the Form 2 sample cannot be used to test hypotheses that shipment data, obtained in other samples, are representative of the underlying shipment data universe.

Characteristics of the Pickup and Delivery Run Sample

The I.C.C. Form 4 sample provided the data for determining the characteristics of pickup and delivery runs. This sample consisted of 7,556 trips containing a total of 59,560 stops. The sampled trips were from terminals selected by the I.C.C. on the basis of a random sampling of terminals in the cost study territories. The days of the week (excluding Saturdays and Sundays) to be sampled at each terminal were selected randomly. The number of trips sampled at each terminal was determined through the application of a sampling rate selected to provide sufficient data to attain predetermined statistical confidence levels for estimating variable means. The types of data gathered on each pickup and delivery trip are shown in Table 2.

The data from this sample were used to determine the running time of pickup and delivery trips, the number of stops made, the shipment weight picked up or delivered at each stop, and the distribution of the sizes of shipments picked up or delivery in each run. The data can be aggregated by city, carrier, or region.

Characteristics of the Line Haul Data Sample

Line haul data were obtained from the I.C.C. Form 7 sample. This sample was constructed in the same manner as the pickup and delivery sample except that Saturdays and Sundays were included. The data gathered on each line-haul trip are listed in Table 3. These data were used to determine average load factors, average line-haul speeds, the proportion of empty and loaded line haul miles, and the length of haul in the same vehicle of shipments weighing 10,000 pounds or more. The data can be aggregated by carrier or region. The sample contained information on 9,057 line-haul trips in all of the cost study territories included in this study.

Characteristics of the Terminal Handling Sample

Two data sets were used to develop estimates of the time required to handle freight across terminal platforms. The physical characteristics of the freight mix handled by the carriers in each territory were determined from the I.C.C.'s From 10 sample. These data were gathered from a sample consisting of 1995 terminals selected through a systematic replicated sampling procedure developed by the I.C.C. The samples for each terminal were taken on the same days that pickup and delivery runs in the Form 4 sample were taken.

TABLE 2
PICKUP AND DELIVERY TRIP SAMPLE DATA

Rate Bureau Territory

Carrier Identification

Trip Number

Terminal

Sample Replicate

Trip Time
- Terminal Departure Time
- Terminal Return Time

Trip Mileage

Meal Time
- Time Meal Started
- Time Meal Ended

Breakdown Time
- Time Breakdown Occurred
- Time Breakdown Ended

Helper Time
- Time Helper Started Work
- Time Helper Finished Work

Shipment and Stop Data[a]
- Type of Stop[b]
- Type of Consignor/Consignee Served[c]
- Indication of Whether or Not a Trailer Drop/Pickup was Made
- Shipment Weight
- Stop Time
  - Time Arrived at Stop
  - Time Departed Stop

[a]Recorded for a maximum of 102 shipments for each sample run.

[b]Whether a shipment pickup or delivery was made.

[c]Either a shipment consignor or consignee, a freight forwarder, or a connecting carrier.

TABLE 3
LINE HAUL TRIP SAMPLE DATA

Carrier

Type of Trip[a]

Driver's Wages

Total Intercity Driving Time

Total Intercity Trip Miles

Trip Leg Data[b]
- Intercity Miles from Last Stop
- Weight of Shipments Loaded at Stop[c]
- Weight of Shipments Unloaded at Stop[d]

Record of Shipments Weighing 10,000 Pounds and Over[e]
- Shipment Length of Haul (Miles)
- Shipment Weight

[a]Whether a wholly empty, intercity or peddle trip.

[b]Recorded for maximum of 48 trip legs.

[c]Not recorded at trips origin

[d]Not recorded at trip's destination.

[e]Recorded for a maximum of five shipments.

The data collected included the total pounds of freight and the number of shipments originated, terminated or otherwise processed at each terminal, and the number of pounds that were actually handled across the terminal platform at the terminal. These data are categorized into nine weight brackets and, for each weight bracket, the amount that was originated, terminated, received from connecting carriers, delivered to connecting carriers, or handled on a break-bulk basis between the reporting carriers' line haul vehicles. These data provide the basis for estimating the frequency with which shipments in each of the weight categories in the demand sample are handled across terminal platforms in each territory.

The time required to handle shipments in each weight category was derived from a special study conducted for the I.C.C. in 1969-70 (U.S. I.C.C. 1973a).

The sample data were developed from observations of the platform operations of 40 carriers in 18 cities throughout the United States. Time and motion study techniques were used to record specific data on each sample unit. Individual sample units were selected randomly in each terminal. A total of 2297 platform movements was included in the sample. The observations included each of the handling methods commonly employed in terminals (hand trucks, platform trucks, forklifts, draglines, etc.) as well as movements in various directions (truck-to-truck, truck-to-platform, and platform-to-truck). Sample sizes in each category were sufficiently large to permit statistical inferences to be drawn about platform handling times. The data collected are listed in Table 4.

METHOD OF ANALYSIS

Data Analysis

The sample data were used to determine how the time and mileage requirements for performing the various carrier operating functions for different sizes of shipments were affected by the physical nature of the freight handled. Each function was analyzed separately through the use of multiple regression analysis. The independent variables selected for each operating function were determined on the basis of those included as determinants of cost by the I.C.C. as well as those that other non-I.C.C. studies have found to be important.

The analysis was done for each cost territory included in this study as well as for the four territories in total. Our analysis in this paper is confined to the costs of the total sample of carriers.

Functional Performance Model

The results of the analysis of the determinants of cost behavior by shipment size for each operating function served as the basis for developing a model of how functional costs behave under varying demand conditions. This highly disaggregated model is based upon the fact that

TABLE 4

DATA COLLECTED IN PLATFORM HANDLING
TIME STUDY

Carrier[a]

Terminal Location[a]

Shipment Data

- Type Traffic[b]
- Shipment Weight
- Number of Pieces
- Dimensions per Piece
- Type of Container[a]

Platform Vehicle Data

- Type of Vehicle[c]
- Method of Propulsion[d]
- Origin on Platform[e]
- Destination on Platform[e]

Handling Time Data

- Sort Time
- Break-out Time
- Platform Vehicle Running Loaded Time
- Stowage Time
- Paper Time
- Platform Vehicle Running Empty Time

Distance Data

- Running Loaded Distance
- Running Empty Distance

Number of Platform Vehicle Trips Across Platform

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[a]Data not placed in computer data base.

[b]Single Line, Interline Originated, Interline Terminated, Bridge, Break-Bulk.

[c]Two- or Four-Wheel Hand Truck, Forklift.

[d]Manual, Forklift, Dragline, or Other

[e]Truck, Dragline or Platform Pile

costs will vary as the composition of freight carried varies. A set of equations was developed for each operating function which permitted the proportions of freight with different sets of physical characteristics (such as shipment size, source or destination of freight, method of handling, method of pickup and delivery, etc.) to be varied. The functional relationship derived from the regression analysis of the sample data was used to specify the relationships between the dependent and independent variables in the model.

Cost Estimation

Cost levels were estimated by applying 1971 costs to the time and mileage estimates for each functional activity obtained from the model. The cost estimates were constrained, for the purposes of this study, to only cases involving the pickup, delivery, and handling of single L.T.L. shipments weighing less than 10,000 pounds. However, the model is capable of evaluating how costs change as the proportion of shipments picked up or delivered at a single stop increases and to include truck load shipments. In effect, the treatment used in this paper enables the estimation of the short run marginal cost of providing motor carrier less-than-truck load service.

PHYSICAL DETERMINANTS OF MOTOR CARRIER COSTS

The results of the analysis of the sample data described in the preceding section are presented in this section. These results were used to specify the model developed for estimating functional operating performance and, subsequently, operating costs.

Demand Characteristics

Shipment Size

The I.C.C. Form 2 data sample described in the preceding section was used to estimate the average weight and type of shipments in each of 13 weight brackets and the proportion of the total shipments in each weight bracket by size of shipment. The sampling method used by the I.C.C. in collecting this data made it possible to calculate only the means. Accurate estimates of the sampling variance cannot be calculated, as carriers report only aggregate data on shipment weights and types of shipment. The weight and shipment type characteristics of freight handled in the four territories included in the I.C.C.'s 1971 cost studies are shown in Table 5. The percentage distribution of shipments among size and shipment type categories is shown in Table 6, and the percentage distribution of types of shipments within individual weight brackets is shown in Table 7.

These tables highlight the magnitude and nature of the so called small shipments problem. Approximately 75 percent of all shipments weigh less than 1000 pounds (Table 6), and slightly more than 40 percent

TABLE 5

MEAN SHIPMENT WEIGHT BY WEIGHT BRACKET AND TYPE OF TRAFFIC FOR CARRIERS PARTICIPATING IN THE 1971 COST STUDIES OF THE NEW ENGLAND I, NEW ENGLAND II, CENTRAL AND EASTERN-CENTRAL COST TERRITORIES

Weight Bracket (Pounds)	Mean Shipment Weight by Type of Traffic				
	Single Line	Interchange Originated	Interchange Terminated	Bridge	All Traffic
0-149	88	87	84	91	87
150-299	217	213	209	209	215
300-499	382	380	378	396	380
500-999	665	659	648	666	661
1000-1999	1297	1285	1286	1288	1297
2000-4999	2789	2792	2813	2727	2801
5000-5999	5261	5257	5244	5291	5276
6000-9999	7432	7517	7504	7740	7490
10000-11999	10651	10755	10716	10633	10665
12000-19999	14946	14862	14713	14881	14911
20000-29999	23624	24286	24245	24298	23735
30000-39999	33989	34181	34407	34619	34003
40000 and Over	44653	43191	42825	43822	44418

TABLE 6
PERCENTAGE OF SHIPMENTS BY WEIGHT BRACKET AND TYPE OF TRAFFIC -
ALL 1971 COST STUDY CARRIERS

Weight Bracket (Pounds)	Precentage of Shipments by Type of Traffic				
	Single Line	Interchange Originated	Interchange Terminated	Bridge	All Traffic[a]
0-149	15.844	6.756	5.797	0.598	28.992
150-299	12.062	4.870	4.068	0.291	21.022
300-499	7.352	2.977	2.371	0.176	12.875
500-999	7.839	2.851	2.268	0.157	13.193
1000-1999	6.043	2.056	1.738	0.096	9.933
2000-4999	4.148	1.240	1.082	0.075	6.546
5000-5999	0.985	0.293	0.255	0.014	1.551
6000-9999	1.020	0.261	0.232	0.014	1.527
10000-11999	0.304	0.079	0.065	0.004	0.452
12000-19999	0.334	0.083	0.061	0.004	0.483
20000-29999	1.230	0.217	0.176	0.006	1.629
30000-39999	0.745	0.098	0.099	0.003	0.946
40000 & Over	1.176	0.096	0.104	0.004	1.380
Totals					
All Wt. Brackets	59.082	21.882	18.384	1.442	100.000
0-999 pounds	43.097	17.454	14.504	1.222	75.992
0-9999 pounds	55.293	21.309	17.811	1.421	95.549

[a]Totals will not exactly crossfoot due to rounding of individual percentages.

TABLE 7
PERCENTAGES OF SHIPMENTS BY TRAFFIC TYPE IN EACH WEIGHT BRACKET - ALL COST TERRITORIES

Weight Bracket (Pounds)	Percentages by Traffic Type: Single Line	Interchange Originated	Interchange Terminated	Bridge	Totals[a]
0-149	54.65%	23.30%	20.00%	2.06%	100.00%
150-299	57.38	23.17	19.35	1.38	100.00
300-499	57.10	22.73	18.42	1.37	100.00
500-999	59.83	21.76	17.31	1.20	100.00
1000-1999	60.84	20.70	17.50	0.97	100.00
2000-4999	63.37	18.94	16.53	1.15	100.00
5000-5999	63.51	19.21	16.44	0.90	100.00
6000-9999	66.80	17.09	15.19	0.92	100.00
10,000-11,999	67.26	17.48	14.38	0.88	100.00
12,000-19,999	69.15	17.18	12.63	0.83	100.00
20,000-29,999	75.51	13.32	10.80	0.37	100.00
30,000-39,999	78.75	10.36	10.47	0.32	100.00
40,000 & Over	85.22	6.96	7.54	0.29	100.00

[a]Totals in each weight bracket may not equal 100.00% due to rounding of individual percentages.

of all shipments weighing less than 1000 pounds involve interline movements between two or more carriers (Table 7).

Length of Haul

The average distances that shipments were carried in the 1971 cost study territories are shown in Table 8. These data were derived from data reported to the I.C.C. independently of the Form 7 data described earlier. The Form 7 sample data on line haul distances was applicable only to individual vehicle runs and not the total distance a shipment moved. The Eastern-Central Territory is primarily a long haul territory, while the other territories have substantially shorter hauls. Thus, the aggregated data reflect both long and short haul operating characteristics.

LTL SHIPMENT COSTS BY WEIGHT BRACKET

Approach

The first step in the determination of LTL shipment costs was to determine the costs, for each weight bracket, of the functions motor carriers must perform in providing transportation services. These functions are 1) shipment platform handling, 2) pickup and delivery, 3) line haul movement, and 4) billing and collection. The LTL Shipment Cost Model developed for this study was first used to determine, by function, the cost per hundred-weight of providing transportation services for shipments in each weight bracket. Next, the costs incurred in each functional area were aggregated to obtain the total mean variable costs per hundred-weight of providing transportation services in each LTL shipment weight bracket. We shall present only the results of the analysis in the remainder of this paper. Space considerations preclude the development of detailed explanations of the probable reasons for the nature of the results.

LTL Shipment Platform Handling Costs

Variables

Multiple regression analysis of the sample data revealed that the time required to handle shipments varied widely depending on whether forklifts or manual handling methods were used. Accordingly, the costs of each type of movement were computed separately in the handling cost module of the Shipment Cost Model. The proportions of freight in each weight bracket handled manually and by forklift were used as weights in calculating the weighted average time required to handle shipments on terminal platforms.

TABLE 8
SHIPMENT AVERAGE LENGTH OF HAUL OF 1971 COST STUDY CARRIERS

Cost Study Territory	Shipment Average Length of Haul
New England I[a]	117
New England II[b]	213
Central[c]	179
Eastern-Central[d]	619
All Regions[e]	308

[a]Source: (U.S. I.C.C. 1973b, p. 30)

[b]Source: (U.S. I.C.C. 1973c, p. 29)

[c]Source: (U.S. I.C.C. 1973d, p. 33)

[d]Source: (U.S. I.C.C. 1973e, p. 28)

[e]Computed from total tons carried and ton miles of service provided for all 1971 cost study territories.

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The independent variables found to significantly affect manual handling costs included the number of pieces in the shipment, the distance moved, the weight of the shipment, handling strategy used (truck-to-platform-to-truck, truck-to-truck), type of handtruck used to carry the shipment, cubic volume of the shipment, and the density. Most time variation (about 68 percent of the total) was accounted for by the number of pieces in the shipment and the distance moved over the platform.

Wide variability existed in the data for forklift handling. The most significant relationships were between handling time and the number of forklift trips required to handle the shipment and the total distance moved. These accounted for slightly more than 42 percent of the observed variation in the data.

Handling Time

The times required for a complete movement across terminal platforms at origin and destination for shipments in each LTL weight bracket, as calculated by the Shipment Cost Model, are shown in Table 9. These data were then adjusted for the proportions of the shipments in each bracket actually moved across the dock and for the average amount of time per shipment consumed in intermediate break-bulk handling. The result, shown in Table 10, is the handling times actually chargeable against each weight bracket and type of traffic.

Handling Costs

Unfortunately, I.C.C. publications on territorial motor carrier costs do not contain the mean hourly cost of shipment platform handling. However, the mean platform handling cost per hundred-weight actually platformed is reported. This mean cost per hundred-weight was used with the mean platform handling time per hundred-weight for all shipments to obtain an estimate of the mean shipment platform handling hourly cost. The estimated mean shipment platform handling hourly costs were used with the shipment platform handling times per hundred-weight contained in Table 10 to determine the mean dollar cost per hundred-weight of providing platform handling services for shipments in each weight bracket and traffic type. The mean shipment weights for each weight bracket and traffic type, shown in Table 5, was used with the mean dollar cost per hundred-weight to compute the estimated per shipment cost of platform handling services. The results of these computations are shown in Table 11.

LTL Shipment Pickup and Delivery Costs

Variables

Pickup and delivery costs were broken down into the costs associated with the time spent at each stop and the time and mileage related

TABLE 9
MEAN PLATFORM HANDLING TIMES PER HUNDRED-
WEIGHT FOR LTL SHIPMENTS HANDLED
OVER THE PLATFORM
(In Seconds)

	Shipments Delivered by Connecting Carriers			Other Shipments		
Weight Bracket (pounds)	Forklifted Shipments	Shipments Handled Manually	All Shipments	Fork-lifted Shipments	Shipments Handled Manually	All Shipments
1-149	382.9	152.2	153.3	289.9	152.2	153.0
150-299	120.7	95.6	96.3	92.6	95.6	95.2
300-499	88.0	72.3	73.8	67.7	72.3	71.8
500-999	51.2	61.7	59.7	39.4	61.7	57.4
1000-1999	28.8	54.3	44.5	21.8	54.3	41.8
2000-4999	20.9	47.1	33.5	16.2	47.1	31.1
5000 & Over	18.0	22.2	19.1	14.3	22.2	16.4

TABLE 10
MEAN LTL SHIPMENT PLATFORM HANDLING TIME
PER HUNDRED-WEIGHT TRAFFIC TYPE
AND WEIGHT BRACKET-ALL COST
TERRITORIES

Weight Bracket (pounds)	Traffic Type: Single Line	Interchange Originated	Interchange Terminated	Bridge	All Traffic
0-149	283.6	278.7	297.8	295.7	285.6
150-299	176.8	173.4	186.1	184.8	180.2
300-499	133.4	130.7	137.4	140.4	133.1
500-999	105.7	103.0	112.3	111.9	106.4
1000-1999	71.9	72.0	79.7	81.0	73.4
2000-4999	48.0	50.0	55.6	58.6	49.8
5000-5999	17.8	20.2	23.9	26.7	19.4
6000-9999	17.8	20.2	23.8	26.7	19.2

TABLE 11

MEAN LTL SHIPMENT PLATFORM HANDLING COSTS BY TRAFFIC TYPE AND WEIGHT BRACKET - ALL COST TERRITORIES

Weight Bracket (Pounds)	Costs by Traffic Type[a] Single Line Mean Cost/ Shpmt.	Mean Cost/ Cwt.	Interchange Originated Mean Cost/ Shpmt.	Mean Cost/ Cwt.	Interchange Terminated Mean Cost/ Shpmt.	Mean Cost/ Cwt.	Bridge Mean Cost/ Shpmt.	Mean Cost/ Cwt.	Weighted Average- All Traffic Mean Cost/ Shpmt.	Mean Cost/ Cwt.
0-149	$1.635	$1.879	$1.607	$1.847	$1.717	$1.974	$1.705	$1.960	$1.647	$1.893
150-299	2.520	1.172	2.471	1.149	2.652	1.234	2.634	1.225	2.568	1.194
300-499	3.360	0.884	3.292	0.866	3.461	0.911	3.536	0.931	3.352	0.882
500-999	4.631	0.701	4.513	0.683	4.920	0.744	4.903	0.742	4.662	0.705
1000-1999	6.181	0.477	6.190	0.477	6.852	0.528	6.964	0.537	6.310	0.487
2000-4999	8.912	0.318	9.283	0.331	10.323	0.369	10.880	0.388	9.246	0.330
5000-5999	6.225	0.118	7.064	0.134	8.358	0.158	9.337	0.177	6.784	0.129
6000-9999	8.837	0.118	10.029	0.134	11.816	0.158	13.256	0.177	9.532	0.127

[a]Based on an estimated shipment platform handling cost rate of $23.862 per hour.

costs associated with travel to and from the terminal and between stops made during the pickup and delivery run.

The time at stops was found to be significantly affected by shipment weight, whether the stop was for a pickup, delivery, or at another carrier's terminal, the population size of the terminal area in which the stop was made, whether the carrier was a short haul or a long haul carrier and whether or not the stop involved the drop off or pick-up of a trailer. Running time was affected significantly by the mileage traveled in the trip, whether or not the trip involved the drop-off or pickup of a trailer, the number of stops made, and the size of the city in which the trip took place.

Stop Times

Mean pickup and delivery stop times by shipment size and type of traffic were computed by first determining how stop time varied by weight bracket for different types of stops (pickup, delivery to inter-line carrier) in different sizes of cities. In the interests of space, we have omitted the tables showing stop times by shipment size within city size for types of stops. Four important findings emerged from this part of the analysis. First, shipments weighing less than 2000 pounds require significantly greater amounts of stop time per hundred-weight than those weighing more than 2000 pounds for either pickup or delivery. Second, stop times increase with city size within each weight bracket. As city size is used as a proxy variable for congestion, this suggests that loading and unloading conditions are most congested in larger cities. The differences range from about 20 percent more time per hundred-weight required in the largest cities as compared with those under 500,000 population for shipments weighing between 6000 and 10,000 pounds to about 50 percent more time required per hundred-weight for the smallest size shipments in cities with over 5 million population as compared with those under 500,000. Third, pickup stops require less time per hundred-weight than delivery stops in each shipment bracket and size of city. This finding is in direct opposition to the current I.C.C. practice of assuming the same average stop times for pickup and delivery. Fourth, stops at carrier terminals for interlining shipments require significantly longer times than stops for either pickup or delivery at other types of stops. This is true for all sizes of cities.

The stop times calculated in the first step were then used in the LTL Shipment Cost Model to calculate the LTL shipment stop times by weight bracket for each type of shipment handled. The weighted average stop times, shown in Table 12, were computed using the percentages of each type of traffic in each weight group from Table 6 as the weights. The data in Table 12 reinforce two rather well known facts about pickups and delivery operation: 1) shipments weighing less than 1000 pounds require significantly greater time per hundred-weight to pickup and deliver than those weighing more than 1000 pounds and 2) the average per shipment stop time experienced by any given carrier for all types of traffic will be significantly affected by the mix of single line, originated interline and terminated interline shipments, as well as the sizes of shipments in each category.

TABLE 12
MEAN PICKUP AND DELIVERY STOP TIME FOR INDIVIDUAL LTL SHIPMENTS BY TRAFFIC TYPE AND WEIGHT BRACKET - ALL COST TERRITORIES
(In Minutes)

	Traffic Type									
	Single Line		Interchange Originated		Interchange Terminated		Bridge		Weighted Average All Traffic	
Weight Bracket (Pounds)	Stop Time/ Shpmt.	Stop Time/ Cwt.	Stop Time/ Shpmt.	Stop Time/ Cwt.	Stop Time/ Shpmt.	Stop Time/ Cwt.	Stop Time/ Shpmt.	Stop Time/ Cwt.	Stop Time/ Shpmt.	Stop Time/ Cwt.
0-149	15.428	17.729	18.244	20.969	7.818	8.986	10.637	12.226	14.465	16.626
150-299	19.736	9.180	22.894	10.649	10.036	4.668	13.194	6.137	18.753	8.722
300-499	23.312	6.135	26.766	7.044	11.742	3.090	15.196	3.999	21.766	5.728
500-999	29.739	4.499	33.567	5.078	15.016	2.272	18.844	2.851	27.922	4.224
1000-1999	41.518	3.201	46.004	3.547	20.978	1.617	25.464	1.963	38.701	2.984
2000-4999	58.797	2.099	64.088	2.288	29.605	1.057	34.896	1.246	54.693	1.953
5000-5999	86.252	1.635	92.612	1.756	43.376	0.822	49.736	0.943	80.148	1.519
6000-9999	107.708	1.438	114.769	1.532	54.133	0.723	61.194	0.817	100.349	1.340

Stop Costs

Stop time costs by shipment size and type of traffic are shown in Table 13. The hourly cost rates used in computing the costs were obtained from I.C.C. territorial cost publications (U.S. I.C.C. 1973b, 1973c, 1973d, and 1973e). The cost rate used in Table 13 is a weighted average hourly cost for the four 1971 cost study territories. It is evident from Table 13 that stop costs per hundred-weight decline rapidly up to shipment weights of 6000 pounds. The rate of decrease falls appreciably in the weight category over 6000 pounds.

A final point to be noted is that the pickup and delivery stop time costs computed in this research are greater than the I.C.C.-computed costs for comparable shipment weights. The reason for this is due to the difference in methodologies used by the I.C.C. and in this research. I.C.C. costs can best be described as the average costs of providing pickup and delivery service at the stop to shipments of a given weight (U.S. I.C.C. 1973f). Consequently, the lower per hundred-weight costs of multiple shipment pickups or delivery stops are averaged with the higher costs of single shipment stops to arrive at an overall average cost per hundred-weight for shipments of a given weight.

The methodology used in this research provides an estimate of the costs associated with the single shipment pickup and delivery services at the stop. As a result, the pickup and delivery stop time costs contained in Table 13 can be considered to be the marginal costs of a single shipment pickup and delivery service at the stop. However, our methodology is fully capable of being extended to the costing of stops involving multiple shipments.

Mileage Costs

The sample data analysis revealed a significant difference in the distance traveled on pickup and delivery trips between trips that involved the pickup or drop-off of a trailer and those that did not. Therefore trip mileages were calculated separately for these two types of trips. The mileages are shown in Table 14. Stem mileage (distance from the terminal to the first stop and from the last stop to the terminal) and variable mileage (distance between stops) are common cost requiring allocation to individual shipments. The I.C.C. allocation basis used in this research uses different bases to allocate the stem and variable components of mileage costs to individual shipments. The data in Table 14 were computed by the pickup and delivery mileage module of the LTL Shipment Cost Model using parameters derived from the multiple regression analysis of the I.C.C. sample data.

Two conclusions are readily evident from inspection of Table 14. First, the total mileage involved in trailer drop trips is less than that for non-trailer drop trips. This is due to fewer stops being involved in trailer drop trips. Second, the mean mileage traveled for both types of trips increases with the size of the city in that the

TABLE 13
MEAN PICKUP AND DELIVERY STOP TIME COSTS FOR INDIVIDUAL
SHIPMENTS BY TRAFFIC TYPE AND WEIGHT BRACKET -
ALL COST TERRITORIES

	Costs by Traffic Type[a]									
	Single Line		Interchange Originated		Interchange Terminated		Bridge		Weighted Average- All Traffic	
Weight Bracket (Pounds)	Mean Cost/ Shpmt.	Mean Cost/ Cwt.	Mean Cost/ Shpmt.	Mean Cost/ Cwt.	Mean Cost/ Shpmt.	Mean Cost/ Cwt.	Mean Cost/ Shpmt.	Mean Cost/ Cwt.	Mean Cost/ Shpmt.	Mean Cost/ Cwt.
0-149	$1.905	$2.189	$2.253	$2.589	$0.965	$1.109	$1.313	$1.510	$1.736	$2.053
150-299	2.437	1.133	2.827	1.315	1.239	0.576	1.629	0.758	2.315	1.077
300-499	2.878	0.757	3.305	0.870	1.450	0.382	1.876	0.494	2.687	0.707
500-999	3.672	0.555	4.144	0.627	1.854	0.281	2.327	0.352	3.447	0.522
1000-1999	5.126	0.395	5.680	0.438	2.590	0.200	3.144	0.242	4.778	0.368
2000-4999	7.259	0.259	7.913	0.282	3.655	0.131	4.308	0.154	6.753	0.241
5000-5999	10.649	0.202	11.434	0.217	5.355	0.101	6.141	0.116	9.896	0.188
6000-9999	13.298	0.178	14.170	0.189	6.684	0.089	7.555	0.101	12.390	0.165

[a]Based on a pickup and delivery hourly cost rate of $7.408.

TABLE 14
MEAN PICKUP AND DELIVERY TRIP MILEAGE FOR MEAN NUMBER OF STOPS
FOR NON-TRAILER DROP TRIPS AND TRAILER DROP TRIPS BY SMSA POPULATION-
ALL COST TERRITORIES

SMSA Population	Non-Trailer Drop Trips		Trailer Drop Trips	
	Stem Mileage	Variable Mileage	Stem Mileage	Variable Mileage
Less Than 25,000	10.894	15.200	10.402	3.260
25,000-49,999	7.903	9.362	7.545	2.191
50,000-99,999	10.586	16.946	9.920	2.659
100,000-249,999	10.684	13.854	10.833	3.863
250,000-499,999	13.740	20.239	12.113	2.523
500,000-999,999	14.171	22.569	13.659	4.418
1,000,000-2,499,999	16.519	29.798	15.539	1.657
2,500,000-4,999,999	18.886	29.140	17.755	8.326
5,000,000 and over	21.017	33.142	19.707	12.037
Weighted Average	15.114	23.996	13.674	4.382

trip is made. This is to be expected because of the larger geographic areas encompassed by larger cities.

Stem mileage was allocated to shipment size on the basis of the ratio of the total shipment weight in each weight bracket to the total shipment weight for all weight brackets. This information was derived from the sample data. Variable mileage was allocated on the basis of only one shipment being handled at each stop. Thus, the variable mileage figure approximates the marginal mileage units required for pickup and delivery service.

The mileage costs shown in Table 15 were then calculated by applying the weighted average mileage costs for the four cost territories included in this study to the mileages allocated to each weight bracket for each type of freight. It is evident from the data in Table 15 that the mean mileage cost per shipment remains relatively constant through all shipment weight brackets. However, the mileage cost per hundred-weight decreases sharply as shipment weight increases up to 6000 pounds. Over 6000 pounds, the rate of decrease diminishes substantially.

Running Costs

The mean pickup and delivery trip mileages shown in Table 14 were used in the LTL Shipment Cost Model along with the appropriate model parameters derived from the multiple regression analysis of the sample data to develop pickup and delivery running time estimates by city size and whether or not the trip involved a trailer drop. The results are shown in Table 16. Once again, significant differences can be seen in the effect that size of city and type of service has on the time required for pickup and delivery operations.

Stem and variable running times were allocated to shipment weight brackets and types of freight in the same way as mileage was in the previous section. The weighted average cost of running time was calculated from the appropriate I.C.C. Territorial Cost Studies and applied to the allocated mileages to obtain the running time cost estimates shown in Table 17. The results are similar to those obtained for mileage costs. The cost per shipment is fairly constant over all shipment sizes, but the costs per hundred-weight declines rapidly up to 6000 pounds where the rate of decline slows markedly.

Total Pickup and Deli·ery Costs

The last step in calculating pickup and delivery costs was to sum stop costs, mileage costs, and running costs to arrive at the total cost for each weight bracket and type of freight. The results are shown in Table 18. The reason that the costs of pickup and delivery are so much higher for originated interline shipment than for terminated ones in this table was the assumption that the originating carrier delivered all interline shipments to the connecting carrier. Thus, the receiving carrier is spared the expense of a pickup trip to obtain interline traffic. The reason that interline costs for pickup and delivery in all weight brackets are higher than single line costs is the fact, noted in

TABLE 15
PICKUP AND DELIVERY MILEAGE COSTS PER SHIPMENT BY TRAFFIC TYPE
AND WEIGHT BRACKET - ALL COST TERRITORIES

Weight Bracket (Pounds)	Costs by Traffic Type[a] — Single Line: Cost/ Shipment	Single Line: Cost/ Cwt.	Interchange Originated: Cost/ Shipment	Interchange Originated: Cost/ Cwt.	Interchange Terminated: Cost/ Shipment	Interchange Terminated: Cost/ Cwt.	Bridge: Cost/ Shipment	Bridge: Cost/ Cwt.	Weighted Average - All Traffic: Cost/ Shipment	Weighted Average - All Traffic: Cost/ Cwt.
0-149	$1.377	$1.583	$1.377	$1.583	$0.688	$0.791	$0.688	$0.791	$1.225	$1.408
150-299	1.446	0.673	1.446	0.673	0.723	0.336	0.723	0.336	1.315	0.611
300-499	1.458	0.384	1.458	0.384	0.729	0.192	0.729	0.192	1.308	0.344
500-999	1.598	0.242	1.598	0.242	0.799	0.121	0.799	0.121	1.452	0.220
1000-1999	1.719	0.133	1.719	0.133	0.859	0.066	0.859	0.006	1.560	0.120
2000-4999	1.905	0.068	1.905	0.068	0.952	0.034	0.952	0 034	1.736	0.062
5000-5999	1.515	0.029	1.515	0.029	0.757	0.014	0.757	0.014	1.384	0.026
6000-9999	1.679	0.022	1.679	0.022	0.840	0.011	0 840	0.011	1.544	0.021

[a]Based on a per vehicle-mile pickup and delivery cost rate of $0.24107.

TABLE 16
MEAN PICKUP AND DELIVERY TRIP RUNNING TIMES FOR MEAN NUMBER OF STOPS FOR NON-TRAILER DROP TRIPS AND TRAILER DROP TRIPS BY SMSA POPULATION - ALL COST TERRITORIES
(In Minutes)

SMSA Population	Non-Trailer Drop Trips Stem Time	Non-Trailer Drop Trips Variable Time	Trailer Drop Trips Stem Time	Trailer Drop Trips Variable Time
Less Than 25,000	49.786	69.464	43.267	13.560
25,000-49,999	32.921	38.999	30.922	8.979
50,000-99,999	47.750	76.437	43.369	11.625
100,000-249,999	42.168	54.680	41.142	14.671
250,000-499,999	57.040	84.020	45.032	9.380
500,000-999,999	50.604	80.594	50.595	16.365
1,000,000-2,500,000	58.568	105.614	64.354	6.862
2,500,000-4,999,999	74.133	114.384	67.975	31.876
5,000,000 and over	82.102	129.469	74.067	45.240
Weighted Average	57.974	91.486	53.297	16.827

TABLE 17
PICKUP AND DELIVERY RUNNING TIME COSTS PER SHIPMENT
BY TRAFFIC TYPE AND WEIGHT BRACKET -
ALL COST TERRITORIES

Weight Bracket (Pounds)	Costs by Traffic Type[a]									
	Single Line		Interchange Originated		Interchange Terminated		Bridge		Weighted Average - All Traffic	
	Cost/ Shipment	Cost/ Cwt.	Cost/ Shipment	Cost/ Cwt.	Cost/ Shipment	Cost/ Cwt.	Cost/ Shipment	Cost/ Cwt.	Cost/ Shipment	Cost/ Cwt.
0-149	$2.693	$3.095	$2.693	$3.095	$1.347	$1.548	$1.347	$1.548	$2.396	$2.754
150-299	2.828	1.316	2.828	1.316	1.414	0.658	1.414	0.658	2.571	1.196
300-499	2.851	0.750	2.851	0.750	1.426	0.375	1.426	0.375	2.558	0.673
500-999	3.097	0.468	3.097	0.468	1.548	0.234	1.548	0.234	2.813	0.426
1000-1999	3.366	0.260	3.366	0.260	1.683	0.130	1.683	0.130	3.055	0.236
2000-4999	3.733	0.133	3.733	0.133	1.866	0.067	1.866	0.067	3.403	0.121
5000-5999	3.017	0.057	3.017	0.057	1.509	0.029	1.509	0.029	2.757	0.052
6000-9999	3.288	0.044	3.288	0.044	1.644	0.022	1.644	0.022	3.023	0.040

[a]Based on a pickup and delivery hourly cost rate of $7.408.

TABLE 18
PICKUP AND DELIVERY COSTS FOR INDIVIDUAL LTL SHIPMENTS BY
TRAFFIC TYPE AND WEIGHT BRACKET -
ALL COST TERRITORIES

Weight Bracket (Pounds)	Costs by Traffic Type									
	Single Line		Interchange Originated		Interchange Terminated		Bridge		Weighted Average-All Traffic	
	Cost/ Shpmt.	Cost/ Cwt.	Cost/ Shpmt.	Cost/ Cwt.	Cost/ Shpmt.	Cost/ Cwt.	Cost/ Shpmt.	Cost/ Cwt.	Cost/ Shpmt.	Cost/ Cwt.
0-149	$5.975	$6.863	$6.323	$7.268	$3.000	$3.448	$3.348	$3.848	$5.407	$6.215
150-299	6.771	3.121	7.101	3.303	3.376	1.570	3.766	1.752	6.201	2.884
300-499	7.187	1.891	7.614	2.004	3.605	0.949	4.031	1.061	6.553	1.724
500-999	8.367	1.266	8.839	1.337	4.201	0.636	4.674	0.707	7.712	1.167
1000-1999	10.211	0.787	10.765	0.830	5.132	0.396	5.686	0.438	9.393	0.724
2000-4999	12.397	0.460	13.551	0.484	6.473	0.231	7.126	0.254	11.392	0.425
5000-5999	15.181	0.288	15.966	0.303	7.621	0.144	8.407	0.159	14.037	0.266
6000-9999	18.265	0.244	19.137	0.256	9.168	0.122	10.039	0.134	16.957	0.226

the stop time part of this section, that longer times are required to pickup or deliver shipments at carrier docks than are required at non-carrier docks. Total pickup and delivery costs per hundred-weight decrease rapidly up to shipments weighing 6000 pounds. The rate of decline slows dramatically as shipment weight increases past 6000 pounds.

Line Haul Costs

Running Time

The last component of LTL shipment costs computed was line haul costs. LTL shipment line haul costs are a mixture of common and joint costs that require allocation to individual shipments. The I.C.C. ton-mile method was used in the LTL Shipment Cost Model to allocate line haul costs to shipment weight brackets.

The first step was to compute the mean line haul trip running time for each mileage block. The average speed for each one hundred mile mileage block to make the computation of mean line haul trip running time by mileage block is shown in Column 1 of Table 19. Average speeds and mileages were calculated from the Form 10 data sample.

The mean line haul trip running time and mileage for each mileage block were used with the weighted territorial average line haul hourly and mileage rates calculated from the appropriate I.C.C. territorial cost publications (U.S. I.C.C. 1973b, 1973c, 1973d, and 1973e) to compute the mean line haul cost per trip and vehicle-mile by mileage block in columns 2 and 3 of Table 19.

The next step in the computation of LTL shipment line haul costs was to compute the mean line haul costs per hundred-weight for the mean line haul trip mileage of each mileage block. This computation required use of the average load factor for each mileage block, obtained from I.C.C. motor carrier territorial cost publications.[6] The mean line haul costs per hundred-weight-mile for each cost study territory's mean line haul trip mileage in each mileage block are shown in the last column of Table 20. In general, line costs declined as trip mileage increased. The decrease is caused primarily by an increase in the average load factor as line haul trip mileage increases. A second, less important, influence is the decline in vehicle-mile costs with increases in trip mileage.

The last step in the computation of LTL shipment line haul costs was to convert line haul trip mileage to rate-making mileage[7] and to compute the mean line haul trip costs per shipment and per hundred-weight-mile for the mean shipment weight in each weight bracket for the mean shipment length of haul. The mean shipment lengths of haul in Table 8 and the per hundred-weight mile costs in Table 20 were used to make the computations of mean line haul costs per shipment and hundred-weight mile contained in Table 20.[8]

TABLE 19
MEAN LINE HAUL RUNNING TIMES AND LINE HAUL OPERATING COSTS FOR MEAN LINE HAUL TRIP MILEAGE BY MILEAGE BLOCK - ALL COST TERRITORIES

Mileage Block (Miles)	Mean Running Time (Minutes)	Mean Costs[a]: Cost Per Trip	Mean Costs[a]: Cost per Vehicle - Mile	Mean Costs[a]: Cost per Hundred-weight Mile
1-99	103.180	$ 34.233	$ 0.549	$ 0.00336
100-199	224.135	78.662	0.512	0.00253
200-299	351.308	126.917	0.507	0.00233
300-399	483.402	173.564	0.500	0.00212
400-499	585.433	216.312	0.485	0.00193
500-599	745.884	271.289	0.493	0.00185
600-699	901.406	322.803	0.501	0.00181
700-799	1026.254	370.700	0.497	0.00178
800-899	1137.459	415.498	0.491	0.00174
900-999	1262.997	463.379	0.488	0.00171
1,000-1,099	1390.096	510.377	0.488	0.00167
1,100-1,199	1496.515	554.926	0.483	0.00166
1,200-1,299	1741.882	626.008	0.499	0.00177
1,300-1,399	1821.323	663.789	0.492	0.00169
1,400-1,499	1895.207	704.808	0.482	0.00165
1,500-1,599	1939.102	734.014	0.474	0.00163
1,600-1,699	2303.516	827.989	0.499	0.00171
1,700-1,799	2324.328	851.878	0.489	0.00168
1,800-1,899	2311.012	874.647	0.473	0.00162
1,900-1,999	-b-	-b-	-b-	-b-
2,000-2,999	2754.165	999.969	0.494	0.00169
Weighted Average - All Mileage Blocks	453.953	$ 157.470	$ 0.517	$0.00241

[a]Based on average costs of $11.204 per vehicle-hour and $0.23984 per vehicle-mile.

[b]No observations for mileage block in sample data

TABLE 20
MEAN LINE HAUL COSTS FOR AVERAGE SHIPMENT LENGTH OF HAUL BY LTL SHIPMENT
WEIGHT BRACKET AND COST TERRITORY

Weight Bracket (PoundS)	Cost Territory: New England I Cost/ Shpmt.	New England I Cost/ Cwt.Mile	New England II Cost/ Shpmt.	New England II Cost/ Cwt.Mile	Central Cost/ Shpmt.	Central Cost/ Cwt.Mile	Eastern-Central Cost/ Shpmt.	Eastern-Central Cost/ Cwt.Mile	All Cost Territories Cost/ Shpmt.	All Cost Territories Cost/ Cwt.Mile
0-149	$0.442	$0.00461	$0.583	$0.00315	$0.526	$0.00294	$1.155	$0.00212	$0.685	$0.00255
150-299	1.165	0.00461	1.428	0.00315	1.285	0.00294	2.821	0.00212	1.692	0.00255
300-499	2.050	0.00461	2.474	0.00315	2.283	0.00294	4.934	0.00212	2.990	0.00255
500-999	3.577	0.00461	4.533	0.00315	3.933	0.00294	8.530	0.00212	5.201	0.00255
1000-1999	6.895	0.00461	8.704	0.00315	7.776	0.00294	17.138	0.00212	10.205	0.00255
2000-4999	14.944	0.00461	18.400	0.00315	16.861	0.00294	36.704	0.00212	22.039	0.00255
5000-5999	28.825	0.00461	35.392	0.00315	31.462	0.00294	69.118	0.00212	41.512	0.00255
6000-9999	38.557	0.00461	48.562	0.00315	45.657	0.00294	98.355	0.00212	58.933	0.00255

Billing and Collecting Costs

The last component of LTL shipment variable costs is billing and collection costs. These costs were obtained from the appropriate I.C.C. motor carrier territorial cost publications (U.S. I.C.C. 1973b, 1973c, 1973d, and 1973e). The weighted average billing and collecting costs for all of the 1971 cost study territories are shown in Table 21.

Total LTL Shipment Variable Costs

The last step was to sum the variable costs of platform handling, pickup and delivery, line haul and billing, and collection to arrive at estimates of total variable costs for LTL shipments by weight bracket and type of freight. Total variable costs per shipment and per hundred-weight mile for shipments moving the average haul length for all shipments in the 1971 cost study territories are shown in Table 22.

Table 22 clearly shows the significant differences in costs between weight brackets and types of freight. The differences are especially pronounced for shipments weighing less than 5000 pounds. While the results of our study show about the same types of relationships as the I.C.C. Territorial Cost Studies, the level of the costs are substantially different. A comparison of the I.C.C. total costs per hundred-weight with the single shipment costs per hundred-weight for single line shipments carried the average distance is shown for each of the cost study territories in Table 23.

I.C.C. costs are substantially below those calculated with our Shipment Cost Model for all weights up to 1000 pounds. They are above our cost for shipments over 1000 pounds. The reason for this is that the I.C.C. methodology develops average costs for all shipments handled while ours more closely approximates the marginal costs of handling a single shipment in a given size range. In addition, our Shipment Cost Model is based on a more accurate representation of the factors that actually affect cost behavior due to the statistical methodology used and the variables examined. As the two sets of figures are derived from identical data bases, a good argument can be made that an analytical methodology based on the reality of the relationships should produce results superior to one that relies heavily upon unanalyzed assumptions about the importance of cost determinants and the relationships between costs and the factors that influence costs.

IMPLICATIONS

The methodology described and utilized in this paper would appear to yield a more accurate representation of the marginal costs of LTL service than those provided by the I.C.C. or those developed from analysis of highly aggregated cost data bases. This methodology can easily be extended to develop estimates of the effects multiple shipment

TABLE 21
MEAN LTL BILLING AND COLLECTION COST PER HUNDRED-WEIGHT BY TRAFFIC TYPE AND WEIGHT BRACKET-ALL COST TERRITORIES

Weight Bracket (pounds)	Costs by Traffic Type[a]				
	Single Line	Interline Originated	Interline Terminated	Bridge	All Traffic
0-149	$1.3189	$1.3340	$1.3817	$1.2754	$1.3340
150-299	0.5349	0.5449	0.5553	0.5553	0.5398
300-499	0.3038	0.3054	0.3070	0.2931	0.3054
500-999	0.1745	0.1761	0.1791	0.1743	0.1756
1000- 999	0.0895	0.0903	0.0903	0.0901	0.0895
2000-4999	0.0416	0.0416	0.0413	0.0426	0.0414
5000-5999	0.0221	0.0221	0.0221	0.0219	0.0220
6000-9999	0.0156	0.0154	0.0155	0.0150	0.0155

[a]Based on a per shipment billing and collection cost of $1.16064.

TABLE 22
TOTAL LTL SHIPMENT VARIABLE COSTS FOR AVERAGE LENGTH OF HAUL BY WEIGHT BRACKET AND TRAFFIC TYPE - ALL COST TERRITORIES

Weight Bracket (Pounds)	Costs by Traffic Type: Single Line Cost/ Shptm.	Cost/ Cwt.	Cost/ Cwt.Mile	Interchange Originated Cost/ Shpmt.	Cost/ Cwt.	Cost/ Cwt.Mile	Interchange Terminated Cost/ Shpmt.	Cost/ Cwt.	Cost/ Cwt.Mile	Bridge Cost/ Shpmt.	Cost/ Cwt.	Cost/ Cwt.Mile	Weighted Average- All Traffic Cost/ Shpmt.	Cost/ Cwt.	Cost/ Cwt.Mile
0-149	$ 9.456	$10.869	$0.0353	$ 9.776	$11.236	$0.0365	$ 6.563	$7.543	$0.0245	$6.899	$7.929	$0.0257	$ 8.900	$10.229	$0.0332
150-299	12.144	5.648	0.0183	12.425	5.779	0.0188	8.881	4.131	0.0134	9.263	4.308	0.0140	11.622	5.405	0.0176
300-499	14.698	3.868	0.0126	15.057	3.962	0.0129	11.217	2.952	0.0096	11.718	3.084	0.0100	14.056	3.699	0.0120
500-999	19.360	2.929	0.0095	19.714	2.982	0.0097	15.483	2.342	0.0076	15.939	2.411	0.0078	18.736	2.834	0.0092
1000-1999	27.758	2.140	0.0069	28.321	2.184	0.0071	23.904	1.843	0.0060	24.016	1.852	0.0060	27.069	2.087	0.0068
2000-4999	45.009	1.607	0.0052	46.034	1.643	0.0053	39.996	1.428	0.0046	41.206	1.471	0.0048	44.338	1.583	0.0051
5000-5999	64.079	1.215	0.0039	65.703	1.245	0.0040	58.652	1.112	0.0036	60.417	1.145	0.0037	63.494	1.203	0.0039
6000-9999	87.196	1.164	0.0038	89.260	1.192	0.0039	81.078	1.082	0.0035	83.389	1.113	0.0036	86.583	1.156	0.0038

TABLE 23

COMPARISON OF SINGLE LINE LTL SHIPMENT VARIABLE COSTS PER HUNDRED-WEIGHT FOR MEAN LENGTH OF SHIPMENT HAUL

Weight Bracket (Pounds)	Cost Territory: New England I: I.C.C. Costs/ Cwt.	Cost Territory: New England I: Single Shpmt. Costs/Cwt.	Cost Territory: New England II: I.C.C. Costs/ Cwt.	Cost Territory: New England II: Single Shpmt. Costs/Cwt.	Cost Territory: Central: I.C.C. Costs/ Cwt.	Cost Territory: Central: Single Shpmt. Costs/Cwt.	Cost Territory: Eastern-Central: I.C.C. Costs/ Cwt.	Cost Territory: Eastern-Central: Single Shpmt. Costs/Cwt.
0-149	$6.815	$8.316	$10.122	$11.336	$8.475	$9.657	$9.449	$14.734
150-299	3.593	4.134	5.435	5.963	4.585	4.943	5.797	8.030
300-499	2.693	2.861	3.909	4.124	3.240	3.353	4.700	5.711
500-999	2.093	2.178	3.019	3.074	2.480	2.441	4.030	4.818
1000-1999	1.664	1.561	2.419	2.175	1.930	1.761	3.470	3.346
2000-4999	1.334	1.196	1.879	1.497	1.430	1.288	3.050	2.598
5000-5999	1.004	0.882	1.329	1.139	1.050	0.975	2.580	1.989
6000-9999	0.956	0.858	1.259	1.115	0.960	0.922	2.380	1.928

tenders have on costs--a topic of no little interest today.

The methodology provides a means of identifying costs by function as well as for specific cities and types of traffic. Thus, if there is serious interest in making rates more reflective of costs, this methodology would be useful in helping develop a more cost oriented pricing system. Further, the development and testing of the model have revealed a number of shortcomings in extant I.C.C. cost finding methodology, not discussed in this paper, that raise questions about the validity of some published I.C.C. costs.

The Shipment Cost Model could be useful in developing simulations of the impact of changes in government regulation on industry costs. One would need only to change the values of the relevant parameters to reflect the anticipated results of regulatory changes on costs.

In sum, the Shipment Cost Model provides a powerful new tool for analyzing transportation costs. The results obtained in its application to existing data bases has provided a more accurate picture of the short run marginal cost structure of the motor carriers in the Eastern United States in 1971 than has been previously available. It can easily be updated with more current costs and data on freight and operating characteristics as they become available.

NOTES

1. Meyer et al. (1959, pp. 64-110) used multiple regression analysis with motor carrier annual report data to determine the costs per ton of motor carrier transportation services, and the degree of variability of motor carrier costs over various ranges of output.

2. Warner (1965) used multiple regression analysis with data on the operating ratios and costs of 72 Class I motor common carriers of general freight to determine how costs varied with the number of shipments handled by carriers, average shipment weight and average length of haul. He drew two conclusions that are pertinent to this research. First, a ten percent increase in average shipment weight will only cause a seven percent increase in average shipment cost. Second, a ten percent increase in average shipment haul will only cause a three percent increase in average shipment cost.

3. Oi and Hurter (1965, pp. 159-226) used a waybill sample to determine how motor carriage costs varied by shipment weight and length of haul. These cost data were subsequently used in their study to determine the circumstances under which the private carriage option would be more advantageous to the shipper than the for-hire carriage option.

4. The study used time and motion study techniques to determine the manner in which shipment platform handling time varied with shipment characteristics such as weight, density, and number of pieces (Kearney 1969, 1970).

5. Shrock (1974) developed a model of a short-haul motor carrier firm using data supplied by one carrier. The primary purpose of Shrock's dissertation was to determine how different methods of allocating indirect costs would affect the costs of different types of traffic.

6. I.C.C. motor carrier territorial cost publications contain load factors for four weight brackets: 0-9,999 pounds; 10,000-19,999 pounds; 20,000-29,999 pounds; and 30,000 pounds and over. The load factors used in this research are those for the 0-9,999 pound weight bracket and were taken from the following sources: U.S. I.C.C. (1973b, p. 30); (1973c, p. 29); (1973d, p. 33); and (1973e, p. 28).

7. The I.C.C. standard circuitry factor of six percent was used in the conversion of trip mileage to rate-making mileage.

8. For all of the four 1971 cost study territories except the Eastern-Central cost study territory, mean line haul trip mileages closely approximated the cost study territory's mean shipment length of haul. Consequently, the weighted average per hundred-weight mile line haul trip mileage cost was believed to be the most appropriate cost and was used to compute the costs for all cost study territories, except Eastern-Central cost study territory, however, the mean shipment length of haul was more than one hundred miles greater than the mean line haul trip mileage due to the heavy use of breakbulk terminals by the carriers comprising this cost study territory. Therefore, it was decided to use a combination of two per hundred-weight mile costs, the weighted average for all mileage blocks and the 100-199 mile mileage block, in the computation of Eastern-Central cost study territory's per shipment and per hundred-weight mile line haul costs (U.S. I.C.C. 1973b, c, d, e).

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THE COST STRUCTURE OF THE REGULATED TRUCKING INDUSTRY

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Changes in the economic regulation of the trucking industry are being considered, which involve the relaxation of some aspects of regulation in order to allow market forces to have greater influence on the allocation of resources in the industry. If such changes are to be considered properly, it is necessary to ascertain the probable reaction by the industry to greater freedom in such areas as ratemaking and entry.

Two different pictures of the motor carrier industry have been put forward. In the first scenario, described by those advocating greater reliance on market forces, the industry is thought of as one that would be stable and healthy if regulations were relaxed. Proponents of this view argue that rate wars would not occur, profits would be adequate, and bankruptcy rates would be acceptable. In the second scenario, described by those advocating retention of present regulatory controls, a deregulated industry is believed likely to become chaotic. Proponents of this view argue that relaxing controls on entry and ratemaking would allow large firms to drive the smaller firms out of business. It is further argued that prices would then be raised to high levels.

The first scenario implies that the industry would be workably competitive. The second scenario is basically that of a natural monopoly. Undoubtedly, a firm would like to be in the position of a natural monopolist, and undoubtedly there are some firms that would be willing to undertake a rate war if the final result would be a monopoly position. However, their ability to achieve that result depends heavily on the cost structure of the industry, and knowledge of the cost structure is needed in order to determine which scenario is accurate.

If the stable scenario is accurate, then the cost structure will be found to be such that the largest firms would have little, if any, cost advantage over the others. Since the preconditions for national monopoly would not be present, a rate war would not give one firm a monopoly position. Therefore, a rate war strategy will not be chosen by an intelligent firm. A firm could act foolishly in starting a rate war, but with this cost structure such a rate war would be mild, and the results would be detrimental to the firm starting the rate war.

If the chaos scenario is accurate, then the cost structure must exhibit economies of scale, or, in other words, the largest firms must be able to produce a given level of service quality at a lower average cost. This cost structure would provide the conditions for monopoly:

(1) The large firms would have a competitive advantage which would allow them to drive the small firms out of business.

(2) Higher costs experienced by all but the largest firms would act as a barrier to entry of new firms when prices are later raised to monopoly levels.

The importance of understanding the cost structure in order to predict the likely market structure of the industry under a different regulatory environment has long been recognized. In the early work done in the '50's (see Meyer, Peck, Stenason, and Zwick 1960; Robert Nelson 1956), the conclusion drawn was that the industry exhibits nearly constant average cost. More recently, several authors have argued that economies of scale and the concomitant tendency toward concentration do occur in the trucking industry. These arguments are often accompanied by the contention that the long-run average cost curve is an inverted U, i.e., with no economies of scale for small firms but with economies of scale for large firms. (See Dicer 1971; Ladenson and Stoga 1974; Wyckoff 1974; and Lawrence 1976). The unusual shape for the long-run cost curve was generally believed to result from certain management considerations within trucking firms. Wyckoff (1974), for example, argued that firms with revenues between \$1 million and \$5 million are of an awkward size, being too large for informal management and too small for formal management. While some of the sources of the apparent economies of scale would seem to have been explained earlier by Nelson (1956), Meyer et al (1960), and Stanley Warner (1965), who traced them to longer average lengths of haul for larger firms, a variety of interesting new questions have been raised. For example, it is argued that concentration is most likely to occur in the sector of industry that specializes in the carriage of less-than-truckload (LTL) shipments.

Because the intention here is to determine the relative abilities of different sizes of carriers in competing for shipments, it is essential to ensure that any cost advantage results from carrier characteristics rather than shipment characteristics. For that reason, an econometric specification that allows important shipment characteristics to be included is required. Important characteristics would seem to be commodity, shipment size, and length of haul. The average shipment size and length of haul for a carrier is easily calculated. The commodity can be standardized to a degree by dealing only with general freight carriers. It could be argued that since all firms dealt with are common carriers which, by law, are required to accept any freight offered to them, all general freight carriers should have similar commodity mixes.[1] This paper takes as a starting point the analysis by Stanley Warner (1965), in which cost is described as a function of a measure of output as well as a variety of shipment characteristics. The output measure is the only independent variable that is related to scale of the firm. The other independent variables are measures such as length of haul, which need not vary with the scale of the firm.

(1) $C = f(O,S)$

where

C = total cost

O = total output, and

S = a vector shipment characteristics

With this formulation, the measure of output chosen is relatively unimportant provided that the shipment characteristics adequately describe the features that both affect cost and are correlated with the output measure. Any shipment characteristic that did not affect cost would clearly be irrelevant, and one that did affect cost but was not correlated with the output measure would not affect the estimate of economies of scale, though its exclusion would lower the explanatory power of the model.[2]

(2) $C = aS^{b_1}L^{b_2}W^{b_3}e^{\Sigma D c_i}$

where

C = total cost for the firm for one year (1971)

S = number of shipments carried in the year

L = the average length of haul for the firm in the year

W = the average weight of a shipment, and

$e^{\Sigma D c_i}$ = a set of dummy variables for geographic area.

The log linear form was chosen so that the coefficient b_1 would be the elasticity of cost with respect to changes in output.[3] Thus, in this model a constant elasticity is assumed. This is appropriate if the level of economies of scale is the same at all firm sizes but inappropriate otherwise. Later the elasticity will be allowed to vary with firm size, making it possible to examine the possibility that the long-run average cost curve is U-shaped.

The data used in this study are from the Interstate Commerce Commission's Motor Carrier Annual Report forms for Class I carriers of general freight. Selected data from the annual reports are recorded on magnetic tape by the ICC. Copies of these tapes have been obtained by the Department of Transportation. Initially, all the firms that reported all necessary data and that had at least 75 percent of their revenue from intercity general freight were examined. This resulted in 518 observations being available. A variety of subsamples were examined in which the carriers specialized more in intercity general freight and more in less-than-truckload shipments. Particular attention was paid to determining the shape of the long-run average cost curve. This was done, not only by allowing the elasticity to vary with firm size, but also by portioning the sample by size and by inserting a dummy variable that allowed the constant term in the regression to be different for firms that had revenues between one and five million dollars. The considerable variance in firm size, from $1 million to hundreds of millions of dollars in revenue, combined with the large number of observations available makes it possible to address this question in some detail.[4]

One variable was sometimes included in the cost function despite the fact that it is not, strictly speaking, a shipment characteristic. It measured the extent of interlining[5] and, based on the assumption that all shipments must be picked up from a shipper and eventually delivered to a consignee, gives the number of pickups and deliveries per shipment. There were about 1.6 pickups and deliveries per shipment, with the remaining.4 being transfers to other carriers.

$$C = aS^{b_1}L^{b_2}W^{b_3}P\&D^{b_4}e^{\Sigma Dc_i} \qquad (3)$$

Because this variable is not truly a shipment characteristic, the assumptions necessary in order to interpret the coefficient on shipments as the economies of scale parameter may not hold. In other words, it may not be realistic to assume that as the firm increases size the extent of interlining remains unchanged. For this reason, results from regressions that contain this variable must be interpreted cautiously. Two factors led to the conclusions that it should be included. First, better understanding of the interlining question would be a desirable side benefit and, second, excluding the variable also could distort the conclusion as to the level of economies of scale. This comes about because the cost of an interlined shipment is reported by two (or more) carriers, and in this data such a shipment would be counted by each of the carriers involved. Firms which interline more could have an apparent cost advantage (due to fewer pickups and deliveries) which would not reflect a lower cost for the entire movement.

RESULTS OF EMPIRICAL INVESTIGATIONS

The empirical results presented here are divided into four parts. In the first part it is assumed that the elasticity of cost with respect to output is fixed. In other words, that economies or diseconomies of scale, if they occur, will occur at all levels of output. In the second part, the assumption of constant elasticity is removed. This is done in three ways, first by partitioning the sample into size categories, then by inserting a second order scale term into the regression, and finally by inserting a second order scale term into the regression, and finally by inserting a dummy variable which allows firms with one to five million dollar revenues (Wyckoff's awkward size)(1974) to have higher or lower costs. In the third part, firms that were more specialized in small shipments were examined. This was done in response to the assertion that the less-than-truckload sector of the industry has a natural tendancy toward concentration. In the final part, the profitability of the firms is examined. This was done in response to the allegation that the higher profitability of large firms is evidence of economies of scale.

Results from the Constant Elasticity Model

Results from this model are shown in Table 1, and the curves are graphed in Figure 1. Equation (1) is drawn from the work of Warner (1965). Differences stem presumably from the differences in the data base. In this case, all Class I general freight carriers that had in excess of 75 percent of their revenue from intercity general freight and reported all necessary data are included. In addition, the data had been through the full ICC verification process. The coefficient on shipments, $^{b}1$, is the elasticity of cost with respect to output. If it were exactly one, the situation would be one of constant cost. In equation (1), it is .991, giving the appearance of some small amount of economies of scale. However, the standard error on the coefficient is .011, so the hypothesis of constant cost cannot be rejected. In other words, the coefficient is not significantly different than one. This is far from a definitive result. A 95 percent confidence interval on the elasticity would be from .969 to 1.013, or in other words, from economically significant economies of scale on the one hand to diseconomies of scale on the other.

The first step that was taken to clarify this situation involved an examination of the significance of measurement errors, an issue raised by Warner. This was done by making shipments the dependent variable and using cost as an independent variable. In this case, $^{b}1$ is the elasticity of output with respect to changes in cost. In equation (2), $^{b}1$ is over four standard errors less than one, indicating diseconomies of scale which are both economically and statistically significant. When equations (1) and (2) are examined together, it is clear that errors of measurement, the so-called regression fallacy, present substantial problems in estimating the elasticity with the accuracy that is required.

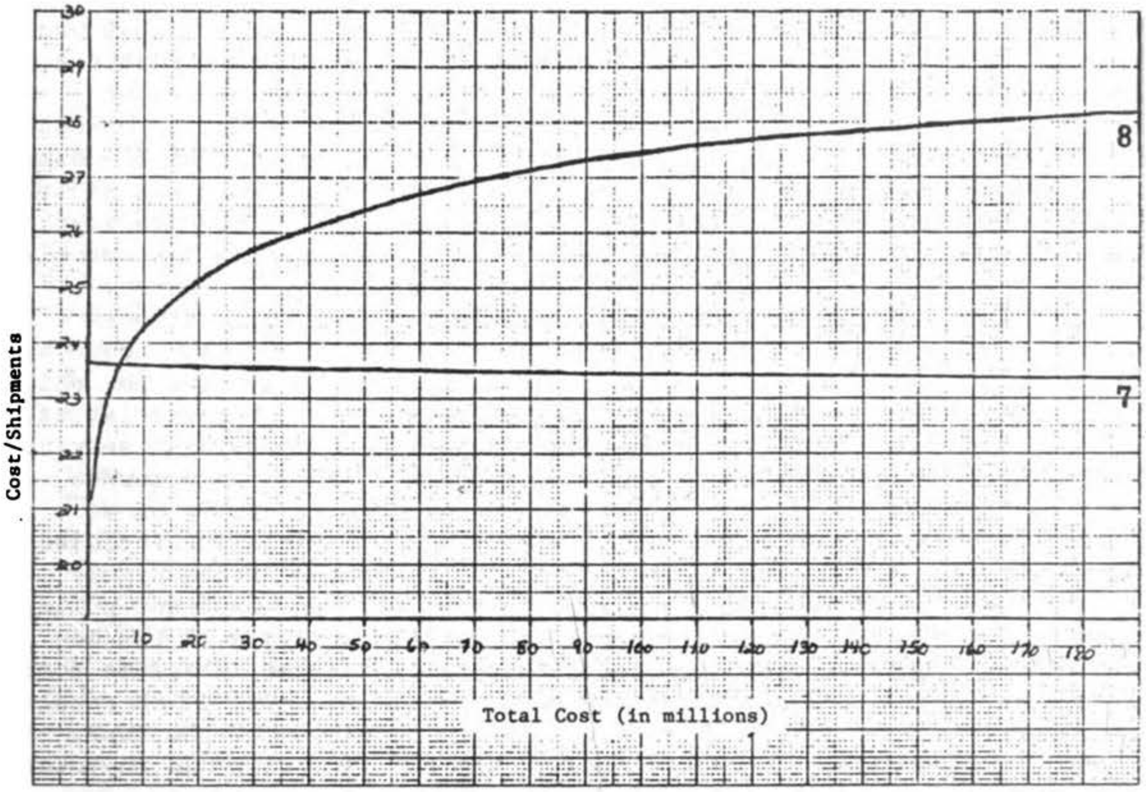
Since more general freight carriers receive at least some income from sources other than intercity general freight, it is desirable on a priori grounds to exclude those that have significant amounts of other types of revenue. This was done by excluding from the sample any carrier that had more than 1 percent of its revenue from the other sources. This left 359 firms. Equations (3) and (4) are identical to (1) and (2) other than for the change in the data base. Unfortunately, there is no indication that this helped the measurement error problem, since the spread between the coefficients is as large as before. To calculate this spread between them it is necessary to invert one of

TABLE 1
RESULTS FROM THE CONSTANT ELASTIBITY MODEL*

#	Description	Dependent Variable	Constant	Scale Variable	Length of Haul	Size of Shipment	Others
1.	518 cases R^2=.962	LnC	= -3.573	+.991 LnS	+.323 LnL	+.689 LnW	
			(.195)	(.0108)	(.015)	(.015)	
2.	518 cases R^2=.965	LnS	= 4.268	+.951 LnC	-.274 LnL	-.699 LnW	
			(.158)	(.0103)	(.016)	(.012)	
3.	359 cases R^2=.967	LnC	= -3.934	+.999 LnS	+.345 LnL	+.706 LnW	
			(.226)	(.0127)	(.019)	(.018)	
4.	359 cases R^2=.965	LnS	= 4.489	+.946 LnC	-.288 LnL	-.708 LnW	
			(.181)	(.0120)	(.021)	(.015)	
5.	359 cases R^2=.975	LnC	= -4.034	+1.012 LnS	+.370 LnL	+.691 LnW	+ ΣDc_i
			(.213)	(.0115)	(.018)	(.017)	
6.	359 cases R^2=.974	LnS	= -4.433	+.946 LnC	-.320 LnL	-.683 LnW	+ ΣDc_i
			(.172)	(.0107)	(.019)	(.015)	
7.	359 cases R^2=.977	LnC	= -5.859	+.996 LnS	+.361 LnL	+.647 LnW	+.464 LnP&D + ΣDc_i
			(.377)	(.0113)	(.017)	(.018)	(.081)
8.	359 cases R^2=.975	LnS	= 5.922	+.961 LnC	-.321 LnL	-.658 LnW	+.372 LnP&D + ΣDc_i
			(.363)	(.0109)	(.019)	(.016)	(.080)

*See page 143 for the definition of variables.

FIGURE 1*
RESULTS FROM THE CONSTANT ELASTICITY MODEL
EQUATIONS 7 AND 8 FROM TABLE 1.



* All curves are calculated using average shipment characteristics for the full sample.

the coefficients so that all measure the same elasticity. For example, if the coefficients in equations (2) and (4) are inverted, the spread originally was 6.1 percent and became 5.8 percent. Nevertheless, because of the *a priori* soundness of dealing only with firms which carry only intercity general freight, the new data base is retained for later regressions, though similar regressions were actually performed on the other data base as well.

The next attempt to reduce the errors of measurement problem was somewhat more successful. This involved the use of eight dummy variables to allow costs to vary over the nine ICC regions. This was done primarily to allow for the possibility that physical conditions, such as congestion, in a different region would have an effect on costs. Other possibilities are that the freight mix or factor prices in one region may be different than in another. Inclusion of the dummies reduced the spread in the elasticities to 4.6 percent. In addition, the R^2 for the regression was raised significantly, and the confidence intervals for both regressions were almost entirely in the diseconomies of scale range, so the policy implications were somewhat clearer.

In the final pair of regressions in Table 1, an additional variable was included which reflects the amount of interlining done by the firm. It is the average number of pickups and deliveries per shipment X 100. This variable, unlike the other shipment characteristics, describes not only the market but also the method of providing service. While interpretation of the economies of scale question is somewhat less certain, it appears acceptable to continue to regard b_1 as an appropriate measure of economies of scale. The variable was included since it reduced the spread between the two estimates, had a highly significant coefficient, and provided insight into an important policy question, i.e., the impact of interlining cost. Analysis of the coefficient on this variable indicates that carriers that interline more have lower cost. This at first may seem surprising until it is recalled that carriers that interline report only their portion of the cost. A hypothetical example was constructed in which a firm that did no interlining was contrasted with two firms that were assumed to interline with each other on every shipment. This resulted in the two interlining firms having the same number of shipments and the same average shipment size as the non-interlining firm, but average lengths of haul and average numbers of pickups and deliveries only one-half as large. The parameters from equation (7) implied that the total combined cost of the interlining firms would be 14 percent higher than the total cost for the non-interlining firm. If the parameters from equation (8) were used, the combined cost of the interlining firms would be only about 1 percent higher than the single firm. These results appear to cast doubt on the conventional assumption that interlined shipments are substantially more costly than non-interlined shipments.

Results from the Variable Elasticity Model

One way of allowing the extent of economies or diseconomies of scale to be different for different firm sizes is to partition the sample by firm size. This is usually done by examining firms of a particular revenue category. This was done, and the results are presented in Table 2. The first four regressions represent the sort that have been presented elsewhere (See, for example, Lawrence 1976). At first glance, they would seem to offer strong support for the hypothesis that economies of scale exist in the industry. In all four regressions the estimate of the elasticity of cost with respect to output is less than one by a statistically significant amount. However, various curious features of these results, such as the close correlation between $R^2$and b_1, indicate the need for further analysis. Curves drawn from these equations are shown in Figure 2. As can be seen from the sawtooth nature of these curves, regressions of this type do not properly describe the cost function. This is a result of the criteria for selecting the sample. Revenue is very closely correlated with cost, the dependent variable, as can be seen from the correlation between the log of revenue and a log of cost which is .998. Partitioning by what, in effect, is the dependent variable results in a situation where the error term in the regression is no longer uncorrelated with the regressors. Recalling that the definition of a Class I carrier at that time required that the firm have revenues in excess of $1 million, it becomes apparent that at each end of the size range the criteria for inclusion is basically the dependent variable of the regression.

One way to overcome the difficulties described above is to use the reversed formulation where shipments are the dependent variable. This is less than perfect though, since shipments are also correlated with revenue though less strongly so., i.e., the correlation between the log of revenue and the log of shipments is .857. Two regressions of this sort are also presented in Table 2 as numbers (5) and (6). In those regressions, diseconomies of scale are found, further evidence of the severity of the problem when the sample is partitioned narrowly. The independent variable in the regression, i.e., number of shipments in the original formulaiton or total cost in the reversed formulation, makes a better criteria for partitioning. This was done, and results are presented in Table 2 as numbers (7) and (10); curves are graphed in Figure 3. This only partially solves the problem, since the criteria for inclusion at the low end of the size range is still revenue, and it is difficult to determine an appropriate minimum level based on the other criteria.

Examination of regressions (7) and (8), in which the method of selection is the number of shipments (the appropriate method for the original formulation), reveals that there are apparent economies of scale in one case but not in the other. Regressions (9) and (10) show the result from the reversed formulation with the sample partitioned by total cost. The R^2 is somewhat higher than in (7) and (8) since with this formulation the definition of Class I is a more appropriate criteria for inclusion. The apparent diseconomies of scale are not statistically significant. It is worth comparing regressions (9) and (10) with their counterparts for the full sample, i.e., regression (8) in Table 1. Except for the larger standard errors caused by the smaller number of observations, the results are virtually identical.

TABLE 2
RESULTS FROM THE VARIABLE ELASTICITY MODELS*

#	Description	Dependent Variable	Constant	Scale Variable	Length of Haul	Size of Shipment	Others
1.	Revenue < \$2.5 M 85 cases R^2=.689	LnC	= 1.294 (1.430)	+.685 LnS (.065)	+.193 LnL (.040)	+.478 LnW (.050)	+.157 LnP&D + ΣDc_i (.142)
2.	Revenue < \$5 M 169 cases R^2=.818	LnC	= -2.869 (.832)	+.842 LnS (.034)	+.266 LnL (.027)	+.504 LnW (.030)	+.516 LnP&D + ΣDc_i (.112)
3.	\$5 M < Revenue < \$20 M 119 cases R^2=.860	LnC	= -3.031 (.955)	+.883 LnS (.039)	+.294 LnL (.028)	+.664 LnW (.040)	+.249 LnP&D + ΣDc_i (.135)
4.	Revenue < \$50 M 328 cases R^2=.965	LnC	= -5.437 (.405)	+.977 LnS (.013)	+.335 LnL (.018)	+.637 LnW (.019)	+.469 LnP&D + ΣDc_i (.082)
5.	Revenue < \$2.5 M 85 cases R^2=.927	LnS	= 6.603 (1.433)	+.882 LnC (.084)	-.261 LnL (.042)	-.660 LnW (.035)	-.381 LnP&D + ΣDc_i (.157)
6.	Revenue < \$5 M 169 cases R^2=.926	LnS	= 6.507 (.752)	+.945 LnC (.038)	-.286 LnL (.029)	-.601 LnW (.023)	-.552 LnP&D + ΣDc_i (.118)
7.	Shipments < 162,755 124 cases R^2=.883	LnC	= -4.554 (.994)	+.927 LnS (.043)	+.333 LnL (.035)	+.635 LnW (.031)	+.401 LnP&D + ΣDc_i (.147)
8.	Shipments < 109,098 81 cases R^2=.883	LnC	= -5.226 (1.367)	+.980 LnS (.062)	+.323 LnL (.044)	+.679 LnW (.038)	+.399 LnP&D + ΣDc_i (.204)
9.	Cost < 3,269,017 133 cases R^2=.920	LnS	= 5.879 (.905)	+.949 LnC (.051)	-.299 LnL (.033)	-.596 LnW (.028)	-.438 LnP&D + ΣDc_i (.131)
10.	Cost < 2,191,288 82 cases R^2=.924	LnS	= 5.746 (1.554)	+.934 LnC (.092)	-.249 LnL (.042)	-.670 LnW (.037)	-.354 LnP&D + ΣDc_i (.156)
11.	359 cases R^2=.968	LnC	= - .915 (1.190)	+.546 LnS (.176)	+.336 LnL (.019)	+.686 LnW (.020)	+.018 SqLnS (.007)
12.	359 cases R^2=.965	LnS	= 2.620 (1.730)	+1.182 LnC (.217)	-.285 LnL (.021)	-.709 LnW (.016)	-.007 SqLnC (.006)
13.	359 cases R^2=.977	LnC	= -3.278 (1.124)	+.623 LnS (.154)	+.355 LnL (.017)	+.631 LnW (.019)	+.015 SqLnS + .438 LnP&D + ΣDc_i (.006) (.081)
14.	359 cases R^2=.976	LnS	= 3.796 (1.511)	+1.233 LnC (.188)	-.318 LnL (.019)	-.659 LnW (.016)	-.009 SqLnC - .377 LnP&D + ΣDc_i (.006) (.080)
15.	359 cases R^2=.977	LnC	= -5.257 (.473)	+.972 LnS (.016)	+.356 LnL (.017)	+.630 LnW (.020)	+.445 LnP&D -.071 LnRevdum + ΣDc_i (.081) (.034)
16.	359 cases R^2=.976	LnS	= 6.343 (.420)	+.939 LnC (.016)	-.319 LnL (.019)	-.659 LnW (.016)	-.065 LnRevdum -.380 LnP&D + ΣDc_i (.033) (.080)
17.	359 cases R^2=.978	LnC	= -1.081 (1.306)	+.405 LnS (.166)	+.343 LnL (.017)	+.596 LnW (.022)	+.395 LnP&D -.113 LnRevdum +.022 SqLnS + ΣDc_i (.081) (.036) (.006)
18.	359 cases R^2=.976	LnS	= 5.361 (1.871)	+1.060 LnC (.224)	-.318 LnL (.019)	-.659 LnW (.016)	-.055 LnRevdum -.381 LnP&D -.004 SqLnC + ΣDc_i (.039) (.080) (.007)

*See page 143 for the definition of variables.

FIGURE 2
PARTITIONING BY REVENUE
EQUATIONS 1 - 4 FROM TABLE 2

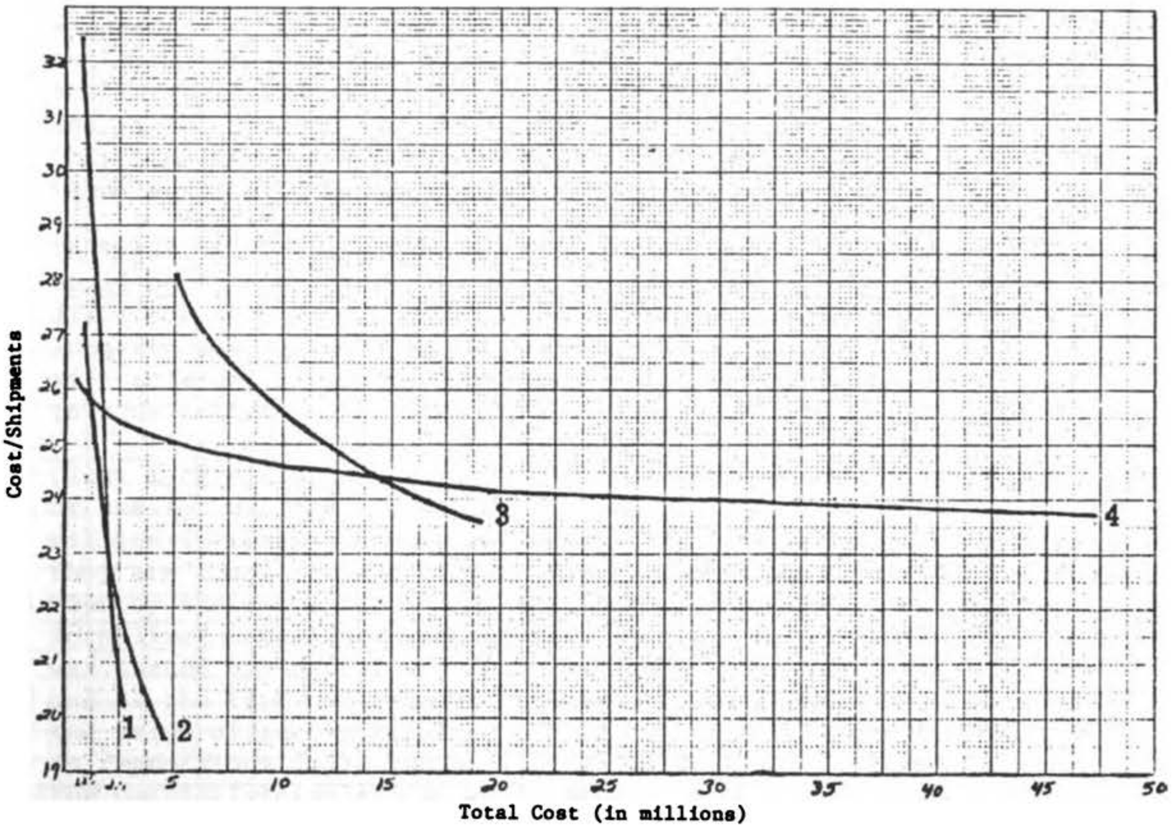
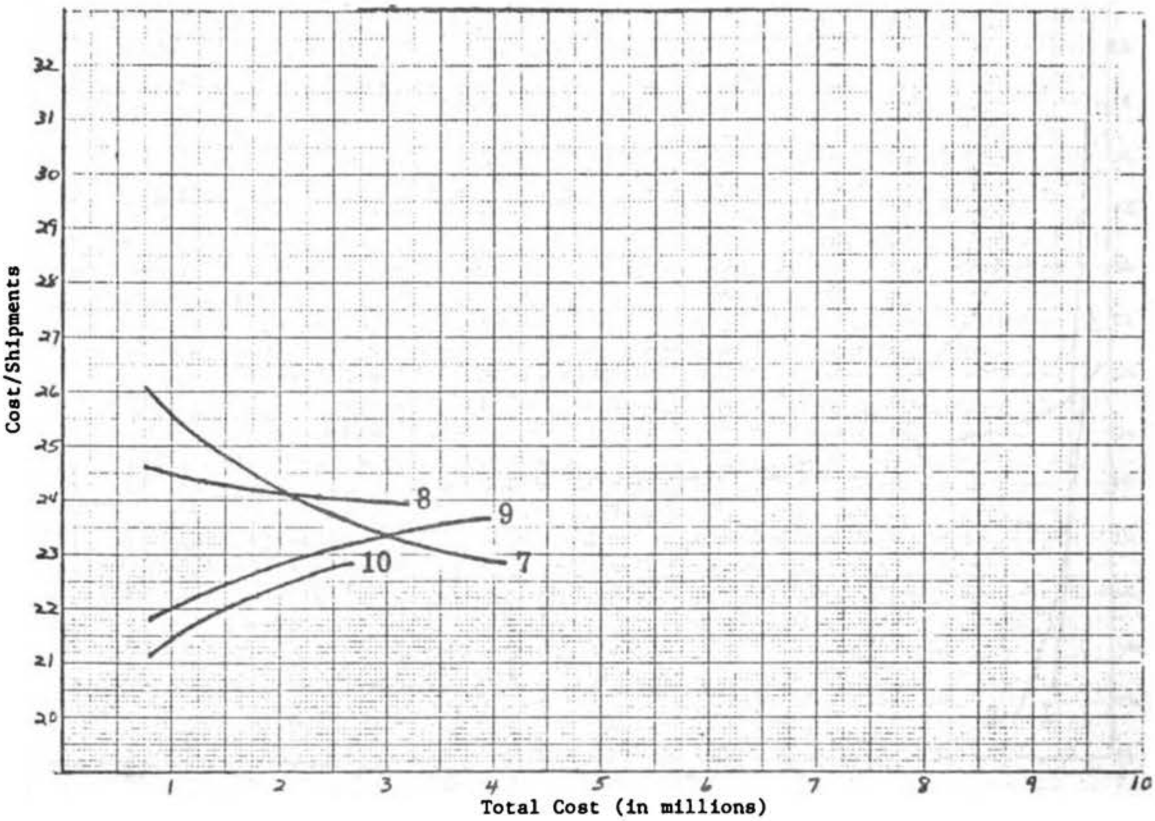


FIGURE 3
PARTITIONING BY THE INDEPENDENT VARIABLE
EQUATIONS 7 - 10 FROM TABLE 2



This contrasts sharply with the noticeable differences between regression (7) and (8) and between (7) and its counterpart for the full sample, i.e., regression (7) in Table 1. The inappropriate criteria for the lower bound and chance are possible causes.

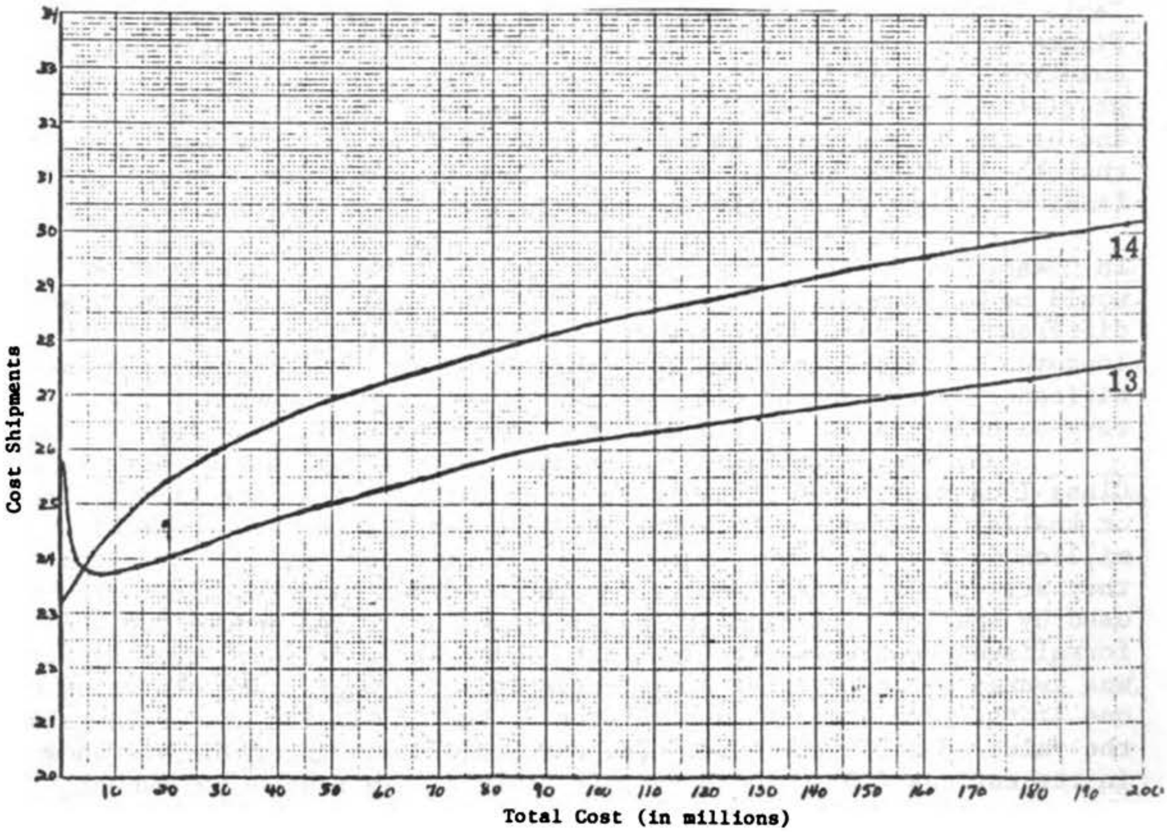
A better way to allow economies of scale to vary with the size of a firm is to use the full sample but include a second order term so that the elasticity of cost with respect to output can change as the scale of operation changes. Results in these regressions are shown in Table 2 regressions (11) and (14), and the curves are graphed in Figure 4. In regressions (11) and (13), those with the original formulation, the coefficient on the second order term is positive and statistically significant, (at the 99 percent level in number (11), and at the 98.5 percent level in number (13)). Thus, it would appear that the long-run average cost curve is U-shaped in the conventional fashion, rather than being an inverted U.

Regressions (12) and (14) have a somewhat different result. In these, the coefficient on the second order term is negative, as would be expected from regressions (11) and (13), but not significantly different than zero. Thus, while there is reason to believe that the long-run average cost curve is U-shaped, it may well be that the significance of the second order term is a result of the use of the revenue criteria for determining the lower end of the sample.

The most significant formulation of the hypothesis that small Class I carriers have higher costs than carriers that are either larger or smaller was made by Wyckoff. He said that firms with $1 to $5 million in revenue have a more difficult time controlling cost because they are too large and complex for the informal management techniques used by smaller firms and at the same time not large enough for the formalized techniques used successfully by larger firms. This hypothesis was tested by inserting a dummy variable which would take the value of one if the firm had revenues between $1 and $5 million and would take the value of zero otherwise. The results of this insertion are shown in regressions (15) through (18) in Table 2. In regression number (15), the original formulation was constant elasticity, the coefficient on the dummy variable is negative and statistically significant, indicating that these firms have lower costs than larger firms. In regressions (16) and (18), the reversed formulation, the coefficient is not statistically significant. Regression number (17) is perhaps the most interesting, since the revenue dummy and the second order term seem to be working in opposite directions. This allowed the average cost curve to be steeply sloped at the small end of the size spectrum without requiring those firms to actually have substantially higher costs and is further evidence of the problems caused by the lower bound of the sample. Further research will include the insertion of a third order term and a new partition for the lower bound of the sample.

Arguments that the motor carrier industry is subject to economies of scale have centered around the less-than-truckload segment of the industry, i.e., those firms which specialize in hauling LTL shipments. While the general freight industry is dominated by the LTL sector, only 43 firms had more than 10 percent of their shipments as truckload

FIGURE 4
RESULTS FROM THE VARIABLE ELASTICITY MODEL
EQUATIONS 13 AND 14 FROM TABLE 2



shipments,[6] efforts were made to select as a sub-sample those firms which were the most specialized in LTL shipments. Table 3 shows the results of that effort. Results are basically similar to those for the full sample.

One final investigation was into the question of the effect of scale on firm profits. The elasticity of profit with respect to changes in output, shown in Table 4 was found to be approximately 1.8, indicating that large Class I firms are much more profitable than small firms. However, since the R^2 in this regression is only .22, it is clear that the determinants of profits are largely unknown. These unknowns have much more to do with determining the actual profit of a firm than does the size of the firm.

Lawrence has argued that this result implies the existence of economies of scale. Actually, there are a variety of circumstances that would bring about this result. The American Trucking Associations has argued that smaller trucking firms make worse profits as a result of limited operating authorities. This will be examined more closely in the policy implications section.

POLICY IMPLICATIONS

It appears that the cost structure of the trucking industry exhibits economies of scale only at the size range which corresponds to the smallest Class I carriers and even in that size range the observed economies of scale may well be the result of a statistical problem. Diseconomies of scale are evident for firms with revenues above approximately $10 million. This finding has a variety of policy implications relating to the appropriate way of regulating the industry. The cost structure is important in determing the likely impact of regulatory changes in concentration, and also in interpreting the current situation.

It is generally accepted that shippers prefer single-line service to interline service, though the magnitude of this preference is not clear. This, along with the usual managerial incentives to expand the firm, makes the creation of a large route network desirable to motor carriers. When this situation is combined with the current restrictions on entry into the general freight industry, carriers have strong incentives to acquire operating authorities via purchase or merger rather than by applying for entry at the ICC. (See the American Trucking Associations 1976) In the absence of economies of scale in the cost structure, it would seem that these incentives are the causes of the current merger wave.

If entry restrictions were relaxed, pressures for mergers would be reduced. Carriers desiring to improve their route networks would have the option of seeking entry rather than merger. In the absence of economies of scale, the entrance of a new carrier into a route would not require the exit of any other carrier. On routes where new entry occurred, market shares would tend to fall and the number of carriers would increase. While it is not clear what the impact on the

TABLE 3
RESULTS FROM LESS THAN TRUCKLOAD SPECIALISTS*

#	Description	Dependent Variable		Constant	Scale Variable	Length of Haul	Size of Shipment	Others
1.	98% of shipments are LTL	LnC	=	-1.949	+.969 LnS	+.292 LnL	+.513 LnW	
	107 cases R^2=.95			(.753)	(.027)	(.038)	(.102)	
2.	98% of shipments are LTL	LnS	=	2.502	+.956 LnC	-.234 LnL	-.481 LnW	
	107 cases R^2=.940			(.732)	(.027)	(.041)	(.103)	
3.	99% of shipments are LTL	LnC	=	-1.588	+.989 LnS	+6.146 LnL	+.607 LnW	
	23 cases R^2=.887			(2.585)	(.082)	(.099)	(.371)	
4.	99% of shipments are LTL	LnS	=	2.766	+.893 LnC	-4.317 LnL	-.538 LnW	
	23 cases R^2=.884			(2.399)	(.074)	(.095)	(.347)	
5.	50% of tons are LTL	LnC	=	-2.351	+.974 LnS	+.316 LnL	+.546 LnW	
	140 cases R^2=.949			(.585)	(.023)	(.035)	(.073)	
6.	50% of tons are LTL	LnS	=	3.066	+.952 LnC	-.258 LnL	-.538 LnW	
	140 cases R^2=.939			(.552)	(.023)	(.037)	(.072)	

*See page 143 for the definition of variables.

TABLE 4
RESULTS FROM THE PROFITS MODEL

#	Description	Dependent Variable	Constant	Scale Variable	Length of Haul	Size of Shipment	Others
1.	359 cases R^2=.220	Ln Profits =	13.386	+1.825 LnS	- .811 LnL	+.870LnW	$+ \Sigma Dc_i$
		(total)	(4.069)	(.220)	(.339)	(.333)	

Glossary

LnC = the log of total cost for one year (1971)
LnS = the log of the total # of shipments carrier in that year.
LnW=the log of the average weight of the shipments carried.
LnL =the log of the total distance a shipment is carried.
Dc_i=a set of dummy variables, with coeficients, which denote geographic area.

LnP&D=Ln(2a+b) where: a is the % of shipments which are originated and terminated by the carrier and b is the % of shipments which are either originated by the carrier and delivered to a connecting carrier or received from a connecting carrier and terminated by the carrier.

SqLnc=$(\text{Ln } c)^2$
SqLns=$(\text{Ln } s)^2$

Revdum = one if revenue is between $1,000,000 and $9,000,000. Otherwise it is zero.

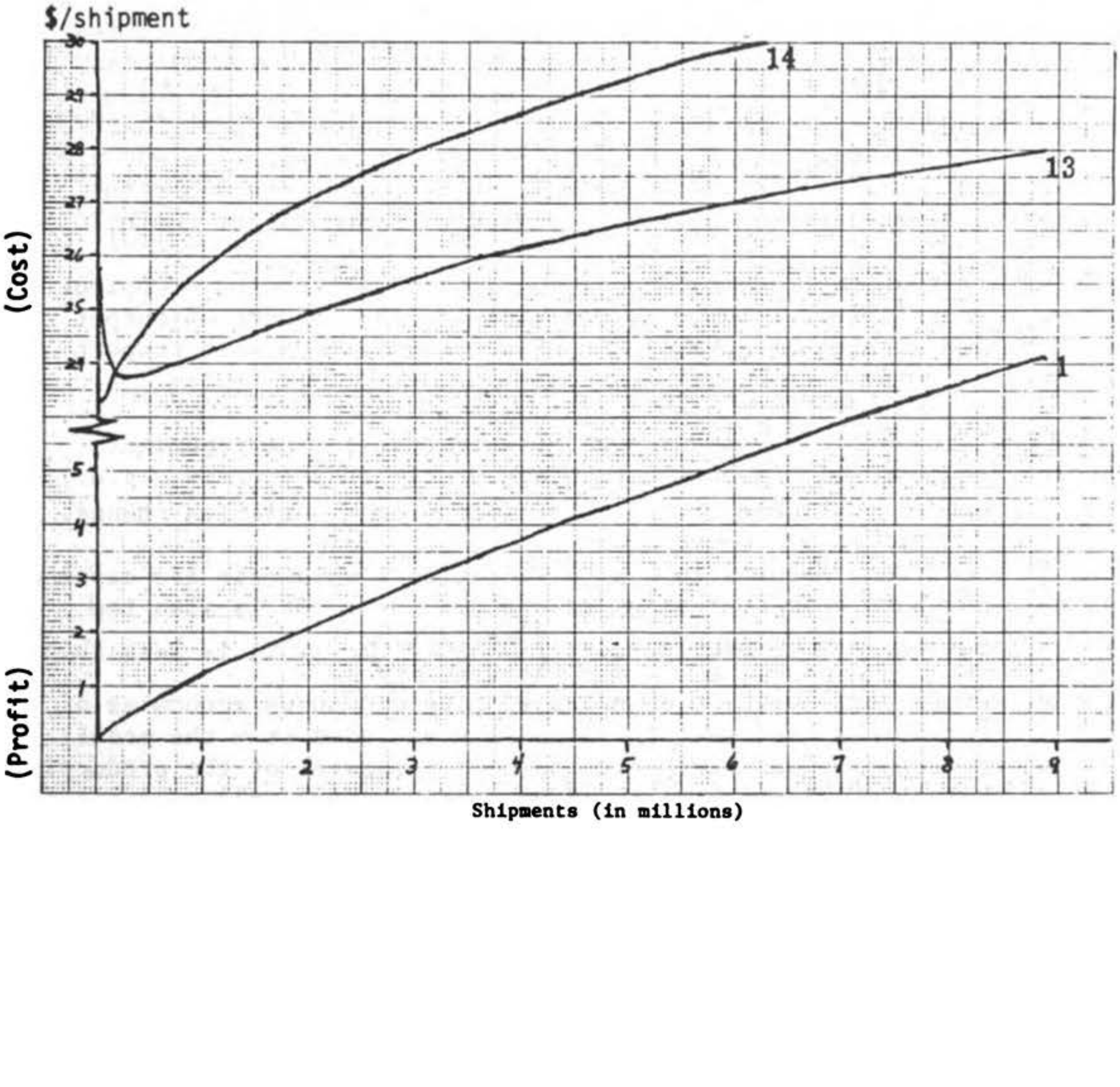
total number of carriers would be, the type of concentration which is of particular importance is the concentration on each route and it would likely be reduced.

Some have argued that, while the initial effect of freer entry would be to increase the number of competitors, the final effect following a period of adjustment would be to reduce the number. They anticipate that the adjustment period would resemble the second scenario described at the start of this paper: cutthroat competition leading to concentration. The cost structure of the industry argues against such a hypothesis and marketing aspects are not sufficient by themselves to support it.

The impact of greater ratemaking flexibility is also affected by the cost structure. If there were economies of scale or large fixed costs, rate wars would be a real possibility. However, since actual long-run marginal cost is likely to be at least equal to long-run average cost, and since the trucking industry is one that can adjust capacity rapidly, rate wars do not seem to be a realistic problem. No class of carrier would have the substantial cost advantages necessary to successfully carry out a rate war. This does not mean that no firm would suffer as a result of rate flexibility. Marginal firms, whether they be marginal due to inadequate management, or whatever, could be seriously affected by lower prices resulting from greater price competition.

An important remaining question is: Why do larger firms tend to make better profits (in relation to revenue) than smaller firms? The current situation, as can be seen from Figure 5, is one in which the low-cost firms also make the lowest profits. While this may turn out to be nothing more significant than the small firms reducing their corporate income (and tax) by paying owners excessive salaries, it certainly appears to be a perverse situation which deserves attention in the form of further research and perhaps regulatory change to remove any regulatory disadvantages suffered by small firms.

FIGURE 5
COST CURVES COMPARED TO PROFITS CURVE
EQUATIONS 13 AND 14 FROM TABLE 2
AND
EQUATION 1 FROM TABLE 4



NOTES

1. Presumably, there are geographic differences in commodity mix, but to a certain extent, these may be taken into account by the inclusion of dummy variables for geographic area. In fact, however, carriers can and do solicit more desirable freight and discourage freight which is less desirable. This remains an area for further research; in particular, it would be desirable to know the bulkiness and fragility of the shipments. Another unknown is the quality of service offered by the individual firm. While there is no known correlation between quality of service and size of firm, such a relation has been postulated by Lawrence and has the potential to affect any conclusion in regard to economies of scale.

2. To verify that the results are independent of the choice of output measure, regressions were run with ton-miles as the measure of output. These gave identical estimates of the elasticity of cost with respect to output.

3. The coefficient b_1 shows the percentage change in the dependent variable associated with a unit percentage change in shipments., i.e., $\frac{ac}{as} \cdot \frac{s}{c}$, provided that none of the other independent variables change.
Hence, it shows what happens to cost if additional shipments are carried which have the same characteristics as the old ones. It is also the ratio of marginal cost to average cost $\left(\frac{ac}{as} \Big/ \frac{c}{s}\right)$. If it is less than one, the average cost curve is downward sloping and shows economies of scale. Factor prices have been intentionally excluded from the model, so b, cannot generally be interpreted to be a parameter of the production function. Unless all firms face the same factor prices, the conditions necessary for duality between this cost function and a production function are not present. This is done in order to capture any market (external) economies or diseconomies of scale which would not show up in the production function. Indeed, it has been hypothesized that small firms pay higher prices for such things as fuel and equipment. If this is so, inclusion of factor prices in the regression equation would cause a potentially important external economy of scale to be ignored and could result in unrealistic policy conclusions.

4. The possibility of heteroscedasticity has been raised by Lawrence. While it is presumably true that the variance of total cost is greater for larger firms than for smaller ones, this is not necessarily true for the variance of the log of total cost. Any given amount of error in equation (2) implies a certain percentage error in total cost. Homosce-

dasticity would occur if percentage errors were equally large for the difference size levels. There appears to be no reason to expect heteroscedasticity.

5. A shipment is interlined when one carrier moves it part of the way and then turns it over to another carrier who continues the movement. In some cases as many as three or more carriers would be involved. Interlining generally occurs when the first carrier does not have legal authority to carry the shipment the entire distance.

6. The Interstate Commerce Commission's definition of a truckload shipment is any shipment which weighs more than 10,000 pounds, so some of them are actually carried on a truck along with a number of other shipments and have the characteristics of a large, less-than-truckload shipment. While shipments which are defined as truckload often are used by these carriers for "noseload", when these firms take a serious interest in truckload freight they generally form a separate division for that purpose.

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DISCUSSANT'S COMMENTS

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Bell Laboratories

Since it has become so popular to accuse economists of disagreeing on practically everything, I find it extremely encouraging that today's papers represent what appears to be an emerging concensus on an issue of fundamental transport policy significance -- the extent of scale economies in the regulated sector of the U.S. motor carrier industry. In my brief remarks on the papers I will sketch my view of the central features of this emerging concensus and suggest some ways to reconcile certain minor discrepancies among the presented papers.

Since Stanley Warner's (1965) work in the mid-sixties, econometric research on motor carrier scale economies has focused on the cost function as an appropriate behavioral model for the common carrier firm. The heterogenity of traffic carried by firms in the industry has also been explicitly recognized; authors have sought to estimate a "pure scale elasticity," as usually formulated, an elasticity of costs with respect to volume of traffic of fixed characteristics. It is now well known that failure to conditionalize estimates of scale effects on traffic characteristics leads to a misleading confounding of effects.[1] The relevant question from the standpoint of regulatory policy is: "Do larger firms have a unit-cost advantage for traffic of fixed characteristics?"

Warner attempted to answer this question by fitting the simple homothetic cost function,

$$C(q,w,h;\ \underline{p}) = \psi(q,w,h)\cdot c(\underline{p}) \tag{1.1}$$

where

$$\psi(q,w,h) = q^{\alpha}w^{\beta}h^{\gamma}$$

is a simple geometric output index, or scaling function, of ton-miles of freight handled per year, q, mean distance of haul, h, and mean weight of loads, w, and $c(\underline{p})$ is a unit cost function of the factor price vector $\underline{p}$. If, as seems plausable, firms face essentially identical factor prices each year, then the parameters of the scaling function are estimable from a simple cross-section. The parameter α is our elusive "pure scale elasticity," the logarithmic partial derivative of cost with respect to traffic volume of fixed characteristics.

The specification of the technology represented by (1.1) is really quite restrictive. In particular it exhibits either globally increasing or globally decreasing returns to scale, it rules out the conventional textbook U-shaped average cost curves which exhibit decreasing costs over an initial range of output and increasing costs thereafter. Marc Nerlove (1965), I believe, first noted that making the scale elasticity, α, a linear function of the logarithm of q

$$\alpha = \alpha_0 + \alpha_1 \ell n\ q \qquad (1.3)$$

yielded a simple log-quadratic form of the scaling function

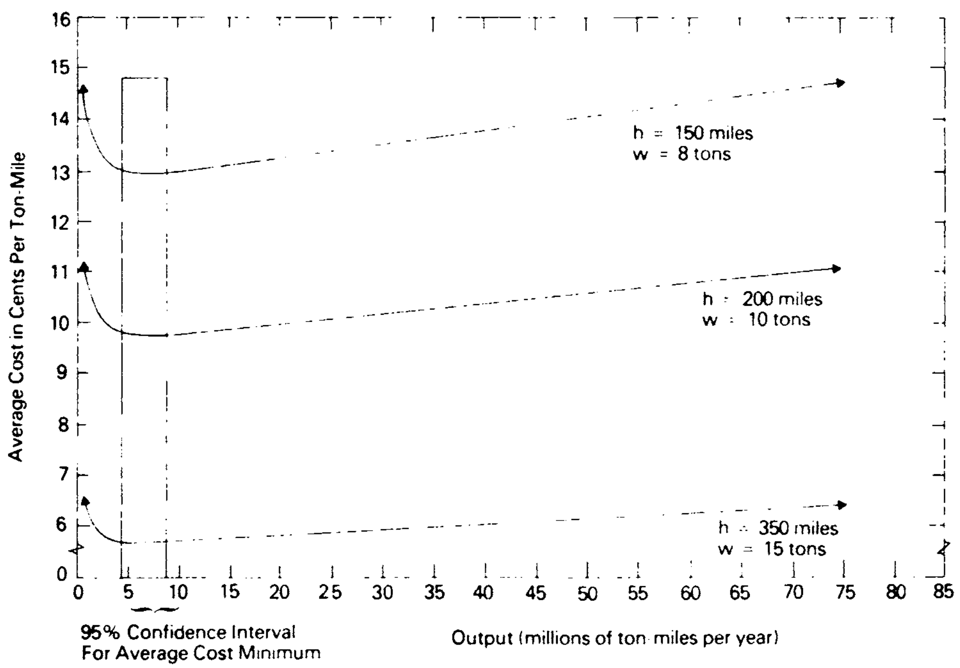
$$\ell n\ \psi = \alpha_0 \ell n\ q + \alpha_1 \ell n^2 q + \beta\ \ell n\ w + \gamma\ \ell n\ h \qquad (1.4)$$

which is remarkably flexible.[2]

In Figure 1, I have illustrated three long-run average cost curves estimated with such a log-quadratic specification (see Koenker 1977). They bear a striking resemblance to the results reported by Dr. Klem and Professor Friedlaender with similar models and different data. Unit costs are highly sensitive to the traffic characteristics variables. Increasing q for fixed traffic characteristics sharply decreases unit costs up to about 6-8 million ton-miles per year but thereafter very gradually increasing costs set in.[3] Both Dr. Klem's and Professor Friedlaender's results suggest optimal scale may be slightly larger, but the important point is if one compares any of our results with the existing size distribution of firms in the regulated sector of the U.S. motor carrier industry, illustrated in Figure 2, one finds that the industry is dominated by firms that appear to be operating on the gradually increasing segment of the long run average cost curve. Most of the revenue of the industry is earned by firms operating in this range. These findings cast serious doubt on the Interstate Commerce Commission's "tight-entry, loose merger" regulatory policy, a policy which has led to a dramatic increase in the average scale of American motor carriers.

Dr. Klem and Professor Chow have also provided us a welter of segmented log-linear models. These models are rather implausible in the sense that we probably don't seriously expect the parameters of the technology to take discrete jumps at points in output space, but such results can be helpful in suggesting alternative specifications.[4] Casual examination of their results suggests that the locally-log-linear approximations to the scale elasticity rise with scale as the log-quadratic results suggest. They also suggest that further work may be necessary to explicitly introduce dependence of the scale elasticity on traffic characteristics. Professor Friedlaender's hedonic approach imposes one such specification, but it too may be insufficiently flexible.[5]

Figure 1.



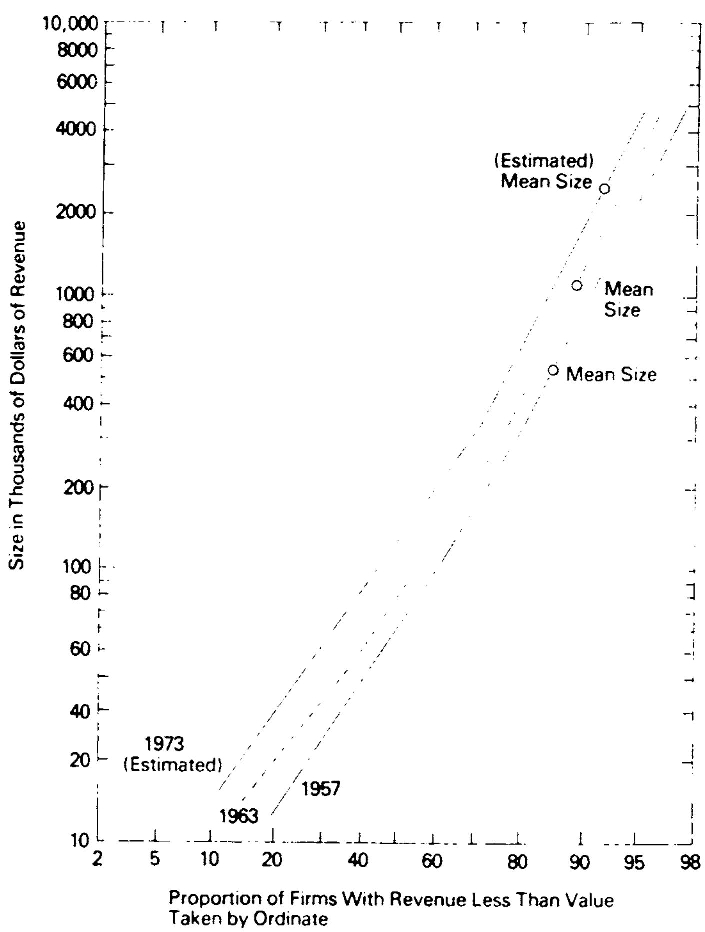


Figure 2.

While certain refinements in the specification of technology are suggested by the research presented in this session, substantial empirical evidence has now accumulated to suggest that scale economies in intercity trucking are exhausted at relatively modest output levels. Whether regulatory policy regarding entry and mergers will adapt to this concensus remains an open question.

NOTES

1. Obviously since larger firms have (on average) more truckload traffic, heavier loads and larger hauls, they will have (on average) lower costs per (raw) ton-mile than their smaller, LTL, light load, shorthaul counterparts. This point is very effectively made by Professor Friedlaender who also points out that for non-homothetic technologies scale elasticity estimates must also be conditional upon input prices. For a slightly different approach see my criticism (Koenker 1977) of the recent work by Ladenson and Stoga (1974).

2. This approach which Nerlove (1965) applied to the investigation of scale economies in electricity generation might be considered the germ of the modern trans-lot technology specifications like Professor Friedlaender's.

3. The bar represents an asymptotic confidence interval for the point estimate of "optimal scale" which from (1.4) is given by,

$$q^* = \exp\left\{\frac{1-\alpha_0}{2\alpha_1}\right\}$$

4. Such segmentation should be done on the independent (output) variables since segmentation on the dependent (cost) variable leads to truncated error distributions and associated statistical difficulties. Klem's attempt to assess the errors-in-variables problem is dubious at best in the present multivariate context, but it might be helpful to have some sampling studies to evaluate the quality of data reported to the Interstate Commerce Commission by trucking concerns.

5. An alternative approach to the log-quadratic specification suggested by Professor Friedlaender is the multilinear spline specifications suggested recently by Poirier (1976). Friedlaender's insistence on a multiplicatively separable index of output quality may be overly restrictive. Her ambitious attempt to test the commonly maintained hypothesis of homotheticity of technology must be regarded as inconclusive in view of the lackluster performance of her crucial share equations. However, this problem deserves further attention and her approach has much merit. Unfortunately, especially in a simple cross-section, and even with several cross-sections, factor price variation is slight and much of what is attributed to factor price variation in Professor Friedlaender's work may instead be variation in the composition of labor and capital inputs within her aggregates.

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DISCUSSANT'S COMMENTS

Gregory Duncan
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I will restrict my comments to the papers concerned with return to scale. These three papers attack the problem of returns to scale in the trucking industry, and my approach is going to be to ask whether or not, on the basis of their methodology, their analysis, and their data, we ought to believe the results that they specified. I will not try to make sense of their results; given that they did what they claim they have done, their explanations should hold.

I will start with Professor Friedlaender's paper. I think the things that are novel about her paper are: first, the notion that returns to scale may be induced by regulation, may not be technological, and the idea that one could investigate this econometrically and second, the methodology of using a flexible functional form to represent costs. At least, I am not as familiar as most of you with the literature on costs and production in the trucking industry, but as a paper in the general area of costs and production, it is current in the use of the state-of-the-art tools.

I do have some quarrels with what she has done. I do not think they are serious quarrels. Were I to have done this paper, I essentially would have done what she did with the exceptions and additions noted below.

I do not think that the results would be too much different, so these are more technical quarrels than anything else.

First, I would not have discussed the composite index of output and qualities. I would have called ton-miles, ton-miles, and said that for differing quantities or qualities of service there are differing technologies, and I would have put this into the framework of restricted profit functions.

Second, I was a little worried about the flexible form she took. She took the trans-log form. That is not the only flexible form. As a result, she had to leave out a good number, or I believe she had to leave out a good number, of firms that did not use some of one or another of the factors. If she had used something like Generalized Leontief production function, which allows for arbitrary elasticities of substitution, she could have included the excluded firms in her analysis, and her analysis would have been more precise.

The third thing is that the data are not very good and nothing, really, can be done about that, though I worry about the inferences she makes in that a number of her price variables are constructed. Certainly more research needs to be done to find, for example, what the price of capital really is and what the price of labor should be.

I have one technical note. She mentions that, in her form, she estimated cost function and then factor share equations or implicitly input demand functions, and when you do that, you have to drop out an equation. She comments that dropping out an equation does not really make a difference. Well, it does unless you do a Full Information Maximum Likelihood. If you do a generalized version of Least Squares, it does make a difference.

All in all, I liked her paper. Indeed I thought it was a very good paper, and I would like to have written such a paper myself.

The papers of Chow and Klem addressed the same problem. They begin with a form that implicitly imposes a lot of restrictions on the underlying technology. They implicitly assume homotheticity, Cobb-Douglas in the extreme production functions. The thing that bothers me the most is that they excluded factor prices. Now, since about 1963, it has been the state-of-the-art to include factor prices. There are times when you can argue that factor prices ought not to be included in a cost function, in particular if the factor prices do not vary within the sample you can exclude the factor prices, if you have a Cobb-Douglas production function. Then running ordinary Least Squares on the equation will give you some notion of what returns to scale are.

However, if you believe either one of two things, one that the functional form is too restrictive, that you should have a more flexible form, or that factor prices, varied across a sample, then you have got some problems. Either way you have a mis-specification, and I think, given the state-of-the-art in cost and production, that rather than asserting homotheticity, it should have been tested, and rather than asserting implicitly that factor prices do not vary across firms or even across regions or within regions, that factor prices should have been included.

Presumably Messrs. Chow and Klem had access to the same data that Professor Friedlaender had, and I think they should have investigated that.

Now, I must, in all fairness to Dr. Klem, mention that his point is that he left out factor prices because they are not parametric; that is, they are not fixed to the firm, and if that is the case, it is true that you should not have the factor prices in these explicitly, but what he should have done in that case, is model what it is that determined the factor prices facing the firm, and he should have done some kind of analysis like Two Stage Least Squares or similar simultaneous equations analysis.

Alternately, it may be that what he has here is a reduced form. I think implicitly that is what he is saying, that he has a reduced form and that he has all things exogenous to the system in there, but if that is the case, I really don't know what the parameters he is estimating have to do with returns to scale. They really have to do both with returns to scale and with the supply of factors it is not clear how one would distinguish those things. I think that is what he was getting at when he talked about an aggregate measure of returns to scale.

I guess to conclude I will simply say that on the basis of the articles and the work put forth by Chow and Klem, I would be hard pressed to make any determination about returns to scale without some more work. On the other hand, I think Friedlaender's results can be believed. They convince me, and I feel they should convince you.

CHAIRMAN'S COMMENTS

Michael Lawrence
Director, Market Development
IU International Management Corporation

I would like to say, as a representative of the trucking industry, that we are delighted that this conference is taking place. For too many years, the quality of research in the trucking industry and concerning the trucking industry has been behind in the state-of-the-art. We think we are going to catch up very rapidly and this conference is good evidence in support of that belief.

I am very much torn between wanting to congratulate Ann Friedlaender for the elegance of her analytical technique on the one hand, and wanting to scold here for careless research design on the other. However, we are delighted that people with her level of sophistication are willing to do research on the structure of this industry. That is one side of the dilemma.

The other side of the dilemma relates to my background as a business research manager. I have been in this position for about five years and, if I have learned anything, it is this: elegant techniques abound. There are thousands of them and there are thousands of people who use elegant research techniques; I think it is very important to select a good, accurate analytical technique. It is more important, though, to do a good job of research design and to understand the structure of the problem that you are working on. Professor Friedlaender's research is lacking in that regard.

The largest trucking company in the United States in 1972, which is the time period of Professor Friedlaender's study, was Roadway Express. It had revenues of $363 million and had 4,287,000,000 ton-miles, the measure of output in Professor Friedlaender's study. The largest firm in Professor Friedlaender's study was Boss-Linco. Boss-Linco had ton-miles in 1972 of 180 million; 20 times less than the size of Roadway Express.

She would like for us to believe she has proven that there are no economies of scale in the trucking industry by having analyzed the small firms in a certain segment of the industry and having shown that none of these small firms seem to be any more efficient than any of the other small firms; the fact notwithstanding that the giants of the industry, the Roadways, the Yellows, the Ryders, are not included in her sample set. The research design is such that it is very difficult for me to attach any validity to it whatsoever.

I do not want to discourage Professor Friedlaender or people like her from working with us to better understand the economic structure of the industry. There are very few people within the trucking industry itself that can do this type of economic research; it seems to me that if we would combine the factual understanding and intuitive with the econometric techniques that Professor Friedlaender and people like her can bring, we would all be better off in that event.

Let me say two other things about her paper. She offers a very peculiar distinction between regulatory economies of scale and technological economies of scale. It is possible that some of the economies of scale that we intuitively see in the industry might be attributable to regulatory economies of scale, and I think it was a very good idea for her to try to test for that econometrically. The problem is that she arbitrarily defines the effects of load average and average length of haul as regulatory economies of scale. There are a tremendous number of people in the industry that would violently disagree with that. It seems to me that that is a test subject in itself, not an arbitrary decision that you can make as a matter of research design.

Finally, relative to her use of factor prices, I have also done econometric research on the subject of economies of scale in the trucking industry. I would have liked to use factor prices. The problem was I could find no valid way of measuring them. Let me give you one example from her paper. In order to get wage rate for each firm, she takes the total labor cost and divides it by the number of employees, which gives an average annual salary or wage per employee.

I am now going to address my comments to Dr. Klem's paper. I was delighted to hear him cite the close similarities in the results of his research and Professor Chow's as a caveat that one has to be very careful in the specification of his research model. I think the words that he used are "a high degree of precision is necessary in interpreting the results because there is such a fine margin for error." That is paraphrasing him, but you get the message.

The work that Dr. Klem and Professor Chow did, and the work that I did two years ago on the subject of economies of scale are frightening, in that the econometric results are so similar. The differences in the conclusions that Klem reaches, which are that there are no economies of scale; and that Professor Chow and I reach, which are that there are economies of scale, are more matters of interpretation than they are of econometric evidence.

One of the things Klem refers to when he says that a high degree of precision is necessary, is that if there are variables or factors that influence the cost structure of the industry that are in some way related to size and that are not included in the specification of the research model, the effects of those variables that are not included in the model will load up on the regression coefficient of size.

Let me give you an example. It is well known within the trucking industry that the very large firms -- Roadway Express, Yellow Freight, and Ryder Truck Lines -- provide a higher quality service than do smaller truck lines. Service in this context refers to speed and reliability of delivery, tracing capability, extensiveness of coverage, loss and damage experience, claims administration, etc. These firms provide this quality service in spite of the fact that they could operate at a lower average cost per unit with poorer service. However, carrier financial objectives are to maximize profits, not to minimize per-unit operating costs. As long as the marginal revenues from higher quality service are greater than the related marginal costs, carriers will provide higher service.

Unfortunately for the smaller carriers, they operate on cost curves such that they cannot afford to match the quality of service provided by the largest carriers. As you can see in the exhibit, at the level of service provided by the large carriers, the cost curves for the medium size and small carriers are increasing at an accelerated rate. The implication that you cannot see from the exhibit is that for these carriers marginal costs are increasing faster than marginal revenues at the highest levels of service.

The industry structure that results is one of a variety of sizes of firms operating on different cost curves, each one providing a unique level of service with its own unique point of profit maximization. And graphically, you get a set of curves such as the top exhibit, with small firms on the highest cost curve and the largest firms on the lowest cost curve. With each firm providing the level of service it can afford to provide (at a regulated and common price), firms of all sizes operate at approximately the same average cost per unit. Graphically, if you take the three points of intersection between quality of service and cost, on the top exhibit, and plot them into a relationship between size of firm and per-unit operating cost (as shown in the bottom exhibit), you get a flat line which lends the appearance of constant returns to scale.

This is to say that econometric research which fails to include quality of service (as defined above) as a control variable will have a significant tendency to produce a cost curve that appears to be flat and that will, therefore, conclude that there are no economies of scale in the industry. Until someone finds a way to encompass quality of service into econometric tests for economies of scale in this industry, we must be very suspicious of the existing econometric evidence.

I can assure you that people in the industry know that there are significant economies of scale in the industry. (The exhibits referred to above follow this page.)

EXHIBIT 1
SIZE VERSUS SERVICE AND OPERATING COST

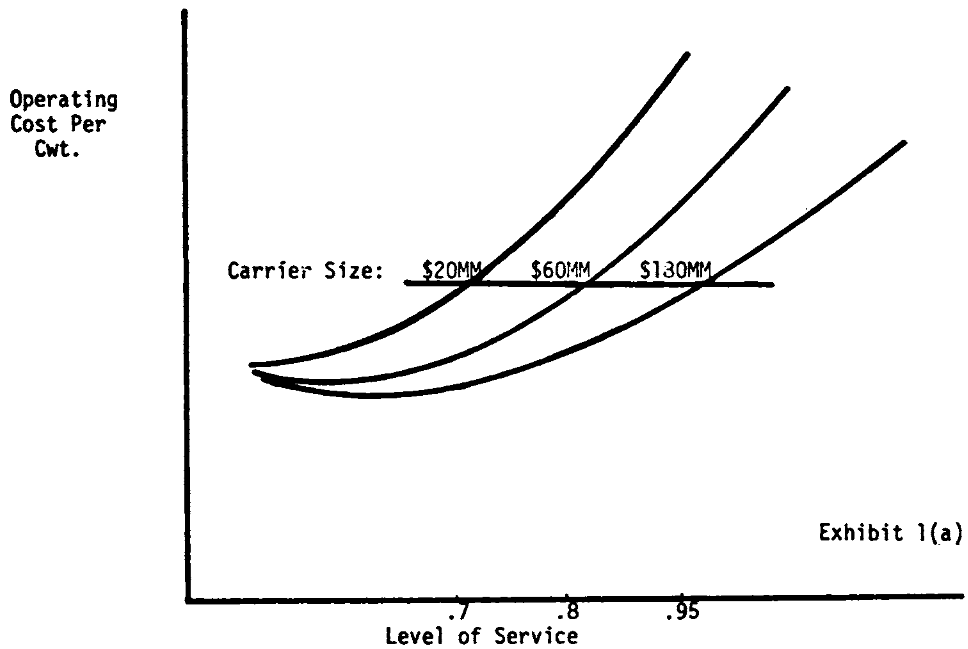

Exhibit 1(a)

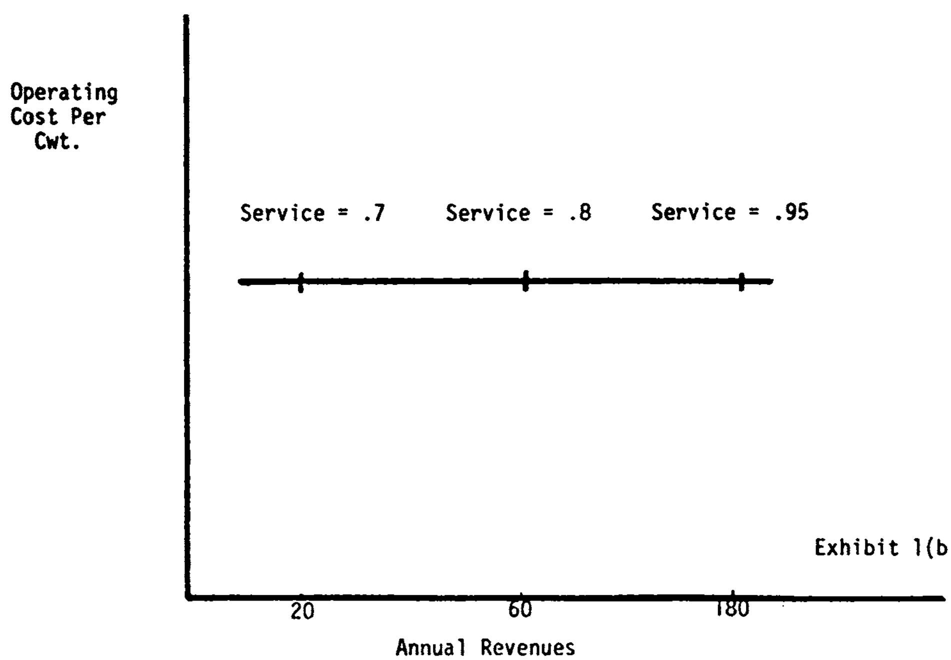

Exhibit 1(b)

SESSION II

THE EFFECT OF REGULATION UNDER THE CURRENT REGULATORY SCHEME

Chairman: Wilfred Owen

THE REGULATORY PROGRAM: THE EFFECT ON ENTRY, BACKHAUL AND ENERGY CONSUMPTION

Ronald K. Kolins
Esquire
Collier, Shannon, Rill, Edwards and Scott

The transportation regulation debate has, over recent years, reached an unparalleled zenith. In the evolutionary process it has virtually transcended the appropriate descriptions of "complex" and "confusing", while entering the realm of "shrill" and, unfortunately, "antagonistic." Rather clear battle-lines have been drawn with the regulators and many carrier interests investing much of their energies in an ever-increasing role of vigilant defense posturing This is, of course, easily understood. After all, in large measure, the system is the creation of the regulators, whose careers are dedicated to its essential continuation, while the carriers perceive the discussion as a predicate to the evaporation of their operational cocoons. The instinct of survival is predictable, and vociferous counter-attack the natural reaction.

Unfortunately, the debate, while boisterous as ever, is becoming repetitive and replete with antipathy. Thus, it may now be approaching the stage of mutual submission, whereby, regardless of its merits, the issue may evaporate for lack of ongoing spontaneity. In short, it could become tiresome and in turn uninteresting. This is all the more possible given the lack of general public participation stemming from a lack of widespread appreciation of the effects of regulation on "our daily lives" and the comfort which is almost always associated with the status quo.

However, the thesis remains vital and, while the subject of regulation exceeds its transportation impact, the concern here is limited to a consideration of the relationship between federal regulatory policies, the motor carrier industry and the legitimate needs of the public. In pursuing the discussion it is conceded that the motives of all concerned are good and proper but, as in all adversary matters, in total or in part, one view will surface as at least more nearly correct than the other.

Perhaps then it is most convenient to begin with a description of the opposing views. All concede that motor carrier transportation is vital to the nation, both in terms of its economy and its administration. There is no question but that the goods must reach the market, and motor transportation, in all its forms, plays an ever-increasing role of importance. The carriers tell us that "if you have it, a truck brought it"[1] and they are probably right. We must have a responsive motor carrier industry leaving to the debators the question of how best to accomplish and maintain one.

The regulators ostensibly act consistent with the "national transportation policy" (National Transportation Policy, 1963) to bring about and assure a nondiscriminatory national transportation system encompassing all surface transport modes. This umbrella mission has resulted, as a practical matter, in the Interstate Commerce Commission becoming a protective haven for regulated motor carriers. The theory, in simplistic terms, is that because the motor transportation industry is so vital - akin to a public utility - each of its individual components must be able to operate in an environment designed to virtually assure its continuing viability. Thus, while a total monopoly is not advocated, semi-monopolies best assure the goal because too much competition may result in the inability of all carriers to survive.

Conversely, those adverse to regulatory control argue that an environment more akin to a free market-place will result in better service, generally lower rates, and more efficient operations. The forces of competition it is said will compel greater productivity which can be reflected generally in lower rate levels coupled with the provision of higher quality service. "Survival of the fittest" perhaps, but it is argued that the general public will be the ultimate beneficiary.

Because there is no definitive proof as to which theory really is superior despite the voluminous figures bandied about by both sides, the regulators have the advantage in the contest. After all, we know what we have now and, while far from perfect, any change can be construed as a gamble. The public welfare is at stake and, so it is argued, we should not "gamble" until and unless there is absolute proof that the change is for the best.

But what "change" is it that is being debated? The word "deregulation" is used often but brings outcries of opposition from the regulators and carriers alike. Perhaps it should, for that word, linguistics notwithstanding, has come to be commonly connoted with the prompt and complete elimination of all transportation regulation. To the contrary, the phrase "regulatory reform" is regarded as referring to some alteration in the scope and direction of regulation imposed on motor carriage. Thus, it is met with a bit less strident reaction, for the ICC at least gives lip-service to the notion that there should be some regulatory modification. The commission, of course, espouses its ability to make whatever changes are necessary itself, without external pressure or mandate. Yet, internal change has not been significantly forthcoming and what is perfectly clear is that unless reform is imposed or urged externally, no significant progress will ever be made.

The motor carriage regulatory scheme is a patchwork of entry, rate, and service impediments which had its genesis in the Motor Carrier Act of 1935. While the fact that this regulation has existed for more than 40 years complicates effective action to modify it, the circumstances surrounding its creation differ substantially from those in force today.

Two factors merged together in the 1930s that provided convenient and perhaps irresistable impetus to regulate motor carriage. On the one hand the motor carrier industry was in its relative infancy and thus unsophisticated and casual in its concerns for safety, service and public responsibility. On the other hand, the country had just suffered its great depression, and public confidence in the economy and the viability of the free market system was less than universal. Government economic programs and federal regulation were extremely fashionable and understandably appealing. With the fact that the railroad industry had, even then, long been the subject of regulation, the climate was ripe for the inclusion of motor carriage and, under the then prevailing conditions, regulation was probably the proper course.

Regardless of the merits or deficiencies of the regulatory scheme, the industry developed in accordance with the reliance upon it. It is, therefore, easy to understand the negative reactions of carriers to reform proposals given their fear that they will suffer from a change in the rules after they have evolved pursuant to those rules. Yet, as will subsequently be discussed, those fears may be unfounded and, in any event, public requirements must transcend private requirements in this instance.

One of the key components of motor carrier regulation is the licensing authority of the ICC. It is by virtue of and implementation of this authority that entry into the common carrier business is controlled. To operate as a motor common carrier one must have a Certificate of Public Convenience and Necessity issued by the commission. Section 207(a) of the Interstate Commerce Act (49 U.S.C. 307 [a]) sets forth the statutory authority and conditions pertaining to the granting of such a license as follows in pertinent part:

> ...a certificate shall be issued to any qualified applicant therefor, authorizing the whole or any part of the operations covered by the application, if it is found that the applicant is fit, willing, and able properly to perform the service proposed and to conform to the provisions of this part and the requirements, rules, and regulations of the commission thereunder, and that the proposed service to the extent to be authorized by the certificate, is or will be required by the present or future public convenience and necessity...

In large measure then, it is the rather open-ended authority to determine what is and what is not "required by the present or future public convenience and necessity" that gives the commission a stranglehold on the extent to which new carriers may enter the field or existing carriers may expand their operations. It is the ICC's implementation of that authority that determines the "entry" opportunities and in turn, the scope of carrier competition. A restrictive view of the requirements of public convenience and necessity results in the protection of existing carriers and it is on just such "protectionism" that existing carriers have come to rely. In reviewing applications for certificates, a tenuous judgmental exercise at best, the commission essentially clings to the overly objective notion that if an existing carrier is licensed and thus "available" to perform the service, the applications, should in most instances, be denied. From the inception of motor carrier regulation, the I.C.C. has defined "public convenience and necessity" as:

> ...whether the new operation or service will serve a useful public purpose, responsive to a public demand or need; whether this purpose can and will be served as well by existing lines or carriers; and whether it can be served by applicant with the new operation or service proposed without endangering or imparing the operation of existing carriers contrary to the public interest (Pan-American Bus Lines Operation, 1 M.C.C. 190, 202 1936).

This definition has remained virtually unchanged throughout the history of motor carrier regulation despite the fact that it derives from railroad regulatory concepts which were designed for an industry, unlike motor, characterized by high economic costs of entry and exit. Thus, in the Pan-American case, prior to enunciating the quoted definition above, the Commission stated:

> Perhaps the best interpretation of the purpose underlying the 'public convenience and necessity' provisions was by the Supreme Court in Texas & N.O.R. Co. v. Northside Belt Ry. Co., 276 U.S. 475, 479, as follows:
>
> The purpose of paragraphs 18 to 22 is to prevent interstate carriers from weakening themselves by constructing or operating superfluous lines, and to protect them from being weakened by another carrier's operating in interstate commerce a competing line not required in the public interest.

Accordingly, the commission believes that existing carriers should have the right to transport all the traffic they can handle adequately, efficiently, and economically without additional competition (see e.g., C. & D. Oil Co. Contr. Car. Applic., 1 M.C.C. 329; Lehigh Co., Inc., Extension-Jersey City, N.J., 51 M.C.C. 653.). Where a license application is opposed by another carrier the burden on the application is dramatic for the "service" of that carrier must be shown inadequate before a grant can normally be expected, the supporting shipper must have given the existing carrier substantial opportunities to perform the service (see Wilson Extension - Dairy Products, 61 M.C.C. 51); it must document the failures and they should be continuous; the documentation must serve to refute any excuses or justifications offered by the carrier and must transcend the generic allegations of the existing carrier that it stands ready, willing and able to perform the service. That the carrier never before had the business and thus could not possibly be harmed by it going to someone else has usually little bearing on the matter. Even if the existing carrier is not properly equipped to perform the service, a shipper must give him the chance to acquire the needed equipment (see Coastal Tank Lines, Inc., Ext. - Animal and Poultry Feed, 78 M.C.C. 135). Even if the existing carrier has a monopoly, the commission will not grant the application unless other justifying factors are shown (see York Interstate Trucking, Inc., Ext.-Muriatic Acid. 67 M.C.C. 626; Transport, Inc., Ext.-Sioux Falls, S. Dak., 81 M.C.C. 751). Certainly, the preference of shippers - those who pay for and rely on the transportation service - for a different carrier which they feel better satisfies their needs is given no weight by the commission nor is the fact that the applicant can perform at a lower rate. The I.C.C. considers applicant representations of lower rates to be speculative and thus, the "mere possibility" of lower rates does not warrant a grant (see Pitzger Contr. Car. Applic., 86 M.C.C. 714). Further, a grant is viewed as unwarranted even if the existing rate is unacceptable to shippers (see Detroit-Pittsburgh M. Freight, Inc., Ext-Asphalt Roofing, 79 M.C.C. 197). It appears that the "convenience" side of the "public convenience and necessity" equation is not considered consequential.

The extent to which the commission has gone in protecting existing carriers under its concept of "public convenience and necessity" was highlighted and chastized by Commissioner O'Neal in a recent speech. (O'Neal, 1976). Recounting his service on the commission's operating rights divison,[2] he stated: "I frequently voted to grant applications that would substantially improve service, even though existing service was technically adequate. Unfortunately, that view was usually in the minority." He then recounted three case examples which are worth repeating:

> In, for example, the Beaufort case, No. MC-78400 (Sub-No. 27), the small business which applicant proposed to serve maintained limited inventories and required prompt service in order to remain competitive. Existing service was slow and had led to diversion to private carriage. Applicant proposed an overnight service which was sorely needed by the supporting shippers. Yet the majority denied the application because of the potential impact on existing for-hire carriers.
>
> In the Subler case, No. MC-116763 (Sub-No. 236), the Review Board granted the authority sought, but Division 1 reversed. In effect, the Division substituted its judgment for that of the supporting shippers whose position had been that insulated trailers capable of transporting 43,000 pound loads were necessary. The Review Board had found that a need for such service existed, and that the protesting carriers were unable to meet that need. But the majority, while not disputing the inability of the protestants to provide the equipment needed, simply

referred to the responsibility of the shipper to arrange its distribution patterns to conform with existing transportation service. Perhaps existing service was okay. But why should we stand in the way when an applicant can make it much better?

A similar result was recently reached in the Schneider case, No. MC-51146 (sub-No. 320). The shipper testified that it had to use a large number of carriers to transport over 3000 small shipments weekly. The applicant's proposal would have permitted consolidation and coordination of a substantial percentage of shipper's traffic.

An Administrative Law Judge found, and Division 1 agreed, that the protestants could not provide the complete service shipper required. Yet, in the face of this fact and evidence of potential diversion to private carriage, the majority denied the application, (Commissioner Christian dissented) largely because of the failure to provide a detailed description of just how the shipper would use applicant's proposed services.

Hence the existing carriers have a manifestly secure posture for the burdens necessary to be borne by new applicants and their supporting shippers are onerous indeed. The adequacy and efficiency of existing service - whether or not it "exists" in the real sense - is viewed by the regulators in a rather strange way. In fact it would appear that "adequacy" and "efficiency" are presumed and cannot be rebutted by showing that a new carrier will provide a better service or a preferred service, even at a lower price. If lower prices or rates are a function of more efficient operations, not only are the existing formal interpretations counterproductive, but the conclusion follows that regulation retards rather then encourages greater efficiency and productivity. Thus it is the priorities that attend entry which deserve greater scrutiny, for it would appear that the paramount interest - the public interest - may be inadvertently going unsatisfied.

This is not to say that all applications for entry are denied. Many are granted, and the ICC claims a substantial majority are granted. This, nevertheless, belies the issue. It is the definition of "public convenience and necessity" and the way one views the "public interest," that is being reviewed in the debate. The number of applications granted or denied ignores the reasons each was so treated and totally ignores the impediments the present interpretation has on the number of applications filed at all. Commentators (see e.g., Moore, 1972) point out that the great majority of applications are filed by existing carriers for extension of their authority rather than by new carriers seeking initial authority. It is reasonable to believe that but for the I.C.C.'s views, additional "new" applications would have been submitted. In any event, the public is not served by the numbers game, and the viability of current policy turns on its substance, not on its form.

The certificates themselves are replete with restrictions including the specific commodities that can be transported and the territory that the carrier may serve. This is perfectly consistent with section 208(a) of the Act (49 U.S.C. 308 [a]) that mandates circumscribed certification and which compounds the broad commission authority regarding the fact of entry, the scope of entry and the viability of entry given the I.C.C.'s terms. That section, as pertinent, states:

> Any certificate issued under section 206 and 207 shall specify the service to be rendered and the routes over which, the fixed termini, if any, between which, and the intermediate and off-route points, if any, at which, and in case of operations not over specified routes or between fixed termini, the territory within which, the motor carrier is authorized to operate; and there shall, at the time of issuance and from time to time thereafter, be attached to the exercise of the privileges granted by the certificate such reasonable terms, conditions, and limitations as the public convenience and necessity may from time to time require...

However, it is the very imposition of those certification restrictions that serves to virtually mandate inefficiency by raising costs, depriving the carriers of substantial operational flexibility, and, in turn, requiring unnecessarily excess capacity to serve the public's transportation needs. Because of the restrictions carriers are denied many hauling opportunities either because the commodity to be moved is not specified in their certificate or because the geographical scope of the movement transcends the certificated territorial limitations. Such restrictions thereby deny public access to vehicles and carriers well situated to provide service and results in useless and wasteful, empty or partially empty truck movements in the backhaul mode.

While, as noted, the Act conceptually mandates the imposition of some of the imposed restrictions, the Interstate Commerce Commission has translated that policy into a zealous fragmentation of authorities many of which so limit the scope of operations that can be performed thereunder that the "system" of motor transportation can fairly be termed an illusory maze. The result, at least in the modern environment, is not only massive inefficiency, but service restrictions which preclude prompt satisfaction of shippers needs and which, in many cases, require a number of carriers to serve one shipper when one carrier could fully respond to all of that shipper's needs if allowed to do so.

Entry control is irretrievably related to the commensurate control of rate levels which together are designed to respond to the "privilege-duty" theory of regulation. Thus, while the receipt of a certificate of public convenience and authority grants the holder the privilege to conduct motor transport operations, it bestows a corresponding duty to serve all who request service to the limits of the carrier's physical capability. As a result, satisfaction of the "duty" in order to retain the "privilege" requires carriers to provide service, in part, which is or may be either non-renumerative or at least marginal. To compensate for this drain on carrier resources, other services must be in the nature of a cross-subsidy or else the viability of the carrier would be seriously undermined. It is unavoidable then that many carrier services, pursuant to regulation, are and must be overpriced, for cross-subsidization connotes a rough balance between under and over priced services. This very concept was addressed by the Brookings Institution (Noll, 1971) in a paper, ("Advisory Council on Executive Organization," evaluating the proposals of the Ash Council). In its chapter entitled "The Failings of Regulation" the following observation was made:

> The licensing function is closely related to price regulation, since the price structure can be used to subsidize nonrenumerative services only if regulators can decide how many and which firms can participate in an overpriced market.. Thus the airlines permitted to fly overpriced routes are also required to fly nonrenumerative, low-density routes; meanwhile, airlines that, in the absence of regulation, would respond to the high prices on the lucrative routes by entering the market and charging lower fares are prevented from doing so.

The practice of entry control has, in turn, not only made it difficult, time consuming, and expensive to obtain a license but has served to make existing certificates very valuable, most likely to an inflated extent. Evidence of this is blatant. An article appearing in a trade paper holding itself out as the "National Newspaper of the Motor Freight Carriers" (Transport Topics, October 18, 1976), reports that the operating rights of Eastern Freight Ways, a bankrupt carrier, were sold at a public auction for nearly four million dollars. The bankruptucy related to that carrier's unfortunate merger with a larger carrier, Associated Transport, whose rights were previously sold for substantially more. Of Eastern's rights, and by way of example, certain routes within New York State and between New York and New Jersey were acquired by another carrier for one million dollars while another carrier spent over one-half million dollars for a route between New York and northern Pennsylvania, and a third carrier spent one-half million dollars for rights within the Delmarva Peninsula.

Motor carrier operating authorities are auctioned off like old rocking chairs as is evident from advertisements in almost any issue of the trade newspaper, and the trade in rights has become so widespread and appreciably lucrative that some companies are now immersing themselves in providing specialized services in that regard. That same issue of Transport Topics, 1976 reports that the Nebraska auction firm of Taylor & Martin "has expanded its auction services to include the sale of ICC authorities." Quoting a carrier official, the article states:

> We've been amazed - downright shocked, in fact -
> at how much people will pay for an authority...

Thus, it is not mysterious to understand why existing carriers consider their licenses to be akin to a property right which would be devalued if entry controls were relaxed. Yet the propriety of certificates themselves being treated as property rights is questionable. It is the authority evidenced by the certificate - the ability to transport goods in interstate commerce - that is or should be the value, and the license itself should not be ensconced with an independent characteristic of great economic worth. Yet the regulatory climate - the restrictive entry policy - has served to bestow just such a status on the certificates for it would appear natural that if a carrier could get the same authority from the commission, it would not pay huge sums to acquire it privately. The very fact of an ongoing private market for authorities coupled with the vast sums paid serves as dramatic evidence that the regulatory entry policy is either unresponsive, unduly burdensome, or both.

While the ICC generally either does not recognize problems associated with its entry policy, or at least will not publicly admit them, any such reluctance is not universal. In his speech given on October 29, 1976, Commissioner O'Neal, while advocating caution in regulatory reform, nevertheless candidly discussed failings in existing entry procedures. He first referenced some of the objections raised concerning the ICC entry process:

(1) Smaller carriers complain that it costs too much in legal fees and otherwise to obtain a license.

(2) Carriers have to return to the commission for additional authority too often when the shippers they serve change their product in a minor way.

(3) Some carriers make a "profession" of protesting applications to serve a shipper in whom the protestors had no prior interest.

(4) A carrier that is willing to provide new service at lower rates can't use lower rates as an argument before the ICC tribunal.

(5) The commission is too slow in rendering decisions.

Subsequently he offered "possible solutions" including the issuance of broader grants in terms of commodities and service points "as free as possible from service-inhibiting restrictions and other limiting or fragmenting features" and the consideration, subject to certain controls, of the rate level proposed by an applicant for operating authority.

The present entry policy then, provided the users of transportation and the public with a host of negatives including artificially inflated rates, inefficient operations, imperfect service, excess capacity, wasted natural resources and quasi-monopolistic practices.

To the regulator, all of this is deferable to the overriding benefit of a "stable" motor carrier industry. Yet it is just this regulatory posture that gives credence to a central observation in the Brookings Institution paper mentioned earlier. There, in discussing the theories of regulation, it is pointed out that, while original regulatory predicates were anti-monopoly, present regulation is founded on the converse concept - anti-competitive:

> Several observers have pointed out that the nature of the mandate to regulatory agencies was profoundly altered by the Transportation Act of 1920. Prior to 1920, regulation was oriented toward preventing the abuses of monopoly. The Interstate Commerce Act of 1887, the Sherman Antitrust Act of 1890, and the Clayton and the Federal Trade Commission Acts of 1914 had all given government agencies a mandate to attack specific problems associated with concentrated economic power. In addition, these acts had, more or less, tried to specify the types of behavior that were to be regarded as antisocial, giving enforcement officials a reasonably clear idea of what they were supposed to prevent.
>
> The Transportation Act of 1920 was the first of a series of laws passed over the course of two decades that embodied an entirely new type of mandate. First, the laws were often distinctly anticompetition rather than antimonopoly. The power to set minimum rates and the duty to oversee the orderly development of an industry - the principal additions of the 1920 act to the ICC's responsibilities - have a distinctly different philosophy than did the maximum rate regulation and the clear prohibition against the short-haul, long-haul rate differentials which were established in 1887. Second, the delegation of responsibility to the regulatory agency ceased being specific. No longer was the mandate simply to prevent certain reasonably well understood (if not well defined) practices. Agencies were now given very general, unspecified authority to manage an industry in the public interest.

Given this "~ew" regulatory mandate, the evolution of the motor carrier industry "benefited" from a federal protectionist attitude justified by the commensurate equating of competitive restraint with the public interest. It is this equation that is now challenged given existing realities and it is this equation that has resulted in the perpetuation of other public detriments.

Among the most serious detriments suffered contrary to the public interest is that commonly referred to as the "backhaul" problem. It cannot be gainsaid that any public benefit is served by the empty movement of trucks but today's regulatory posture significantly contributes to this problem with little expectation that the ICC will attempt to do much about it. The backhaul dilemma imposes itself in a variety of ways starting with empty movements by common carriers as a direct function of the operational restraints imposed in their certificates.

Because the ICC equates the public interest with the maintenance of a very circumscribed competitive environment in motor carriage, licenses that are granted at all are limited to the territory and commodities for which additional service has been shown, to the commission's satisfaction, not to constitute a threat to other existing licenses. Hence many certificates only permit a carrier to operate "outbound" thereby mandating an empty return movement unless the carrier can secure an exempt load. In other cases, while a carrier may have territorial authority to return, the commodity restrictions imposed effectively preclude the likelihood of a productive backhaul movement. The results are gross inefficiencies which impact the public in a variety of ways including excess capacity, excessive costs, higher rates due to the need of the carriers to subsidize their empty movements, the wasteful expenditure of fuel which is so vital a commodity today, and the negative ecological ramifications of non-productive motor movements which serve no public purpose.

Needless to say, the ICC claims that the amount of empty or partially empty miles travelled by motor common carrier is overstated and, to the extent it exists, is not a function of regulation but results from such other factors as inherent trade imbalances between states. In support of its posture, the commission refers to the Mitre report (Bisselle, 1976) which the ICC contracted for to assess the empty mileage travelled by regulated carriers. That report concludes, in part, as follows:

> By and large, empty miles are an inevitable part of the trucking industry...Inherent trade imbalances, equipment limitations, shipper preferences, cleaning between hauls, and poor timing are among the many practical reasons for empty miles.

Putting aside contention as to the study's conclusions, its representativeness, completeness and thus authoritativeness are not only questionable but are, in fact, conceded as deficient by the study itself, holding itself out as nothing more than "preliminary". It recognizes that six[3] methods of research would be appropriate, of which only a literature survey and carrier interviews were utilized, the other four being considered impractical under the circumstances. The drivers' log study, which was not implemented for time and expense reasons, was conceded by Mitre to "possibly provide the best data." Of the two approaches utilized, the literature survey was found unsatisfactory by Mitre: "Unfortunately, there is not enough information in these files to provide a meaningful product." Thus, the study is primarily based on interviews with carriers, yet that methodology was limited to only six carriers of which two were general commodities carriers and four were specialized carriers.[4]

Clearly, and as recognized in the study, "general freight carriers represent the largest category in terms of a variety of parameters (pieces of equipment, revenue, ton-miles, etc.)." Yet, only two such carriers were interviewed, and they are among the largest and most efficient of the many thousands in operation. As stated by Mitre:

> All of them [carriers interviewed] have better than average....operating ratios. In short, the carriers visited represent large, well-managed operations where one would expect empty miles to be a matter they are trying to minimize.
>
> It should be noted that the carriers interviewed are large, well-managed organizations with <u>admittedly adequate authority</u>. (Emphasis supplied)

Given the foregoing, it is hard to conceive of the Mitre study[5] as being representative or in any respect authoritative. To its credit, the study is essentially forthright in recognizing its limitations both in terms of scope and substance, and it admits that many factors beyond its framework need attention before a definitive result can be obtained, stating, among other things, in this regard: "The present preliminary study has indicated the need to gather more and better quantitative data as well as to discuss more sides of the problem... There might also be extended coverage of the commodities examined in this document, particularly general freight since it is such a large category."

Norman H. Jones, Jr., a commentator on regulatory issues, agrees that empty backhauling can never be totally eliminated given the nature of the industry, but contends that "the ICC in its effort to restrict the supply of service through route and commodity restriction, however, has exacerbated this backhaul problem. (Jones) Claiming that regulated vehicles return empty 38 percent of the time, Jones suggests that, in the regulated sector alone, excess capacity exceeds 15 percent.

Similarly, Richard W. McLaren, then Assistant U.S. Attorney General, cited with favor the view of Professor James Nelson as follows:

> Empty mileage from insufficient commodity or return-haul authority, added mileage from route and gateway restrictions involving circuitous routes, and idle truck time occasioned by commodity and class-of-shipper restrictions obviously increase excess capacity and raise unit costs (Glines and Regeimbal, 1971).

It seems beyond argument that certification restrictions serve to create and compound the backhaul problem. They require duplicate operations with the participating carriers experiencing compounded costs. The social costs, over and above rate consequences, are acute, particularly in the unnecessary consumption of fuel. With the manifestation of the energy crisis in recent years the commission due to the inexorable external pressures flowing in response thereto, was forced to take at least some action to reduce the wasteful operations over which it presided. While one of its first moves was to attempt a regulatory foothold over private carriage, it did nothing significant in terms of limiting its use of certification restrictions which would likely reduce the scope of empty backhaul movements.

Perhaps the most meaningful step taken by the commission in response to the need for energy conservation was the promulgation of regulations that allow irregular route carriers to eliminate certain gateway restrictions so long as elimination of the gateway would not save the carrier more than 20 percent of the distance that is traversed via the gateway (Ex Parte No. 55 [Sub-No. 8], Gateway Elimination, 119 M.C.C. 530). While this was certainly a positive step, predicated on the fuel savings that would result - estimated to be over 300 million gallons - the question of why this gateway relief was so circumscribed is irresistable. If this limited gateway relief which eliminated a portion of the agency mandated circuity could save so much fuel, why not eliminate the gateways entirely? Obviously, even under the pressures of energy conservation, the commission would go only so far in expanding competition as a function of reducing the circuity of carrier operations thereby making those carriers more competitive with "non-gateway" carriers.

The commission has publicly stated its reasons for offering only partial relief. In its booklet entitled "The Regulatory Issues of Today," January, 1975, the commission rationalizes its decision in the Gateway case by offering the thesis that "carriers whose service via gateways was up to 20 percent more miles than the direct service were likely to be competitive already with carriers providing the direct service; thus allowing direct service in these cases would not likely injure existing carriers very significantly." Thus the commission retains the regulatory notion that existing carriers must be protected, even at the expense of fuel waste, but rationalizes that the new rules serve to save some fuel but don't harm existing carriers. Yet, with approximately 20,000 carrier filings for the elimination of gateways in response to the new rules, some market relocations and reactions would appear inevitable. Nevertheless, the ICC concludes that the decision has resulted in greater efficiency, better service, energy conservation, less defouling of the environment, and the possibility of lower rates:

> ...carrier organizations claim that this action will conserve at a minimum 300 million gallons of fuel a year and has already assisted in reducing air pollution... The industry has shown no competitive ill-effects from our action. If anything, the carriers are apparently operating more efficiently, providing more adequate service, and meeting competition from the same carriers as before. (Emphasis supplied)
>
> The new regulations in addition to conserving energy and protecting the environment are expected to provide improved service to the public with the possibility of a reduction in charges for the transportation service where appropriate...Since the carriers will be able to operate more efficiently and to better utilize their equipment, presumably such economies will be passed on to the ultimate

consumer in the form of lower prices for the transportation service.

To the extent that even this modest commission relaxation can be considered a sample of "regulatory reform" -- and why not? -- it has, according to the regulators themselves, worked -- it has bestowed a variety of public benefits without any commensurate loss of motor carrier stability. To be sure the commission makes no concessions to regulatory reform and limits its rationale to a situation it initially considered not competitively distruptive due to essential competition in the various markets anyway. But there appears to be nothing particularly magical about the 20 percent figure in the Gateway case, and it certainly suggests that, when pressed, as it was there, the ICC would agree that at least some reform would bring benefit without detriment.

The impact of motor carrier regulation, however, extends beyond the realm of the regulated carrier, because the "industry", generically, is also comprised of exempt commodity carriers and private carriers. As put by Mr. Jones: "ICC regulation (and service as a cartel manager) extends over the for-hire market. It also, however, participates in the definition of the boundaries between that market and the other two. In this respect, the ICC tends to behave as one might expect and seeks to expand its dominion over activities in the other markets through the definition of exempt commodities and the role of private carriage." This impact is significant when one considers that approximately 60 percent of truck traffic is unregulated.

While not authorized to regulate private carriage, the ICC has much to say over its scope, because, in interpreting the Interstate Commerce Act definition of private carriage, the agency has been able to define it in a circumscribed way. Thus, the definition of "person" in the Act as it relates to private carriage has consistently been held by the commission to exclude corporations affiliated with or subsidiary to the transporting corporation. In a recent and major decision on the issue, the ICC maintained the fictional transportation distinction between a division of a corporation on the one hand, and, on the other, a subsidiary or affiliate. It held that a policy of piercing the corporate veil so as to recognize as private carriage transportation operations performed by one related corporate entity for another would not be in the public interest (No. MC-C-8506, Petition for Declaratory Order Regarding Intercorporate Parent-Subsidiary Transportation, 123 M.C.C. 768 [1975]).

The commission discussed at length the "primary business" test of section 203(c) of the Act and concluded that the test was not discretionary [6] and its strict application was necessary to protect regulated carriers:

> The commission continues to believe that illegal for-hire carriage, not specifically exempted from regulation, is a threat to the stability of the regulated transportation industry and that the best tool available to combat such illegal activity is strict enforcement under and strict application of

the "primary business" test embodied in section 203 (c).

In other decisions, albeit involving applications for contract carriage permits, the commission has gone even farther so as to preclude, in some instances, a corporate division and the corporation itself from being considered a single "person" under the Act. In No. MC-87720 (Sub-No. 131) Bass Transportation Co., Inc., Extension - St. Louis, Mo., 125 M.C.C. 233, now under appeal, the commission strongly reaffirmed its policy to foster the protection of common carriers by restricting the scope of all other forms of trucking. While the case specifically dealt with contract carriage its rationale could extend beyond. The commission there defined "person" pursuant to section 203(a)(1) of the Act as including "any unincorporated entity which has substantial independence from its parent..." Id. at 243.

In its 90th Annual Report to Congress, 1976, the commission referred to two prior decisions[7] in this regard, stating: "The commission found that in considering the statutory requirement of a 'limited number of persons' it is appropriate to look beyond the parent corporation to its divisions, including those which are not separate corporations, in order to preserve the essential distinction between common and contract carriage. It was further pointed out that mere membership in a corporate conglomerate does not merit consideration as a distinct class of shippers."

The commission again has recently refused to allow the grant of authority as a for-hire carrier to a private carrier, particularly when the license would be used for backhaul movements (U.S. Interstate Commerce Commission, 1976, p. 48). Thus the commission adheres to its own and long-standing policy of denying such "backhaul" licenses even for contract carrier status (Geraci Contr. Car. Application, 7 M.C.C. 371 and Veon Contr. Car. Application, 88 M.C.C. 279) which are to be considered pursuant to the test of "consistency" with the public interest -- a test that is more lenient than the common carrier test of being required by the public convenience and necessity.

Private carriers suffer tremendous burdens because of empty backhauling which are demonstrably exacerbated by the existing and growing regulatory barriers imposed. The business and social cost resulting therefrom are aggregious yet the ICC not only refuses to ameliorate the situation but may well be antagonizing it. That private carriage continues to grow despite the dramatic backhaul limitations may well serve as a conspicuous indictment of the service and cost results of regulation but, in any event, as stated by Richard W. McLaren:

> The very fact that now 60 percent of truck traffic is unregulated, demonstrates, I think, that many shippers are unsatisfied with the services and rates of regulated motor carriers. Apparently large shippers increasingly find it preferable to enter the transportation business themselves, rather than to rely upon the services of a common

carrier regulated by the ICC. The shift to private trucking is all the more remarkable considering that private carriers must cope with the costs resulting from such regulatory barriers as return-haul limitations (Glines and Regeimbal 1971).

The costs of private carriage empty backhauls is significant in the same respects as the empty backhaul costs for regulated carriage, although perhaps to an even greater extent given that more trucks are private than regulated and the barriers to backhaul for the former are even greater than for the latter. One of the primary prices paid by society for empty private backhauls is the fuel waste it engenders. It is certainly beyond the scope of this paper to attempt to universally quantify the fuel so wasted, but a benchmark quantification will serve to make the point. The Transportation Task Force of the Food Industry Advisory Committee to the Federal Energy Administration submitted a progress report to FEA on June 3, 1975, in which it estimated that the impediments to intercorporate hauling and backhauling by pivate truck fleets in the food industry alone caused the waste of 100 million gallons of fuel and increased distribution costs by $300 million annually. While that report did not only reference ICC regulatory restrictions, and while other factors certainly do bear upon the issue, what is clear is that fuel waste, negative environmental impact, and increased direct costs are rampant by-products of restrictions on private carriage backhaul opportunities. This is all the more evident when the figures offered for the food industry are projected for all industries nationwide.

In view of the foregoing, there appears to be significant reason to substantially reform motor carrier regulation. This is not to say that the posture of the regulators is totally unviable, for it cannot be denied that a vibrant motor transport network is a national imperative and stability is a virtue. We must ask, however, whether stability is worth any price and whether it would dissipate as a function of reform. Louis M. Kohlmeier may well be correct stating:

> In the final analysis, it seems to me that we as a nation have not decided what we want from government. In this sense, regulation is a vast security blanket -- or, more accurately, a huge patchwork of security blankets. If we let go of the security, we don't know what economic freedom, enforced by the antitrust laws, might bring (Kohlmeier).

Yet, the historical commission performance of rigid and excessive adherence to the conceptual status quo, all in the name of stability, fails to recognize that certain reforms, albeit substantial reforms, are likely, on balance, to bring about a more responsive and more efficient carrier network, of benefit and saving to the public of economic and natural resources, while at the same time not evolving into the predicted "chaos". At least a corner of the regulatory security blanket should be turned away and, regulatory reform -- not deregulation -- should be effectuated. The Interstate Commerce Commission should remain and it should retain much of its regulatory options, for sudden change would be unfortunately disruptive. However, it is submitted that, within the confines of the matters discussed in this paper, the following reform suggestions should be considered:

(1) Ease entry into regulated carriage.

(2) Undertake the modification of all certificates so as to broaden their commodity and territorial framework.

(3) Authorize intercorporate hauling for private carriers

The first should incorporate consideration of license applications with a view toward whether a grant would result in more efficient operations by the carrier; less fuel use; better equipment utilization; improved service to the public; satisfying the preference of users in terms of service and rates, and thus giving consideration to lower rates as a function of grant of authority.

As to the second, a limited number of commodity classes should be developed which would encompass all products transported. There could be perhaps as few as from 6 to 10 classes[8] including, by way of example, general commodities, household goods, bulk commodities, "Mercer" and other heavy commodities, explosive and hazardous commodities, and automobiles, motor homes, and boats. Existing certificates could then be modified to reflect the appropriate commodity class. Each carrier would retain at least as much commodity authority as now held, and all new certificates would incorporate commodity descriptions reflecting one or more of the generic classes.

As to territorial restrictions, a similar "class" approach can be taken, with each present carrier authority being modified to encompass a geographical framework corresponding to the states in which that carrier operates. Thus, each existing carrier will have territorial authority at least as broad as at present and in many cases broader.

These modifications, particularly when taken together, will not only rationalize the existing patchwork of certification restrictions but will allow carriers to provide more complete, responsive, and efficient service. The empty backhaul problems of common carriers will be substantially mitigated and substantial fuel can be saved. While, to be sure, this approach would have competitive ramifications, it will eliminate many counter productive and artificial barriers to good motor transport while at the same time retaining with the commission much of its present control and regulatory functions. Carriers would enhance their service privileges while retaining the duty to so serve.

These three steps represent a tempered, middleground approach to regulatory reform. They would serve to significantly address many of the service, fuel, environmental, productivity, and cost ramifications which negatively attend the present regulatory scheme without threatening the "stability" which ostensibly is the primary virtue of regulation. This is not to say that the reform proposals offered are insubstantial, for, in fact, they are major. This is also not to say that they will not have the effect of altering some competitive markets with some resulting relocation. However, they would appear to respond to some of the major concerns of both sides of the regulatory debate. They would affectuate additional competitive forces, improve productivity, conserve energy, and they would move part of the way toward mitigating the efficiency and backhaul problems of private carriage. While private carriers would thus have a limited increase in their service sector, the increased service capabilities that would accrue to regulated carriers would likely more than offset the impact. Further, the commission's concerns for stable and fair transportation would not be undermined.

It may well be that we now have the best motor transportation system in the world. That, however, does not mean it can't be improved nor does it mean we are now paying a fair economic, energy, and environmental price for it. It also may well be that total deregulation is the best approach, leaving motor transport, like most other industries, to operate within a pure, free-market environment. However, radical reform is not only unlikely soon as a practical matter but may, at least for now, be too much too soon. The industry has operated with the guiderail of regulation for many years, and, as a first step at least, the rail should be lowered rather than removed.

NOTES

1. Motor carrier industry television advertising slogan.

2. Division 1 of the commission.

3. Literature survey; interviews with carriers; mail questionnaires; drivers' logs; loadometer type survey; and review operating authorities.

4. Two petroleum carriers and two household goods carriers.

5. In its report to Congress dated April 14, 1976, pursuant to Section 382(a)(2) of Part E, Title III, of the Energy Policy and Conservation Act (P.L. 94-163), the Interstate Commerce Commission suggested that "consistent with improving energy efficiency in a realistic way" it was considering, among other things, an expansion of the MITRE study "so that unnecessary empty mileage and potential fuel savings might be more clearly defined." However, the commission has not undertaken an expansion of the MITRE study, opting instead to conduct a survey of its own, the results of which have not yet been reported.

6. In a prior case the commission did pierce the corporate veil but distinguishes that case on the ground that the transporting entity was a religious entity. See Status of Certain Church Transportation, 112 M.C.C. 59(1970). Here the commission makes the distinction stating that prior cases "dealt with transportation to further a commercial business while the latter [Certain Church] was in direct furtherance of the church's mission." No. MC-C-8506 Petition for Declaratory Order Regarding Intercorporate Parent-Subsidiary Transportation, 123 M.C.C. 768 at 778.

7. Continental Contr. Car. Corp. Ext. - Modification of Permit, 121 M.C.C. 882(1975) and Crete Car. Corp. Ext. - Animal Food Ingredients, 121 M.C.C. 636 (1975).

8. The list of commodity classes offered is not presented as absolute, but merely conceptual. While alternative or a small number of additional classes may be appropriate, it is the limited class concept which is the matter set out for consideration.

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REGULATION AND THE LEVEL OF TRUCKING RATES IN CANADA

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INTRODUCTION

In the debate over the relative advantages and disadvantages of trucking regulation, there are relatively few opportunities to appeal to empirical evidence to resolve disputes. Opportunities to trace the impact of deregulation in situations where this has occurred are few and far between, and, independent of the methodological problems of resolving whether this action has been "good" or "bad", the generalization of the results of such experiences is complicated by the fact that most of them have taken place in foreign countries, with specific industry structures, competitive conditions and institutional frameworks, or have occurred in highly specialized areas of the trucking industry (for example, agricultural movements in the United States and dump-truck operations in the province of Ontario in Canada).

In the light of this paucity of opportunity for empirical analysis, the case of the Canadian trucking industry, (in which differing regulatory structures have been established by each of the ten provinces) takes on a special importance. Among the examples of empirical analysis cited in motor carrier regulatory debates, the Canadian case is unique in being based primarily on cross-sectional analysis rather than on time series analysis, thus avoiding the problems of changes in market conditions and other exogenous factors during the period of analysis. In addition, the Canadian case should be of particular interest to the United States, since of all the countries of the world, the Canadian economy and motor carrier industry bears the closest resemblance to those of the United States.

References to the Canadian situation in regulatory debates rely heavily on the results of four articles published by three authors: McLachlan (1972), Palmer (1973), and Sloss (1970, 1975), each of whom has concluded that regulation of the motor carrier industry has raised rates by between 0.68 and 2.5 cents per ton-mile. The existence of three separate authorities, each arriving at similar conclusions, is somewhat illusory. The principal analysis performed by each of these authors has been the same: the fitting of a multiple regression equation with "revenue per ton-mile" as the dependent variable, and the testing for the effect of regulation either by the inclusion of a dummy variable or by the analysis of residuals from the resulting equation for "regulated" and "nonregulated" groups of traffic. In addition to similarities in approach (and model specification), each author also employed the same basic data.

It is the thesis of this paper that the results of McLachlan, Palmer and Sloss are open to severe question, doubts arising from three major directions: the definition of "regulation", the specification of the model, and the quality of the data employed. This paper is composed of two major elements: a discussion of the deficiencies of the published research in this area, including a general discussion of the methodological difficulties of employing multiple regression analysis to detect the effect of regulation; and an attempt to replicate the work of McLachlan, Palmer and Sloss, dealing with the deficiencies and difficulties noted. The major conclusions of the paper are that the use of multiple regression analysis to detect whether regulation has raised trucking rates is inherently limited, and that correction of the faults of previous analyses leads to results that contradict those of previous authors.

CANADIAN MOTOR CARRIER REGULATION

The division of powers between the federal government and provincial governments of Canada is primarily determined by the British North America Act of 1867, the original act of confederation that created the Dominion of Canada. While explicit reference was made in the act to federal control of railways, canals and water transport, no such reference was made to highway transportation, although the construction of roads and highways was, and remains, a provincial responsibility. In the absence of a prevailing federal statute, each province evolved its own set of economic controls to deal with the emerging motor carrier industry, both for intraprovincial and extra-provincial[1] operations.

This situation prevailed until the early 1950's, when provincial jurisdiction over extraprovincial trucking operations was successfully challenged in the courts, and was transferred to the federal government. For a variety of reasons, the federal government was unwilling or unable to perform the regulatory functions for extraprovincial operations, and passed the Motor Vehicle Transport Act of 1954, which empowered the provinces to continue regulating extraprovincial operators, subject to the sole proviso that such regulation should be conducted in a like manner to the regulation of intraprovincial operations. As may be imagined, this arrangement created many problems, among the most prominent of which was (and is) the fact that, due to the absence of any provision for joint hearings by provincial regulatory agencies, a motor carrier has to justify his application for an interprovincial route authority before the regulatory agency of each province through which he plans to travel.

In 1967, the federal government passed the National Transport Act of 1967, one of the aims of which was to create the Canadian Transport Commission, intended as a single regulatory agency for all modes over which the federal government has jurisdiction. While Part III of this Act, which provided for assumption of control over extraprovincial highway transport, was proclaimed in 1970, it has not yet been implemented, except for a single highly specialized instance in 1976.[2]

As of January 1977, therefore, regulation of motor carrier enterprises, both on an intraprovincial and extraprovincial basis, remains the responsibility of the provincial governments.

As will be discussed at greater length below, it is not a simple task to describe briefly the regulatory structures of each province. In part, this is due to the complicated nature of regulatory acts which may or may not include provisions concerning entry, rates, commodity restrictions, classifications of carriers by legal form, schedules and so on.[3] It is also due, however, to the problems that while regulatory laws may exist in a given province, it does not necessarily follow that the regulatory powers are enforced, or, if enforced, to what extent. A final aspect of the problem is that, in some provinces, both the regulatory laws and the degree of their enforcement have changed over the years. As we shall discuss below, this problem of categorizing provinces as either "regulating" or "nonregulating" is one of the most difficult, yet crucial, problems in the quantitative analysis of the effects of regulation.

For the purposes of introduction, however, a broad overview of provincial practice in entry and rate regulation in 1976, based on information assembled by the Canadian Trucking Association, is presented in Table 1. It may be seen that except for intra-Alberta operators, entry regulation exists for all carriers. Intraprovincial rate regulation varies from prescription of rates by the regulatory agency (Saskatchewan and Manitoba), through approval being necessary for increases (British Columbia, Quebec and Newfoundland), through the requirement for the filing of rates without agency power to disallow (Ontario, New Brunswick, Nova Scotia and Prince Edward Island) to complete rate freedom (Alberta). Interprovincially, only Quebec attempts (somewhat successfully) to regulate rates, while Newfoundland is also reported to be attempting the same (much less successfully).

Some estimate of the relative proportions of traffic subject to regulation may be gained from Table 2, which shows the volume of traffic (measured in tons) in each province-to-province "lane". It may be seen that approximately 44 percent of tons transported in Canada in for-hire operations were subject to some form of rate regulation.

A SUMMARY OF PREVIOUS RESEARCH

Sloss' 1970 Paper

The first published (and most frequently cited) attempt to use regression analysis to detect the effect of regulation on Canadian

TABLE 1
Canadian Trucking Regulation, 1976

PROVINCE	INTRAPROVINCIAL		INTERPROVINCIAL	
	ENTRY REGULATION	RATE REGULATION	ENTRY REGULATION	RATE REGULATION
British Columbia	Yes	Yes[1]	Yes	No[2]
Alberta	No	No	Yes	No
Saskatchewan	Yes	Yes[2]	Yes	No
Manitoba	Yes	Yes[2]	Yes	No[3]
Ontario	Yes	No[3]	Yes	No[3]
Quebec	Yes	Yes[1]	Yes	Yes[1]
New Brunswick	Yes	No[3]	Yes	No[3]
Nova Scotia	Yes	No[3]	Yes	No[3]
Prince Edward Island	Yes	No[3]	Yes	No[3]
Newfoundland	Yes	Yes[4]	Yes	Yes[3]

1. Filing of rates required, with approval necessary for all increases.
2. On intraprovincial traffic, Saskatchewan and Manitoba prescribe rates.
3. Filing of rates required.
4. While Newfoundland's regulatory agency has the power to regulate rates on extraprovincial traffic, there is some doubt whether this power has ever been effectively applied. Even on intraprovincial operations, the power to disallow rate increases has rarely been exercised.

Source: Canadian Trucking Association

TABLE 2
1973 For Hire Trucking Volumes, by Province-to-Province "Lane".*

(Thousands of Tons)

D / Ø	N	P	NS	NB	Q	O	M	S	A	B	T	IT
N	153		24	6	1	7					192	39
P	4	47	24	10	4	23					112	75
NS	30	42	2330	360	85	33	1		2	7	2891	561
NB	27	64	411	1971	216	83	5	1	1		2778	807
Q	9	19	134	513	19502	3236	126	12	62	62	23675	4173
O	5	11	139	145	2853	36385	480	71	237	317	40644	4259
M			1	7	85	540	1333	320	185	60	2531	1198
S			1		14	59	514	2584	412	51	3634	1050
A	1		3	1	91	167	185	649	7051	1175	9342	2291
B			1		24	82	64	90	989	13089	14339	1250
T	229	183	3067	3013	22877	40635	2707	3726	8940	14761	100611	
IT	76	136	737	1042	3375	4250	1375	1142	1916	1685		

* Abbreviations used are as follows: Ø - Province of Origin; D - Province of Destination; N - Newfoundland; P - Prince Edward Island; NS - Nova Scotia; NB - New Brunswick; Q - Quebec; O - Ontario; M - Manitoba; S - Saskatchewan; A - Alberta; B - British Columbia; T - Total; IT - Interprovincial Total.

Source Canada: Statistics Canada, Motor Carriers Freight, 1973, Ottawa, Ontario: Queen's Printer, 1976.

motor carriers rate levels was by Sloss in 1970. Sloss used data on intraprovincial operations from the years 1958-1963 (inclusive) to fit a regression equation of the form

$$y^j = a + \sum_i b_i x_i^j + u^j$$

where y = revenue per ton-mile
x_1 = average length of haul
x_2 = average net weight per loaded vehicle
x_3 = average fuel tax per gallon
x_4 = average licence cost per truck or tractor per year
and x_5 = average annual wage per employee.

He then tested for a difference in the means of the residuals (u^j) for regulating and nonregulating provinces, using both a 't' test (i.e. assuming normality) and a x^2 test (i.e. a non-parametric test). The results of this showed that the hypothesis of no difference could be rejected at the 0.005 percent level of significance (t test) or at the 2 percent level (x^2 test). He then estimated that the effect of regulation had been to raise rates 0.68 cents per ton-mile. (The results of Sloss' analysis are shown together with those of McLachlan and Palmer in Table 3). It should be noted that this analysis was based on a grouping of British Columbia, Manitoba and Saskatchewan as 'regulating provinces'; Quebec, Ontario, New Brunswick, Nova Scotia and Alberta as 'nonregulating provinces', and omitting Prince Edward Island and Newfoundland from the analysis.

Sloss repeated his analysis for extraprovincial traffic, but found no significant differences between the residuals for 'regulated' and 'nonregulated' traffic, although a pooled data set of intraprovincial and extraprovincial traffic did reveal such a difference. Sloss (p. 347) concluded that "additional payments by users of truck transportation [due to regulation] has been estimated at slightly less than $10 million."

As noted in the introduction, the criticisms that may be made of this research fall into three major categories: the definition of regulation, the specification of the model, and the quality of the data employed. We shall address each of these in turn.

The appropriate treatment of regulation in models of the type used by Sloss is crucial to the analysis. If any dispute exists concerning which provinces are to be treated as regulating and which as nonregulating, then the entire effort is called into question. Sloss does not treat this problem lightly, giving extensive recognition to the difficuty of forming the two categories of provinces, but a number of important perspectives are either missing or underplayed in his paper; perspectives which, if not grasped by the reader, may lead to serious misinterpretation of his results.

The central problem in any attempt to divide the motor carrier industry into "regulated" and "nonregulated" sections is the fact that "regulation" is <u>not</u> a homogeneous entity. Apart from entry and rates, there are a number of other regulatory tools that may vary from one

TABLE 3
Summary of Models Employed in Previous Research*

Explanatory Variables	SLOSS (1970)**	McLACHLAN**	PALMER**	SLOSS**(1975)
Length of Haul (miles)	-0.0102 (0.0056)	-0.03697 (0.00357)		-0.0242 (0.0055)
Net Wt. per Vehicle (tons)	-0.7779 (0.1807)	-0.34679 (0.11767)	-0.313 (-4.75)	
Fuel Tax (cents)	+0.1983 (0.0740)	not significant	+0.080 (1.59)	+0.3727 (0.1253)
Licence Fees ($)	-0.0096 (0.0029)	not significant	-0.008 (-5.55)	
Wage Rate (Trucking)($)	+0.0021 (0.0007)			
Wage Rate (Provincial)($)		+1.61390 (0.64615)	-0.027 (-0.88)	
Transport Cost Index		+0.08007 (0.02080)		
Regulation Dummy		+2.58190 (0.27699)	2.20 (11.06)	
Tons Transported				-0.00009 (0.00004)
(Length of Haul)$^{-1}$			+84.09 (2.79)	
Commodity Dummy				+6.3545 (0.6084)
Time			+0.089 (0.80)	
Miles Per Gallon			+0.545 (2.51)	
Constant	9.7691	.68383	9.71	2.6508
R^2	0.7241	0.96	0.984	0.9266
Observations	48	35	30	24
t-test for regulation	2.828			0.818
Years used	1958-63	1957-63	1958-63	1970-72
Regulating provinces	BC,S,M	BC,S,M,Q	BC,S,M	BC,Q
Non-regulating provinces	A,O,Q,NS,NB	A	A,Q	O,A,S,M

*Figures in parentheses represent standard error of coefficient, except for Palmer where they indicate t-values.

**Intraprovincial data only.

*Only one of Palmer's 24 models is shown here.

regulatory environment to another, and which may change the services and cost characteristics of the trucking industry sufficiently to obscure any relation between, say, entry regulation and the level of rates. Provisions for commodity restrictions, adherence to published time schedules and categories of exempt traffic are all examples of regulatory tools that vary significantly among Canadian provinces. It may be argued that the effect of such variations are partially 'captured' in Sloss' model by the use of the variable "average weight per loaded vehicle", since commodity restrictions and schedule requirements will affect the size of this variable. Unfortunately, a large number of other factors, including maximum weight limitations, the proportion of TL traffic and service requirements imposed by the market also contribute to the size of this variable.

Even if one is to pass over such problems (as Sloss does) one cannot evade the problem that regulation, at a minimum. contains two major elements: entry and rates. Sloss defines "regulation" in his model to mean regulation of entry and rates: failure to regulate either of these causes a province to be categorized as nonregulating. Such a categorization scheme places such disparate provinces as Alberta and Ontario into the same category of "nonregulating" provinces. The problem that this poses is amply demonstrated by the fact that, in 1975, the Alberta legislature formed a parliamentary committee to enquire whether to introduce trucking regulation, while a corresponding enquiry was also launched in Ontario, in response to appeals for abandoment (or relaxation) of regulation (i.e. entry controls). Sloss' scheme also groups together provinces that prescribe rates (Saskatchewan and Manitoba) with provinces in which regulatory approvals is needed only for rate increase.

Since in only one province (Alberta) out of the eight considered by Sloss is there an absence of entry regulation, it is clear that his categorization is dominated by rate regulation, and his results must be interpreted with this perspective in mind. If anything, Sloss' results seem to suggest that the marginal effect of rate regulation, when added to entry regulation is to increase rates by 0.68 cents per ton mile, although even this conclusion is in doubt because of the presence of Alberta in the analysis. Sloss' result has little bearing on entry regulation (usually the dominant aspect in regulatory debates), and even less on 'regulation' in the abstract.

A further complication for any researcher attempting to use regression analysis to detect the effect of regulation is the problem of varying degrees of regulatory enforcement. Sloss deals at length with this problem, in an attempt to determine whether de facto rate regulation existed as opposed to de jure regulation. As a result of making this distinction, Sloss was led to changing the classification of Quebec from a "regulating" province to a "nonregulating" province, primarily because of two pieces of evidence: a high (30 percent) proportion of traffic moving under (nonregulated) agreed changes, and an examination of the annual reports of the Quebec Transport Board that revealed "unusual liberality ... a relatively light case load ... in reviewing the rates of trucking firms and a high percentage of approvals in proceedings involving permit applications" (p. 340). (It might be noted in passing that this adjustment was not made a priori, but because "initial quantitative analysis produced results for this province which differed markedly from a priori expectations and from results calculated for the other provinces which had been classified 'Regulating'" [p. 340]).

A number of reservations may be held in regard to this procedure. First, surrogate variables such as "percentage of applications approved" are notoriously poor indicators of the degree of regulatory enforcement, because they exclude from consideration applications that were never made because of fear of rejection. The percentage of entry applications approved by the ICC in the United States is also reported to be high (D. D. Wyckoff and D. H. Maister, 1977 introd.) but to classify the United States as 'nonregulating' would indeed be foolish. Second, even if the degree of regulatory enforcement could be measured by such variables (and the development of a methodology to do this would be a significant contribution), the appropriate method of including it in any model would be as a scale variable, rather than as a binary choice. Third, the percentage of "agreed charges" traffic, while high, was by no means dominating, and argues more for Quebec's exclusion from the analysis rather than its classification as a nonregulating province.

We now turn to consideration of the specification of Sloss' model. The major criticism that may be made here is the omission of a number of potentially significant variables that may be important in explaining rate variations between provinces. Not only would the addition of these variables alter the coefficients of all variables included in the model, but they would have a disastrous effect on Sloss' conclusions in regard to the effect of regulation to the extent that they are correlated with his regulatory classification.

Among the potentially significant variables that should be considered in a thorough analysis are the mix of commodities carried, the mix of common and contract carriage, variations in size and weight limitations (and quality of highways), the mix of truckload and less-than-truckload shipments, and the existence (or degree) of intermodal competition. Each of these variables differs significantly from province to province, and may be expected to affect the average rate per ton-mile prevailing in any province. Exploration of the effects of these variables (with the exception of the common/contract mix) is included in the analysis reported later in this paper. However, one of these variables merits some further discussion here: the degree of competition.

In the years covered by Sloss' analysis (1958-63) rail traffic within and from the Maritime Provinces[4] was subject to the Maritime Freight Rates Act, and travelled at artifically low rates in exchange for a subsidy paid to the railways by the federal government. Until these subsidy payments were extended to the trucking industry in 1969, motor carriers in the Maritimes were at a competitive disadvantage to the railways, a disadvantage that can be expected to be reflected in trucking rates. Sloss does not recognize this problem, which should have been dealt with either by introducing a dummy variable to denote traffic flows affected by the Act, or by excluding the Maritime Provinces from the analysis. Sloss did exclude Newfoundland and Prince Edward Island from his analysis, again ex post, because of "(1) the relatively small size of their for-hire truck populations, (2) their insular locations, resulting in unique transportation problems, (3) caution expressed in D.B.S. reports that estimates for these provinces contained a large degree of sampling error, and (4) the impracticability of prorating to these provinces a reasonably accurate share of their costs and revenues when published in consolidated form for the Atlantic Provinces as a whole" (p. 358).

Exception may also be taken to certain of the variables that Sloss did include in his model. As Palmer (1973, pp. 658-660) argues convincingly, a more appropriate way to account for the effect of a distance taper would be the substitution of the average length of haul by its inverse, to account for the non-linearity of the taper. The use of average wage rate of trucking firms based in each province may be criticized because of a potential correlation between wage rate and the existance of regulation. This argument is made by McLachlan[5]. It should also be noted that this variable is significantly correlated with Sloss' other explanatory variables. The use of average license fees per power unit has the problem that variations in size and weight limitations affect the size of this variable (thus leading, incidentally, to a negative coefficient in Sloss' analysis[6]).

A final criticism of Sloss' model specification arises from the fact that while pooling cross-sectional and time series data (i.e. using data from each province for a number of years), he makes no attempt to account for the possible effects of time by including a dummy variable. As Palmer was to note (1973, p. 662), if the rate of inflation or change in demand conditions were to have a differential impact between the provinces, such a variable could be important in explaining a significant proportion of the variance in rate per ton-mile present in the data.

The third major dimension of criticism that may be made of Sloss' work (apart from treatment of regulation and model specification) is the quality of the data employed. Three of Sloss' variables (average fuel tax per gallon, average annual license cost per power unit and average annual wage) were taken from a Dominion Bureau of Statistics (DBS) publication Motor Carriers-Freight based on reports submitted by trucking companies to DBS. While these statistics are generally regarded as accurate, a problem exists in that the statistics are accumulated by the home-base province of the reporting firms, even though they may reflect significant interprovincial operations. The data therefore do not reflect the true variation between provinces of fuel tax, license cost or average wage rates.

The remaining variables in Sloss' analysis (revenue per ton-mile, average length of haul and average net weight per loaded vehicle) were taken from another DBS publication, Motor Transport Traffic. This publication was based on a sample questionnaire survey of registered trucks (by province of registration, raising the same problem of interprovincial use). The response rate to this survey was always very low. In 1963, for example, 115,232 questionnaires were sent out (compared to an estimated population of 1,001,000 trucks) of which 43,177 were returned completed and 30,774 trucks were reported not used during the survey week (p. 10). As the 1964 issue of Motor Transport Traffic acknowledged, "the accuracy of the data being reported was unsatisfactory" (p. 10). In this statement, and by the act of discontinuing the survey the following year, DBS was sharing in a distruct of the data long held by the motor carrier industry in Canada. In addition to the problem of accuracy, it should be noted that data contained in Motor Transport Traffic was based on truck movements, not shipments. Hence, for any shipment which was interlined, or passed through a "break-bulk" facility, the average length of haul recorded would understate (often considerably) the true length of haul of the shipment, upon which the rate per ton-mile would be expected to be based. Of all the criticisms made of Sloss' work, the unreliability of the data itself is probably the most critical.

McLachlan's 1972 Paper

The second article to use regression analysis to examine Canadian motor carrier rate levels was that of McLachlan, which appeared in 1972. As McLachlan acknowledged in his paper, his model is "basically similar to that used by J. Sloss" (p. 80) taking the following form:

$$y = k + \sum_i a_i x_i + u$$

where
- y = average revenue per ton-mile
- x_1 = average provincial wage rate per hour
- x_2 = average cost per gallon of fuel (including tax) in each major provincial city
- x_3 = an index of the relative costs of transport in each major provincial city
- x_4 = a dummy variable standing for regulation
- x_5 = average annual license cost for standard, small medium and large trucks
- x_6 = average distance in miles that each ton was carried
- x_7 = average weight carried in tons.

It may be seen that McLachlan's adjustments to Sloss' model were (i) the substitution of the provincial average wage rate in each province for the average trucking industry wage rate (in order to avoid any correlation between the degree of regulation and wage rates); (ii) the substitution of the total purchase price of fuel for the fuel tax; (iii) inclusion of the x_3 variable as a means of making some allowance for such things as different equipment and repair prices and different rents in each of the provinces; and (iv) the inclusion of regulation as a dummy variable, rather than the analysis of residuals. Two other modifications made by McLachlan, of no little significance, were (a) the re-categorization of the provinces, into those that had been "consistently competitive" (Alberta) and those that had been "consistently regulating" (Saskatchewan, Quebec, British Columbia, and Manitoba), (all other provinces being omitted from the analysis); and (b) the use of data covering the years 1957-1963 inclusive, (in contrast to Sloss' exclusion of 1957).

McLachlan's analysis (which was restricted to intraprovincial traffic) yielded insignificant coefficients for the variables x_2 (cost of fuel) and x_5 (licence fees), and these variables were then omitted. The revised equation yielded a coefficient of +2.58 for the dummy variable, indicating that the effect of regulation had been estimated as increasing rates by an average of 2.58 cents per ton-mile.[7]

Many of the criticisms made above of the Sloss paper apply with equal force to McLachlan's. Specifically, these are: (1) the binary classification of regulation; (2) the omission of potentially significant variables such as average shipment size, commodity mix, and so on; (3) the use of distance rather than its inverse; (4) the pooling of cross-section and time series data; and, most importantly, (5) the extreme unreliability of the data.

McLachlan's treatment of regulation differs significantly from that of Sloss. While Sloss recognized the problem of changing regulations during the period of analysis (particularly in Nova Scotia and Ontario), he judged these changes insufficient to warrant the exclusion of those provinces. McLachlan, however, "includes only those provinces which, after careful consideration, were considered to have been consistently competitive or consistenly regulating over a long period" (p. 64). This leads him to exclude from his analysis (alas without further explanation or comment) Ontario and all four Atlantic Provinces. The omission of Ontario (which introduced a requirement for filing of rates during the period of analysis) is particularly unfortunate, since intra-Ontario truck traffic accounts for a large proportion of intra-provincial truck operations in Canada (over 40 per cent in 1973, for example) (Maister, 1976a, p. 10). In addition to this difference from Sloss, McLachlan also chooses a different regulatory criterion, requiring that a province regulate neither entry nor rates to be included as "competitive". Thus, while Sloss classified Quebec as "non-regulated" because it did not in his judgement regulate rates, McLachlan classifies Quebec as regulated. He is thus making a distinction between "no regulation" and some regulation (either entry or entry and rates). It should be noted that Palmer asserts that the difference between Sloss' and McLachlan's classification schemes is between *de facto* and *de jure* regulation (pp.656-657). McLachlan's article does not allow final resolution of this difference of interpretation, thus demonstrating the difficulty of determining exactly what has been demonstrated in the analysis.

Particular attention needs to be drawn to the unreliability of the data that McLachlan uses. The (significant) reservations that were noted about Sloss' use of these data are increased by McLachlan's inclusion of the year 1957. While 1957 data had been available to Sloss, he had deemed it wise to exclude it "Because of the usual reporting and sampling errors associated with a new system of data collection" (p. 332). In addition, McLachlan's "transport cost index," was formed by taking the relevant provincial data for 1969, and working out "their corresponding values from 1957-63 on the assumption that transport costs in each provincial city have moved in line with general price changes there" (McLachlan, p. 72). The validity of this procedure is open to some question.

Palmer's 1973 Paper

In 1973, Palmer published a short article that criticized the models employed by Sloss and McLachlan, and repeated their analyses with some modifications. Palmer's major criticism was the specification of the 'average length of haul' variable, which he argued should be replaced by the inverse of average length of haul in order to present more accurately the true relationship between revenue per ton-mile and distance. He demonstrated that this change was necessary on grounds not only of theory, but also because of the (coincidental) relationship between average length of hauls and whether or not a province regulated its intraprovincial truck traffic.

While arguing that a similar substitution for average weight per vehicle by its inverse was not necessary on theoretical grounds, Palmer decided to test whether such a substitution improved the "fit" of the equation. He also experimented with including an additional variable, average miles per gallon of fuel, "in the hope that it might proxy for differences in terrain and pick up some additional costs" (p. 660). Noting that Sloss and McLachlan differed on the classification of Quebec, Palmer also experimented with each classification. Finally, he used three data sets: all ten provinces; the eight provinces (excluding Newfoundland and Prince Edward Island) used by Sloss; and the five provinces used by McLachlan.

Palmer thus performed 24 separate regression analyses:

2 (with and without miles per gallon)
times 2 (using average weight or its inverse)
times 2 (Quebec as regulating and nonregulating)
times 3 (different data sets)

As a final change, he also included a variable denoting the year to which the data referred. His model thus was:

$$y = \sum_i b_i x_i + u$$

where x_1= the inverse of length of haul
x_2= average weight per vehicle or its inverse

x_3= time
x_4= fuel tax
x_5= license fee
x_6= provincial wage index
x_7= regulation (with and without Quebec)
x_8= miles/gallon of fuel (omitted in half the regressions)

In 18 of the 24 regressions, the dummy variable for regulation proved significant, and the six regressions in which it was not significant were those in which data for Newfoundland and Prince Edward Island (which Sloss had forcibly argued were unreliable) were included. Palmer concluded that "de facto regulation (i.e. treating Quebec as unregulated) generally leads to rates which are about two center higher per ton-mile while de jure regulation (i.e. treating Quebec as regulated) increases rates by somewhere between 0.9 cents and 1.8 cents" (p. 663). However, he concludes his paper on a note of caution, due to the "strange" behavior of his time variable, whose coefficient changed sign depending on the number of provinces included, Palmer suggests that this might be due to differential rates of inflation and innovation between the provinces in the years 1958 to 1963, leading to the conclusion that trucking rates were not entirely cost determined, and the model was thus called into question.

Since Palmer's work is largely a reworking of that of Sloss and McLachlan, it is subject to the same criticisms made of their work. Palmer has made important contributions in the inclusion of the inverse of length of haul, the recognition of the pooling (of cross-section and time series) problem, and in the demonstration of the significant effect that these changes have on the results obtained. However, these modifications do not deal with the major defects of Sloss' and McLachlan's work, and Palmer's results must be treated with many of the same reservations.

Sloss' 1975 Paper

The latest research considered in this paper is that by Sloss, appearing in 1975. Sloss made use of a revised series of data made available by Statistics Canada for the years 1970-72 inclusive, which gave a breakdown of revenues, tons and ton-miles for six commodity groupings,[8] between and within five regions: Quebec, Ontario, British Columbia, the four Atlantic Provinces[9] and the three Prairie Provinces[10] combined. Sloss discarded data relating to two of the commodity groupings and the Atlantic Provinces, on the grounds that their proportion of the traffic was small, and combined the remaining four commodity groups into two "owing to their generally similar shipping characteristics" (p. 12). He then classified the remaining data into the two groups of "regulated" (British Columbia and Quebec) and "non-regulated" (Ontario and the Prairie Provinces), and fitted the following model:

$$y = a + bL + cT + dD + eV + u$$

where

y = average revenue per ton-mile
a = constant
L = length of haul
T = fuel tax per imperial gallon
D = dummy variable distinguishing two commodity groups
V = tons transported per year
u = residual

Using first intraprovincial data only, then extraprovincial data only, Sloss compared the residuals from this equation for the regulated and non-regulated groups. In the intraprovincial analysis, he detected a difference with a significance level of between 20 and 25 per cent, and concluded that this constituted "a relatively weak affirmation of the hypothesis that economic regulation has been responsible for higher intraprovincial trucking changes than would prevail in the absence of regulation" (p. 17). The interprovincial data failed to show any significant difference between the regulated and non-regulated groups.

While this paper represents the first attempt since Sloss' own 1970 paper to employ different data, it unfortunately contains a number of critical problems. First, the treatment of regulation is unacceptable due to the classification of the Prairie Provinces as "non-regulating". Sloss justified this action "on the strength of Alberta's predominance in representing 47 percent of motor truck and truck-tractor registrations" (p. 12). This is a very weak justification for grouping together Alberta with the two provinces that not only regulate rates but prescribe them, and classifying the group as "nonregulating"!

Doubts are also raised by the somewhat arbitrary exclusion of two of the commodity groupings because of their small proportion of total ton-miles, and by the even more arbitrary combination of four commodity groups into two. No explanation is given as to why this modification was necessary. As will be demonstrated below, the principal effect of this combination is to reduce the variance of the dependent variable which will generate a (misleading) higher R^2. In addition, the criterion for combination is a curious one. Sloss combines "Food, feed, beverages and tobacco" with "End products, inedible", and "Crude materials, inedible" with "Fabricated materials, inedible". One cannot agree with his assertion that the commodities in each group have "generally similar shipping characteristics".

The model employed is a very limited one, containing even fewer explanatory variables than his 1970 paper, and it fails to take into account the modification of the length of haul variable recommendation by Palmer. As Sloss himself points out, the reliability of his data is also in question. The data used were the result of a new survey methodology being employed by Statistics Canada (1970, pp. 5-9). While this agency published its 1970 results, the 1971 and 1972 data that Sloss used were never made available to the general public. The explanation for this, and the source of doubts about the validity of using these data, is amply provided in a citation given by Sloss himself (p. 29):

> For three years the Transportation and Communications Division (of Statistics Canada) has been developing a For-Hire Trucking survey designed to provide statistics on the origin and destination of commodity shipments. The results of the 1972 survey represent the final year of developmental study and may be useful to provide an indication of commodity flows movements by the commercial trucking industry in Canada. The results should, however, be used with caution as changes in survey objectives, an improved universe, larger sample size and more effective sample size and more effective sampling procedures preclude year-to-year survey compatibility.

The data that Sloss used clearly were subject to the "usual reporting and sampling errors associated with a new system of data collection" that he claimed were justification to exclude 1957 from his previous analysis, and his results barely significant that they are, must be treated with caution.

ANALYSIS OF 1973 DATA

As noted above, Statistics Canada spend three years (utilizing data from 1970-72) developing a new survey methodology for collecting data on truck traffic flows in Canada. This developmental work was completed in 1975, and led to the publication (in 1976) of the (For-Hire Trucking Survey - 1973), which contained (inter alia) estimates of total revenue, tons and ton-miles for each of six commodity groups, between and within each of the 10 provinces (pp. 24-35).

This data represented a significant improvement in quality over that contained in (Motor Freight Traffic), the series it was designed to replace. The data in the For-Hire Trucking Survey was based on a two-stage sampling scheme in which, first, a sample of carriers was chosen, and, second, a sample of waybills selected from the carriers' files.[11] This methodology improved on that used to generate the data of (Motor Transport Traffic) in (at least) two major ways: the use of the way-bill as the sampling unit, rather than the truck; and the fact that the selection and recording of data was conducted by Statistics Canada personnel, rather than by questionnaire.

The availability of these improved data created the opportunity to replicate the work of Sloss, McLachlan and Palmer. The opportunity was also taken to include in the model explanatory variables ommited in previous research, and to adjust the treatment of regulation.

The Model

The basic model employed in the analysis reported here took the following form:[12]

$$y = a + \sum_i b_i x_i + u_i$$

where
y = average revenue per ton-mile (cents)
x_1= (average length of haul)$^{-1}$
x_2= average shipment size (tons per shipment)
x_3= index of provincial average wage rate (all-Canada average = 100)
x_4= license fee per vehicle($)
x_5= maximum weight limitation on provincial highways (Thousands of pounds)
x_6= fuel tax per gallon of diesel (cents)
x_7= provincial sales tax (percent)
x_8= 1 if rates are prescribed by any regulatory agency, 0 if not
x_9= 1 if rate increases are subject to the approval of any regulatory agency, 0 if not
x_{10}= 1 if rate filing is not required by any regulatory agency, 0 if it is.

In addition to these variables, the following variables were included in the appropriate analyses:

x_{11}= 1 if commodity 1, 0 if not
x_{12}= 1 if commodity 2, 0 if not
x_{13}= 1 if commodity 3, 0 if not
x_{14}= 1 if commodity 4, 0 if not
x_{15}= 1 if commodity 5, 0 if not

The dependent variable was formed by dividing estimated total revenues in each lane by estimated total ton-miles in each lane, the average length of haul by dividing estimated total ton-miles by estimated tons and the average shipment size by dividing estimated total tons by estimated total number of shipments.[13] This latter variable was provided by Statistics Canada upon special request, and does not appear in the (For-Hire Trucking Survey).

The data sources for variables x_3, x_4, x_5, x_6 and x_7 are discussed in the Appendix. It should be noted that, in each case, the available data for these variables was given by province. Further processing of the data was necessary to arrive at applicable values for interprovincial movements, and the reader's attention is drawn to the assumptions made in performing this processing.[14]

Some comments here on these variables is in order. In order to disentangle the effects of license fees and maximum weight limitations (i.e. to avoid the problem of high license costs due to high weight limitations), license fees for the same gross vehcile weight of 72,000 pounds was used for all provinces. The fuel tax was used, rather than fuel purchase price (including tax), (which would probably be preferable) because of the unavailability of data for the latter variable. However, there is reason to believe that this should not affect the results too greatly, particularly in the light of McLachlan's analysis in which the purchase price for fuel proved insignificant. The inclusion of the provincial sales tax as a explanatory variable was suggested by a number of trucking industry personnel contacted in the course of this research. This tax is applicable on the purchase price of trucks, and applies to all trucks operating in a given province, whether the truck was purchased in that province or not. However, as noted in the Appendix, a pro-rating system for sales tax exists, based on number of miles travelled in each province.

The treatment of regulation in the model differs sharply from previous research. An attempt has been made to distinguish (by the use of three dummy variables) between four categories of regulation: (1) Prescribed rates; (2) Rate increases subject to approval; (3) rate filing required without regulatory power to approve or disapprove; and (4) no rate filing required. It should be noted that the fourth category relates only to intra-Alberta traffic, and thus is compounded with the absence of entry controls. Variable x_{10} should therefore be carefully interpreted as measuring the difference between no regulation (of either rates or entry) and the base case (entry controls, rate filing but no regulatory power to disallow).

In order to test the effect of this treatment of regulation, all analysis reported in this paper were repeated using a different specification: omitting variables x_8, x_9 and x_{10} from the model and substituting

x_{16} = 1 if rates are prescribed or rate increases subject to approval;
= 0 if not.

The regulatory classification of each province was accomplished using the information presented in Table 1, with the exception that Newfoundland was treated as requiring only rate filing in 1973, and not exercising its power to disallow rate increases (either on intra-provincial or extraprovincial traffic). This adjustment was made in response to assurances by various trucking industry personnel that such was the situation prevailing in 1973. No disagreement on this point has been encountered. It should be also noted that, by 1973, Quebec had begun to enforce its powers to disallow rate increases on intraprovincial and extraprovincial traffic, and the uncertainty about Quebec's regulatory status that existed for Sloss and McLachlan did not exist in 1973.

It is clear that the regulatory formulation employed in this paper is far from perfect. The problems of recognizing regulatory tools apart from entry and rates, and the potential impact of varying degrees of regulatory enforcement, have not been dealt with, largely because a methodology for measuring these variables does not currently exist. However, it was felt that it would be worthwhile to proceed with the analysis: at the least, the analysis would allow the effects on the results of previous research of improved data and model respecification to be traced.

Analyses

As noted above, the (For-Hire Survey - 1973) contained tables giving the revenues, tons and ton-miles between and within each of the ten provinces for six commodity groupings. The groupings are shown on Table 4, together with the percentage of total revenues, tons and ton-miles, and the (national) average revenue per ton-mile. It should be noted that the availability of data for six commodity groupings allows the model to be fitted to three sets of data: (1) each of the six commodity groups individually; (2) the complete data set utilizing dummy variables to distinguish between the data relating to each commodity group; and (3) the aggregate of all traffic in each lane (i.e. summing the revenue, tons and ton-miles within each lane). In what follows, each of these approaches is employed and discussed. We shall defer detailed discussion of the results until they have all been presented.

In conducting the analysis, there was some a priori doubt whether data relating to the Atlantic Provinces should be included. This doubt stemmed from three sources: (1) the existence of the Maritimes Freight Rate Act, and the consequent lack of homogeneity between data relating to the Atlantic Provinces and other provinces; (2) the large number of missing observations for interprovincial movements involving the Atlantic Provinces; and (3) the fact that the sampling errors reported by Statistics Canada for interprovincial flows involving the Atlantic Provinces were consistently higher than those involving other provinces. It was therefore decided to exclude the Atlantic Provinces from the analysis.[15]

TABLE 4
CLASSIFICATION OF COMMODITY GROUPINGS

Group #	Description	Percent of Revenue	Percent of Tons	Percent of Ton-Mile	National Average Revenue Per Ton-Mile
I	Live Animals	1.2	1.2	1.2	6.113
II	Food, feed, beverages and Tobacco	16.9	14.2	17.7	5.627
III	Crude Materials, inedible	5.3	18.2	10.9	2.877
IV	Fabricated Materials, inedible	39.2	51.3	49.5	4.674
V	End Products, inedible	34.8	13.7	19.0	10.877
VI	General, or Unclassified	2.6	1.4	1.8	8.454

The model was first applied to each commodity group. In Principle, there should be 36 observations (6 provinces x 6 provinces) in each these analysis. However, some province-to-province lanes have either insignificant levels of, or no, traffic for individual commodity groups, and the number of observations is correspondingly reduced.

The results of the regression, using both of the regulatory formulations discussed above are presented in Table 5. It may be seen that the fit of the model is variable, the R^2 ranging from 0.41 to 0.72. No single variable has a significant coefficient for all commodity groups and in no commodity group are more than two of the independent variables significant. In no model are the regulatory dummies significant.[16]

The model was then applied to the combined data set, with five dummy variables introduced to distinguish between observations from each commodity group. It should be noted that this procedure is valid only under the assumption that the six subsets of the combined data do indeed belong to the same structure (i.e. are generated by the same model.). The statistical test for this assumption[17] has not been performed, and the analysis presented here should be treated with caution. The results of the analysis are shown in Table 6, where it may be seen that neither regulatory formulation proves significant. Apart from the inverse of distance, average shipment size, and four of the five commodity dummies, no other variable proves significant in both models.

In order to test whether the lack of significance for the explanatory variables was due to errors in the estimating of their interprovincial values (i.e. the assumptions described in the appendix), the model was fitted to intraprovincial data alone, again combining the six commodity groups. The result of this analysis is shown in Table 7. It may be seen that labour cost, license fee, maximum weights, fuel tax and sales tax all continued to be insignificant, thus discrediting the hypothesis that the lack of significance was due to errors in the interprovincial scaling of the variables.

The final step in the analysis was to apply the model to the summarized data, i.e. that in which the total (all commodity) revenues, tons and ton-miles were first calculated. In order to retain some measure of the variability of commodity mix between province-to-province lanes, an additional "commodity mix" (x_{17}) variable was added to the model. This variable was calculated as follows. First, for each lane, the percentage of tons in each commodity group was calculated. A weighted average of these percentages was then created, using the national average revenue per ton-mile for each commodity group as the weights. Finally, the weighted averages were divided by the national average rate per ton-mile for all commodities, thus creating an index. The higher the value of this variable, the higher the proportion of traffic on the given lane that has high national rates (i.e. ignoring interprovincial variations).[18] The results of applying the modified model to the summarized data are shown in Table 8.

TABLE 5
REGRESSION RESULTS, SINGLE COMMODITY GROUP DATA

Commodity Group	ONE		TWO		THREE		FOUR		FIVE		SIX	
Number of Regulatory Dummies	1	3	1	3	1	3	1	3	1	3	1	3
Number of OBS.	27	27	36	36	35	35	36	36	35	35	33	33
S.E. (Y)	5.67	5.67	2.94	2.94	2.36	2.36	1.47	1.47	4.29	4.29	7.90	7.90
S.E. ($\hat{Y}$)	4.05	4.24	1.83	1.84	1.88	1.92	1.29	1.31	3.48	3.46	6.16	6.25
F Test Value for Regulation	0.55	0.30	0.63	0.81	2.45	1.12	0.66	0.58	0.25	0.51	0.05	0.47
COEFFICIENTS AND STANDARD ERRORS												
Constant	-32.2	-31.8	23.0	9.95	1.68	13.0	-9.12	-3.72	-20.2	-48.5	-1.75	23.5
$(\text{Distance})^{-1}$ $(\text{miles})^{-1}$	886* (413)	916* (453)	766* (200)	400 408	136 (175)	243 (217)	-107 (245)	-236 (444)	1330* (539)	632 (1340)	810 (462)	1190 a (573)
Shipment size (tons)	-0.293 (0.178)	-0.294 (0.186)	-0.172* (0.083)	-0.163 (0.084)	-0.222* (0.049)	-0.233* (0.052)	0.015 (0.024)	0.026 (0.030)	-.487 (.469)	-.221 (0.677)	-.481 (.275)	-.490 (.280)
Labor cost (index)	3.55 (3.24)	3.56 (3.65)	-1.35 (1.07)	-1.46 (1.15)	0.365 (0.203)	-2.27 (1.24)	-0.940 (0.777)	-1.34 (0.878)	0.048 (0.040)	0.084 (0.052)	-3.74 (3.43)	-4.56 (3.91)
Licence fee ($100)	0.098 (0.169)	0.076 (0.180)	0.016 (0.062)	0.031 (0.063)	0.114 (0.060)	0.092 (0.066)	0.028 (0.051)	0.020 (0.050)	0.068 (0.114)	0.092 (0.109)	-0.179 (0.214)	-.221 (.220)
Maximum weight (pounds)	0.082 (0.656)	0.056 (0.743)	-0.068 (0.179)	0.154 (0.312)	0.365 (0.203)	0.258 (0.233)	0.322* (0.149)	0.335 (0.243)	0.437 (0.400)	0.817 (0.619)	0.688 (0.514)	0.467 (0.579)
Fuel tax (cents)	-0.336 (0.724)	-0.126 (0.940)	-0.063 (0.295)	-0.190 (0.371)	-0.222 (0.303)	-0.237 (0.389)	-0.048 (0.209)	-0.232 (0.275)	-0.297 (0.531)	0.001 (0.010)	0.190 (1.06)	0.268 (1.30)
Sales tax (per cent)	0.513 (1.200)	-.041 (1.86)	0.126 (0.487)	0.286 (0.771)	-0.084 (0.496)	-0.021 (0.746)	-0.242 (0.355)	0.132 (0.275)	0.096 (1.00)	-1.05 (0.898)	-.650 (1.64)	-1.19 (2.50)
Rate Regulation	-1.82 (2.44)		0.794 (0.989)		-1.48 (0.965)		0.726 (0.925)		-1.01 (1.98)		0.709 (3.24)	
Rate Prescription		-2.58 (4.19)		1.73 (3.32)		-3.00 (1.83)		0.954 (2.42)		3.39 (6.90)		-4.91 (6.34)
Rate Approval		-.884 (3.07)		0.16 (1.12)		-0.804 (1.22)		0.863 (0.949)		-1.52 (2.12)		3.08 (3.86)
No Rate Filing, No Entry Regulation		-3.59 (6.89)		3.22 (2.98)		-0.601 (3.35)		2.45 (2.48)		-2.69 (6.02)		-6.00 (10.6)
R^2	0.65	0.66	0.70	0.72	0.51	0.53	0.41	0.43	0.50	0.52	0.54	0.57

*Indicates significant coefficient

TABLE 6
REGRESSION RESULTS, COMBINED DATA

	SINGLE REGULATION DUMMY		THREE REGULATION DUMMY	
	Coefficient	Standard Error	Coefficient	Standard Error
Constant	-2.25		0.499	
$(\text{Distance})^{-1}$	688*	137	752*	159
Shipment Size	-0.145*	0.035	-0.146*	0.035
Labor Cost	-1.25	0.878	-1.27	0.982
Licence Fee	0.034	0.056	0.021	0.052
Max. Wt.	0.348*	0.150	0.300	0.171
Fuel Tax	-0.108	0.247	0.005	0.305
Sales Tax	-0.076	0.403	-0.354	0.595
Commodity 1 dummy	-3.59*	0.978	-3.61*	.868
Commodity 2 dummy	-4.30*	0.899	-4.26*	.772
Commodity 3 dummy	-5.11*	0.929	-5.13*	.813
.Commodity 4 dummy	-5.41*	0.911	-5.38*	.787
Commodity 5 dummy	-0.054	0.906	-0.00	0.000
Rate Regulation	-0.657	0.812		
Rate Prescription			-1.56	1.54
Rate Approval			-0.161	0.939
No Rate Filing, No Entry Regulation			-2.26	2.45
Number of observations	202		202	
S.E. (Y)	5.16		5.16	
S.E. ($\hat{Y}$)	3.70		3.69	
R^2	0.52		0.52	
F Test Value for Regulation	0.01		0.01	

TABLE 7
REGRESSION RESULTS, INTRAPROVINCIAL DATA ONLY

	SINGLE REGULATION DUMMY		THREE REGULATION DUMMY	
	Coefficient	Standard Error	Coefficient	Standard Error
Constant	152		26.8	
$(\text{Distance})^{-1}$	1380*	284	1380*	284
Shipment Size	0.014	0.055	0.014	0.055
Labor Cost	-9.92	7.90	-8.85	6.22
Licence Fee	-.964	0.636	-1.44	1.00
Max. Wt.	0.000	0.000	0.000	0.000
Fuel Tax	-2.14	1.93	-0.265	0.678
Sales Tax	4.60	3.81	2.82	2.44
Commodity 1 dummy	-8.59*	2.35	-8.59*	2.35
Commodity 2 dummy	-7.10*	2.25	-7.10*	2.25
Commodity 3 dummy	-14.6*	2.39	-14.6*	2.39
Commodity 4 dummy	-11.7*	2.55	-11.7*	2.55
Commodity 5 dummy	-0.067	2.27	-0.067	2.27
Rate Regulation	-16.5	13.8		
Rate Prescription			-6.45	6.18
Rate Approval			-17.70	14.80
No Rate Filing, No Entry Regulation			0.00	0.00
Number of observations	36		36	
S.E.(Y)	7.37		7.37	
S.E. (Y)	3.89		3.89	
R^2	0.82		0.82	
F Test Value for Regulation	0.44		0.44	

*Denotes significant coefficient

TABLE 8
REGRESSION RESULTS, SUMMARIZED DATA

	SINGLE REGULATION DUMMY		THREE REGULATION DUMMY	
	Coefficient	Standard Error	Coefficient	Standard Error
Constant	-19.1		-26.7	
$(\text{Distance})^{-1}$	493*	121	341	271
Shipment Size	0.151*	0.074	-0.108	0.105
Commodity Index	0.038*	0.013	0.040*	0.014
Labor Cost	-0.002	0.005	-0.001	0.005
Licence Fee	0.000	0.000	0.001	0.000
Max. Wt.	0.310*	0.095	0.399*	0.155
Fuel Tax	-0.001	0.001	-0.001	0.002
Sales Tax	-0.001	0.002	-0.003	0.003
Rate Regulation	-1.10*	0.48		
Rate Prescription			0.028	1.67
Rate Approval			-1.17*	0.51
No Rate Filing, No Entry Regulation			0.072	1.58
Number of observations	36		36	
S.E. (Y)	1.48		1.48	
S.E. (Y)	0.80		0.82	
R^2	0.78		0.79	
F Test Value for Regulation	5.29*		1.86	

*Denotes significant value

The overall fit of this model is quite good ($R^2 = 0.78$), although there is little stability between the two models in the variables which prove significant. In the one-regulatory-dummy model, a significant coefficient for regulation is obtained, with a negative coefficient, i.e. suggesting that regulation reduces rates by 1.1 cents per ton-mile! This conclusion fails to hold, however, for the 3-regulatory dummy model. While one of the 3-regulatory dummies has a coefficient that is in excess of twice its standard error, the F test value for the three dummies together is not significant.

Upon inspection of the correlation matrix for the independent variables (Table 9), an explanation of these results is found, since there appears to be a high degree of correlation among the explanatory variables (maximum weight, but are also correlated with the regulatory dummies. In part, the multicollinearity among the explanatory variables may be due to the precedures used to generate their interprovincial values. However, the correlation matrix generated by the intraprovincial values alone (Table 10) exhibits a similar pattern of high intercorrelation.[19]

The normal procedure when faced with such multicollinearity among the independent variables is to omit one or more of them. However, such a procedure would be inappropriate here, since we are engaged not in a model-fitting task, but in an attempt to measure the effects of a single source of variation--the existence (or degree) of regulation. Even if we were to omit, say maximum weight and sales tax from the analysis, and a significant coefficient for the regulatory dummies appeared, this would not constitute firm evidence that regulation affected rates.[20] Rather, it might be the case that the regulatory variable was significant only because it explained variation in rates due to the (omitted) maximum weights and sales taxes. In such a situation, one can only conclude that the effect of regulation is obscured, and no firm statement may be made. It is of some interest, however, to note that the computer program used to estimate the coefficients of the models reported employed a stepwise criterion to add variables to the model one at a time (although not to choose the final model). In no case did a regulatory dummy "enter the equation" with a significant coefficient and then become insignificant with the addition of the other variables. This suggests that there is no strong regulatory effect on rates.

CONCLUSIONS

It is of significance that the only model in which a significant coefficient for the regulatory variable(s) was obtained was that which most closely approximated the model employed by previous researchers, i.e. that which utilized a single regulatory dummy and also used aggregate (all commodity) traffic flows. (Table 8). Each of these two conditions involves a process of aggregation, and hence an obscuring of the detail of reality. The single regulatory dummy obscures the different forms of regulation that exist in Canada,

TABLE 9
CORRELATION MATRIX, INTRAPROVINCIAL AND INTERPROVINCIAL DATA

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{16}
1. $(\text{Distance})^{-1}$											
2. Shipment Size	-.60*										
3. Labor Cost	-.15	.08									
4. Licence Fee	-.36*	-.14	.05								
5. Max. Wt.	.61*	.51*	0.14	0.07							
6. Fuel Tax	-.07	.09	-.12	.46*							
7. Sales Tax	-.03	.11	.07	.52*	.58*	.88*					
8. Rate Prescript.	.51*	-.07	-.42*	-.16	-.00	-.07	-.02				
9. Rate Approval	-.07	-.04	.19	.68*	.42*	.47*	.52*	-.17			
10. No Rate Filing	.29	.02	-.03	-.20	-.10	-.27	-.53*	-.04	-.12		
16. Rate Regulation	.18	-.07	-.01	.58*	.41*	.43*	.49*	.30	.89*	-.13	
17. Commodity Index	-.55*	-.60*	.07	.38*	-.25	.25	.20	-.21	.21	-.16	.10

TABLE 10
CORRELATION MATRIX, INTRAPROVINCIAL VALUES ONLY

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
1. $(\text{Distance})^{-1}$										
2. Shipment Size	.06									
3. Labor Cost	-.21	.19								
4. Licence Fee	.15	.34*	-.19							
5. Max. Wt.	.34*	.19	.53*	.00						
6. Fuel Tax	.50*	.29	-.10	.67*	.63*					
7. Sales Tax	.37*	.19	.14	.39*	.80*	.81*				
8. Rate Prescript.	.02	-.23	-.83*	.14	-.54*	-.07	.00			
9. Rate Approval	.09	-.05	.62*	-.59*	.78*	.04	.42*	-.50*		
10. No Rate Filing	-.18	-.07	-.04	-.31	-.53*	-.52*	-.89*	-.32	-.32	
16. Rate Regulation	.11	-.28	-.21	-.44*	.24	-.04	.42*	.50*	-.63*	

while the use of aggregate traffic flows (and hence rates) obscures the true variability of the dependent variable. This latter point is amply demonstrated by the fact that the standard deviation of the dependent variable in the aggregate traffic flow model (Table 8) was 1.48 cents per ton-mile, while the standard deviation of rates between and among different commodity groups and provinces (Table 6) was 5.16 cents per ton-mile. Since the significance of a binary classification of data (such as the use of a single regulatory dummy) is determined by comparing the 'between groups' variance to the 'within groups' variance, a reduction of the total variance through a process of averaging (such as the use of aggregate traffic flows) can yield a 'significant' difference that is due merely to the suppression of the within group variance. It is for this reason that the results of the model shown in Table 8 (and those of previous researchers) should be treated with extreme caution. It is also for this reason that little importance is attached in these conclusions to the negative coefficient for regulation appearing in Table 8.

Because of the effects of aggregation, it is clear that particular attention should be given to the most disaggregated data employed; i.e. to the results shown in Table 5. Not only were the rate regulation dummies insignificant, but the lack of significance of the "no rate filing" dummy in these (and all other) analyses tells us something about the effects of entry regulation, since this dummy represents a single observation: intra-Alberta. Hence, there appears to be no significant difference between rates in a free entry, no rate filing environment from those in an entry regulated, filed rate environment. Apart from the lack of significance of the regulatory dummies (an important conclusion), it is interesting to note the lack of stability in which of the other variables appear as significant. In part, this is due to the multicollinearity that exists among the explanatory variables. As noted above, the results shown in Table 5 were obtained using a step-wise regression program, and two conclusions may be drawn from examination of the order in which the variables entered the equation. First, in no case did regulation enter the equation with a significant coefficient only to "lose" this significance with the addition of further variables. Second, this did occur in a number of models to the inverse of distance and average shipment size variables. This suggests that we may draw the general conclusion that the three dominating influences on rates are distance, average shipment size and commodity mix, a conclusion supported by the results of Tables 6, 7 and 8.

A further comment on the multicollinearity of the explanatory variables is in order. As may be seen in Tables 9 and 10, significant multicollinearity exists between the regulatory dummies and the other explanatory variables. Careful examination of Table 10 (which uses only intraprovincial data and hence avoids any collinearity due to the estimation technique employed for interprovincial values) shows that this problem is greater for the three regulatory dummies (taken together) than for the single regulatory dummy. That this should be so is not surprising.

If one is to ignore the Atlantic Provinces, as there is very justification for so doing, then there are only six provinces and twelve regulatory structures (intraprovincial and extraprovincial for each province) left to consider. The use of three regulatory dummies to distinguish four categories of regulation results in categories that include only one or two provinces (no rate filing and rate prescription respectively), which clearly creates problems in the confounding of the regulatory status and the other non-homogeneities between the provinces. The use of data from a set of different commodity groups does not solve this problem, since within a given province-to-province lane, the values of the regulatory variable and such variables as labor cost, maximum weight, sales tax, and so on, are all constant from one commodity group to another. Similarly, if the inflation rate across Canada is constant, then data from separate years will differ only by a constant ratio and will also fail to solve this problem. (If the inflation rate is not constant, then this creates problems of its own, as was discussed above).

It would appear, therefore, that in attempting to use the Canadian situation to measure the effect of regulation, one is forced either to employ a single regulatory criterion (i.e. to group together disparate regulatory structures) or to specify a model that accounts for all the non-homogeneities between the provinces that may be expected to have an effect on rates. This is the problem of model specification to which we now turn.

The number of factors that it may be reasonable to include in any model is clearly large, and the model employed in this paper shares with those of previous researchers the fault that it excludes a number of potentially significant variables (e.g. the mix of common and contract carriage).[21] As has just been noted, this problem (which exists for nearly all attempts to use regression analysis), is particularly acute in this situation, because of the relatively small number of provinces (and hence regulatory structures) between which we are trying to distinguish.

There is, however, an even more crucial problem of model contruction. Even if a "complete" set of explanatory variables were available, there is strong justification to believe that many of them should not be included in the model because of their possible interaction with the regulatory variable. Apart from the previously noted use of provincial rather than trucking industry wage rates, to avoid any interaction between labor costs and regulation, interactions may be hypothesized to exist between regulation and any of the following: length of haul, common/contract mix, extent of empty backhaul, average shipment size, and a host of cost variables.[22] Whether or not such relationships exist, the existence of an a priori hypothesis concerning these interactions makes model specification an extremely difficult, if not impossible, task.

In the light of these comments, and the preceding discussion, the ultimate conclusions of this paper must be that: (1) little confidence can be held in the results of previous attempts to apply regression techniques to detect the effect of regulation in Canada;

(2) applying these techniques to more recent (and reliable) data suggest that there is no strong relationship between rate regulation and the level of trucking rates in Canada, although because of multicollinearity and omitted variables this cannot be considered a definitive conclusion; (3) there is weak, but suggestive, evidence that there is no significant effect of entry regulation on rates; and, finally, that the problems associated with the application of regression techniques to this problem are numerous and complex, and that all such applications should be examined and interpreted with the utmost care and attention.

APPENDIX: INTERPROVINCIAL VALUES OF THE EXPLANATORY VARIABLES

When attempting to apply a model such as that described in the paper to interprovincial data, one encounters the problem that statistics for some of the variables are available only on a provincial basis. This Appendix describes the processing of data that was performed to arrive at interprovincial values.

Data on labour costs were obtained from Canada. Statistics Canada, Employment, earnings and hours. The two major portions of labour cost are driver's wages and terminal labour. On interprovincial truck movements, a driver will normally receive the highest provincial rate of the provinces through which he drives. Terminal labour of course receives the appropriate provincial rate. The mix of driver and terminal labour will vary with the proportion of Truckload/Less than Truckload movements, and will thus vary on a lane-by-lane basis. Incorporating this will, however, cause the labour cost variable to be highly correlated with the average shipment size variable, and it was thus decided to base the calculation of labour cost for interprovincial movements on the terminal labour alone, which led to the use of 50 percent of cost in province of origin plus 50 percent of cost in province of destination.

Data on licence fees were obtained from Canada. Statistics Canada, Principal taxes and rates. Appropriate values for interprovincial movements had to take into account the prevailing reciprocity and pro-rate agreements between provinces. No single source was available (or perhaps exists) on this topic, and information on these agreements was obtained from industry personnel from carriers and carrier associations. Among the six provinces outside the Atlantic Provinces, only Quebec requires provinces, a fixed rate of $10 per registered ton for out-of-province trucks applies. This figure was used, also taking into account the opportunity to reduce the total licence fees payable by changing the 'home province'. Thus on a move from A to B, passing through C and D, the lowest home province rate was taken plus $10 per registered ton for each of the other three provinces. To avoid compounding this variable with maximum size and weight limits, a standard truck of 72,000 pounds was used. Full reciprocity was assured among Quebec and the Atlantic Provinces.

Maximum weight limitations were obtained from American Trucking Associations, Inc., and the appropriate interprovincial value taken as the lowest of any province on the route.

The Fuel Tax and Sales Tax data were found in Canada. Statistics Canada, Principal taxes and rates, and were pro-rated between provinces on the route by the proportion of the total trip miles spent in each province, in accordance with prevailing pro-rate agreements. Miles were calculated between the major city of each province, by the Trans-Canada Highway route.

NOTES

1. Throughout this paper, the term "extraprovincial" refers to the sum of "interprovincial" and "international" operations.

2. The operations of a bus company in Newfoundland.

3. The best reference for a clause-by-clause analysis of provincial regulations is Feltham (1969), although this work is somewhat out of date.

4. The term "Maritime Provinces" normally applies to the provinces of New Brunswick, Nova Scotia and Prince Edward Island. After Newfoundland joined the Dominion of Canada in 1961, the Maritime Freight Rates Act was extended to include Newfoundland.

5. D.L. McLachlan, personal communication.

6. This explanation of the negative coefficient of the average license fee variable was suggested by Sloss to Palmer. See Palmer, (1973), p. 663.

7. McLachlan's article also contains an analysis of the effect of regulation on the level of profits and the extent of private trucking. These analyses are outside the scope of this paper.

8. (I) Live Animals; (II) Food, feed, beverages and tobacco; (III) Crude materials, inedible; (IV) Fabricated materials, inedible; (V) End products, inedible; (VI) General or unclassified freight.

9. Nova Scotia, New Brunswick, Prince Edward Island and Newfoundland.

10. Alberta, Saskatchewan and Manitoba.

11. The sampling universe excluded all carriers earning less than $100,000 annually, local carriers and carriers domiciled outside Canada (Canada: Statistics Canada, 1973, p. 8).

12. Other variables included by previous researchers were excluded here solely because of the lack of available data. Two additional variables were considered: The traffic volume (measured in tons) and the balance of traffic (originating tons divided by terminating tons) in any lane. The first was excluded because the relationship between rates and volume may be either a supply or demand one, and it is not possible to disentangle these two efforts. Traffic balance was excluded on the grounds that no

values for intraprovincial traffic could be calculated, and because previous analysis (Maister, 1976_b_) had shown this variable to be only slightly correlated with rates.

13. It should be noted that this procedure will not necessarily yield true averages, since it involves division of an estimated total by an estimated total.

14. It is unclear whether Sloss (1975) makes any adjustments to his independent variables in performing an analysis of interprovincial data, since he provides no explanation of how he dealt with this problem.

15. In fact, all the analyses shown here _were_ duplicated including data from all 10 provinces, the model including a dummy variable to denote traffic originating or terminating in the Atlantic Provinces. While changes in the coefficients occurred, none of the conclusions of this paper were affected.

16. In order to test whether the regulatory dummies would become significant in the absence of the other non-significant variables, "step-down" step-wise regression was employed to each of the analyses reported in this paper until all coefficients were significant. In no case did a regulatory variable prove significant where it was not in the full equation.

17. The appropriate test for the compatability of _two_ subsets of data is given by Chow (1960). I am not aware of any test for the compatability of six subsets of data, and hence it is necessary to perform ${}^6C_2 = 15$ pairwise comparisons. Since such a procedure would not affect the conclusions of this paper even if adverse results were obtained, this analysis has not been performed here. It may be noted in passing that Sloss (1975) does not test for compatability of subsets.

18. For further discussion of this procedure, and the results for each case, see Maister, 1976_b_, pp. 6-7.

19. Except for the problem of missing values, Table 9 is the correlation matrix for the analyses shown in Tables 5, 6 and 8. Table 10 is the correlation matrix for the analysis shown in Table 7.

20. In fact, this procedure was followed for the analysis reported in Table 8. The single regulatory dummy did not become significant, but in the three-regulatory-dummy model, "rate prescription" had a significant coefficient of -1.98 cents a ton-mile and "no rate filing" had a coefficient of -2.78 cents a ton-mile.

21. Of particular concern is the absence of "average weight per loaded vehicle" which, as discussed in the text, is a (albeit poor) surrogate for the level of service provided. Another potential fault of all the

models is, of course, the use of rate per ton-mile as the dependent variable. The problems associated with using ton-miles as a measure of output are well known.

22. The extent to this problem was drawn to my attention by Professor D. L. McLachlan.

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THE NEED FOR REDEFINING THE ICC COMMERCIAL ZONE: THE CASE OF PHILADELPHIA

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INTRODUCTION

Section 203(b)(8) of the Motor Carrier Act of 1935 delineates that the movements of certain flows within a certain area including and adjacent to a municipality (in practice known as a commercial zone) are exempt from the provisions of the Act. The main purpose of this section was to eliminate regulations over traffic that is inherently local in nature, despite the fact that state boundaries are sometimes crossed. In addition, since a very large amount of trucking activity is intracity in nature (DOT statistics for 1972 show more revenue being generated by intracity than intercity truck traffic), the exemption from Interstate Commerce Commission regulation was also designed to relieve the administrative burden on the regulatory agency.

In layman's terms the commercial zone concept yields an area free of federal regulation for shipments that both originate and terminate in the zone. As such, it is a microcosm that may contain results of behavior under deregulation that may be generalizable to larger areas. This is particularly relevant in the context of the current deregulatory pressures being brought to bear on trucking by such things as the administration's Motor Carrier Reform Act of 1975. In addition, since commercial zones and motor carrier terminal areas are treated as one entity, expansion of the commercial zone results in de facto entry into long haul markets by certificated carriers previously precluded from providing service.

The remarks addressed herein refer primarily to the commercial zone as defined specifically for Philadelphia. The commercial zone for Philadelphia is interesting in two respects. First, it entails portions of two states (Pennsylvania and New Jersey) and thus involves unregulated, interstate shipments (that normally would be federally regulated). Second, the commercial zone of Philadelphia has been defined specifically by the ICC. The Motor Carrier Act of 1935 did not prescribe how commercial zones were to be established and the commission was allowed to make its own determination. The commission did so by defining a general population-mileage formula (where higher base population means a larger zone) and, in certain cases, specific boundaries for some cities (43 cities prior to the recent rule making).

In the case of the population-mileage formula, the commercial zone is somewhat flexible over time. Although the population-mileage formula is a step function (with some broad steps), it is possible for a growing city to have an automatically growing commercial zone. In the case of a specifically defined city, e.g., Philadelphia, such built-in growth is not possible, nor is such growth possible when the top step is reached.

It is possible to petition the commission for an expansion of a zone beyond its defined or population-mileage size. Between 1935 and 1970, there were 118 such cases presented to the commission. Ninety-two of the cases were approved (although not all to the degree asked for by the proponents), 21 were denied, and five cases were dismissed (see Spanton 1972). With a success rate of almost 80 percent, one might expect that the expansion of a commercial zone would be a fairly easy task. This is a mistake commonly made by some careless researchers and used by the commission itself when citing its liberality with respect to its regulation over rates, entry, exit, etc.

To show the problems involved with merely looking at the success rate of cases in front of the commission, consider the case of railroad abandonments. In recent years the commission's acceptance rate in rail abandonment cases has been 98 percent (Allen 1974). However, at the same time many "solutions" to the railroad "crisis" have significant abandonment playing a major role in railroad restructuring. Indeed, the trustees of the Penn Central once proposed a plan to abandon 9,000 of their 20,000 mile system. Based on the commission's acceptance rate, it would appear that exit from the rail industry would be easily accomplished.

What has happened, of course, is that the railroads have moved significantly up the learning curve, and since abandonments which require hearings are time consuming and costly to pursue, the carriers have determined which cases the commission is likely to approve and have submitted only those cases. The denied cases represent miscalculations on the part of the carriers or submissions designed to increase the knowledge of the carriers (e.g., effects of a change in constituency of the commission, etc.). If such a test case is approved, presumably a whole new set of cases will be submitted to the commission.

Thus, the commission's acceptance rate does not show the cases desired but not submitted. Cases are not submitted when one is fairly sure that one will lose. The cost, time, and low probability of success will eliminate such submissions to the commission. A similar situation has frustrated groups who have been interested in the expansion of the Philadelphia commercial zone. The ground rules that the commission has apparently adopted (as inferred from the 118 cases and divided into various time periods) are documented by Spanton.

The specific questions to be addressed herein refer to the impact of the commercial zone on the industrial process, the impact of expansion of the zone (such expansion is suggested in the recent ICC rule making procedure: Commercial Zones and Terminal Areas, Ex Parte No. MC-37 [Sub. No. 26], July 14, 1975, approved by the commission on

December 17, 1976, and now awaiting a court appeal), and the appropriate way to define a zone. All of the questions will be developed in the Philadelphia context.

BACKGROUND

The boundaries of the initial commercial zones were to "conform as closely as possible to the needs and facts of the involved urban area, giving due regard to the practical administration of the exemption" (U.S. ICC, 1976, p. 134). The commission also describes its determination of commercial zones as being recognition of economic fact, not creations of the commission. Thus, the Philadelphia zone, which was initially defined in 1939 and changed only twice since then (almost immediately with the adoption of the six New Jersey communities and more recently [1964] with the addition of a portion [458 acres] of the Fort Washington industrial park), represents the "economic facts."

Several items are worthy of noting here. To the extent that the industrial, wholesale, and retail processes are influenced by transport in their location decisions and to the extent that being in the commercial zone conveys certain transportation advantages (to be outlined below; see Yaseen, 1966), the commission's definition of economic fact, while valid for the initial determination of a zone, becomes a self-fulfilling prophecy. The zonal boundary would create a border beyond which it would be disadvantageous to locate _ceteris paribus_. Thus, this interdependence between location and commercial zone must be recognized; and the commission, in responding to economic fact in a case today, must recognize that it had a hand in forming that economic fact.

Of course, there are many non-transport items that influence the location decision--e.g., taxes, amenities, property cost, promotion, labor costs and availability, power costs and availability, agglomeration economies, proximity to raw materials, proximity to the market, etc. Because some of these items hold greater advantages for some entrepreneurs outside _vis-a-vis_ inside the zone, some economic activity has located outside the zone since the commission's initial definition. Thus, to some extent, the suburbanization process that the country is observing todays occurs in spite of the commission, i.e., employment moves out when the net benefits of the outlying areas exceed the net benefits of the artifically created zone.

A second, but related, item covers the commission's general tendency to reward economic continuity. The commission seems to be saying that solid areas of economic activity are good. This attitude is being promoted at a time when the nation has become vitally aware of its environment, and localities are embarked on a policy of some land use planning and land use control--all of which may preclude contiguous economic development. If good planning requires open space, but commercial zones require continuous development, then a conflict may exist between planning and commercial zone expansion.

The current (prior to the pending expansion) population-mileage formula is shown in Table 1.

The mileage column deserves some explanation. The mileage is mileage from the border of the base community--an incorporated place. If the particular mileage involved runs through an unincorporated place, then all the area between the particular mileage and the border of the base community is in the base community's commercial zone. However, if the particular mileage runs through an incorporated community, then all of the incorporated community is in the base community's commercial zone--regardless of whether all of the incorporated community is within the mileage limit.

Note, too, that since the steps are quite large, significant growth can occur without growth in the commercial zone and that after population has reached 100,000, growth in the zone is not possible, except via petition to the ICC, community boundary changes, etc.

Another interesting aspect of commercial zones is their overlapping but non-exhaustive nature. For instance, Camden, New Jersey, is in Philadelphia's zone and Philadelphia is in Camden's zone; but Collingswood, New Jersey (contiguous with Camden), is in Camden's zone but not Philadelphia's. Or Philadelphia is in Bellmawr, New Jersey's commercial zone, but Bellmawr is not in Philadelphia's.

Recently the ICC announced a proposed rulemaking regarding commercial zones. This rulemaking suggested that the commission might adopt a much expanded population mileage formula. This proposed formula is set out in Table 2. The plan was tentatively proposed by the commission (January 12, 1976) and adopted by the commission on December 17, 1976--to take effect 90 days therefrom.

The degree of expansion involved in the new proposal is very large. This degree can be approximated by assuming that the mileage formula applies from the center of the core city (instead of from its boundaries). Table 3 shows this expansion. What is interesting about this large expansion is that the commission has sometimes thwarted expansion attempts that involved areas within a mile or two from the existing zone (e.g., Atlanta, Southern New Jersey across from Philadelphia). Now, for the largest population centers, one can suddenly go out 15 miles farther than is currently possible.

A general argument to support the expansion of the commercial zone is to argue that the economic facts have changed (despite the commission) since the zones were first defined and that the facts have changed in a way that the population-mileage of Table 1 cannot conform to. The decentralization (suburbanization) of both residences and places of employment nationwide is documented by Hoover and Vernon (1962), Niedercorn and Hearle (1963), Niedercorn and Kain (1963), Moses and Williamson (1967), Muth (1969), and Mills (1972), among others.

Mills has calculated the employment density function over time for many of the large U.S. municipalities. While the data cover only from 1920 through 1963, they show that even at those relatively early dates the decentralization had begun. (It will be shown below that such decentralization heightened in the subsequent period to 1970. Other

TABLE 1
POPULATION-MILEAGE FORMULA FOR DETERMINING COMMERCIAL ZONES

Population of Incorporated Municipality Whose Zone is to be Determined, i.e., Base Community (Highest Population from 1940 Census on)	Mileage
less than 2,500	2
2,500 - 24,999	3
25,000 - 99,999	4
100,000 - up	5

SOURCE: U.S. ICC, 1975.

TABLE 2
PROPOSED POPULATION-MILEAGE FORMULA FOR DETERMINING COMMERCIAL ZONES

Population of Incorporated Municipality Whose Zone is to be Determined, i.e., Base Community (Highest Population from 1940 Census on)	Mileage
less than 2,500	3
2,500 - 24,999	4
25,000 - 99,999	6
100,000 - 199,000	8
200,000 - 499,999	10
500,000 - 999,999	15
1,000,000 and up	20

SOURCE: U.S. ICC, January 12, 1976.

TABLE 3
HIGH SIDE ESTIMATE OF INCREASED AREA ENCOMPASSED BY THE PROPOSED NEW POPULATION MILEAGE FORMULA VIS-A-VIS THE OLD POPULATION MILEAGE FORMULA

Population of Incorporated Municipality Whose Zone is to be Determined, i.e., Base Community (Highest Population from 1940 Census on)	Increase in Area Served Assuming Mileage is from Core of City
less than 2,500	2.25
2,500 - 24,999	1.78
25,000 - 99,999	2.25
100,000 - 199,999	2.56
200,000 - 499,999	4.00
500,000 - 999,999	9.00
1,000,000 and up	16.00

SOURCE: Computed from Tables 1 and 2.

work by the author now in progress relating a single STCC (Standard Transportation Commodity Code) industry to the Philadelphia total shows a continuation of the earlier trend through 1974 for that industry).

Mills estimates the following function:

$$D(u) = De^{-\gamma u}$$

where

D(u) is the density, i.e., employment/unit of land area u miles from the center of the city

e is the base of the natural logarithm

D, γ are parameters to be estimated, where D is the measure of density at the city center and γ is the measure of the rate at which density declines with distance from the center.

If γ is large, density falls off rapidly, i.e., high concentration of employment near the center. If γ is small, density falls off slowly, i.e., dispersion of employment. If a time series of γ estimates shows γ falling over time, then the conclusion is that employment is relocating from center city (an alternative possibility of all employment falling, but center city employment falling faster will be shown implausible below).

Since the work herein concentrates on Philadelphia, only Mills' Philadelphia results of estimating the above equation on population, manufacturing employment, retailing employment, service employment, and wholesale employment are shown below in Table 4. The Philadelphia results are indicative of what has been happening nationwide.

In general, most D's decline with time as do most γ's. This is consistent with the decentralizing hypothesis stated above. A graph depicting the above discussion is presented as Figure 1. An interesting result from the Mills' data is that decentralization has been going on since the inception of commercial zones.

THE CASE OF PHILADELPHIA

In investigating the impact of expansion of the Philadelphia commercial zone, five geographical areas were examined. These areas are (in general order of area size):

(1) the existing commercial zone;
(2) the urbanized area of Philadelphia (as defined by the Bureau of the Census);
(3) a population-mileage formula distance of 20 miles from the corporate limits of Philadelphia (as adopted by the commission);
(4) a population-mileage formula distance of 25 miles from the corporate limits of Philadelphia (as proposed by the commission); and

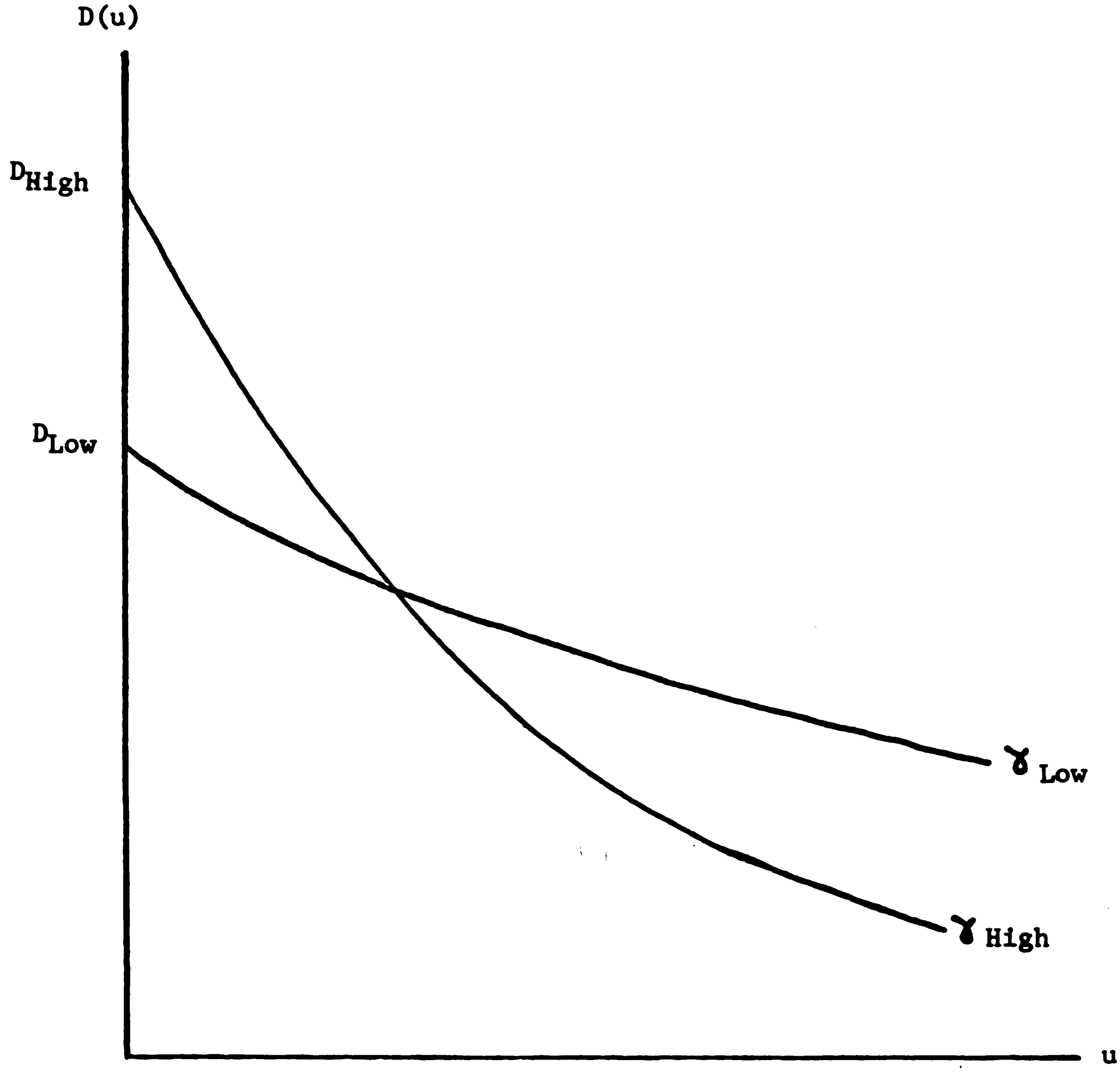
TABLE 4
DENSITY FUNCTIONS FOR PHILADELPHIA

		1920	1930	1940	1948	1954	1958	1963
Population	γ	.25	.37	.36	.31	.27	.25	.23
	D	67,595	62,034	59,789	53,264	45,714	41,868	38,268
Manufacturing	γ	.32	.35	.32	.33	.30	.29	.26
	D	7,586	7,332	5,243	9,229	7,836	6,896	5,765
Retailing	γ	NA	.47	.39	.37	.44	.30	.26
	D	NA	4,493	3,118	4,182	5,797	2,855	2,229
Services	γ	NA	NA	.49	.43	.42	.39	.36
	D	NA	NA	1,243	1,604	1,685	1,720	1,710
Wholesaling	γ	NA	.70	.63	.59	.49	.44	.37
	D	NA	4,384	2,934	4,139	3,058	2,529	1,891

NA = data not available, therefore no estimate made

SOURCE: Mills, pp. 45-46

FIGURE 1. BEHAVIOR OF MILLS' PHILADELPHIA DENSITY FUNCTIONS OVER TIME (LOW SUBSCRIPTS DENOTE THE CURRENT SITUATION)



(5) the Philadelphia SMSA (as proposed by the United States Department of Transportation).

Time and resource limitations prevented investigation of other geographical possibilities, e.g., the Census of Transportation's Philadelphia production area (the Philadelphia SMSA, the Wilmington SMSA and the Trenton SMSA) or the BEA's Philadelphia region (comprised of 23 counties in the Philadelphia area) or the five mile population-mileage boundary that Philadelphia currently would have were its zone not defined. The main source of data on the Philadelphia area's spatial economic activity was the Delaware Valley Regional Planning Commission (DVRPC) whose jurisdiction entails only the Philadelphia and Trenton SMSA's.

Since the Mills' data demonstrate the Philadelphia decentralization up to 1963, the data presentation herein will concentrate on what has occurred in the decade between 1960 and 1970. Unfortunately more recent data could not be assembled within the time constraints. The data include detailed spatial (by municipality or DVRPC data collection districts) breakdowns of employment by type, population, and land use. These have been aggregated to the five geographical areas cited above. Industrial park locations, zoning, and vacant, developable land are noted. In addition, the results of a study of the new locations relative to the old locations of manufacturing activity on a two-digit SIC (Standard Industrial Classification) level are presented.

The employment data reported herein represent those for manufacturing and trade. These occupations were felt to be more truck-dependent than other major occupations, e.g., finance, insurance, real estate, government, transportation, communication, utilities, and services. Construction was not included due to the use of private carriage and the fact that home office and actual workplace locations do not coincide. Mining was not a factor in the region considered. Agriculture is already exempt from ICC trucking regulation. The employment data used made up 52.7 percent of the total employment of the Philadelphia SMSA. These employment data were then mapped into the above five areas.

The data show that 64.7 percent of all SMSA manufacturing and trade employment and 70.8 percent of all SMSA manufacturing and trade firms were located within the Philadelphia commercial zone in 1970. Comparable figures for total SMSA employment and firms are 67.6 percent and 72.8 percent, reflecting the greater concentration of services in the older areas due to the need for face-to-face contact and other specialized services available under agglomeration, e.g., finance, insurance, and real estate have 81.4 percent of their SMSA employment and 80.7 percent of their SMSA firms in the Philadelphia commercial zone.

While the above figures may appear to be quite large, they must be put into perspective. The commercial zone has created an artificial area within which certain benefits occur. Thus, _ceteris paribus_, there is a bias keeping the commercial zone figures high. Also, there is the basic inertia inherent in the industrial location process. A new location, in general, would not be sought until the _net_ benefits of the new location (that includes any capital outlays necessary) exceeds the net benefits of the old location. Since the capital outlays are a variable expense item in the consideration of the new location, but may well be a fixed expense in the old location, significant advantages must be available in the new location before some firms will move.

In 1960, 78.9 percent of the SMSA employment in manufacturing and trade was in the commercial zone and 79.9 percent of the total SMSA employment was in the zone. While there are several ways for relative shares to change, Table 5 shows that the shift here occurred in a manner, that strongly supports the argument that economic activity which benefits by the commercial zone concept is moving out of the commercial zone, i.e., SMSA manufacturing and trade employment increased from 1960 to 1970 (by 9.6 percent), but commercial zone manufacturing and trade employment decreased from 1960 to 1970 (by 10 percent). Clearly this demonstrates that current economic fact is not being followed by the commission.

A further example of decentralization of economic activity in Philadelphia is found in the work of Blair (1976) following on some earlier work of Harris (1956). Blair has determined the manufacturing center of gravity for 18 two-digit SIC manufacturing industries within the five Pennsylvania counties in the Philadelphia SMSA for 1957. The center of gravity is, of course, a resolution of various vectors of forces and does not necessarily depict the actual location of the industry, much like an average of a group of numbers does not necessarily represent any of the numbers in the group. Like any average, the center of gravity can be strongly influenced by data outliers, i.e., data far away from the mean.

Blair has also determined the center of gravity for all new locations between 1957 and 1968 for each two-digit SIC industry. The centers of gravity for both the 1957 firms and the new locations between 1957 and 1968 are shown in Table 6.

Plots of Table 6 and directional changes, as well as the Philadelphia commercial zone, are shown on Map 1. As can be seen, the center of gravity of the new locations of five of the 18 SICs, i.e., 20 (food processing), 28 (chemicals), 34 (primary metals), 37 (transportation equipment), and 38 (precision instruments) is outside of the commercial zone. Only SICs 22 (basic textiles) and 39 (miscellaneous manufacturers) seem to be centralizing. Of course, since these are averages, nothing is revealed about the actual locations, although a more detailed investigation in a longer time frame would certainly allow more information on location. However, the general outward movement and the fact that some locations had to be beyond the commercial zone to pull the center of gravity beyond the zone is a fact not to be disregarded.

The work of Harris et al. traces the new location process prior to 1957. It too shows the general out-migration of manufacturing firms away from the Philadelphia core.

The accompanying map (Map 2) delineates the commercial zone as a solid line (along with the other four areas).

The next area of interest is that of the Bureau of the Census urbanized area. The urbanized area includes a central city of at least 50,000 population and surrounding closely settled territory. The latter is defined as incorporated places with a population greater than

TABLE 5
COMPARISON OF COMMERCIAL ZONE EMPLOYMENT RELATIVE TO SMSA EMPLOYMENT, 1960-1970

	Employment in Commercial Zone	Manufacturing, Trade & Mining Employment in SMSA	% of Employment in Commercial Zone	Total Employment in Commercial Zone	Total Employment in SMSA	% of Employment in Commercial Zone
1960	765,847	973,221	78.9	1,362,525	1,606,398	84.8
1970	689,012	1,066,523	64.6	1,283,304	2,010,955	63.8
% change	-10.0	+9.6		-5.8	+25.2	

SOURCE: Calculated by author from Delaware Valley Regional Planning Commission (DVRPC), Philadelphia, Pa., computer run of June 4, 1975 and DVRPC Plan Report No. 1, 1985 Regional Projections for the Delaware Valley Supplement. The first yielded 1970 figures and the latter 1960 figures.

TABLE 6
GEOGRAPHICAL CENTERS OF GRAVITY (COORDINATE POINTS)

SIC	New Locations 1957-1968	1957 Location
20	10.0W, 3.3N	2.1W, 3.3N
22	.6W, 4.7N	2.7W, 4.7N
23	2.9W, 2.5N	2.7W, 3.1N
24	4.5W, 10.2N	6.6W, 4.0N
25	2.1W, 6.9N	2.6W, 5.1N
26	4.5W, 2.8N	5.0W, 4.2N
27	3.6W, 1.9N	3.3W, 1.2N
28	12.2W, 4.2N	3.1W, 5.3N
29	3.1W, .6S	2.2W, 2.7S
30	6.6W, 1.9S	8.1W, 9.1N
32	6.2W, 7.2N	5.7W, 8.9N
33	8.4W, 6.7N	5.8W, 8.2N
34	3.0W, 10.9N	2.8W, 6.6N
35	1.4W, 6.7N	3.0W, 3.7N
36	6.3W, 5.3N	2.6W, 4.1N
37	10.0W, 11.7N	2.7W, 4.3N
38	10.5W, 3.2N	2.0W, 9.3N
39	.9W, 3.7N	3.9W, 6.6N

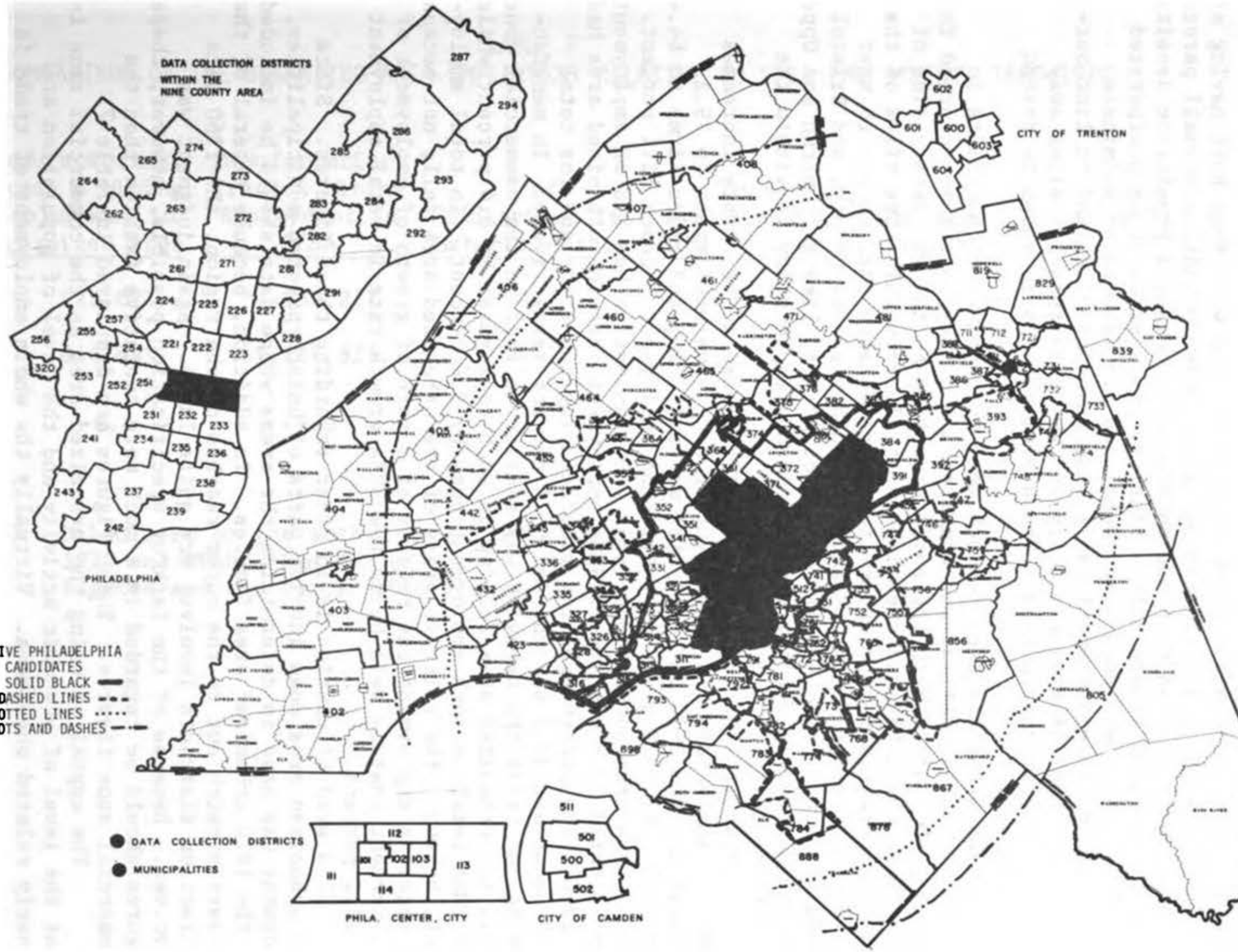
Note: Point (0,0) is City Hall, Philadelphia; Distance is in miles; W = West, N = North, S = South, E = East.

SOURCE: Blair, 1976.

MAP I

MAP I :CENTERS OF GRAVITY OF PHILADELPHIA MANUFACTURING FIRMS BY 2 DIGIT SIC FOR 1957 AND FOR NEW FIRMS LOCATING 1957-1968 (ARROW RUNS FROM OLD LOCATION TO NEW LOCATION).

MAP II



MAP II: ALTERNATIVE PHILADELPHIA
COMMERCIAL ZONE CANDIDATES
COMMERCIAL ZONE SOLID BLACK
URBANIZED AREA DASHED LINES
20 MILE LIMIT DOTTED LINES
25 MILE LIMIT DOTS AND DASHES
SMSA TOTAL MAP

2,500, or with a population less than 2,500 but with some part having at least 100 housing units closely settled. Also included are small parcels of land, normally less than one square mile, having a population density greater than 1000/square mile. Finally, small areas in unincorporated territory with lower population densities are allowed to eliminate enclaves, to close indentations of less than one mile, and to link outlying areas that otherwise qualify and are less than 1.5 miles away from existing urbanized area. The urbanized area is shown in dashed lines on Map 2.

The urbanized area is much more responsive to the shifts in population and industrial and commercial activity that have occurred in the last 40 years. With the noted exception of the New Jersey side of the river, the urbanized area is almost always within five miles of the existing commercial zone except for three fingers that go out to meet Malvern in Chester County, Norristown in Montgomery County, and Bristol in Bucks County. (In a small number of places, like Whitemarsh and Upper Dublin, Montgomery County, the urbanized area boundary is within the commercial zone).

However, the relatively small increase in territory increases the 1970 share for SMSA manufacturing and trade employment to 79.2 percent and the 1970 share of SMSA manufacturing and trade firms to 84.4 percent. The 1970 share of total SMSA employment becomes 81.1 percent.

The tremendous impact that suburbanization has had on employment can be noted by the share of SMSA employment that the urbanized area had in 1960. The percentages for manufacturing and trade and for total employment are 94.7 percent and 95.6 percent respectively. In manufacturing and trade the behavior was similar to that in the commercial zone, i.e., the urbanized area falling in such employment by 8.4 percent while the SMSA total in such employment grew by 9.6 percent. In total employment, however, the relative share of the urbanized area fell, not because of negative employment but because of a rate of growth of employment of 6.2 percent that is well below the SMSA growth rate in total employment of 25.2 percent.

A word of caution is in order regarding these figures. Since the urbanized area does involve parts of unincorporated municipalities, judgment was used in determining the areas whose data should be included in the 1970 urbanized area figures. In addition, because several of the fingers stretch out to the outer reaches of the region, the 1960 data collection districts involved are quite large. Again judgment was involved. Because of the lack of specification possible, however, these figures should be regarded in a much more tentative fashion than the commercial zone figures. These figures are displayed in Table 7.

The appeal of using the urbanized area as the commercial zone is that the level of economic activity and the level of population are closely related phenomena. Virtually the whole employment of trade is population serving, and so locations of trade facilities generally tend to be where the people are. Because of the virtual ubiquity of the highway system, much industrial activity is more footloose than it was previously. Much activity seems to be <u>following</u> population (note the generally higher γ's in Table 4 for the non-population items).

TABLE 7
COMPARISON OF THE URBANIZED AREA EMPLOYMENT RELATIVE TO SMSA EMPLOYMENT, 1960-1970

	Manufacturing, Trade & Mining Employment in Urbanized Area	Manufacturing, Trade & Mining Employment in SMSA	% of Employment in Urbanized Area	Total Employment in Urbanized Area	Total Employment in SMSA	% of Employment in Urbanized Area
1960	921,621	937,221	94.7	1,535,740	1,606,398	95.6
1970	844,481	1,166,823	79.2	1,631,507	2,010,955	81.1
% change	-8.4	+9.6		+6.3	+25.2	

SOURCE: Calculated by the author from DVRPC computer run of June 4, 1975 and DVRPC Plan Report No. 1. The first yielded 1970 figures and the latter 1960 figures.

Since the decennial censuses or special censuses provide the opportunity to redefine the urbanized area periodically, the definition has a type of built-in responsiveness--unlike the current system. In addition, as mentioned above, the distribution of population and economic activity are closely correlated.

Several drawbacks exist: The first is that the finger development mentioned above makes for an octopus-type zone. Some type of arcing process is a possible solution. This process would fill in the gaps.

The second is that the definition basically requires continuous development. As mentioned before, environmental goals or community differences may dictate that land use diversity occur or that planned industrial development be buffered from existing population. Accommodation of local land use planning and the use of the urbanized area could be a forceful tool for using the commercial zone definition to plan for the future rather than reacting to the past.

Thus, although the growth in current manufacturing and trade employment appears to be occurring beyond the urbanized area (subject to the data caveats mentioned above), the urbanized area represents a significant increase in the percent of SMSA employment covered relative to the area increase.

As Table 8 shows, only 67 or 26.9 percent of the SMSA's industrial parks are in the commercial zone. A crude analysis shows that at least 78 more parks or 31.3 percent would be added if the zone were enlarged to include the urbanized area.

Blair (1970) has plotted the rings of development in the Delaware Valley. Six rings are defined: (1) the central business district; (2) old urban areas; (3) suburban areas; (4) new suburbs--ample space; (5) rural with scattered towns; and (6) mainly rural.

The commercial zone includes all of ring (1), all of ring (2) (except Trenton), and virtually all of ring (3) (with the exception of some areas in Camden and Delaware Counties and the strip development up the Delaware River to Trenton and the area surrounding Trenton). These are all older areas where the population growth is declining or negative.

Immediately surrounding the commercial zone is ring (4) that entails the new suburbs and the areas involved in the fastest growth. The 1970 urbanized area covers most of ring (4) on the New Jersey side and the inner part of ring (4) on the Pennsylvania side.

The remaining two areas are the population mileage proposals of 20 and 25 miles from the corporate limits of Philadelphia (including all areas of incorporated municipalities that meet those limits). These areas are shown as dotted lines and dots and dashes respectively on Map 2. It should be noted that both the 20 and 25 mile areas include both Trenton and Wilmington. The 25 mile area includes virtually all of the Trenton SMSA. With the exception of a significant area of western Chester County, a very small amount of northern Montgomery County, a relatively small amount of northern Bucks County, a trivial part of Gloucester County, and a relatively small part of Burlington County (all of that is in the Pine Barrens), the 25 mile limit covers the SMSA; plus it adds significant areas to the northeast and southwest

TABLE 8
INDUSTRIAL PARK LOCATIONS RELATIVE TO THE COMMERCIAL ZONE

County	Number Of Parks in SMSA	Number of Parks in Commercial Zone	%
Bucks	62	17	27.4
Chester	34	0	0
Delaware	16	8	50.0
Montgomery	55	7	12.7
Philadelphia	19	19	10.0
Burlington	25	0	0
Camden	24	16	66.7
Gloucester	14	0	0
SMSA Total	249	67	26.9

SOURCE: Calculated from DVRPC files.

of the SMSA. As can be seen below, this area includes virtually all of the SMSA employment.

The manufacturing and trade sectors located within the 20 mile area are approximately 84.8 percent of the SMSA manufacturing and trade employment and approximately 95.8 percent of the SMSA firms. The comparable 1960 employment figure was 98.3 percent. The 1970 total employment share was 95.8 percent while the 1960 share was 96.0 percent. See Table 9.

These numbers also involved judgment in determining what municipalities to include in the 20 mile area and which to exclude. The 1970 figures have an overstatement bias since they were calculated by subtracting communities not in the 20 mile area from the SMSA total. (The bias is due to the underreporting of some data in the areas outside the 20 mile area due to disclosure problems).

The manufacturing and trade sectors located within the 25 mile area made approximately 98.1 percent of the SMSA manufacturing and trade employment in 1970 and approximately 98.4 percent of the SMSA firms. The comparable 1960 employment figure was 98.3 percent. The 1970 total employment share was 98.2 percent while the 1960 share was 98.4 percent. The same caveats that apply to the 20 mile area apply to the 25 mile area. The figures appear in Table 10.

Although these latter areas cover virtually all of the SMSA employment (plus add a significant amount of activity from Wilmington and Trenton), they do so at the expense of adding vast amounts of virtually unoccupied land to the commercial zone.

Since unknowns are involved in the deregulation process (as discussed below), it is argued herein that small changes are preferable to large changes. As Map 2 shows, the jump from the current area (solid line) to the 20 mile limit (dotted line) is a vast increase in size. A much smaller increase to the urbanized area will pick up proportionately (by area) much more coverage (14.6 1970 percentage points as opposed to the 30.2 for the 20 mile limit) than do the 20 or 25 mile limits. In addition, the urbanized area has an economic rationale and is flexible and subject to automatic change. Such is not the case for the 20 and 25 mile limits.

The last area is the SMSA. Its data have already been presented as the basis for comparison for the other four areas. The SMSA is felt to be too large for reasons analogous to those given for the 20 and 25 mile areas.

Other bits of spatial data are available on a single time period basis. These data relate to land use by municipality in 1970. The data yield available land, i.e., current undeveloped land (including farm land, open space, vacant land), manufacturing land in use, commercial land in use, industrial zoned land, and vacant industrial zoned land--all in acres.

Comparing the five areas investigated herein relative to the SMSA with respect to land use and land available for development yields Table 11.

The absolute acreage available is not trivial as can be seen in Table 12.

TABLE 9

COMPARISON OF 20 MILE AREA EMPLOYMENT REALTIVE TO SMSA EMPLOYMENT, 1960-1970

	Manufacturing, Trade & Mining Employment in 20 Mile Area	Manufacturing, Trade & Mining Employment in SMSA	% of Employment in 20 Mile Area	Total Employment in 20 Mile Area	Total Employment in SMSA	% of Employment in 20 Mile Area
1960	927,707	973,221	95.3	1,541,428	1,606,398	96.0
1970	1,010,558	1,055,523	94.8	1,919,190	2,010,955	95.5
% change	+8.9	+9.6		+24.5	+25.2	

SOURCE: Calculated by the author from DVRPC computer run of June 4, 1975 and DVRPC Plan Report No. 1. The first yielded 1970 figures and the latter 1960 figures.

TABLE 10

COMPARISON OF 25 MILE AREA EMPLOYMENT RELATIVE TO SMSA EMPLOYMENT, 1960-1970

	Manufacturing, Trade & Mining Employment in 25 Mile Area	Manufacturing, Trade & Mining Employment in SMSA	% of Employment in 25 Mile Area	Total Employment in 25 Mile Area	Total Employment in SMSA	% of Employment in 25 Mile Area
1960	956,387	973,221	98.3	1,580,120	1,606,398	98.4
1970	1,046,065	1,066,523	98.1	1,974,436	2,010,955	98.2
% change	+9.4	+9.6		+25.0	+25.2	

SOURCE: Calculated by the author from DVRPC computer run of June 4, 1975 and DVRPC Plan Report No. 1. The first yielded 1970 figures and the latter 1960 figures.

TABLE 11
LAND USE AND LAND AVAILABILITY (IN ACRES) BY AREA TYPE RELATIVE TO SMSA TOTALS, 1970 (%)

	Available Land	Manufacturing Land	Commercial Land	Industrial Zoned Land	Vacant Industrial Zoned Land
Commercial zone	2.8	35.8	28.0	16.2	5.8
Urbanized area	17.4	68.4	59.6	67.1	37.0
20 mile area	51.4	88.1	83.4	84.8	81.7
25 mile area	71.3	95.2	91.9	94.2	92.9
SMSA	100.0	100.0	100.0	100.0	100.0

SOURCE: Computed by author from DVRPC computer run.

TABLE 12
LAND USE AND LAND AVAILABILITY (IN ACRES) BY AREA TYPE, 1970

	Available Land	Manufacturing Land	Commercial Land	Industrial Zoned Land	Vacant Industrial Zoned Land	% Vacant
Commercial zone	45,024	8,826	7,436	36,539	9,368	25.6
Urbanized area	284,083	16,857	15,834	108,219	59,702	55.2
20 mile area	842,103	21,702	22,168	191,639	131,701	68.7
25 mile area	1,166,578	23,452	24,430	212,825	149,709	70.3
SMSA	1,637,019	24,630	26,569	226,037	161,188	72.3

SOURCE: Computed by author from DVRPC computer run.

The above tables show that an expansion of the zone to the urbanized area vastly increases the amount of available land (over sixfold) and provides for the largest marginal jump in manufacturing land, commercial land, and industrial zoned land (i.e., the highest change in percentage points as one reads down Table 11). Again, expansion to the urbanized area obtains a proportionally large amount of land that is currently used or is available for use in economic activity that benefits by the commercial zone concept. The expansion of the commercial zone to the urbanized area will almost double the manufacturing acreage covered by the zone. (It will not double the employment, as shown above, due to the land intensive nature, i.e., one story production process, of the suburbanized firm).

The same pattern holds for population as is shown in Table 13.

The biggest marginal jump in population is from the commercial zone to the urbanized area. The share of SMSA population in the commercial zone has dropped due to its small population growth relative to the SMSA's growth. In fact, all areas grow slower than the SMSA except the areas outside the 25 mile area. However, the urbanized area growth rate is much more in line with the SMSA growth rate than is the current commercial zone's, even with the urbanized area's figure biased downward since it contains the commercial zone's figures.

Since much activity is population serving, the new growth relative to the existing zone seems ripe for servicing by an expanded commercial zone.

The documentation of the change in the spatial economic structure of the Philadelphia area is now completed. The above analysis presents significant evidence that the current Philadelphia commercial zone definition is outmoded from an economic point of view. The surrounding areas are growing in population and industrial and commercial activity. The commercial zone is stagnant or experiencing negative growth. Industry is migrating to the outlying areas because of relocation forced by the construction of the Delaware Expressway or because of any number of the location-influencing factors mentioned earlier in this paper.

Thus, the commission must recognize this economic fact. An alternative definition of the zone, that accounts for a significant increase in population coverage, manufacturing and commercial land use, industrial land availability coverage, and manufacturing and trade employment coverage is the Bureau of the Census urbanized area. The urbanized area accounts for 84.6 percent of the 1970 SMSA population versus 59.3 percent for the commercial zone; 68.4 percent of the SMSA land used in manufacturing versus 35.8 percent; 59.6 percent of the SMSA land used in commercial activities versus 28.0 percent; 67.1 percent of the industrial zoned land versus 16.2 percent; 79.2 percent of SMSA employment in manufacturing and trade versus 64.6 percent; and 81.1 percent of total SMSA employment versus 63.8 percent. All of this is accomplished with a relatively small increase in area--especially in relation to the five mile population mileage limit that would exist if the Philadelphia zone were not specifically defined.

The urbanized area is a flexible concept and can change as conditions change. Ample land availability (284,083 acres) can allow

TABLE 13
POPULATION BY AREA--1960-1970

	1960	Share of SMSA Population	1970	Share of SMSA Population	% Population Change
Commercial zone	2,842,836	65.5	2,857,438	59.3	.5
Urbanized area	3,748,890	86.4	4,079,477	84.6	8.8
20 mile area	4,138,883	95.4	4,537,699	94.1	9.6
25 mile area	4,221,409	97.3	4,688,688	97.2	11.0
SMSA	4,377,416	100.0	4,820,040	100.0	11.1
Population outside 25 mile area	116,007	2.7	134,352	2.8	15.8

SOURCE: Computed by author from DVRPC computer run.

for a diverse, balanced growth. Subject to the feedback relationship of the existence of the commercial zone and the location of economic activity, the high population-employment correlation will allow the economic system to define the commercial zone rather than have an arbitrary definition imposed by the commission.

It is suggested that amendments to the urbanized area as proposed by land use planners (to avoid the continuous growth prerequisite of urbanized areas--that may be objectionable on a planning and/or environmental basis) be entertained by the commission. Also, an arcing process should be adopted to fill in the gaps so that the scheme would be administratively more feasible.

The rest of the paper will address the specific questions raised by the commission on pages 3-5 of Ex Parte No. MC-37 (Sub-No. 26). Many of the results cited herein are from a case study of the Philadelphia commercial zone by the author's students--Mathie, Eyring, English, and Phalon (1974).

It has already been argued that the current definition of the commercial zone is inadequate and that an expanded formula would better satisfy the statutory requirements and needs of those affected.

With respect to the impact of greater use of nonregulated carriers for local movements, it is clear that the volume of local goods movement is quite large. Current Transportation Association of America (1976) estimates show that over 50 percent of the dollars spent on trucking services in the United States are for intracity and local movements. If Philadelphia is typical of the nation (and there is no reason to think that it is not), a significant amount of local traffic exists. Such traffic, to the extent that it will move outside of the existing zone, should benefit as the result of the increased number of carriers available to provide the service. This increased competition for movements, especially on the service side, must be regarded as a positive benefit for the shippers/receivers.

The case study of the Philadelphia commercial zone investigated the 1964 addition of part of the Fort Washington Industrial Park to the zone (Mathie et al.). A before and after study was done with traffic managers recalling the situation both outside and inside the zone and comparing the statements of opposition of the carriers, who had the franchises to operate to this point, to their feelings after the expansion had taken place.

The results of the study show that service has improved greatly for some shippers. The service advantage of being in the zone results from a reduction of the number of carriers that have to handle a shipper's product from his loading dock to the destination. Shippers within the zone are able to cut down on delivery time and receive better service by eliminating the local carrier and having their products shipped by a line haul carrier. It is also a generally expressed preference of traffic managers to avoid interlining where possible.

Shippers located within the zone also benefit from reduced rates in some cases, because more carriers are available to carry their products, thereby increasing competition and the possibility that carriers will undercut each other to increase business. Interviews with traffic managers in the Fort Washington Industrial Park and with traffic managers in local and line haul carrier companies indicated that savings were within the range of 5 to 30 percent depending on the commodity and destination.

Interviews with 15 traffic managers at companies in the Fort Washington area generally upheld the conventional wisdom on the advantages of being within the zone. As with most generalizations, however, there were important exceptions indicating that the zone has minimal, if any, advantages for some shippers there. This is also shown in some of the evidence available from a Philadelphia Chamber of Commerce survey (1975) on commercial zones.

A recent chamber survey on interest in expanding the zone netted 85 replies. There were 58 NO's and 27 YES's. Of the 58 NO's, 40 answered the question of whether they shipped to points outside the current zone. Of those 40, 22 did not ship outside of the zone; 18 did. It would make an interesting study to determine why these 18 shippers are not interested in zonal expansion. Reliance on private trucking is one possibility. Another expanation is ignorance of the benefits of expansion. A third explanation is satisfaction with the existing service.

There are approximately 35 companies in the Fort Washington area now, an increase of 15 since the area was included in the zone in 1964. Of the 35, 11 ship their products at least once a day. An additional 10 have from one shipment a week to one shipment a month going out. The interviews were constrained to shippers requiring daily service.

Large volume shippers emphasized that, although they have saved minimal amounts on lower rates since being included in the zone, the primary advantage of the zone is better service because of the increased number of carriers available. Availability is not the only element of service. The managers point to savings in inventory costs (due to decreased time in transit) and reduced loss and damage claims. One company has 42 carriers available today, 12 more than before the expansion of the zone (it is, of course, not clear whether these carriers could have become available on a certification basis from the ICC and, hence, without expansion of the zone). The same shipper estimates that one day has been saved on most shipments because of the increased availability of capacity and competition. A subsidiary of the same company, located just above the zone, is served by 25 carriers and estimates that they lose a day as the result of local carrier-line haul carrier interchange.

However, despite rate and service improvements, another major shipper decided to go to private trucking--a possibility that more and more shippers are turning to nationwide.

The principal opponent to the Fort Washington extension was the Joint Northeast Motor Carrier Association that represented 40 carriers doing business inside the commercial zone. They sought to protect the franchise rights held by their constituents. The same attitude exists today with respect to expansion. One carrier states, "We paid considerable money to purchase operating authority beyond the zone." Another carrier states, "We are one of the fortunate carriers who have the authority beyond the Philadelphia commercial zone, and we would strenuously object to other carriers obtaining this authority without proving proper need and necessity." Other carriers also made statements as to how their business would be hurt as the result of expansion.

However, the evidence suggests, at least in this case, that the harm initially feared by the franchise holders is either not fulfilled or is not long lasting. In addition, many of the carriers are small and, like many of us, fear a change in the status quo.

The reactions of two carrier traffic managers are typical of the reactions of the then-involved carriers today. "We fought the expansion because our operating authority would have been infringed upon. We didn't want our competitors to be able to go in there. It (the expansion) hurt us a little, but a lot of our customers stayed with us anyway, and besides, we've grown so much in the last 10 years that it really didn't matter at all." "We fought it because we figured that we'd get cut right out and it did hurt us. But we're doing more business (today) than we did then and we more than made up from whatever we lost."

Such reactions seem to show that a time of general economic growth is a good time for such an expansion. If the size of the transportation pie is increasing faster than competition is increasing, the carriers can experience an absolute increase in traffic. While market share may fall, this industry is not obsessed with the concept of market share and is concerned rather with keeping their existing equipment filled.

The initial reactions of these impacted carriers is to be expected. To them a reasonably stable situation is being disturbed and they know that more competition will be present. Such carriers have a vested interest in claiming that the worst will happen in testimony before the commission. Such testimony is not unlike the testimony of shippers in rail abandonment cases before the ICC, i.e., the shippers have a vested interest in forecasting doom if the line is abandoned. However, the before and after studies done on shippers by Simat, Helliesen, and Eicher (1973), Boston University (1967), and by the Public Interest Economics Center (1974) show a remarkable ability of the protesting shippers to survive the abandonment--just as the abovementioned protesting motor carriers survived the extension of the commercial zone. One must also remember that the expansion will open up new markets in other areas for the impacted carriers.

The general position of the truckers on expansion is not clear. Some truckers, as those above, perceive losses and oppose the expansion. Other carriers perceive new markets and favor the expansion. In the case of the recent appeal for expansion by the Southern New Jersey Development Council (the appeal was rejected, ICC-MCC-6, 1972), 25 certificated carriers protested, the joint Northeastern Motor Carrier Association protested (although two of its members were for the extension), and 12 carriers, currently not certified to the area, supported the expansion. It seems clear that those who foresee increased competition and possible losses oppose extension, while those who perceive possible gains support extension.

If one is overly concerned with the impact on the franchised carriers, the federal government could purchase the operating rights of such carriers (analogous to eminent domain compensation). Or the government could subsidize abnormal losses for a period of time (analogous to industries injured by changes in U.S. import tariff policy). Or it could be determined, at least in the interstate situation, that the government gave the right and, thus, the government can take it away. (Precedent exists in other commercial zone expansions).

The overall impact of expanded commercial zones and terminal areas on long haul operations is mostly favorable. Surely, more efficient operations will occur with respect to truckload operations. If an interface with a local carrier can be avoided, significant time and handling can be saved. What is not definite is the impact of less-than-truckload (LTL) traffic. If the shipper is currently outside the zone, he must bring his shipment to the zone (unless he deals with a carrier who is certificated to handle him directly) or he must arrange with a local carrier with operating authority for a movement to the zone. Thus, interlining must occur. On the other hand, if the point were in the zone, the line haul carrier would pick up the LTL freight on a pick-up run. In the Fort Washington area, this latter process is suggested to be less time consuming that the former.

Competition increases as per the Fort Washington case study. Quality of service improves. Except in a few cases, the rate changes in Philadelphia were not of a large magnitude. The revenues of the trucking firms were not severely impacted over time.

What is not clear is the impact on operating efficiency, the impact on conservation of scarce resources, the impact on the environment, and the impact on private carriage.

The impact on operating efficiency is clearly present on truckload operations. Here a savings is quite obvious. An interface is eliminated. Time is saved. Resources too are saved, since one trailer and tractor can move the goods instead of two. Likewise the movement is more direct and less fuel is likely to be consumed. However, unless care is taken with land use planning, more land may be used for industrial purposes in the outer zone areas yielding the pollution and the spoiling of the environment that has degraded much of urban life. In addition to the extent that the expanded commercial zone does lead to a location incentive (see Yaseen), one has to be concerned with the impact on the urban core and with urban development. The suburban locations of industry may not be the fuel efficient way of operating the economy. Likewise, suburban employment locations may preclude the captive urban dweller from these employment opportunities (due to lack of accessibility). This may, in turn, further degrade what has become known as the urban environment, e.g., poverty, crime, substandard housing, etc.

While the desired impact and somewhat expected impact of an increase of the commercial zone would be a decrease in private carriage (due to the post zone expansion, relatively lower rates and better service of for-hire carriage), the limited results available seem to suggest that this may not happen. The impacts on rates and service of being in the zone do not seem great enough to offset the (perceived) advantages of private trucking for some users. One shipper in Fort Washington determined that private trucking was still better even after obtaining the benefits of the commercial zone. As the Sutton et al. (1973) study on private trucking shows, the reasons for private trucking are often highly idiosyncratic and sometimes provide little economic rationale. It may be difficult to fight a battle against such a strong foe.

On LTL movements, the issues of operating efficiency, conservation of scarce resources, and impact on the environment are totally open questions. One can envision cases where the pick-up and delivery runs of the line haul carriers are much tighter than those of the local carrier--line haul carrier combination movement. On the other hand, one can envision much looser runs. More study is needed on this question.

The same comments apply to the conservation of scarce resources. If the runs are tighter, resources are saved; if not, they are wasted. If runs are tighter, fuel is saved; if not, it is wasted.

The impact on applications for operating rights for short haul movement is likely to decline (since such authority would no longer be needed to provide service to the expanded zone). However, one could envision situations where long haul authority applications might increase due to the opening up of many new attractive traffic-generating points in Philadelphia. On the net, it would be expected that such application activity would decrease.

The shippers that responded positively to the Philadelphia Chamber of Commerce's commercial zone survey (27 of the 85 replies) represent some of the nation's largest firms. Their comments regarding expansion mirror the discussion above:

Shipper 1: "We would appreciate the increased flexibility in carrier selection it would offer us."

Shipper 2: "Carriers with authority between X and Philadelphia could serve us and each carrier wouldn't have to petition for authority."

Shipper 3: "The expansion of the commercial zone is extremely important to the business environment of the Delaware Valley."

Shipper 4: "It would offer us better service, lower rates."

Shipper 5: "We want long haul direct delivery to branch stores."

Shipper 6: "Potentially better service."

Shipper 7: "Allow final delivery to store locations by carrier."

Shipper 8: "Pure economics--better service."

Shipper 9: "Better transit times through carriers not now authorized to serve Y--to improve customer service."

Shipper 10: "Many customers in Philadelphia who will benefit if our costs are reduced by lower freight rates."

Shipper 11: "Increases selectivity of available carriers."

It should be noted that Shipper 1 suggested that the expansion was "not a matter of life and death." Shipper 7 stressed that they have "no complaints about current carrier availability."

Of the 17 firms that responded to the question, "Would you testify before the ICC on this matter?" 15 said yes. Of the 15 firms that responded to the question, "Would you help finance a case before the ICC?" 11 responded yes.

It is interesting to note that the desired expansions of the 27 firms include most of the communities within the urbanized area (see Table 14). Of 38 communities specifically mentioned, only 12 are outside of the urbanized area (and two of those, Voorhees and Concordville are just out--Voorhees will be in under the next definition due to the development of over 3,000 housing units adjacent to its Echelon Mall). Thus, expansion of the zone to the urbanized area would go a long way in satisfying the specific demands of the shippers who desire zonal expansion.

SUMMARY:

The case for the outmodedness of the specifically defined Philadelphia commercial zone can be strongly made. Industry and trade have moved out, and employment in the area of the commercial zone is falling. The new growth is on the outside of the existing zone. This growth has been going on since the formation of the zone in the 1930s. Ample evidence is presented in the text to document this decentralization phenomenon. Thus, on the demand side, the case for an expanded zone is quite good.

The Bureau of the Census urbanized area is suggested as the best candidate for commercial zone expansion. This area marks a significant increase in the coverage of manufacturing and trade employment and land availability. One achieves a significant amount on the demand side with only a relatively small (relative to the other areas considered) increase in the size of the zone.

In the spirit of gradual deregulation, the expansion to the urbanized area is the logical candidate. The 20 and 25 mile areas and the SMSA entail a vast increase in area (and hence might not be regarded as gradual) but with a much smaller proportional increase in coverage of employment and developable land.

It is also suggested that the urbanized area should be adopted as a base, with possible alterations and additions made in concert with the local land use planning agency. Such planning will allow for the preservation of ample open space and for environmental protection and, at the same time, provide for the needs of commerce.

On the supply side, i.e., carriers, and on the environmental side, the results are less specific and the conclusions to be drawn are less clear. In the case of truckload movements, it seems most likely that fewer vehicle miles will be performed and less fuel used and less equipment required. The results of the Fort Washington case study show that more competition occurs, with resultant improvements in rates and service quality. However, the magnitude of these improvments is such that they are not perceived as significant by all shippers. It is difficult to determine (because the rate of turning to private carriage may have been slowed), but it was observed that some firms in the zone continued to turn increasingly to private carriage. On net, however, the conclusions for truckload movements were positive.

TABLE 14
COMMUNITIES MENTIONED BY THOSE SHIPPERS DESIRING AN INCREASED COMMERCIAL ZONE AND THOSE IN THE URBANIZED AREA

Ambler	in
Boothwyn	out
Bridgeport	in
Burlington	in
Carney's Point	out
Cherry Hill	in
Cinnaminson	in
Concordville	out
Croydon	in
Deepwater	out
Delran	in
Devon	in
Elwyn	in
Frazer	in
Gibbsboro	in
Gibbstown	out
Horsham	in
King of Prussia	in
Langhorne	in
Lansdale	out
Maple Shade	in
Montgomeryville	out
Moorestown	in
Neshaminy	in
New Castle	out
Norristown	in
Paoli	in
Plymouth Meeting	in
Riverside	in
Riverton	in
Royersford	out
Southampton	in
Springfield	in
Trenton	out
Valley Forge	in
Voorhees	out
West Chester	out
Willingboro	in

SOURCE: Compiled by the author from Philadelphia Chamber of Commerce data.

With respect to less than truckload movements, few clear-cut conclusions could be drawn. Competition certainly increased and service improvements resulted. Rate improvements were not perceived to be significant by all the shippers. The effects on operating efficiency, conservation of scarce resources, and impact on the environment are not clear. Since LTL requires pick-up and delivery and terminal operations, it is possible that an increased zone could involve more vehicle miles, more fuel consumed, more air and noise pollution, and more scarce resources being consumed. Of course, the exact reverse could occur. The result depends on the shipping patterns. No conclusion can be drawn here; the information at hand does not permit it.

A slight amount of information does exist on what happens to truckers whose exclusive authority is effectively eliminated. A before and after study of the truckers who served the Fort Washington addition to the Philadelphia commercial zone showed initial injury to their operations but subsequent growth to beyond their pre-expansion levels. The lesson indicated is that the time for zonal expansion should be a time when general growth is occurring.

From the supply side too, the evidence seems to point to a modest expansion. A modest expansion would be to the urbanized area. The modest expansion could, in part, be justified on the basis of the five mile area that Philadelphia would have, had the zone not been specifically defined. The size of the expansion to the urbanized area (that would approximately double the existing zone) is small relative to the other suggestions but, nevertheless, large enough to show demonstrable effects (that should be monitored if expansion does take place) in the area of operating efficiency, conservation, impact on the environment, etc.

Since the commission has expanded the zone for Philadelphia to 20 miles, it is incumbent for researchers to carefully monitor the impact of this expansion (and the expansion of other municipalities). Seldom do researchers have the opportunity to obtain such a large increase in deregulation and in so many different "laboratories." This opportunity to collect many more data points in the regulation-deregulation controversy should not be lost by the commission and the U.S. Department of Transportation.

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THE OPERATING RATIO EFFECT AND REGULATED MOTOR CARRIERS

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ABSTRACT

This paper constructs an analytical model of the effects of operating ratio regulation. The model shows that an operating ratio constraint causes a distortion of the resource allocation ratio; specifically, the cartel-firm hires excess labor and undercapitalizes.

An empirical test of these effects is carried out using the factor shares equations generated in the model using a transcendental logarithmic (trans log) production function. The undefined Lagrange multiplier appears as a coefficient in the equation relating labor's share to the trans log marginal product, and is estimated directly assuming that profit maximization is the cartel-firm's objective. The validity of the estimated value of the Lagrangian function is tested using a likelihood ratio test. The results of this test confirm the existence of the operating ratio effect.

INTRODUCTION

Economists have long had an interest in the effects of regulation on firm behavior, and this predates the use of analytical models to investigate these effects. For example, rate-of-return regulation was long thought by economists to lead to overcapitalization, but this intuition was mainly conjectural. Averch and Johnson (1962) developed an analytical approach to the question, and began to show why overcapitalization might take place; this model revived interest in regulation, and led to an ever-growing literature on the subject. Recently several empirical tests of the Averch-Johnson effect have confirmed its existence.[1]

Despite renewed interest in regulation, methods other than rate-of-return regulation have received relatively little attention. This study will examine the effects of operating ratio regulation, that constrains the ratio of the cartel-firm's noncapital expense to total revenue. This method of regulation was long applied to motor common carriers by the Interstate Commerce Commission as the exclusive method of economic regulation. The rationale for this method of regulation is that it provides more "stability" for cartel-firms with a low capital-labor ratio than rate-of-return regulation, because a small change in employed capital implies a large change in the allowed rate of return (Bailey 1973). The effects of operating ratio regulation on the resource allocation ratio and the level of output of the cartel-firm are examined in the context of a static neoclassical model. The resource allocation implications of the analytical model are tested using factor share equations derived from the model.

The next section reviews the organizational aspects of the trucking industry, and the third section is an exposition of the analytical model of operating ratio regulation. The fourth section derives the equations necessary to translate the theoretical implications of the model into equations that may be estimated empirically, and discusses the data used to estimate the equations. The fifth section presents the empirical results of the study, and the sixth discusses the inferences that may be drawn from these results.

CHARACTERISTICS OF THE TRUCKING INDUSTRY

The industry consists of over 15,000 individual firms; large firms (ICC Classes I and II), constitute less than one-third of the industry. Small firms are typical of the industry; Class I firms, with revenues over $1,000,000 annually, make up approximately 10 percent of the total (Phillips 1969).

There is much evidence that the industry would be competitive in the absence of regulation. The product, the shipment of goods between points, may not be stored, and there seem to be no significant economies of scale in line-haul movements, but scale economies may exist in administration, dispatching, and terminal management.

ANALYTICAL ASPECTS OF REGULATION

Operating ratio regulation is applied to the industry by setting the allowed ratio of non-capital expense to total revenue equal to some target level. We assume that the industry operates as a cartel and that capital and labor are the only factors of production. The ICC seems to feel that the preferred level is 92.5. This is often explained in ICC publications as 90 percent of expenses plus one-half of a 5 percent return on investment.

When the cartel-firm is subjected to regulatory review, the <u>actual</u> level of the operating ratio is compared to the target level; if actual operating ratio were less than the target level, the cartel-firm would be earning excess economic profit and, conversely, if the operating ratio exceeds the target level, it would be earning less than is believed fair. Presumably, increases in the tariff rates would be granted only if the cartel-firm were earning less than the fair operating ratio. The two-factor assumption is relaxed in the empirical section of the paper.

In a two-factor model, noncapital expense is labor expense alone so that actual OR is:

$$(1) \qquad OR = wL/PQ$$

where w = wage rate per man-hour, L = labor input in man-hours, Q = output in ton-miles, and P = price per ton-mile.

The OR constraint may be written:

$$(2) \qquad OR \geqq OR^*$$

where OR* = target level of OR. Substituting Equation 1) into Equation 2) gives:

$$(3) \qquad wL/PQ \geqq OR^*.$$

The constraint effectively allows the cartel-firm to earn a "fair" markup on noncapital expense. We see this by inverting Equation (3);

$$(4) \qquad PQ/wL \leqq 1/OR^*$$

Let 1/OR* = g; then Equation (4) may be written:

$$(5) \qquad PQ \leqq gwL.$$

The inverse of OR*, g, is the markup allowed on non-capital expense.

Assume that the regulatory constraint holds as an equality,[2] and that the cartel-firm faces the inverse demand function given by

$$(6) \qquad P = f(Q), \; dP/dQ < 0,$$

and acts to maximize profit, so that the problem may be specified as a constrained profit maximization:

$$(7) \qquad \begin{aligned} &\text{Max } PQ - wL - rcK \\ &\text{s.t. } PQ - gwL = o \end{aligned}$$

where r = price of capital services, c = acquisition cost of capital, K = capital stock in physical units.

Necessary Conditions

The production function is assumed to be homogenous:

$$(8) \quad Q = f(K,L) \; f_K, \; f_L > 0; \; f_{KK}, \; f_{LL} < 0; \; f_{KL} > 0.$$

The objective function and constraint are combined into a Lagrangian function denoted by $\underline{Z}$,

$$Z(K,L,\lambda) = PQ - wL - rcK - \lambda(PQ - gwL). \tag{9}$$

Let the partials of the Lagrangean be denoted by Z with a subscript denoting the appropriate argument, and also let the marginal revenue products of capital and labor be, respectively, $G_K = (P+QdP/dQ)f_K$ and $G_L = (P+QdP/dQ)f_L$. With this simplifying notation, the necessary conditions for a regular interior maximum are:

$$Z_K = G_K - rc - \lambda G_K = 0 \tag{10}$$

$$Z_L = G_L - w - \lambda G_L + \lambda gw = 0 \tag{11}$$

$$Z_\lambda = PQ - gwL = 0. \tag{12}$$

The solution to these equations is:

$$G_K = rc\ /(1 - \lambda) \tag{13}$$

and

$$G_L = \left(w(1 - \lambda g)\right)/(1 - \lambda) \tag{14}$$

that gives the following resource allocation ratio:

$$f_K/f_L = rc/(1 - \lambda)w\ (1 - \lambda g). \tag{15}$$

The nature and implications of this resource allocation ratio are examined below. Since Equation (15) contains λ, we must first establish bounds on a value for λ in order to make inferences about the expansion path under regulation.

Bounds on the Lagrange Multiplier

The value of λ must lie between zero and the ratio of the wage rate to the fair markup on the wage. From Equation (11), we may solve for λ that is:

$$\lambda = (G_L - w)/(G_L - gw); \tag{16}$$

when the cartel-firm is unconstrained by regulation, labor will be paid its marginal revenue product, $G_L = w$; therefore, we can argue that for the unconstrained cartel-firm λ would be zero. As regulation is applied, the allowed markup on labor is reduced and λ will approach unity. Although we have shown that $0 \leq \lambda \leq 1$, tighter bounds may be established. Equation (11) (from which Equation (16) was derived) may be written:

$$G_L(1 - \lambda) = w - \lambda gw.$$

The left side of this equation is positive by inspection, and, therefore, we can use the right side to establish that λ lies in the interval, $0 < \lambda < w/gw$, and $w/gw = 1/g = OR^*$ so that:

$$0 \leqq \lambda \leqq OR^*. \tag{17}$$

The Effect of the Operating Ratio Constraint on Cartel-Firm Behavior

The necessary conditions of the model contain some interesting implications for the behavior of the cartel-firm. These implications may be formulated into results that can be proved. The first is:

Result I <u>The profit-maximizing cartel-firm subject to an operating ratio constraint will not minimize the cost of production</u>

The cost minimizing resource allocation ratio is:

$$f_K/f_L = rc/w. \tag{18}$$

Rewriting Equation (11) or Equation (16), by adding λw to both sides of either equation, we have:

$$\frac{f_K}{f_L} = rc/[w+\lambda(w-gw)] \tag{18a}$$

It follows immediately that the cartel-firm will overstaff since:

$$f_K/f_L > rc/w, \text{ for all } g > 1$$

This results because the markup on labor expense reduces the effective cost of labor to a level below the opportunity cost of labor.

The Expansion Path

Since the cartel-firm regulated by operating ratio will hire excess labor relative to the unregulated monopolist; it is natural to inquire about the level of output relative to the unregulated monopolist. It may be shown that the regulated cartel-firm produces less than an unregulated monopolist:

Result II <u>The profit maximizing cartel-firm subject to an OR constraint will increase output as the allowed markup is increased</u>

The effect of regulatory constraint may be found by totally differentiating the constraint function and evaluating its slope in L, K space. The total differential of the constraint function, (treating g as a variable), is:

(19) $$wLdg - G_K d_K + (G_L - gw)dL.$$

Setting dg equal to zero gives an isoconstraint locus. The slope of the isoconstraint locus in L, K space is:

(20) $$dL/dK = - G_K/\ (G_L - gw).$$

The slope of the isoconstraint locus in equilibrium depends on the sign of $(G_L - gw)$. Adding $-gw$ to both sides of Equation (11), we have:

(21) $$(G_L - gw) = w - gw/(1 - \lambda) < 0 \text{ for all } g > 1$$

Since $G_L - gw < 0$, Equation (20) will be positive and, therefore, the equilibrium slope of the isoconstraint locus will be positive.[3]

The isoconstraint locus of the isoquant map is shown in Figure 1. Tightening regulation leads to an isoconstraint locus with a larger diameter in L, K space; therefore tightening regulation (lowering g) will reduce the output of the cartel-firm by displacing it to an isoquant closer to the origin (see also Cherry 1975).

To show that a decrease in the allowed markup on labor input, g will decrease output is somewhat tedious algebraically but straightforward conceptually.

To find the sign of dQ/dg, take the total differential of the production function:

(22) $$dQ/dg = f_L \frac{dL}{dg} + f_K \frac{dK}{dg}.$$

We can then substitute into this function to find its sign. First, take the total differential of the partial of the Lagrangian with respect to capital, $d(G_K(1-\lambda) - rc)$:

(23) $$G_{KK}(1 - \lambda)dK + G_{KL}(1 - \lambda)dL.$$

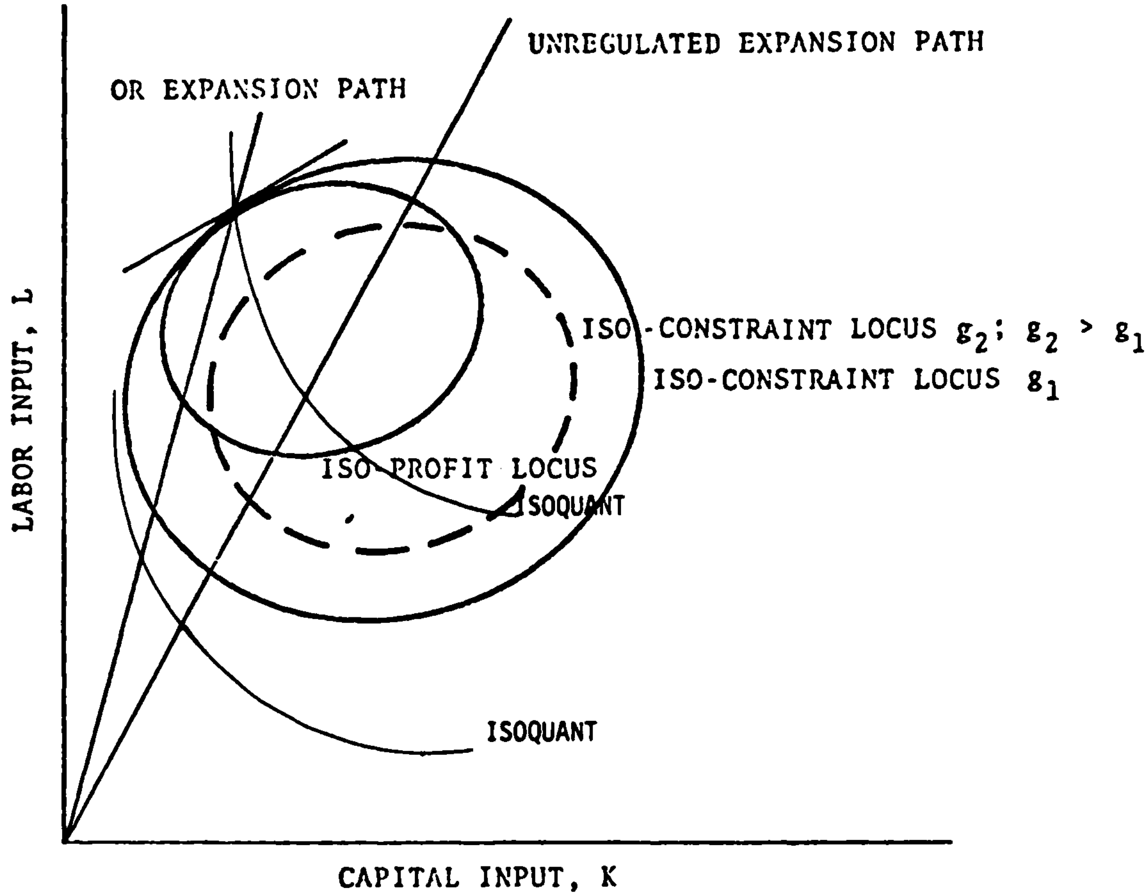
Solving (23) for dK we have:

(23a) $$dK = - (G_{KL}/G_{KK})dL.$$

Substituting (23a) into (22) and rearranging we have:

(24) $$dQ/dg = \frac{(f_L G_{KK} - f_K G_{KL})dL/dg.}{G_{KK}}$$

FIGURE 1 THE EFFECTS OF OR REGULATION
SHOWN ON THE ISOQUANT MAP



Expanding the numerator of this expression we have:

$f_L[G'f_{KK} + (2dP/dQ = d^2P/dQ^2Q)f_K^2] - f_K[G'f_{KL} + (2dP/dQ + d^2P/dQ^2]$

f_Kf_L

This expression is equal to:

$$(f_Lf_{KK} - f_Lf_{KL})G'.$$

Now we know that G' is nonnegative since $G_K(1 - \lambda) = rc$, and $G_K = (P + QdP/dQ)f_K = G'f_K>0$, since $0<\lambda<1$ and $rc > 0$. Now, since $(f_Lf_{KK} - f_Lf_{KL}) < 0$ if labor is non-inferior, then the numerator of this expression must be negative. Since the denominator is negative by the assumption of diminishing marginal revenue returns to capital, that is $G_{KK} < 0$, the entire expression must be positive. Therefore we can conclude that:

(25) $$(\text{sign})dQ/dg = (\text{sign})dL/dg.$$

To find the sign of dL/dg, take the total differential of the constraint function, and rearrange it as:

(25a) $$d(PQ - gwL) - G_KdK + G_LdL - wLdg.$$

Then substituting in from Equation (23a) we have:

(25b) $$\frac{-G_KG_{KL}}{G_{KK}dg} + G_L\ dL/dg =$$

$$\frac{[G_{KK}G_L = G_KG_{KL}]\ dL/dg}{G_{KK}} = wL$$

Therefore:

(26) $$dL/dg = G_{KK}wL/(G_{KK}G_L - G_{KL}G_K).$$

Expanding the denominator of 26) we have:

$[G'^2f_Lf_{KK} + (2dP/dQ + d^2P/dQ^2Q)f_K^2f_LG' - G'^2f_Kf_{KL} - (2dP/dQ+d^2P/dQ^2Q)$
$f_K^2f_LG']$

that is equal to:

(26a) $$G'^2(f_Lf_{KK} - f_Kf_{KL}) < 0$$

since $G_{KK} < 0$ $dL/dg > 0$.

Because the sign of dL/dg is positive, an increase in g, that corresponds to a reduction in the allowed operating ratio, implies an increase in labor, and an increase in output as well. Conversely, a reduction in the allowed markup g, will cause a reduction in output. This is shown in Figure 1 by the smaller isoconstraint locus as g is increased from g_1 to g_2.

A TEST OF THE OR EFFECT

The empirical section of the paper tests the theoretical implications of the model, following the methodology developed by Spann (1974) to test the Averch-Johnson effect. This method uses the transcendental logarithmic (TL) production function to combine the marginal productivity conditions implied by the analytical model with estimable equations, and also allows the derivation of restrictions on the coefficients that result in a more efficient estimation procedure.[4]

While the analytical model used only two inputs, the empirical model uses a third input, line-haul input, H, that includes diesel fuel, gasoline and other petroleum products and tires.

The three input TL production function is:

$$(27) \quad \ln Q = \ln A + B_1\ln K + B_2\ln L + B_3\ln H + B_4\ln K^2 + \ldots$$

$$\ldots + B_5\ln L^2 + B_6\ln H^2 + B_7\ln K\ln L + B_8\ln K\ln H + B_9\ln L\ln H.$$

The marginal products of the TL function are:

$$(28) \quad \partial\ln Q/\partial\ln K = B_1 + 2B_4\ln K + B_7\ln L + B_8\ln H = f_K Q/K$$

$$(29) \quad \partial\ln Q/\partial\ln L = B_2 + 2B_5\ln L + B_7\ln K + B_9\ln H = f_L Q/L$$

$$(30) \quad \partial\ln Q/\partial\ln H = B_3 + 2B_6\ln H + B_8\ln K + B_9\ln L = f_H Q/H.$$

The addition of a third factor input does not change the meaning of the necessary conditions; since the third factor is allowed a fair markup, the partial equilibrium condition has the same form as Equation (11). The three necessary conditions are:

$$(31) \qquad G_K = rc/(1 - \lambda)$$

$$(32) \qquad G_L = w - gw/(1 - \lambda)$$

$$(33) \qquad G_H = z - gz/(1 - \lambda),$$

where z is line-haul cost.

The marginal revenue products of the factor inputs may be written in the form $G_i - P(1 - 1/e)f_i$, where e is elasticity of demand; this identity may be used to derive factor share expressions from the necessary conditions.

Let $\Lambda = \lambda/(1 - \lambda)$. Then by adding $\underline{\lambda rc}$, $\underline{\lambda w}$ and $\underline{\lambda z}$, respectively, to both sides of the necessary condition for capital, labor, and line-haul input, respectively, allows them to be written:

$$G_K = rc + \Lambda rc \tag{34}$$

$$G_L = w + \Lambda(w - gw) \tag{35}$$

$$G_H = z + \Lambda(z - gz). \tag{36}$$

Solving these expressions for marginal product and letting $G' = P(1 - 1/e)$, gives:

$$f_K = rc/G' + \Lambda rc/G' \tag{37}$$

$$f_L = w/G' + \Lambda(w - gw)/G' \tag{38}$$

$$f_H = z/G' + \Lambda(z - gz)/G'. \tag{39}$$

Substituting these expressions back into Equations (27), (28), and (29), three expressions result that relate the factor shares and marginal products.[5] Let $S_K = rcK/PQ$, $S_L = wL/PQ$, and $S_H = zH/PQ$. Then, after some manipulation, the following three semi-logarithmic factor share equations obtain:

$$S_K = \beta_1 + \beta_2 \ln K + \beta_3 \ln L + \beta_4 \ln H \tag{40}$$

$$S_L = \beta_5 + \beta_6 \ln K + \beta_7 \ln K + \beta_8 \ln H + \lambda\hat{g}S_L \tag{41}$$

$$S_H = \beta_9 + \beta_{10} \ln H + \beta_{11} \ln K + \beta_{12} \ln L + \lambda\hat{g}S_H. \tag{42}$$

Since the TL derivations have some common elements, the coefficients are not independent across equations. The coefficient of capital in Equation (41), β_7 is equal to the coefficient to labor in Equation (40) B_3, since:

$$\beta_7/\beta_3 = \left[\xi/(1 + \Lambda)\right] B_7/ \left[\xi/(1 + \Lambda)\right] B_7 = 1. \tag{43}$$

Since these coefficients are equal, a linear constraint in the estimation procedure is appropriate; similarly the coefficients of labor in Equation (42) and line-haul in Equation (41) are equal. To avoid spurious correlation between S_L and gS_L, that might result if g were regarded as a constant, g is estimated from a regression equation in which total revenue is the dependent variable and the independent variable is the wage bill. The coefficient of the wage bill is $\hat{g}$, the estimated allowed markup. A final possible restriction occurs since λ lies in the unit interval.

The Data

In OR regulation, the factor shares of inputs that are allowed a markup - labor and line-haul input in this case - from the basis for the regulatory constraint. This makes the computation of factor shares simple. By finding the share of one of the inputs allowed a markup, the other may be found by subtracting the first from the operating ratio.

However, there is some distortion of allowed expenses because leased capital is allowed a markup, while owned capital is not. This necessitates some adjustment of the computed OR series to reflect the use of leased capital and leased operators. The description of each series of data that are used in testing the OR effect is given below. The data are time series for Class I and II carriers of general freight between the years 1950 and 1964. (Data in this section are derived from U.S. Interstate Commerce Commission, annual).

Capital's Share

The capital service price was estimated as the weighted average costs of acquisition of both terminal capital, rolling stock and financial capital using the commercial paper rate as the cost of funds for rolling stock, the mortgage rate as the cost of funds for terminal capital, and the weighted average value of depreciation of each type of capital. Depreciation was measured as the proportion of retirements of capital stock to total capital stock, and was computed separately for rolling stock and terminal capital.

Capital

The capital stock data are based on the investment series from annual reports to the ICC.[6] The series was adjusted to allow for actual depreciation (as opposed to accounting depreciation), and also to provide an accurate estimate of the capital stock in the base period.

The problem of actual depreciation may be dealt with by adjusting retirements from the capital stock to account for capital gains. Increases in the value of capital over time cause the value of retirements to be understated if they are subtracted from the total capital value at acquisition cost.[7]

The economic life of rolling stock is measured by computing the value of retirements in a given year as a proportion of total capital stock.

The value of terminal capital value was adjusted for capital gains in a similar manner, using an index of construction costs.

Labor Input and Labor's Share

Labor input is measured as the number of man hours of labor employed in the industry. Labor's share is the total compensation paid employees as a proportion of total revenue. Operators of leased equipment are excluded from man-hour calculations.

Line-Haul Expense, Line-Haul Input, and Line-Haul Share

Line-haul expense is the total expense for nonlabor items - petroleum products, including diesel fuel and gasoline, oil and other lubricants, for example.

Line-haul input may be computed by constructing a weighted index of the component prices of line-haul input and dividing this into total expenditure of line-haul items.

Line-haul share was computed as one minus the OR corrected for leasing bias.

Hypotheses Tests

Testing the existence of an operating ratio effect belongs to a class of problems that have received relatively little attention in the literature. The general nature of the problem is one of discriminating between alternative models, or alternative specifications of the same model (Quandt 1974).

This problem has been referred to as the problem of a "non-tested" hypothesis. In the example we must deal with in testing the OR effect, we are dealing with two separate hypotheses H_1 and H_2, where the first is that λ has a zero value and the second is that it has a non-zero value, assuming that firms maximize profit.

Because of the nature of parameter space, we cannot test the null hypothesis by testing the significance of the regression coefficient; we can only test whether or not the constraint is effective against the alternative that it is not, <u>conditional</u> on the assumption of profit maximization may be tested, conditional on the assumption that λ is non-zero.

The test used was a likelihood ratio of the error sums of squares of the regressions with and without λ, assuming that the cartel-firm maximizes profit, plus a test of the profit maximization assumption assuming that λ is non-zero. The test statistic is given by:

$$\chi^2 = - N \ln \left(L(\Theta_2) / L(\Theta_1) \right) \tag{44}$$

where

N = number of observations

$L(\Theta_1)$ = null hypothesis likelihood function

$L(\Theta_2)$ = alternate hypothesis likelihood function

EMPIRICAL RESULTS

The factor share equations were estimated both as single equations and as constrained sets of equations. A summary of this work is presented in the form of two equations used to test separate aspects of the theoretical implications: 1) That the cartel-firm is effectively regulated given that it maximizes profit and 2) whether cartel-firms are profit maximizers given that regulation is effective.

Table 1 summarizes the equations used to test the two hypotheses. In set I, the equations for labor's share and capital's share were estimated simultaneously subject to the aforementioned coefficient restrictions and estimate of the allowed markup, g. These coefficients are β_7 in Equation (41) and β_3 in Equation (40). These coefficients were shown to be equal in (43) above.[8]

Set I in Table 1 was used to test the null hypothesis that $\lambda=0$ against the alternate hypothesis that $\lambda\neq0$. This was accomplished by estimating the same set of equations omitting the term of which λ is the coefficient, gS_L in one run. It is assumed that the cartel-firm maximizes profit; therefore, it is appropriate to apply the coefficient constraint.[9]

The χ^2 statistic used to test the null hypothesis of $\lambda=0$ is specified by Equation (44). The results of this are shown in Table 2. The results are significant at over the .005 percent level; consequently, we conclude that λ is non-zero.[10]

In the second test we assume that λ is non-zero and test the coefficient restrictions implied by the profit maximization assumption. This is reported in set II of Table 1. Since $\lambda\neq0$ was assumed in this set of equations, the value of λ was found using a binary search technique, carried out by constraining λ to assume values between zero and one at intervals of .1. The two highest F values from this procedure were selected, and the search continued at intervals of .01. The procedure was repeated, choosing values of λ that bracketed the highest F values at intervals of .001 and then .0001 until the reported regression set was obtained. The χ^2 test of the profit maximization assumption is reported in Table 2; it is significant at over the .005 level.

CONCLUSIONS

The model shows that the profit maximizing cartel-firm subject to an OR constraint has an incentive to overstaff, since the effective labor cost is below its opportunity cost; it has a disincentive to use capital because its effective cost exceeds its opportunity cost.

The implications of the theoretical model were tested by estimating the undefined Lagrange multiplier, that enters the firm's objective function given that regulation is effective. We reject the null hypothesis that $\lambda=0$ with considerable assurance; we can also reject the null hypothesis that the cartel-firm does not profit maximize conditional on the assumption of effective regulation.

These test results are consistent with the implications of the model; in a constrained maximization problem, λ may be interpreted as the change in the equilibrium value of constrained profit. If the constraint were relaxed (if the target level of operating ratio were lowered) by 10 percent, industry profit would increase by approximately 4.6 percent.

TABLE 1. RESTRICTED MAXIMUM LIKELIHOOD ESTIMATES OF FACTOR SHARE EQUATIONS

Method	Equation	Intercept	ln K	ln L	ln H	$\hat{g}S_L$	R^2	F	DW*
RMLE									
I	S_L	-1.7797 (0.3531)	-0.0145** (0.0213)	0.2550 (0.0568)	-0.1425 (0.0674)	0.4608 (0.07030)	.98	153.99	2.48
	S_K	3.8024 (0.5656)	-0.1223 (0.0672)	-0.0145** (0.0213)	-0.0433 (0.0800)	-	.86	16.18	2.27
	Joint Error Sum of Squares: .0021625								
RMLE (Binary Search)									
II	S_L	-1.3993 (0.1800)	-0.0160 (0.0185)	0.3156 (0.0457)	-0.2233 (0.0451)	0.5263*** -	.99	266.94	2.40
	S_K	2.9463 (0.4338)	-0.1119 (0.0488)	-0.4495 (0.1202)	0.4320 (0.1425)	-	.93	32.58	2.82
	Joint Error Sum of Squares: .0024527								

*Durbin-Watson statistic corrected for degrees of freedom.

**Coefficients were restricted to be equal.

***Lambda was restricted to have a constant value in the interval zero to one, until a value was found which maximized the F values of both equations.

TABLE 2
TEST OF NULL HYPOTHESIS THAT LAMBDA EQUALS ZERO
ASSUMING CONSTRAINED PROFIT MAXIMIZATION

$\tilde{\lambda}$	χ^2
0.4608	21.406**

Test of Null Hypothesis That Firms Do Not

Maximize Profit Subject to Regulatory

Constraint Assuming Lambda

Is Non-Zero

$\chi^2 = 8.649$**

**Significant at .005 level

NOTES

1. The Averch and Johnson literature is quite extensive, so no attempt was made to provide a complete list. An excellent introduction to the subject is provided in Baumol and Klevorick (1970), and Bailey (1973) treats it at length. At least three studies confirm the existence of the AJ effect; two studies by Spann (1974 and unpublished) and Courville (1974).

2. If the regulatory constraint does not hold as an equality, the problem must be solved using the Kuhn-Tucker Theorem. For a detailed discussion, see Bailey.

3. There is an extended discussion of this methodology in Bailey (1973). It is shown that the solution to any constrained maximum problem is found at the point of tangency between the isoconstraint and isoprofit loci. The isoconstraint locus alone may be used to find the equilibrium slope of the cartel-firm's position operating on the isoquant map by substituting in the first order conditions of the model. This methodology was used by Baumol and Klevorick (1970), to find the equilibrium position of the firm in the AJ model.

4. In the regulatory context, the TL function has a great attraction because it enables us to estimate the Lagrange multiplier directly. The use of the TL function to estimate λ was originated by Spann (1974). A similar use of the TL function to test factor share restrictions in a competitive case is found in Berndt and Christensen (1974).

5. Adding $\underline{\lambda r}$, $\underline{\lambda w}$, $\underline{\lambda z}$ to both sides of Equations (33), (34) and (35), respectively, gives:

(1) $\quad G_K = r(1 + \Lambda)$

(2) $\quad G_L = w(1 + \Lambda) - gw.$

(3) $\quad G_H = z(1 + \Lambda) - gz.$

Since $G_i = P(1 - 1/e)f_i$, where $i = K, L, H$, solving these three equations for f_i gives Equations (37), (38) and (39). From the definitions of the TL marginal products, $\partial\ln Q/\partial\ln K = f_K Q/K$, $\partial\ln Q/\partial\ln L = f_L Q/L$, $\partial\ln Q/\partial\ln H = F_H Q/H$; substituting from these definitions into Equations (37), (38) and (39) we have:

(4) $\left[rK(1 + \Lambda)\right]$ $PQ(1 - 1/e) = [\cdot]_k$

(5) $\left[wL(1 + \Lambda) \quad \Lambda gw\right] /PQ(1 - 1/e) = [\cdot]_l$

(6) $\left[zH(1 + \Lambda) \quad \Lambda gz\right] /PQ(1 - 1/e) = [\cdot]_h$

Where the expressions in brackets on the right hand sides of these equations are the derivatives of the TL function given in Equations (28), (29) and (30). Factoring out the fair mark-up terms (terms which contain $\underline{g}$) and transferring them to the right hand sides of Equations (5) and (6), only one additional step is necessary to derive the econometric form of the factor share equations. Let $\xi = (1 - 1/e)$. Then it follows immediately that the factor share equations are:

(7) $S_K = (\xi/1 + \Lambda)B_1 + 2(\xi/1 + \Lambda)B_4 \ln K + (\xi/1 + \Lambda)B_8 \ln H$

(8) $S_L = (\xi/1 + \Lambda)B_2 + 2(\xi/1 + \Lambda)B_5 \ln L + (\xi/1 + \Lambda)B_9 \ln H + \ldots$
$\ldots + \lambda\hat{g}S_L$

(9) $S_H = (\xi/1 + \Lambda)B_3 + 2(\xi/1 + \Lambda)B_6 \ln H + (\xi/1 + \Lambda)B_9 \ln L + \ldots$
$\ldots + \lambda\hat{g}S_H$

since the coefficients of the final terms of Equations (8) and (9) reduce to λ.

Industry representatives are understandably a little sensitive about this issue, and characteristically maintain that leasing has no effect on OR. The purpose in discussing the bias is not to produce an exposé, but to adjust OR to prevent any bias in the estimation of the factor shares.

6. The capital series was adjusted by B. Rogstad (Frucht et al. unpublished). A similar procedure was used to adjust the value of terminal capital to account for increases in costs. The data on rolling stock were adjusted for capacity utilization using the capacity utilization technique found in Friedlaender (1969). The series on terminal capital were not adjusted for capacity utilization. Capacity utilization in rolling stock is quite low; it averaged 44 percent corrected for empty back-hauls.

7. The regulation of motor common carriers by restricting operating ratio was not devised to allow the inclusion of capital expense. The theoretical consequences of this have been shown to be overstaffing, or excess use of inputs that are allowed a fair markup, while the use of capital is discouraged. In addition to any administrative costs of regulation, operating ratio regulation leads to an inefficient allocation of resources.

In practice operating ratio regulation does not work as it was intended. The ICC has decided that leased capital (rolling stock) may be treated as current expense. The apparent rationale for this is that leasing is viewed as a short-run phenomenon that is practiced because firms cannot meet current traffic demands with existing rolling stock. Whatever the rationale, the net effect of this treatment is to allow firms to earn larger profits than were initiated, while seeming to constrain the

industry to the target level of OR. A simple numerical example will demonstrate the effects of leasing on OR. Assume that there are two identical revenues of $1,780,000.00 per year. From the definition of OR, noncapital expense must be equal to .90 times revenue, or $1,602,000.00. Now, if the firms cross-lease rolling stock from each other they will receive additional revenues as rent, and incur additional expenses of identical size. This sounds quite innocuous until OR is recomputed, treating leasing expense as allowable expense. The result is that OR will be raised even though capacity will not be changed *certeris paribus*. If the two firms cross-lease $535,000.00 of rolling stock, the new allowed expenditures and revenues will change OR to .915.
The importance of leasing as a source of rolling stock declined during the period 1950-1964 - it fell from .417 in 1950 to .304 in 1964 - but the distortion of industry profit as a result is large. For example, gross margin (one minus OR) averaged .0719 when leasing was included and .2450 when leasing was not included. The purpose in using the corrected OR data is to avoid a bias in the observed values of factor shares. The shares of labor and line-haul expense should sum to OR if there is no distortion in their computation. The two shares were found not to sum to OR unless the bias due the leasing was removed; a discussion of the correction of OR for leasing bias if found in Frucht et al. (unpublished).

8. The justification for this somewhat unusual form of the likelihood ratio is found in Kendall and Stuart vol. 3 (1966), 42.7, p. 266: "We have left the criteria ℓ [the likelihood ratio in their notation] in the form in which they naturally arise: clearly any power of ℓ would serve our purpose equally well. In particular, we might use the (2/n) th power, in which case the criterion....becomes the ratio of determinants and it is - n times the logarithm of this ratio that is distributed as x^2."

9. The regressions in which the restrictions were relaxed have not been reported, but their sums of errors squared were used in computing the test statistic.

10. In addition to the results of the test reported in the text, we also note that the estimate of λ obtained in the first tableau in Table 1 is over six times its standard error. If we assume that the distribution of the estimators is asymptotically normal, this would indicate significance at over the .01 level using a 't' statistic to test the null hypothesis that λ is zero.

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BIOGRAPHICAL NOTE

Russell C. Cherry, Economist, Transportation Systems Center, U.S. Department of Transportation, Cambridge, MA.

Russell C. Cherry received the B.S. degree from Cornell University 1963, the M.S. degree from Texas A & M University in 1965, and the Ph.D. degree from Brown University in 1972. Dr. Cherry's current research interests are in the areas of quantitative microeconomics, and the economics of regulated industries.

The author wishes to express his gratitude to a number of individuals for the helpful criticisms they provide at different stages of this work; particularly helpful were Mark B. Schupack, George H. Borts and Harl E. Ryder.

SPECIAL DISCUSSANT'S COMMENTS

James C. Miller, III
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In keeping with the title of this session, I will attempt to assess the economic performance of the portion of the U.S. trucking industry that is regulated by the Interstate Commerce Commission (ICC). This assessment will be brief and fairly subjective. It does, however, comport generally with assessments made by other economists looking at the issue.(Cf. DeVany and Saving, 1976; Hilton, 1973; MacAvoy and Snow, forthcoming; Moore, 1972, 1976a, 1976b)

THE INDUSTRY UNDER REGULATION

Market research in the trucking industry has generally concluded that there are reasonably constant returns to scale. For a given type of service, it does not matter significantly whether the firm is large or small: the cost of doing business per unit of output is pretty much the same. Even though there may be minimum efficient firm sizes, the majority of markets can support more than one carrier. Demand in major markets is relatively price and service elastic because of the "safety valve" of private carriage and the existence of intermodal competition. Laid on these inherent market conditions are two important restraints imposed by the ICC: control over entry and control over rates.

Interactions among the ICC and the regulated firms have produced a heterogeneous industry. In certain markets there is substantial monopoly power, whereas in others (non-price) competition eliminates excess profits.

Let us first look at the regulated monopoly markets. With respect to entry, despite trucking ton-mileage having increased more then 10-fold since 1935, the majority of operating certificates currently relied upon by the carriers date from that period. It is difficult to obtain significant new operating authority. An applicant must prove that it is fit, willing, and able to provide the service. It must prove -- usually with witnesses -- that the market needs the service. It must prove that the incumbent carriers cannot provide the service. And often it must show that, as a result of entry, there would be no adverse financial impact on the incumbents. This is a very difficult burden of proof, especially in cases that really matter and therefore are likely to be opposed.

Despite the difficulty of obtaining new operating authority, attempting to do so is a thriving business. In fact, the major activity at the commission is processing motor carrier applications. Of the 8,857 cases before the ICC in fiscal year 1976, 6,800 involved carrier operating permits -- 77 percent. While a very large fraction of these are approved, this does not mean that entry into significant markets is "easy." After all, there are many six-figure lawyers in this city whose job is to advise clients when and how to go after operating authority, but more importantly, when it is not worth the effort.

Another factor that gives rise to monopoly power is the relative laxity of rate regulation. In fiscal year 1976, there were 216,967 motor carrier tariffs received by the ICC. Of these, only 7,312 were criticized, and only 1,986 were rejected -- less than one percent. While I suspect the major ones were criticized and the minor ones got through easily, this does suggest some laxity on the part of rate regulation.

Even if rate regulation were "tight," a firm can usually earn excess profits by diminishing the quality of service and therefore reducing average cost. Ways in which truckers are able to alter service quality include time of dispatch, frequency of service, size of trucks, and ordinary sales effort.

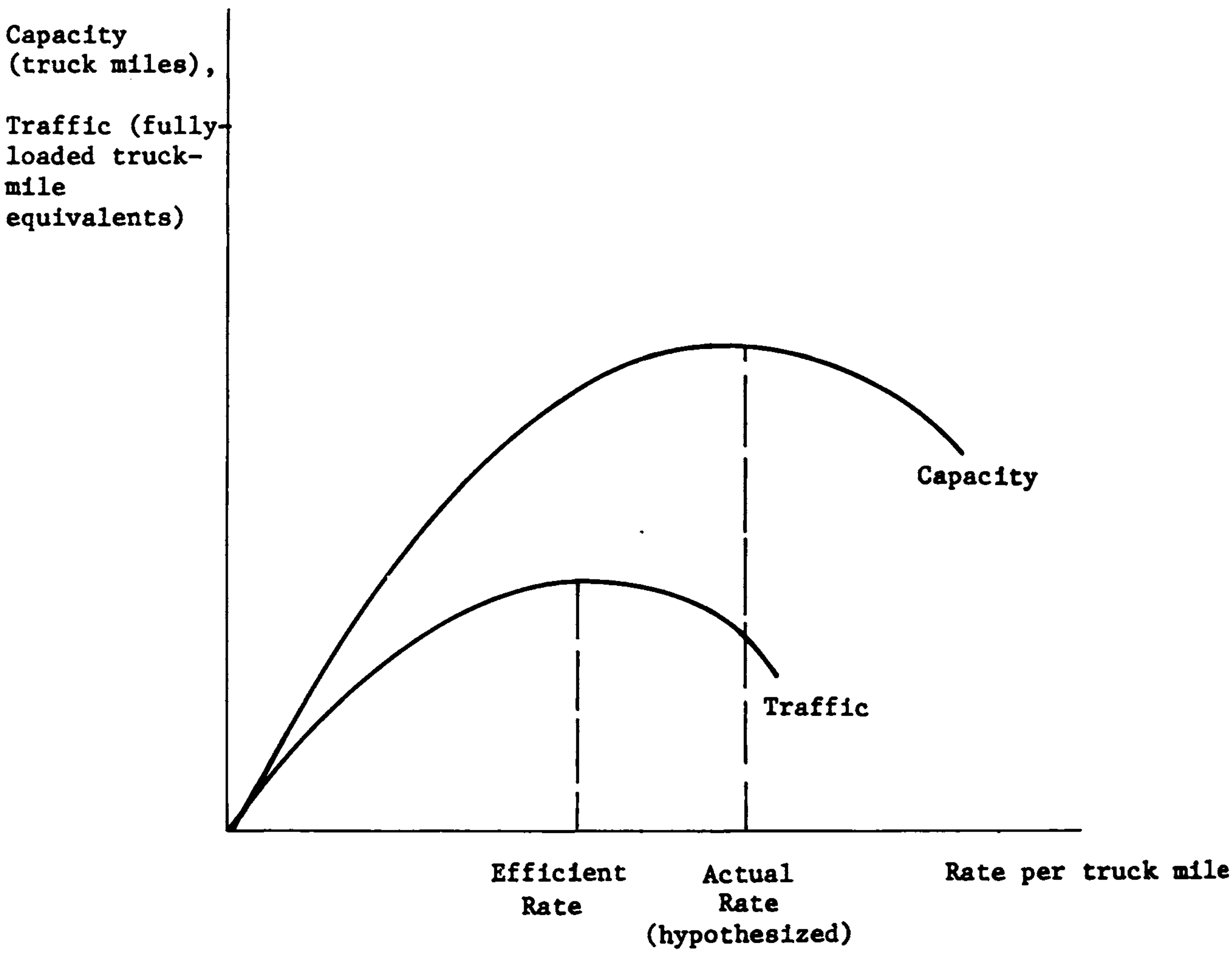
In other markets there is sufficient competition so that potential excess profits are bid away. In those markets any attempt by the ICC to regulate carrier rate of return at a level other than the firm's perceived cost of capital will be futile. Lower rates simply result in lower service quality. While I do not have hard evidence of this, I would conjecture that rate regulation, through the aid of the rate bureaus, serves to maximize total investment in these non-price competitive markets. If the industry were efficient, traffic, rather than capacity, would be maximized. (See Figure 1) Rate bureaus usually proposed rate increases whenever in their judgment this would raise the actual load factor temporarily above breakeven and thus enable the firms to realize quasi-rents on existing capital (until capacity is increased).[1]

THE COST OF REGULATION

We may now attempt some truly back-of-the-envelope estimates of the social cost of trucking regulation. First, let us look at the regulated monopoly markets. According to the American Trucking Associations (ATA), the value of operating certificates is approximately 6.1 percent of total assets, or 12.4 percent of shareholders' equity. (American Trucking Associations, 1972). The ATA also states that between 15 and 20 percent of the annual revenue attributable to operations made possible by new certificates is wrapped up in the value of those certificates.

The fact that these operating permits have value is evidence that they are generating monopoly rents. But translating this information into the total social cost of monopoly is not easy. For one thing, the ATA figures do not reflect the implicit value of certificates that have been capitalized through sale of the enterprise and transfer of the

FIGURE 1: CAPACITY, TRAFFIC, AND RATES IN REPRESENTATIVE TRUCKING MARKET



Source: Adapted from Miller, forthcoming.

authority. But let us assume that 12.4 percent of shareholders' equity is the appropriate measure of the value of these certificates. On a 1975 stockholders' equity of $2.9 billion, this implies the existence of "excess rates" on the order of $360 million, or a markup of approximately 2.4 percent in 1975 revenues of $15.2 billion. Assuming that the price elasticity of demand is (negative) 2.0, this implies a "welfare triangle loss" on the order of $8.5 million annually.[2] In a real sense, however, some of the $360 million in excess rates is also a social cost. That is, firms will compete to hold onto their monopoly power, and from a social point of view resources spent in attaining authority and preventing others from getting it are wasted.

Addressing the social cost due to inefficient price/quality options in non-price competitive trucking markets is even more difficult.[3] What is needed is to determine the amount of excess fares -- as compared with the efficient option(s) -- and subtract from that the value of the increased service quality. This is very difficult to do, and I know of no one who has even made an attempt. Absent such an input, let us just assume that the net cost of this inefficiency in trucking is on the same order of magnitude of what George Douglas and I found to be the case in the airlines industry -- that is, between 3.8 and 5.5 percent of total revenues. (Douglas and Miller, p. 172). If we assume that two-thirds of the regulated trucking industry is non-price competitive, this implies a social cost ranging between $386 million and $559 million annually.

There are, of course other costs attributable to trucking regulation. There is circuitous routing, needless backhauls, constraints on interlining, underutilization of private carriage, lack of competitive pressures that lead to excessive costs, rate imbalances with respect to direction of movement and seasonality, and, because of the emphasis on capacity, externalities in the form of excessive air and noise pollution, increased road accidents, crowding, and excessive fuel consumption. As a conservative estimate, I would gauge that these costs add another billion dollars a year.

In conclusion, I suggest that trucking regulation costs the U.S. economy at least $1.4 to $1.9 billion per year.[4] While this is not very precise, the amount is quite significant. As the late Senator Everett Dirksen used to say, "A billion here and a billion there, and pretty soon it adds up to real money."

NOTES

1. This hypothesis would be supported by a finding that $e \approx 1/c$, where e is the "full price" elasticity of trucking demand, and c is the proportion of total cost accounted for by capacity (vis a vis traffic). (Douglas and Miller, 1974, p.60; and Miller, 1976, pp. 17-20).

2. If we assume that the appropriate measure of the value of the certificates is 20 percent of one year's revenue, or two percent of total revenue (discounting at 10 percent), this means that there were excess rates in 1975 of $305 million and a welfare triangle loss of approximately $7.2 million (again assuming a -2.0 demand elasticity).

3. It should be noted that welfare losses due to non-optimal price/service options may exist in monopoly markets as well.

4. This does not count the rents (if any) being earned by trucking labor. On this issue, see Moore, 1976a.

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DISCUSSANT'S COMMENTS

Michael E. Levine
Professor of Law
University of Southern California

Taken together, both the Kolins and Cherry papers suggest that the Interstate Commerce Commission trucking regulation distorts resource allocation. Mr. Kolins gives us numerous examples of the inefficiencies occasioned by entry restriction. These include empty backhauls, customer dissatisfaction, and energy waste. So distorted are the economic conditions created by ICC policies and the Motor Carrier Act of 1935 that even with these inefficiencies, ICC operating rights command substantial economic rents, as evidenced by the high prices paid for them. Dr. Cherry's paper hypothesizes and partly confirms that rate regulation through operating ratios may produce overstaffing, undercapitalization, and perhaps restriction of output.

If both major ICC regulatory efforts, entry control and rate regulation, lead to important waste and distortion in use of resources, then the burden of justification falling on those who favor the existing regulatory arrangements is severe. Justification and burden of proof were not mentioned in these papers, but if debate over regulatory policy is to be fruitful, ground rules ought to be established. I will leave specific justification or criticism to those who are currently evaluating trucking regulation. But as an economics-trained lawyer I would like to discuss the problem of burden of proof in evaluating regulation.

The papers I am discussing exemplify two methods of making findings about regulation:

(1) Papers like the Kolins paper ("Institutional" papers) are focused on institutions and particular facts, in some ways anecdotal, often rich in detail, and obviously precisely tailored to the "real world" of the subject industry and its regulators.

(2) Papers like the Cherry paper ("analytic" papers) are attempts to build abstract, rigorous models which quantify conclusions and are in principle testable from data.

One can overstate the differences between these methods (institutionally-focused anecdotal papers require the use of theory to make them coherent; model building requires something to model, i.e., facts); but they do involve two distinct paradigms of research. Each has advantages and disadvantages:

"Institutional" papers are "real," less likely to overlook important real-world factors or institutional influences; easily understood (although not necessarily easily done); and politically appealing (e.g., the dramatic studies done on the performance of California intrastate airline markets have been an important buttress for those favoring airline regulatory reform).

On the other hand, such studies are "messy", easily debated by the addition of facts or psuedo-facts (there is always something you have left out), require enormous investments of time and effort in acquiring industry background information and, because they don't always focus clearly on theory, sometimes miscombine data to reach erroneous conclusions.

The "analytic" papers are clean, precise-appearing, often cut through lots of static to get to essentials, can often be done without lots of specific industry background, and are intimidating.

On the other hand, analytic papers can be insufficiently rich (the models can be "clean" to the point of being sterile, not capturing important features of industry situation or behavior); the analyst may be misled by atypical time periods or circumstances; there are some limits to complexity imposed by the tools used; and such efforts are easily dismissed as impractical theorizing by those who don't understand them or just don't like what they say.

Where does this leave us? We could cope with this from a public policy standpoint if it weren't for the artificial burden of proof imposed by the political process on researchers doing work whose implications suggest regulatory change. But for these realities, defenders of regulation would be required to build models or conduct institutional inquiries of their own and subject them to professional disinterested criticism (and I might add that what few efforts have been put forth in this way have been notably unsuccessful). Then we could compare reformist research and criticisms with status-quo-oriented efforts and make our best guess as to which research was right. We might even rightly have some threshold bias in favor of a status quo which, after all, works pretty well, and against untried "improvements" unless they were particularly well supported by research and argument. But once this prima facie presumption in favor of the status quo was overcome, the burden would shift to the defenders of present policy.

But that is not the way things are. In the current political climate, proponents of reform are first put into rigorous proof, and if they meet that burden, are then subjected to an ineradicable residual skepticism. Defenders of the status quo are permitted more (one might say infinite) leeway.

Whether this is because proponents of status quo have economic interests at stake and are thus prepared to invest in the political process, while most of those in favor of change are not economically interested and thus cannot justify those investments, or for more complicated and less ominous reasons, I do not know.

But some way must be found to balance more equally the burden of proof between proponents and opponents of regulatory change. How much weight do we give to unsupported assertions of benefits from defenders of the status quo? How many counterstories must be refuted, and how many countermodels exploded, before we can justify change?

DISCUSSANT'S COMMENTS

Robert C. Baesemann
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What I would like to do first is recall that this is the second conference on regulatory reform that I have helped to organize. I remember, a year ago, a conference on regulatory reform in the airline industry. At that time a call to battle was issued by John Snow and Steven Breyer, a law professor at Harvard Law School. In those halcyon days of the deregulators (whom Mr. Miller has referred to as the White House crazies), the claim was that enough research had been done. It was time for scholars to put down their books and take positions in order to do something about welfare losses in the airline industry.

In the course of helping to organize this conference, I found only a few people were willing or able to participate in a conference on motor carriers as compared to an earlier conference on the airline industry. I find on listening to the papers this morning that a call to battle regarding regulatory reform in the motor carrier industry is not in order. Notwithstanding some people's opinion that academics always want to do more studies and not act, there is good reason for us to do more research.

Not to be insulting to some of the people who reported on very interesting findings this morning or this afternoon, I say this because I think that the papers this afternoon relate to the papers this morning in the sense that they reflect a pronounced need for more and better research in the future. I find that Professor Maister's paper asked the question, Does different regulation in different provinces of Canada result in different rate structures in those provinces and, does, in some sense, more severe regulation lead to higher rates than otherwise? The question here is, do different kinds of regulation lead to different cost structures or different demand structures which, in turn, lead to higher rates? Because Professor Maister's conclusions are a bit ambiguous (although I think they are less ambiguous than he does) I suggest that we have one paper today that says we really do not know exactly what it is we wish to model. At least in the case of Canada we are not able to identify the effect of regulation. If we are willing to extrapolate from the Canadian experience to the United States, there may be a note for caution here -- alternate forms of regulation may have unpredictable effects.

Professor Allen raised two issues that I found particularly interesting. He discusses the consequences for location in the case of deregulation and suggests that we still have a way to go before we can say what will happen to demand in the very long run when users are free to relocate.

In addition, I found Professor Allen's paper very interesting because he suggested that in an instance of regulatory reform, rates fell by approximately five percent. This is not an alarming or precipitous decline in rates. If his findings refer to nominal rates, it may be interpreted as a more serious decline in rates. More importantly, service quality did not suffer in his findings.

At any rate, Allen's paper is suggestive of the fact that there are things left to learn about long run demand and what we should expect from deregulation. In addition, I found the Cherry paper very interesting. Cherry finds that firms do not simply minimize costs. They are concerned with more complicated objectives usually summarized by saying firms maximize profits. Indeed, cost minimization is a simple process whereas a firm subject to regulatory constraints, may maximize profits by doing something other than minimizing costs. If, in fact, firms do not cost minimizers in response to regulatory constraints, the data they generate is not amenable to the estimation of cost functions. This is another question we still have not dealt with.

Finally, a list of important points that were not addressed here would include the question of, are there really any binding constraints on firms in the industry? To what extent are the regulations enforced? Does the very complicated nature of the rate structure allow for effective rate freedom by virtue of the fact that it is always possible to post a new rate involving some new definition of the service? As a consequence of these observations, I am delighted with the papers we heard today, but I look forward to seeing more and better papers in the future.

EVENING SESSION

Chairman: Raymond L. Bisplinghoff

MOTOR CARRIER ECONOMIC REGULATION

Frank E. Fitzsimmons
President
International Brotherhood of Teamsters

I would like to say in the beginning that I am most grateful for the opportunity to be with you tonight to share what I consider to be some very important viewpoints on the question of motor carrier economic regulation.

In all candor, it is my firm conviction that the public interest is being trampled upon by advocates of deregulation of surface transportation.

Economic dreamers and other occupants of academic and governmental ivory towers are pouring out inflated and unsupported guesses of the economic cost of regulation. And in so doing they are ignoring its economic and social benefits. They falsely charge that regulation benefits only the regulated carriers and the Teamsters Union, which currently seems to be everyone's fall guy.

The market economists apparently are totally unconcerned that deregulation will result in gross public abuses and deterioration of highway safety.

Fortunately, the responsibility for regulation rests with the Congress which must account to voters for protection of the public interest.

Congress, in its wisdom, has seen through similar unsupported charges in the past and preserved a national transportation system as essential to our economy and our national defense. I have every confidence that it will continue to do so.

The Interstate Commerce Act was enacted to protect the public against abuses. The commission was created by Congress in 1887, largely to combat discriminatory pricing practices employed by railroads. In 1935, Congress passed the Motor Carrier Act because the industry then was unstable economically, dominated by ease of competitive entry, cutthroat rates, and unsafe operations.

The industry was overcrowded with small economic units unable to satisfy even the most minimal standards of safety or financial responsibility. In addition, unregulated motor carriers were creating unfair competition to the railroads which had common carrier obligations.

A combination of abuses, deterioration of safety standards, financial irresponsibility, destructive competition, and inadequate service necessitated regulation of motor carriers. The conditions that necessitated regulation and which certainly would recur if it were terminated, are not just fictional paper tigers. Rather, they were presented to Congress with documentation by the Honorable Joseph B. Eastman whose name goes hand in hand with public service and integrity in the field of transportation.

I do not believe that a dollar value can be affixed to the numerous benefits which directly or indirectly flow from regulation. Regulation in the public interest means the establishment of rates that are not unduly discriminatory or preferential.

Regulation means the provision of adequate, reliable, and efficient transportation service to all shippers of this country, regardless of their size or location. Regulation assures service to small as well as large communities.

It means the enforcement of safety standards and protection of the motoring public on the highways.

It means the maintenance of a transportation system, capable of meeting the needs of national defense. Through the years, regulation has enabled small businesses and small communities to develop through the guaranteed availability of transportation at reasonable rates.

Deregulation not only would result in the rebirth of the abuses that led to regulation, but also would result in widespread dislocations of small businesses and their employees, with substantial economic impacts on every part of our country. In my judgment no one can adequately put a dollar value on the varied economic and social benefits of regulation.

In 1948 the Teamsters Union intervened in a rulemaking proceeding commenced by the Commission on Regulations to govern the leasing of vehicles.

During the course of that proceeding, the union and others presented detailed evidence of the severe abuses which the lack of adequate regulation was creating.

It showed that marginal owner-operators, or gypsies, driven by economic necessity, were forced into wholesale violations of the safety rules of the commission.

It demonstrated that these gypsies, in order to maintain payments on their equipment, drove as many as 16 and 18 hours a day, many taking drugs to keep awake.

It proved that their tractors and trailers were not maintained and were a menace to everyone using the highways. The rates available to these gypsies were frequently little more than enough to pay for gas and oil.

Fortunately, the commission and the United States Supreme Court recognized the necessity of exercising reasonable economic control over our transportation system. The motoring public can be very thankful they did.

We also owe a debt of gratitude to the commission and the courts for the sound economic condition of motor carrier transportation today.

The unrebutted testimony of actual drivers in the leasing rules proceeding amply demonstrates that economic regulation is essential to safety on the highway. Unless the economic condition of carriers and owner-operators is preserved, equipment will not be maintained, and safe hours of driving will not be observed. You can't have safety with empty pockets.

Notwithstanding the ease with which some economic dreamers pluck figures alleged to be the costs of regulation, actual costs are difficult to support. Professor Thomas Moore has suggested that if the transportation system were deregulated, there would be an automatic 20 percent reduction in trucking rates.

Professor Sloss, another deregulator, has estimated that deregulation would lower trucking rates by 6.73 percent. The wide discrepancy in their figures alone reflects the virtual impossibility of trying to determine the cost of regulation.

In my judgment, the level of rates at any one time under deregulation are a function of demand for transportation and availability of equipment.

The water carrier industry, where only about 5 percent of the tonnage is regulated, illustrates my point. Proceedings before the commission show that in 1969, rates on unregulated bulk commodities -- such as grain -- ranged from 50 percent to 150 percent of rates published by regulated carriers. The rates depended upon level of demand and availability of barges.

Under deregulation, there would be no certainty as to the rate that a shipper would have to pay at any particular time. Rates, as I have shown, could vary as much as 200 percent from the low to the high. The adverse effect on small shippers of such swings would be severe.

Furthermore, the financial ability and economic incentive of motor carriers to acquire and maintain adequate equipment depends on revenues.

If rates under deregulation would be as depressed as Professor Moore would have them, carriers would have neither the ability nor economic incentive to replace equipment or to maintain it.

Lack of equipment would become even greater as large corporations -- private carriers -- under deregulation, siphoned off profitable return loads, thereby reducing revenues needed by common carriers to meet transportation needs of the general shipping public.

The level of unregulated rates also would reflect the size and location of the shipper. While large shippers with their enormous economic power would gain rate advantages from deregulation, small businesses and small communities would be forced to pay much higher rates, if they were still able to obtain service at all. This explains why big shippers -- seeking a competitive advantage -- now lobby for deregulation. These are some of the hard realities that economic dreamers ignore in their headlong rush to deregulate motor carrier transportation.

But there are others. Professor Moore and other deregulators completely neglect the biggest cost of deregulation.

They shut their eyes to the billions of dollars in taxpayers' money that would be spent by government to provide service to the tens of thousands of smaller communities that carriers would no longer be required to serve after deregulation.

If anyone doubts the Congress would vote subsidies to provide transportation service to small communities that would lose it, let me call attention to the so-called 4R Act of 1976.

In that act, Congress provided that, even when the Interstate Commerce Commission finds that rail service is uneconomic and should be abandoned, a shipper, town, county or state can obtain a federal subsidy to continue such service. Subsidies are available even though the community receives adequate service by truck.

With this precedent, does anyone doubt that Congress would provide subsidies for maintenance of the only transportation service that small communities throughout the country now receive. As trucking companies abandon small communities after deregulation, shippers and towns all over our vast country would demand, and receive, subsidies. The bureaucracy to administer this program would make the Interstate Commerce Commission look like a pygmy in comparison.

I am for free enterprise. I am opposed to any unnecessary subsidies. But, if there is deregulation, there will be subsidies, and I will urge that motor carrier employees who lose their jobs be given lifetime protection equivalent to that granted by the Congress to the employees of the Penn Central.

In measuring the monetary values of regulation versus deregulation, these costs must be included.

Some academic theorists have alleged that the Teamsters Union is a major monetary beneficiary of regulation. Professor Moore, for example, suggests that the average annual compensation of employees of regulated trucking companies is higher than that of unregulated trucking companies. While this is an interesting statistic, it is meaningless.

He made no comparison of man-hours worked by employees of regulated companies with those of unregulated companies, Second, he made no comparison of employee productivity as, for example, ton-miles of freight handled per employee. Third, wage levels are lower in the South than in the North and West. Moore's grade school comparison ignores these critical considerations.

Professor Moore asserts that by 1972 regulation of surface transportation had resulted in inflation of compensation of drivers, helpers, and platform workers between 48 percent to 61 percent, and had increased the total wage bill of trucking in 1972 by $1.8 billion to $2 billion. Even the barest analysis shows that Moore's figures are worthless.

In arriving at his figures, Moore compared the average weekly earnings of drivers and helpers with those of all workers engaged in manufacturing. He concluded that from 1938 to 1972, wages of drivers and truckers increased 48 percent more than the average wage in manufacturing.

Within the category of manufacturing, average weekly earnings in 1972 ranged from $93.96 in apparel and other textile products to $219.22 in motor vehicles and equipment. In non-manufacturing industries, average weekly earnings ranged from $75.71 in hotels and motels to $217.46 in bituminous coal mining. Obviously, average weekly earnings differ as between industries and such variances have no relationship to regulation or deregulation.

I am proud of the job that the Teamsters have done in increasing severely depressed wages paid to drivers in the 1930's. Thirteen hundred dollars a year for a man and his family can hardly be said to be a living wage, yet that is what drivers were making in 1938.

Under the National Master Freight Contract and supplemental agreements, which we negotiated in 1976, a local cartage truck driver in the Central States will receive a straight-time rate of $8.50 per hour effective April 1, 1977. He will also receive 3 days paid sick leave, or a payment of $204 at the end of the year if he does not use his earned sick leave.

If the driver works 40 hours per week and 52 weeks of the year, he will earn $17,680. A family of four is not going to have money to squander with those wages. The Bureau of Labor Statistics has indicated that an intermediate budget for a family of four in the autumn of 1975 was $15,638.

Considering increases in the consumer price index since that time, an intermediate budget would be $17,000 to $17,500 for the year beginning April 1, 1977. In this budget, no allowance is made for college education expenses, increases in property taxes and other local taxes, or rises in social security taxes.

A local cartage driver working full time in 1977, and not missing even one day, will have earnings approximately equal to an intermediate budget, and he will have to depend on overtime earnings to buy a few of the "comforts" or to hope to send his children to college.

Accordingly, I am amazed at Professor Moore's suggestion that $17,500 is inflated compensation.

I intend to use all of my efforts, and those of our union, to increase that figure so that our members will have a decent standard of living. Many of the local cartage companies that are covered by our union contracts are not regulated by the federal government.

They operate in commercial zones and are exempt from such regulation.

I have news for Professor Moore. The important factor in obtaining adequate wages is the strength and effectiveness of the union rather than whether the industry is regulated or not.

I personally can assure Professor Moore that the wages of drivers, who are members of the Teamsters Union, will not go down if there is deregulation.

The Teamsters Union has more members outside of the trucking industry than it has within that industry. Through negotiations with employers, it has obtained for its members in nonregulated industries increases which compare most favorably with those negotiated with the regulated motor carrier industry.

Many other comparisons could be made to demonstrate the shallowness of the deregulators' guesses on the cost of regulation, and I expect to make them in the future. Suffice it to say for now that the social costs of deregulations are unthinkable.

Hazardous highways on which our members drive more often than others, cutthroat competition, an unsound national transportation system, vastly unequal rates as between large and small shippers, and total loss of transportation service to thousands of communities -- or more likely high government subsidies -- are the realistic costs of deregulation.

Thank you.

MOTOR CARRIER ECONOMIC REGULATION

J. Robert Morton
Vice President
Corporate Transportation and Distribution
Combustion Engineering, Inc.

I want to tell you in all sincerity that I, as President of the National Industrial Traffic League, as a Corporate Vice President of Combustion Engineering, Inc., as a student of transportation; and you, as suppliers and users of transportation, as molders of public opinion, have a proud heritage.

You and I also know that America's surface freight transportation system, the finest man has ever devised, is under attack. You and I know that the growth of any nation can be measured by its transportation systems -- its ability to move people and goods.

Over a year ago, February 5, 1976 to be exact, President Ford signed the Railroad Revitalization and Regulatory Reform Act of 1976. This act brought the Consolidated Rail Corporation (better known as ConRail) into a viable corporation. It revised and updated policies and is designed as one part of the basis of energy and imagination to bring into being a balance to transportation. It recognizes that railroads are a business affected with the public interest. It recognizes that we must leave the provisions of transportation to private initiative and keep government in the role of regulator and referee.

In December of 1975, the Ford Administration sent to Congress a Motor Carrier Reform Act to amend the Interstate Commerce Act. This new act would increase efficiency and competition and reduce costs in the motor carrier industry. It would allow easier entry and greater price flexibility and remove excessive and wasteful regulation, among other purposes.

I want to make it perfectly clear in reciting the purposes of that bill, that neither the National Industrial Tafffic League, nor the American Trucking Associations, nor the motor carriers supported the Reform Act in totality, nor did a great many others. We all found items of agreement -- we found others of total disagreement. As you know, the bill that was introduced died with the 94th Congress.

Let's take a few minutes to step back and take an overview look at the transportation industry.

No industry is more characteristically American than transportation. Without the ability to move goods and people about cheaply and expeditiously, industrial civilization is impossible. The United States, confronted with the challenge of its great spaces, developed that ability even before anyone foresaw exactly what industrial civilization would be like. What America has become, to a large extent, it has become possibly because of its transportation system, and without any doubt, our system has set the pace for the world.

Trends in transportation result from technological change, changing desires in what the public will buy, the practices and policies of carriers, and from government policy. A major trend of the 70's emphasizes the increasingly active efforts on the part of government to manage our national economy. You and I, as businessmen, can no longer forecast and evaluate economic trends; instead we must hover nervously over crystal balls and guess government's next move. This policy implies short-run decisions on expansion, inventory, and investments, all of which lead to instability in the marketplace.

We cannot afford to discuss transportation in a vacuum. Transportation, the bedfellow of all industrial and agricultural activity, is, in turn, affected by all business. All the factors of our economy have a continuing, constant affect on our transportation carriers -- surface, water, and air.

But let us look at transportation today. The great U.S. transportation system inspires less pride than indignation. Like a lot of the national self-criticism invoked these days, complaints about transportation are often ill-informed and lacking in perspective.

Characteristically, I must admit, our government, any government, ignores complex problems until they become critical and then rushes into action before the consequences are fully evaluated. This I find to be an accelerating trend. As a result, we have confusion -- sometimes chaos -- a waste of time and resources, and an adverse impact on the public as a whole. The policy problem can be clear, but the solution is in the hands of politicians.

Yet you and I, shippers and carriers, do have a tool. Our effectiveness can be broad. We embrace technical competence, organizational and human relations skills, visions, and, above all, an infinite fortitude. We hold our positions because we have demonstrated our above-average measure of management effectiveness to our respective companies.

Do we use our effectiveness to its best degree? Are we contributing to the effective solution of our mutual problems in transportation? Are we communicating most effectively? I will not answer yes or no. I say to you -- judge your method of operation; ask yourself, am I contributing my total communication abilities?

I do not feel that shipper-carrier communications are being used most effectively, nor do I feel they are being fully exploited by both parties. I sincerely believe that we need to forge new, strong links in a chain of communications which will lead all of our transportation systems back toward viable operations free from government ownership or disguised government control.

Academic theorists, bureaucratic "planners," and I put the word planners in quotes, and the members of the news media have joined in a concerted effort to eliminate or water down federal regulation of transportation.

By and large, these critics have no practical knowledge, and no experience in the complex world of handling and moving freight.

Senator Barry Goldwater of Arizona refers to the ongoing regulation-deregulation fued. I think "fued" is an understatement.

What you and I face, as well as the American consumer, is one of the greatest gambles with the basic structure of the American economy in our history. At stake is the destiny of transportation -- this country's largest industry -- and the ripple effect that can jolt every other industry should transportation and distribution undergo what is referred to as deregulation.

Too many amateurs want to dismantle an irreplaceable machine. They don't want to fix it. They want to take it apart.

I am concerned as I stand here before you this evening -- concerned that untruths are being heisted upon the American public. Concerned that highly placed individuals are "selling deregulation."

What is more, I am concerned that in transportation's fight to stay under private ownership, transportation executives are not talking as a united front. These executives and their staffs appear to obtain satisfaction in name calling, petty accusations, and refusing to talk as responsible transportation individuals. They are satisfying selfish whims and wishes, reacting to the short-range and forgetting the long-range implications of bringing the user a complete transportation system.

It is my fervant hope that, promptly, we are going to see transportation statesmanship return to our profession. That no matter who we work for -- the over-the-road carrier, the airline, the railroad, the waterway or industry -- we will be united as one telling the truth and preserving the American way of transportation operated by the private company, financed by private capital under sensible regulation and regulatory agencies.

As I said previously, I am President of the National Industrial Traffic League. It pleases me to be able to work with a group of shippers who are dedicated to the development and maintenance of sound conditions in transportation, having in mind the needs of the nation, the carriers, and the shippers. Perhaps, we may not always agree on every word, there may be even whole ideas we do not always agree upon, but there is one thing that, as statesmen of transportation, we must agree to, and that is the attainment and preservation of an adequate and efficient national transportation system privately owned and operated. Permit me to quote Article II of our Constitution:

> ....to promote adequate national and international transportation, and to this end: to interchange ideas and information concerning traffic and transportation matters; and to cooperate with the Interstate Commerce Commission, the Federal Maritime Commission, the Civil Aeronautics Board and other regulatory bodies, both federal and state, with the Department of Transportation, and with the transportation companies, in developing a thorough understanding by the public, the carriers and the national and state governments, of the transportation requirements of industry;

to obtain legislation that will be helpful to commerce, and to secure the modification of laws, rulings, and regulations that may be found harmful; and to promote cordial relations between shippers and carriers....

We of the league are very much cognizant that for 90 years the Interstate Commerce Commission has functioned as an arm of Congress. Its mandate has grown as our national system of surface transportation has expanded. It is widely recognized that our network of intercity freight carriers is the finest in the world. While some limitations are imposed on entry and rates, it is, nevertheless, a private enterprise system. We must keep it private. Believe me when I tell you, as I visit the Washington scene, there are those who would force government ownership and operation of all transportation.

I know that not every shipper may get perfect service at the rates he desires. It may not be ideally energy-efficient. And it may contribute, to some degree, to pollutants in our environment. But again I say our transportation system is still second to none.

I believe, I know, that the concept of regulating an industry by means of an independent regulatory agency has contributed, in no small way, to the advancement of our transportation systems. The idea is remarkable for its effectiveness. Regulation by an independent agency has, in my estimation, created a stability of policy crucial to long-range national growth.

There are those who feel that transportation policy should repose in the executive arm of our federal government. I am one who believes in transportation regulation by an Interstate Commerce Commission responsible to the Congress -- the Legislative Branch -- and to Congress alone. I am not one who believes that regulation fosters competition among shippers and carriers. Industry, such as my company, can choose to locate anywhere with assurance that there already exists, or will soon exist, the stable transportation services necessary to meet our immediate and growth requirements.

I want to address the remainder of my remarks to the present Congress -- the 95th. There is presently before Congress a Regulatory Reform Act for the aviation industry. Hearings have been held before the Subcommittee of the Senate Aviation Committee. I know you share with me without any doubt, the feeling that the Carter Administration will shortly introduce a new motor carrier reform act and, very likely this will be followed with waterway legislation.

The motor carrier reform act is not only expressed in terms of being mandatory by President Carter, but Secretary of Transportation, Brock Adams, has spoken out on several occasions as to the need for such legislation.

Before we go any further, let's look at two words -- DEREGULATION and REREGULATION. It is too bad that all too many individuals want to carelessly throw around DEREGULATION when they are actually interested in sponsoring an updating of legislation. In my humble opinion, this is REREGULATION. Let's start using the correct name.

Late in December 1976, as President of the National Industrial Traffic League, I directed a "transportation white paper" to members of

Congress, regulatory agencies, the Department of Transportation, the Administration, the carriers, and others. In this paper, we urged the Carter Administration and the 95th Congress to squarely face the issues of a new national transportation policy, highway financing, reform of the regulatory agencies and motor carrier regulatory changes. We said:

> The 94th Congress and the Ford Administration responded to the crisis facing Northeastern railroads, and the national railroad financing and regulation problems, by enacting the Railroad Revitalization and Regulatory Reform Act, and the Rail Transportation Improvement Act ('Son of ConRail').
>
> The challenge facing government and the transportation industry in 1977 is to act upon the issues facing highway financing and motor carrier regulation before they become critical. The time to act on these issues is now, not later. Also to be considered is reform of the transportation regulatory agencies.

We went on to say:

> The National Industrial Traffic League is a voluntary organization of shippers, shippers' associations, boards of trade, chambers of commerce, and other entities concerned with rates, traffic and transportation services of all carrier modes. The League is dedicated (1) to the attainment and preservation of an adequate and efficient national transportation system, privately-owned and operated, and (2) to the protection of the shippers' interest in transportation problems.
>
> The League for many years has urged the enactment of a new National Transportation Policy for all modes, and intermodal transportation. At the League's 1976 Annual Meeting held in Seattle, Washington, November 15-19, the members voted to establish a Special National Transportation Policy Committee to develop League viewpoints and policies in order to communicate League positions on this matter.
>
> The new National Transportation Policy Study Commission and the Department of Transportation should act promptly to develop such a new Transportation Policy, and the League's Special Committee will assist in presenting shippers' and receivers' views.

I do not want to burden you this evening with exact details of league policy, positions or thoughts on each of the subjects of our "white paper." I believe many of you have read articles in the transportation press as to what we did say. Others have read the paper. If you do not know its contents, please get in touch with our Washington office; we will be glad to send you a copy.

With this conference being dedicated to economic regulation of the motor carrier industry, please let me enumerate the subject areas we address the league to in the field of over-the-road transportation:

a. Entry
b. Rate Bureau Changes
c. Aircraft Exemption
d. Private and Contract Carriers
e. Commercial Zones
f. New Plants and Motor Carrier Service
g. Private Carrier Equipment Leases to Common Carriers
h. Restrictions on Dual Operations
i. Commodity and Route Restrictions
j. Back Haul Exemption
k. Suspension of Common Carrier Rates
l. Common and Contract Carriers Compensatory Rates
m. Protesting Discrimination
n. Soundly Conceived Mergers
o. State Filing Requirements
p. Motor Carrier Safety
q. Common Ownership
r. ICC Control over Intrastate Motor Carrier Rates

I believe that most of you in this room tonight know that I am dedicated to communication -- open communication -- good, meaningful interchange, both as President of the National Industrial Traffic League and as a shipper. To this end, I will not condone working in a vacuum. Currently, league officers, cognizant committee chairmen, and league counsel are meeting with other transportation executives, both regulatory and carrier. We know we will not agree and support every legislative bill in total, nor will we meet eye-to-eye on every policy. But, I do believe as we communicate and meet face-to-face, we are finding a far greater number of agreements than disagreements. It is even possible to find, by slight modifications, we can agree.

One of these meetings was with executives of the American Trucking Associations. President Bennett Whitlock, Jr., of ATA, wrote me recently:

> As stated earlier, it is unfortunate, but completely understandable, that there are differences in the policies of our industry and that of the league in some of the critical areas of transportation regulation. However, I am sure many of these are subject to a greater degree of harmony by more dialogue and exchanges such as this opportunity to reply in detail to your 'white paper.'
>
> What is more important than these differences, however, is the fact that we are seeking the same overall objective -- the continuation of a sound, responsive transportation system operating under private ownership. The alternative to this is nationalization, which neither the league nor our industry wants, and which we must resist with the greatest possible mutual efforts.

Bennett went on to say in his letter:

> All forms of transportation are necessary in our system as each carries out its specific function. However, so that

the system we have today of private ownership and operation may continue, it is imperative that the common carrier, by whatever mode, be preserved. It is the common carrier upon whom the vast majority of shippers must depend if they are to have the type of transport services needed. Anything that threatens the common carrier and his ability to properly carry out his function is a threat to the entire system and a step toward nationalization. We feel, therefore, that any, and all, recommendations that would modify or radically alter transportation regulation must be viewed in this light. We have no doubt that the league membership and our industry are in complete agreement on this point.

Our transportation system, under informed regulation, is still the best in the world. We must not approach innovation with trepidation. We must all, you and I, be willing to move forward in the public interest, to take the untried road. But, we must all recognize that statutory tinkering will not be a panacea for the ills of the carriers. As we consider regulatory changes, we must be sure that we will be doing it in a manner that will be genuinely beneficial. New transportation regulation must be for the carrier, be for all people, and must be in the consumer interest.

What we need is confidence. Confidence demands our most thoughtful concern, as it requires our full trust as well as our belief in the reliability and trust-worthiness of other persons, companies and institutions. When you analyze it, institutions are not more than the lengthened shadows of the men who hold responsibility for them.

You and I, as leaders in transportation and to whom people we deal with and those who work for us look up to, must, nonetheless, keep our eyes on the future. We must have confidence, we must be truthful, fully communicating with one another. Our thoughts and ideas are bound to have good effects.

MOTOR CARRIER ECONOMIC REGULATION

Lee R. Sollenbarger
Chairman of the Board
Transcon Lines
and
Past Chairman
American Trucking Associations, Inc.

I am grateful for the opportunity to be here today, but I think you have a right to know I came here with apprehension and concern.

First, I looked at the title of this get-together: "Workshop on Motor Carrier Economic Regulation." I wondered, and I think with good reason, if we were really going to have a "working over of motor carrier economic regulation." I say this because 1) every workshop or symposium or conference I have attended on the subject of motor carrier economic regulation -- and they have been legion over the past few years -- every single one of them boiled down to a dispute over whether we should have motor carrier regulation at all and 2) those who would not go so far as to call for complete deregulation nonetheless proposed or supported changes in the existing regulatory structure which are tantamount to deregulation.

It, therefore, I am sure, comes as no surprise to anyone in this audience that my position and that of the industry for whom I speak is one of clear and unequivocal support of regulation. This is not to say that the present regulatory framework is perfect and no modifications or changes of any kind should ever be made. The trucking industry has a clearly established record of supporting many regulatory changes in the past, and we are actively supporting changes today. Transportation is a dynamic activity, and economic regulation must be subject to study from time to time to see what changes, if any, would be in the public interest.

At the same time, however, the regulated motor carrier industry has not supported, and will not support, any changes that represent deregulation -- however cleverly these proposed changes may attempt to masquerade as reform. To say our industry would not support such changes is actually an extreme understatement. We will vigorously oppose any such recommendations.

This was the case with the so-called "Motor Carrier Regulatory Reform Act of 1976," which, hopefully, suffered a well-deserved death in the last Congress. I say "so-called" because the proponents of this ill-advised legislation called it "regulatory reform" when actually it was deregulation, pure and simple. And I say "hopefully" because deregulation doesn't ever seem to die...it won't even fade away.

We all have, or should have, a lasting commitment to preserve the finest transportation system in the world and that is what we have now under regulation. It is the only transportation system that basically remains under private ownership and operation -- as opposed to nationalization, or semi-nationalization, which is the case in almost every other country in the world. To preserve this system, to improve it where improvement is necessary, which includes modification of existing regulation when modification is justified, is a challenge to each of us. But to meet this challenge we must have a determined effort to separate fact from fiction, myth from reality, and theory from practicality.

It is in this general, and important, area of a better understanding of what the regulated motor industry is and how it operates that I hope this workshop can make a helpful contribution. My study of the proposals that have been made, and of some still being made, leaves me convinced that many of them come from a complete, almost inexcusable, lack of understanding of the basis for the economic regulation of the motor carrier industry, as well as how the industry functions in our economy. Needless to say, the question of regulatory reform in all areas of business will continue to be one of the most pressing items before the present Congress as it was before the last. Everyone is for regulatory reform or regulatory change. But it is here where a dangerous misconception has taken root. The rash of new regulations that have spilled forth from the Congress during the past several years in the areas of energy, environment, motor vehicle safety, occupational health and safety, etc., has led to charges that we have too much regulation. It is said to be too costly in terms of benefits realized and has become an undue burden to industry and to the consumer.

I do not question the validity of these charges. Unfortunately, this thinking has spilled over to include all government regulation, regardless of type, industry covered, or reasons imposed. Thus, we have found that regulation in economic areas, such as motor carrier regulation, which has proven itself over the years, is often included in the general condemnation. It has put our industry in the position of defending what is working because of what may not be working in other areas.

In the motor carrier industry, the regulation that came into being with the Motor Carrier Act of 1935 has worked, and is working today. It has given us the most efficient and flexible transportation system in the world. Under sound regulation, in the public interest, the industry has provided and continues to provide dependable service to all shippers at fair and reasonable rates with provisions to guard against undue discrimination or prejudice. Modern motor carrier transportation is distinctly a public service industry and the record of the past 40 years shows clearly that it best and most effectively performs its function under regulation.

The growth of the motor carrier industry since 1935 and the critical role it plays in our economy are, in my opinion, adequate evidence that economic regulation has succeeded. When we review the basis for regulation, as brought into being in 1935, including all of the reasons for regulation, and the great success of this transport system, it is difficult for me to conceive how anyone can find serious fault with it.

The success of economic regulation to the present, and its continued success into the future, depend on adequate regulatory controls in three vital areas. These areas are: (1) effective monitoring by the ICC over entry into the motor carrier industry; (2) permissive right of the regulated carriers to engage in collective, or bureau, ratemaking under adequate safeguards; (3) adequate and effective authority over motor carrier rates by ICC.

The basic components of regulation are essential for the continuation of a dependable, efficient, and financially sound motor carrier industry. They are important for the success of our transportation system if we wish it to continue to operate under the free enterprise concept

If these basic components are removed or rendered ineffective by damaging amendments to the existing law, then we have deregulation, not reform. We would have a return to the conditions that existed prior to the regulation that came into being 42 years ago. These conditions were succinctly summed up by the Supreme Court in 1953 when, in commenting on a case under consideration, it described the trucking industry prior to regulation as: "Unstable economically, dominated by ease of competitive entry and a fluid rate picture -- as a result, it became overcrowded with small economic units which proved unable to satisfy the most minimal standards of safety or financial responsibility."

The impelling need for the economic regulation of the motor carrier industry was clearly recognized at a time when regulated, for-hire motor carriers were receiving 17 percent of the total revenues paid to all domestic for-hire freight carriers.

Today, the regulated for-hire motor carriers are responsible for more than 55 percent of total freight services as measured by revenues earned. This position of increasing importance indicates that economic regulation is more important today than it was 40 years or more ago.

In the absence of sound regulation, shippers would never know if the rate they were paying was a fair rate -- a rate that did not subject them to preference or discrimination vis-a-vis their competitors. Regulation assures relative rate stability. In its absence, shippers would be faced with frequent rate fluctuations, leaving them handicapped in planning their market practices and revising their distribution and transportation requirements. Without monitoring of entry controls, the country could not reach the necessary balance in terms of numbers of carriers needed in order to maintain the nation's motor carrier industry at the high level of performance enjoyed and required by the shipping community.

It is interesting and highly informative to note that the shipping community -- from which the loudest complaints against regulation should come, if there are any complaints -- has consistently supported economic regulation of the motor carrier industry. A survey of shippers conducted by the Department of Transportation, and made public in 1975, concluded that, overall, motor carriers were rendering high quality service.

Respondents to the survey indicated that 80 percent of motor carriers gave good service. Furthermore, a <u>larger</u> number of medium and small shippers said that motor carriers gave "excellent" or "quite good" service more often than any other mode. This type of response from small shippers is not surprising. It is the small shipper, and small community, that would suffer the most if economic regulation of the motor carrier industry were abandoned or seriously weakened. It is regulation that assures the small shipper and small community of the transportation services they require in order to survive and prosper. That is a major reason for regulation in the first place.

In another shipper survey, the results of which appear in the March-April 1976 issues of Transportation and Distribution, 70 percent of those surveyed felt that the strongest single argument in favor of the present system was that it prevents competitive chaos and assures continuity of service. There are many other surveys indicating the same conclusions as to regulation. Time does not permit me to give the results of all of them. Let me please emphasize, however, that deregulation, or so-called "reforms" so severe as to amount to deregulation, is not being sought by either the motor carrier industry or those who need and depend upon its services.

Some proposing drastic changes in motor carrier regulation point to the Railroad Revitalization and Regulatory Reform Act as an example of regulatory reform and say that the same treatment should be given to the motor carrier industry. There is talk of "evenhanded" regulatory treatment of each form of transportation.

This is a dangerous comparison that has no valid application to what should, or should not be, done in the motor carrier area. The railroad industry, under the 4-R Act, lost some of the rights they previously had for collective ratemaking. But what did this really amount to? They lost the right for single-line collective ratemaking, but the question must arise as to whether or not they need this right today. Perhaps they do not and can function efficiently and serve their shippers satisfactorily without it.

With the mergers and consolidations within the railroad industry in recent years, it is questionable whether collective ratemaking is as important as it once was -- to the railroad industry.

However, in the trucking industry it is an entirely different situation. To get an idea of the difference, there are 332 line-haul railroads regulated by the ICC -- and more than 16,000 motor carriers. We must have a continuation of the permissive right to engage in collective ratemaking under adequate controls. It is, and has proven to be, an essential element of sound, modern motor carrier transportation. This is the opinion, also, of the shipping community.

The 4-R Act also provided for an experimental period of suspension for ICC authority over rail rates. I am not sure anyone can be absolutely sure at this time as to exactly what authority has been eliminated in terms of what has or has not been achieved. However, as in the case of modification of the railroad industry's right to engage in collective ratemaking, the change in ICC rate authority may be a change the rails want and which they believe will improve their ability to serve the users of rail service.

However, such a change in the commission's authority over motor carrier rates is not desirable. It would not benefit the motor carrier industry nor the users of motor carrier services. The present law should remain essentially as it is -- it has the flexibility necessary to protect the interest of shippers while at the same time enabling the carriers to equitably and dependably perform the services required of them.

The question of entry controls on the basis of "evenhanded" regulatory treatment should need no discussion. The railroad industry's problem is not one of getting into the business, it is more a problem of how to get out.

Those attacking regulation often cite the conditions existing in the exempt for-hire or non-regulated sector of motor carrier transportation as an example of efficiency and dependability. Because of this alleged efficiency and dependability, they maintain we do not need regulation in any sector of motor carrier transportation.

Of course, they are comparing two entirely different types of transportation from the standpoint of common carrier responsibility and types of transportation services being performed. But more important, the situation prevailing today in the exempt areas is not nearly as rosy and perfect as they would have us believe.

Quite the contrary. The situation in exempt trucking is chaotic. As far as availability of trucks is concerned, it is feast or famine. Crops have not been moving in an orderly way, and the absence of rate stability has been a continuing problem. It has reached the point where many involved in exempt transportation are now talking of some form of economic regulation, in order to bring stability into their area.

Motor carrier traffic moving today under economic regulation is moving efficiently and more dependably than that moving without regulation. Another illogical comparison in the area of transportation regulation is now being played out in the Washington scene. I am talking about the proposals to deregulate the domestic airlines.

It may well be that in passenger transportation by air there is an untapped market or demand that lower fares will bring into existence. There is certainly some elasticity in the intercity passenger market. And the airlines, mass movers of people, have been having their problems lately. However, freight transportation is another matter. It is a different market with vastly different conditions of demand. The freight transportation pie is one of relatively fixed dimensions. It grows in total only as the economy grows. We can move only as much freight as the economy produces.

Despite this obvious fact of economic life, there are some who believe that if more people are put into the freight transportation business and engage in cutthroat rate competition, somehow a greater total volume of traffic will be produced. The pie will become bigger and everybody will be better off. It just doesn't work that way. Deregulation or drastic changes in the regulatory structure may well vary the relative sizes of the different slices of the pie, but they will not make the pie any bigger. But there is a very real threat to our transport system if we recklessly or unwisely permit the relative sizes of the pieces of the freight transport pie to be altered. The very thing we are united to prevent -- nationalization -- could quickly be upon us.

Within the freight transportation family, all types of carriers are important. Each works to fulfill its particular function, doing what it does best and most efficiently. However, we cannot escape the fact that the common carrier, by whatever mode, is and will continue to be the key to an efficient transportation system. It is the one on whom the vast majority of shippers and communities must continue to depend for transportation service. If the common carrier is unable to fulfill its responsibilities and meet the shippers' needs, then our system will fail and we will have nationalization.

Perhaps, as the retiring President of Johns Hopkins University suggested, we ought to ask ourselves a couple of leading questions. In his last appearance before the Board of Trustees, the retiring official said there should be only two items on the agenda at each and every board meeting. First, shall we fire the president today? If the answer is yes, then let's name a replacement. But if the answer is no, then we come to the second major item: What can we do to support him?

So perhaps we ought to ask ourselves: Do we need and want a common carrier transportation system. If the answer is no, then we ought to scrap the system in its entirety. But if the answer is yes, and how could it be otherwise, then we ought to quit kicking it around. We ought to quit devising ways to take away from it the profitable freight. We should stop asking it to subsidize certain types of freight and thereby placing them in a non-competitive position in relation to other freight. We should be looking for ways and means to support and enhance its operations.

The answer to these questions will not be found in theoretical abstractions or blackboard formulae. The answer lies in the day-by-day practical world of providing transportation services. We cannot prove or disprove the validity of economic regulation by application of theory or by devising cures for diseases that do not exist.

These are two different worlds we are talking about. It is one thing to pursue a pet theory from a comfortable office, surrounded by books written by other theorists in other comfortable offices. It is a completely different thing to be down there on the line wrestling with bills of lading, maintaining schedules of pickup and delivery, making sure the equipment is first-rate, and all the other countless chores that go into the practical world of shipping freight.

The plain fact is that economic regulation of the motor carrier industry has worked very well in the past, is working very well today, and will work very well tomorrow. The job is being done. The freight is being moved. There has been no great outcry for change on the part of the shipping public.

Regulation can be made to work better, but you don't improve something by killing it. Otherwise, a homicidal maniac could protest his innocence on the grounds that he was practicing medicine. The motor carrier industry has traditionally supported improvements in motor carrier transportation, and we have had more than 40 years of consistent improvement.

MOTOR CARRIER ECONOMIC REGULATION

A. Daniel O'Neal
Chairman
Interstate Commerce Commission

There is no secret that I think regulation does provide a positive force in our country. I think that common carriage does make some sense for many of the reasons that have been expressed earlier tonight and that I am sure have been expressed in your meetings today and during the course of this workshop.

Rather than try to give any answers, I think actually what is more interesting are some of the questions that one can raise. Certainly it is legitimate and proper in a society such as ours to raise questions about our institutions. Certainly, no institution, no individual, is perfect, and challenges produce improvements and vitality.

Some of the questions are a little embarrassing. One relates to an American Trucking Associations letter to the Financial Accounting Standards Board dated June 22, 1976, in which the trucking association says, and I quote,"Virtually the only way for a carrier to obtain additional operating authority is to buy it from another motor carrier." It is stated further that the operating rights certificate is a carrier's most important asset. That raises immediate questions. I think this is of concern to me at least.

Do motor carriers, does anybody, have a right to the value of such certificates? What of the argument that a public license should not be an article of commerce?

But, on the other side, what about the disruptions of the motor carrier financial markets and the consequent adverse impacts on service to the public if those values are suddenly depleted? What would be the social as well as the economic effect of liberalized entry control? How viable is the motor carrier's common carrier obligation to provide service? Do carriers provide non-compensatory service? To what extent? Are there ways that carriers can, as a practical matter, avoid tendering certificated service? Can the commission police this sort of thing? Are we doing it? What is the effect of a refusal of a carrier to publish joint rates and through routes?

How good is the data that is used by advocates of regulatory reform or deregulation in their arguments? Can better data be obtained? At what expense? And what efforts are now underway?

Assuming that the reformers are right and that some deregulation would improve motor carriage, wouldn't this draw more traffic to the less-energy-efficient mode? I think that is a question worth considering. If there is to be reform, what form should it take? What alternatives exist? What would be the effect on competition? It is possible to argue, I think, that no regulation could, in the end, mean a lot less competition.

It is important to consider whether we are asking the relevant questions. Putting aside the theoretical arguments, shouldn't we look at what the problems are? Are the users of the system satisfied or not? If not, what approach is likely to produce satisfaction with the least cost or disruption?

Those who propose changes in the system, I think, carry with that advocacy the burden of proving that their particular approach is the right approach. The costs of drastic action would seem great, so it is a relevant question whether the proponents have, in fact, met their burden.

The debate over motor carrier regulation has gone on for too long to just fade away. I think that the public policy equilibrium on motor carrier regulation has been disturbed and a new equilibrium will have to be reached, and I predict that it will be achieved within the next few years.

Indeed, we may be in the middle of that process right now. The commission has, for example, taken several actions which have an impact on that equilibrium, not the least of which, I think, is the recent action in expanding commercial zones. Other actions would include eliminating gateways.

I think it is important in the discussion that is likely to go on for the next few years, to recognize that while there are imperfections in regulation, there are also imperfections in unfettered competition. It is really not an either/or situation. We need to find the proper balance that will provide adequate service to the users of the system consistent with environmental and energy considerations and all the other considerations that impact on our actions today. And we have got to find answers that will do while retaining a viable privately-owned transportation system.

MOTOR CARRIER ECONOMIC REGULATION

C. Jack Pearce
General Counsel
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for Efficient National Trucking

When Dr. Moses called me, he suggested that it had been suggested to him that the panel needed a flavor, perhaps -- and he hesitated -- a little radical, a little more radical. I delightedly assured him that I was his man, and I would try to perform that service.

This morning one of the members of my committee whom I try to counsel called up and suggested that it would be well if I were to refer to President Carter's recent message to the Congress on airline regulation that proposes in the airline area substantially what the current group and I propose as to motor carrier regulation; and also mentioned that about every President since World War II has made similar representations and recommendations. All of this in aid of showing how responsible and really mainline are our proposals. I assured him that, of course, I would do that.

You might wonder how I can perform the role of radical and simultaneously perform the role of espousing the most respectable and conservative of viewpoints.

Well, I propose to resolve it by the following observation. I suggest that in the transportation area, in dealing with some elements of regulation, what we are dealing with is a particularly backward subculture in our national economy -- a subculture so backward as to some regulatory aspects that what has become the rule in the most advanced economy on the earth at this moment is perceived by the artisans of the existing regulatory process as heresy, radical, and somehow inconceivable.

I really cannot resist a challenge, so I want to deal on this antinomy for just another moment. Let us look at the course of our economic history for the last 300 years or more as related to what we are really talking about here tonight.

If I really cannot espouse a viewpoint which is anything but economically orthodox, I can at least try to provide the role of astringency in being blunt about what we are really discussing.

What we are really discussing is whether there ought to be collective price determination, that diminishes -- suppresses -- competition; whether there should be barriers to entry and markets, which are designed and have the effect very largely of suppressing competition; and then whether, if the answer is no to both of those questions, we should be levying large social burdens on the people who would then not have these protections from competition.

We are talking about rate bureaus, price fixing, entry barriers, and the degree of price flexibility. It is not regulation versus deregulation. It is how competitive will be this regulated market.

The course of our history for the last 200 or 300 years has been, as you can easily recognize when you call it to mind, generally in the direction of opening markets, assuring price and product competitiveness, and diminishing barriers to trade. We went to an interstate federal system instead of having 13, and then 50, state hegemonies. We are progressively diminishing tariff barriers; and have been trying to do that since the Great Depression showed us how destructive can be the attempts progressively to raise them.

In the existing economy, well over the half, the bulk of it, exists under a regulatory regime -- let us face it, antitrust lawyers do not like to say it that way, but we are regulated -- under a regulatory regime that positively demands that prices be made competitively and entry into markets not be blocked by private action.

What we are talking about in substance and in short is not the practice of a group of impractical dreamers or economic theoreticians. It is the combination of the practice and theory of an advanced industrial nation -- as perceived by its leading students, the economists, and by its leading practitioners, the heads of the companies and the other policy-making people in the companies, who generally, together with consumers and other bodies, determine the public opinion on the proper course of economic policy. It is the case that every President since Harry Truman attempted to veto the legislative enactment creating collective price determinations, since World War II. And every President has strongly recommended that the matters that we are here discussing -- that I have defined -- be changed.

One of them, Lyndon Johnson, perhaps did not do a great deal about it, but he also strongly recommended it, and the last three, Mr. Nixon, Mr. Ford, and Mr. Carter have all made very sharp and pointed recommendations in this direction.

One of the advantages that I have, at least, in being in this position on the schedule, is that I get to comment on the comments of each of those preceding me. Let us take up the positions of those for and against this kind of change.

The largest labor union in the regulated industry opposes the changes. Now, two people have published studies of compensation in the regulated trucking industry. Not merely Tom Moore, Mr. Fitzsimmons, but also another fellow named Annable who was with the Sloane Institute back in 1973, published in 1973 another examination of the effects of the existing entry barriers and price determination mechanisms on compensation in the trucking industry. Both observers have concluded that the effects have been to raise incomes above what they would otherwise have been for drivers by about a billion to two billion dollars a year.

Annable overstated it. He argued that all of the gains in income had accrued to the workers and none to the owners of certificates.

But both students found the same phenomenon. What they suggested was not related to the question of variance in incomes among industries, but rather to the fact, to the observation, that the teamster wages for line-haul drivers had increased much more rapidly than other wages in the post-war period even though there was no comparable observable change in skills in the two major groups being compared.

The labor representative, the ATA, and the regulated carrier representative have suggested a long list of bugaboos that have become standard fare when one discusses regulatory change -- the effects on small towns -- the effects on the common carrier system. We do not have alleged effects on old or young people, but with a few more years of debate, we can probably get around to that.

What is observable is that we have, I would suggest, the following situation (just to be provocative). Under the existing regulatory system, we do not really prevent discrimination if you define discrimination in rates as persistent, sizeable variances in returns over costs. That is not what we have done. Rather, the system creates the opportunity for regulatory arbitrage between various interested groups. It does that by creating market power in the sellers through the use of rate bureaus and entry barriers, and then by providing an open forum for argument about how the enhanced prices, or the returns of the enhanced prices, are to be distributed.

This is often claimed to be a value of regulation. But as the Council on Wage and Price Stabilization recently pointed out, we really cannot say that we are getting any net social benefit from a mechanism that first creates discrimination or enhanced prices in one area and then simply distributed the income to other areas without any concrete definition of where or why.

We have a system that is alleged to provide for service to small towns and out-of-the-way places and to provide cross subsidization. But we have no clear evidence that these cross subsidies are occurring, no quantitative measures at all, and when you look at the regulatory system, you can perceive rather easily that it is not even designed to bring it about.

There is no power in the Interstate Commerce Commission to evoke service. Service is offered upon the initiative of private individuals when they see profit opportunities. There is no accounting mechanism in the regulatory agency for determining on a consistent and valid basis where capacity exists or how it is distributed. At most, there is a mechanism, on an occasional ad hoc basis, for trying to hold a carrier to provide service to small towns upon complaint. I do not want to denigrate that, but it is a most unsystematic, and I suggest, ineffective mechanism, when considered on a national basis with thousands of carriers.

For three decades now, the regulated carriers have been saying that this system works better than the exempt. For three decades or so we have been told that the exempt transportation area is chaotic, prices are fluctuating wildly, and bankruptcies are rife. For about two or three decades the market share between exempt and private transport and regulated transport has been about 58 to 60 percent exempt and private and about 40 to 42 percent regulated; and the users of the exempt and private transport have been strenuously defending the exemptions, if you will, which permit them to make use of this chaotic and doomed system.

Further, and really most embarrassing, the comparisons between the regulated markets and markets in which price competition and entry are freely allowed, consistently come up showing better price/quality offerings in the exempt markets than the markets where price competition is diminished and entry is often barred.

I could refer to a long list of studies, including Mr. Moore's, a great number of others, and testimony before Congress. This finding seems to be quite a consistent result.

Finally -- and perhaps the most refreshing experience of the evening -- has been to have an ICC chairman who asks questions and who can keep his speech to 10 minutes. I have not quite met those standards, but applaud them. I suggest, and I hope, that he is correct when he says that the equilibrium, the regulatory equilibrium, of the last few years has been disturbed and that it will settle in the next few years in another posture.

What I am suggesting to you is that the bulk of our economic history and practice, the bulk of our economic theory derived from that history and practice, the bulk of the evidence, the hard evidence on exempt and regulated markets in this country, Canada, England, Australia, and Germany, France, and Sweden all point, when you sum it up, to getting greater performance, a more productive economy, from bringing this somewhat backward subculture somewhat closer to our national norms.

SESSION III

CROSS SUBSIDY ISSUES: SMALL TOWNS, SMALL SHIPPERS, SMALL SHIPMENTS AND THE EFFECT ON THE COMMON CARRIER

Chairman: Robert Harbeson

EMPIRICAL ASPECTS OF SERVICE-DIFFERENTIATED TRANSPORT DEMAND

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ABSTRACT

In this paper a model allowing for choice of market and mode by country elevators is posed and estimated. The model incorporates market prices, transport rates and service differentiation. Expected equipment delay (equipment availability) is measured and included in the model as a service-induced cost. The resulting estimated models are examined for significance and used to find own- and cross-elasticities for the different returns and costs in the model. Issues concerning shipping firm size and service perceived in a regulated environment, as well as responsiveness of demand to supply generated service improvements are examined.

INTRODUCTION

The analysis of regulatory change must be based on a thorough understanding of four questions: 1) what are the characteristics and components of demand for freight transport; 2) what is the structure of transport service costs; 3) what is the nature of the relationship between costs and supply; and 4) what is the nature of the interaction of supply and demand? The purpose of this paper is to contribute to understanding the characteristics and components of demand. It is our contention that this area is less understood than formerly thought and that much effort needs to be expended here before serious analysis of regulatory reform issues can draw meaningful conclusions.

As is often noted (Daughety, Inaba, and Zlatoper, 1976) freight service demand arises from the spatial distribution of production centers and markets. A spatial equilibrium concept has evolved to explain not only the interrelationships among goods prices in geographically separated markets, but to also explain the interdependence between spatially separated markets and the transport sector. Elsewhere, we have examined the relationships that give rise to residual demands for service-differentiated transport in a spatial context (Daughety and Inaba, 1975, 1976). This paper will focus on a specific example of such demand functions and on some estimation results. Specifically, we will analyze the characteristics of demand for moving corn to markets in the Midwest. The model that will be proposed will allow for mode and market choice based on prices at the markets, transport rates, and service characteristics. The model will then be estimated and the results interpreted.

The second section of the paper provides the basic structural considerations for a model of transport demand. It also includes a discussion of the potential econometric techniques for estimating demand. In the third section, we develop the actual model to be tested, including the measurement of the major service characteristics associated with the distribution problem to be examined. In the section called Empirical Results we discuss the data used and the estimation results. Finally, the last section summarizes what we observe.

THEORY OF THE FIRM AND DISAGGREGATE TRANSPORT DEMAND

Consider a typical shipper who can sell his product in various markets and can use several alternative transport modes. We assume that the firm is competitive in the sense that it takes market prices and transport rates as given.

In the following analysis we use the notation:

P_j: price of the product in market j, $j=1, \ldots, J$.
t_{jm}: transport rate to market j by mode m, $j=1, \ldots, J$ and $m=1, \ldots, M$.
q_{jm}: quantity shipped to market j by mode m.
$H_{jm}(q_{jm})$: service-induced transport cost of shipping q_{jm}
$C(q)$: cost of producing $q = \sum_j \sum_m q_{jm}$.

Notice that the alternative of not selling in any market and merely holding inventories can be included by identifying one of the market-mode pairs with not selling and not shipping.

Modes are differentiated by their service attributes such as speed and reliability. These attributes induce certain costs that are central to the theory of transport demand as a derived demand. The structure of these induced costs and how they relate to service attributes is discussed in the following paragraphs.

(1) Equipment Availability Costs: Uncertainty as to the availability of transport equipment when it is needed induces certain costs. For example, inventory costs are incurred when a shipment must be placed in a holding position while waiting for the arrival of transport equipment. Penalty costs may be levied on a shipper who cannot make delivery as scheduled. To the extent that late arrivals of equipment exacerbates

on-time delivery, these penalty costs can be associated with equipment availability. The opportunity costs that are incurred when a shipment is tied up because equipment is not readily available is another category of availability costs. Thus, availability is a service attribute that imposes certain costs on the shipper.

(2) Transit Costs: Interest and inventory carrying costs are incurred on the value of a shipment during transit. Furthermore, variance in scheduled transit times increases the risk of incurring penalties due to late delivery of goods and loss of goodwill. Thus, transit time on each mode is a service attribute that induces costs of using a particular mode.

(3) Loading and Handling Costs: These costs will vary by mode when different combinations of labor and capital inputs are required. For example, special facilities may be needed to load rail cars vis-a-vis trucks.

An important aspect of transport service is reliability. In the case of physical reliability, there are risks associated with loss and damage. In the case of schedule reliability, there are risks associated with the ability of the shipper to deliver a shipment on a promised date. These risks are attributable in part to uncertainty in equipment availability and transit time variance. Thus, reliability introduces the notion of risk into the shipper's decision as to where to ship and by what mode.

In Daughety and Inaba (1976) the selection of market and mode was treated as a portfolio problem of investment in risks assets. Under the assumption of risk-aversion the service-induced cost function, $H_{jm}(q_{jm})$ can be expected to be strictly convex in q_{jm}. This conclusion has important implications as to the nature of the shipper's transport demands and the appropriate econometric techniques for estimating these demands.

Consider the firm's profit function

$$\Pi(q_{11}, \ldots, q_{jm}) = \sum_j \sum_m [P_j q_{jm} - t_{jm} q_{jm} - H_{jm}(q_{jm})] - C(q) .$$

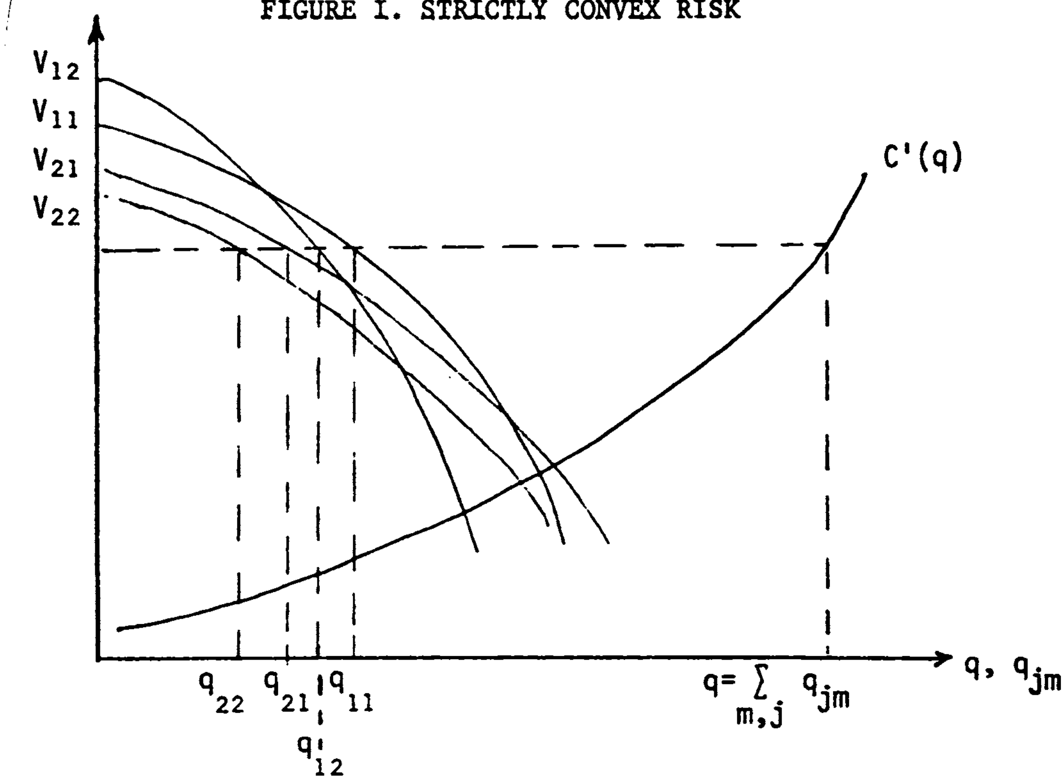
The shipper chooses nonnegative q_{jm}'s so as to maximize $\Pi(q_{11}, \ldots, q_{JM})$. The resulting q_{jm}'s are functions of prices P_j, rates t_{jm}, and the parameters for the functions $H_{jm}(\cdot)$ and $C(\cdot)$. These constitute the firm's derived demand for transportation. The first order conditions are:

$$\begin{aligned} P_j - t_{jm} - H'_{jm}(q_{jm}) - C'(q) = 0 \\ q = \sum_j \sum_m q_{jm} . \end{aligned} \tag{1}$$

There are two interesting cases that follow from the convexity of the service-induced cost function.

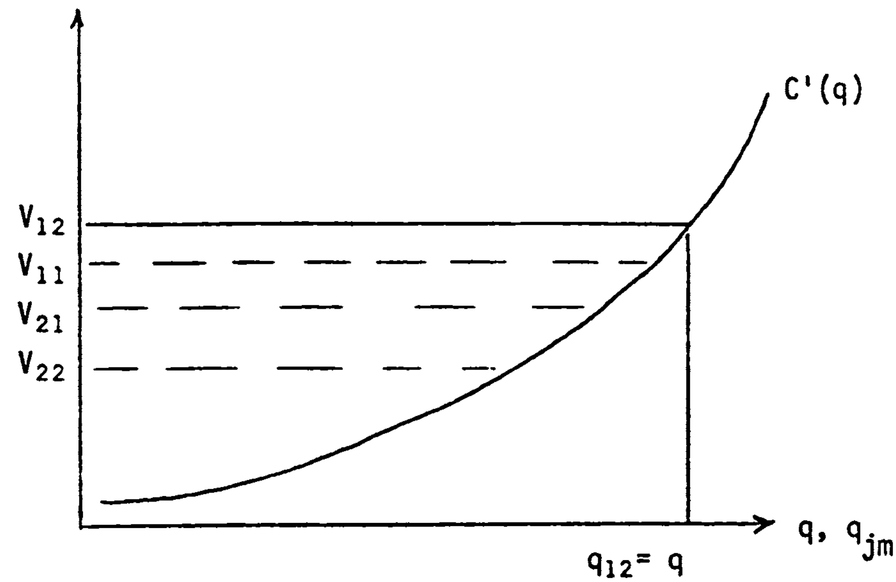
<u>Case 1</u>: Suppose the $H_{jm}(\cdot)$ are <u>strictly</u> convex. Then the functions $V_{jm}(\cdot) = P_j - t_{jm} - H'_{jm}(\cdot)$ are downward sloping and so in general an optimal solution to (1) contains more than one positive q_{jm} flow. In general, a shipper whose service-induced transport costs increase nonlinearly in the quantity shipped will choose to ship by more than one market-mode pair. This case is illustrated for two markets and two modes in Figure 1. The downward sloping curves represent the V_{jm}'s and the upward sloping curve is the firm's marginal cost curve.

FIGURE I. STRICTLY CONVEX RISK



<u>Case 2</u>: Suppose the $H_{jm}(\cdot)$ are linear. Then the functions $V_{jm} = P_j - t_{jm} - H'_{jm}(q_{jm})$ are constants equal to price net of transport costs. Here an optimal solution $(q_{11}, \ldots, q_{jm})$ usually contains exactly one positive flow. That is, a shipper whose service-induced transport costs increase linearly in the quantity shipped chooses to ship by the market-mode pair which yields the highest price net of transport costs. He then sends all he produces, determined by setting the highest net price equal to marginal costs, to the single market-mode pair. This case is illustrated in Figure 2.

FIGURE 2. LINEAR RISK



As mentioned above, H_{jm} is strictly convex in general. However, for firms such as we are examining here (country elevators) a linear approximation to the risk function is not too inaccurate (Daughety and Inaba, 1976) because elevators typically ship only a fraction of their holdings at a time. Thus, in terms of wealth put at risk, these firms are relatively (compared to the other actors in the system, e.g. terminal elevators) close to the origin of the risk function and thus a linear approximation to the unknown function is appropriate. This is not necessarily true for very large shippers with a multi-level coordinated decision process such as terminal operators.

When model 2 is appropriate, quantal choice techniques can be used to estimate transport demands. In particular, logit models used in the study of urban travel demand can be used to estimate the shipper's market-mode selection probabilities. Thus when shippers choose only one market-mode pair logit analysis can be applied to estimate shipper behavior. On the other hand, if Case 1 is the appropriate model, then the assumptions of quantal choice techniques are not satisfied, i.e. more than one alternative is being chosen. Consequently, other estimation methods such as regression must be used to estimate the transport demands implied by (1). In this paper we report empirical results about country elevator shipper behavior obtained by applying a logit model. The basic logit model is described in the following paragraphs.

Define the choice variable y that takes the value $y = \eta$ if the shipper chooses the η-th alternative. Here the alternatives are defined as market-mode pairs. Let x_η be a vector of observable attributes of the η-th alternative. Let z be a vector of observable characteristics of the shipper and let w be a vector of unobservable variables. We assume that the shipper's decision depends on the x_η's, z, and w. Thus the probability distribution of y is determined by the vectors $x = (x_\eta)$, z and the unknown parameters that characterize the distribution of w. Then the most general choice model (Amemiya, 1976) can be mathematically represented by

$$\text{Prob}\{y = \eta | x, z\} = \frac{\exp F_\eta(x, z, w)}{\sum_\eta' \exp F_\eta(x, z, w)} \tag{2}$$

McFadden (1973) has given the following argument that behaviorally justifies a special case of the general choice model. Suppose that the shipper's choice index (e.g. profit, net price, etc.) associated with alternative η is the sum of a nonstochastic part and a zero-mean random variable, i.e.,

$$V_\eta + \varepsilon_\eta$$

Here only the nonstochastic part depends on the x_η and z , i.e. $V_\eta = V_\eta(x_\eta, z)$.

If we assume that the individual behaves so as to maximize his choice index, then

$$\text{Prob } \{y=\eta | x, z\} = \text{Prob } \{V_\nu + \varepsilon_\nu < V_\eta + \varepsilon_\eta, \forall_{\nu \neq \eta}\} .$$

McFadden has shown that if the ε_η's are independent with the distribution $\exp[-\exp(-\varepsilon_\eta - \alpha_\eta)]$ where α_η is a parameter, then the choice probability has the form (2).

EMPIRICAL ANALYSIS OF THE THEORY

Introduction

In this section we will model a specific type of shipper: a country elevator that ships corn to various markets. In general, such characteristics as loss and damage and schedule reliability are not critical to such shippers although other service characteristics are important. Specifically, we develop a measure of equipment delay, i.e. availability. The measure provides an approximate cost to the shipper associated with using a mode which enters the shipper's profit function.

After determining the availability measure, we specify the model and the assumptions that can be used to convert the logit model output (probabilities) into demand for alternatives. Special attention is paid to the relation between probability and demand elasticities.

Measuring a Service-Induced Cost: Availability

Shippers form expectations about various service parameters. Miklius and Casavant (1975) found that such expectations may not reflect reality. Nevertheless, shippers act on their expectations. In the specific case at hand, grain elevator operators evaluate the availability of transport equipment, i.e. how much equipment delay they expect to experience in ordering and obtaining transportation vehicles (trucks, rail cars, barges) in order to fulfill commitments. This is often particularly felt during the harvest period when transportation use is at its peak and resources are scarce. Then the availability of a piece of equipment can be critical. A number of different types of contracts with various provisions for delivery times exist and are used (Zlatoper, 1976). In all cases, however, elevator operators require a high degree of confidence in the availability of equipment to make deliveries. Thus, opportunities may be foregone or bids altered due to expectations about the availability of transport equipment.

In this study, two groups of shippers were questioned about their expected delay times for ordering a small number of cars. The first group was comprised of shippers who used only truck or single-car-rail (SCR). The second group was comprised of those shippers who made use of truck, single-car-rail and multiple-car-rail (MCR). One might generally consider the first group to be small shippers and the second group large shippers. Because these shippers are all from the same region and face similar markets with essentially the same information, one would expect the sample means of the answers of each group to be normally distributed. A natural availability measure thus arises. We take the <u>α-expected delay</u> to be <u>n days</u> where n is the value such that $Pr\{T<n\}=\alpha$ with T the number of days till the arrival of equipment. Thus, if the sample mean and sample variance of the first group (small shippers) are $\bar{X}_1$, and s_1 respectively, and if the sample mean and sample variance of the second group are $\bar{X}_2$ and s_2 respectively, then for specified α (say $\alpha=.95$) one can easily compute n_1 and n_2. These values represent the number of days that one would expect to wait if one wanted to be 100α percent confident of having equipment. In the following table we display values found for small (truck and single-car-rail) and large (truck, single-car-rail and multiple-car-rail) shippers. Values are in days.

TABLE 1. 0.95 - EXPECTED DELAY (IN DAYS)

SHIPPER	SAMPLE MEAN	SAMPLE VARIANCE	95% CONFIDENCE LEVEL
Small (Truck, SCR)	6	5.7	7.8
Large (Truck, SCR,MCR)	10	16.1	13.5

Contrary to all expectations, the table indicates that larger shippers perceive poorer service! Though this seems perverse, it is not. The data are for the harvest period (as is explained below). During this period of the year, rail service is typically strained to its maximum: every car is put into service, even many in various states of disrepair. Under these conditions, and in view of the fact that rates are regulated and cannot rise to meet demand, it is quite reasonable to find that consolidating a number of empty cars is more difficult than providing one or two cars. The multiple-car user generally faces some shortages. This is especially true in that MCR expectations are formed from activity wherein the MCR shipper is taking advantage of MCR rates. These rates provide discounts to the shipper. However, during a period of time in which the system is being used at capacity, the marginal car will be most profitably allocated at the single-car and <u>not</u> the multiple-car rate. Thus, the result of poorer service to larger shippers under a regulated system is quite understandable.

To evaluate this risk we multiply the α-expected delay by the inventory holding cost. This provides a lower bound on the cost to the shipper of the delay. The delay requires the shipper to hold grain longer and make commitments earlier than is otherwise optimal. The delay may also produce penalties and other such losses (Daughety and Inaba, 1976). By valuing the delay at the market inventory holding cost we get a lower bound on the delay cost.

The average holding charge is 1.6¢/bushel/month. Relatively few firms charge ½¢ more or less than this value. Thus, we find that the expected cost to SCR shippers is 0.42¢/bushel, while the expected cost to MCR shippers is 0.72¢/bushel. While this may seem like a trivial amount of money, we shall see otherwise. In fact, normalizing the values to one month, they are comparable to the inventory storage charges. Thus, they should enter significantly in our model of the shipper's choice process.

Finally, it should be noted that virtually all firms own or have ready access to trucks. Truck merchants (Zlatoper, 1976) provide ready access to the independent trucking market, which is unregulated for this commodity. Thus, their availability cost is zero.

Specification of the Model to be Estimated

The behavioral model of the country elevator takes risk as linear and thus only one market and one mode is chosen so as to maximize the elevator's choice index (i.e. net price or profits). Therefore, the logit technique is appropriate.

The observable part of the choice index consists of three types of exogenous variables or attributes: market variables, market-mode variables, and shipper-mode variables. Let $P(n)$, $t(n)$, $A(n)$ be the vectors of exogenous variables observed by the n-th shipper where:

- $P_j(n)$ is the price or revenue (i.e. price x quantity) at the j-th market
- $t_{jm}(n)$ is the transport rate or cost (i.e. rate x quantity) of shipping to the j-th market by the m-th mode

$A_m(n)$ is the perceived availability cost per bushel or per shipment (i.e. per bushel cost x quantity) of shipping by the m-th mode.

Following the theoretical considerations in Section 2, the choice index of the country elevator can be either net price or profits = net price x quantity. Therefore, we shall write the observable part of the choice index as

$$V_{jm}(n) = \alpha_{j1}P_j(n) + \alpha_{jm2}t_{jm}(n) + \alpha_{m3}A_m(n) .$$

The logit model used in this study thus becomes

$$\Pr\{y = (j,m)|P(n), t(n), A(n)\}$$

$$= \frac{e^{\alpha_{j1}P_j(n) + \alpha_{jm2}\, t_{jm}(n) + \alpha_{m3}A_m(n)}}{\sum\limits_j \sum\limits_m e^{\alpha_{j1}P_j(n) + \alpha_{jm2}t_{jm}(n) + \alpha_{m3}A_m(n)}}$$

For SCR shippers, the availability cost for rail is 0.42¢/bushel, whereas for MCR shippers, this variable has the value 0.72¢/bushel. Since trucks are assumed to be readily available, its availability cost is zero for all shippers in the sample.

Elasticity and the Demand for Transport

Of prime interest are the elasticities of transport demand with respect to the different independent variables of the model. The model itself produces probability estimates, not demands. These need not be converted into demand functions, however, in order to say something meaningful about regional demand for transport. The model projects the probability of choice of an alternative by a representative shipper. Thus, we are using the model to provide regional responses. The total amount of grain to be shipped in a region is that amount provided by farmers to the system for distribution.

Let Q denote the quantity to be shipped. Then given the choice $y = \eta$ (i.e. $\eta = (j, m)$), Q is determined by $MC(Q) = V_\eta + \varepsilon_\eta$. Hence its conditional distribution is

$$\Pr[Q \leq q|y = \eta] = \Pr[V_\eta + \varepsilon_\eta \leq MC(q)]$$

$$= P_\eta(MC(q) - V_\eta)$$

where P_η denotes the probability distribution of the error term ε_η .

Not let Q_η denote the quantity distributed by alternative η . Its probability distribution is given by

$$\Pr[Q_\eta \leq q] = \Pr[Q \leq q|y = \eta] \Pr[y = \eta]$$

$$= P_\eta(MC(q) - V_\eta) \cdot p_\eta \ .$$

Therefore, the expected quantity shipped by alternative η is

$$E(Q_\eta) = p_\eta \int q \, dP_\eta(MC(q) - V_\eta) \ .$$

Hence

$$(*) \qquad E(Q_\eta) = p_\eta \ E(Q|y = \eta) \ .$$

Since p_η is estimated by the choice model, then an estimate of $E(Q|y = \eta)$ used in (*) will yield an estimate of $E(Q_\eta)$. Since, in general, most elevators seek to maximize turnover of stock then the real limit on shipment size (besides indivisibilities present in the system) is the quantity of grain available for distribution. Thus, one can estimate $E(Q|y = \eta)$ by estimating the quantity available for distribution. Since we are making regional projections with the model, this assumption is not contradictory.

The elasticity of demand with respect to an independent variable X_k is:

$$\frac{\partial E(Q_\eta)}{\partial X_k} \frac{X_k}{E(Q_\eta)} = \frac{\partial \ p_\eta E(Q|y = \eta)}{\partial X_k} \ \frac{X_k}{p_\eta \ E(Q|y = \eta)}$$

$$= \frac{\partial p_\eta}{\partial X_k} \frac{X_k}{p_\eta} + \frac{\partial E(Q|y = \eta)}{\partial X_k} \ \frac{X_k}{E(Q|y = \eta)}$$

$$= \frac{\partial p_\eta}{\partial X_k} \frac{X_k}{p_\eta}$$

since the second term is zero by previous assumption. Thus, the elasticity of demand with respect to X_k is simply the elasticity of the probability function with respect to X_k. Two such elasticities can be calculated: own and cross. They are:

$$\frac{\partial p_\eta}{\partial X_{\eta k}} \frac{X_{\eta k}}{p_\eta} = \alpha_{\eta k} X_{\eta k} (1 - tp_\eta) \qquad \text{(own)}$$

$$\frac{\partial p_\eta}{\partial x_{\nu j}} \frac{X_{\nu j}}{p_\eta} = -t\alpha_{\nu j} X_{\nu j} P_\eta \qquad \text{(cross)}$$

where t=2 if the variable is the availability variable and =1 otherwise.

EMPIRICAL RESULTS

In this section, we will describe the data base and the results of estimating some mode-market choice models. We will then give results for two models: a two-market, two-mode model and a two-market, three-mode model.

The Data Base

In the summer and early fall of 1976, a survey was circulated to elevators in Indiana, Illinois, and Iowa. The survey asked for firm level information (ownership structure, capacity, modes used, markets traded with, monthly storage charge, and accessibility to transport system), subjective assessments (the distribution of delay times in receiving equipment of various modes), the finally randomly selected shipment examples for specified periods of time of the year and specified crop. The individual shipment records contained information on quantity shipped, mode, destination, contract price, transit time, transport rate, who paid the transport, destination, expected travel time, date of contract commitment and shipment due date. For this study, only contract price, quantity shipped, transport rate, whether the shipper paid the transport rate, destination, mode and the distribution of delay times were used. In general, no records are kept that indicate opportunities foregone. Thus, it was necessary to construct alternatives for each shipper. This will be discussed shortly.

Four major market areas were initially specified: East Coast, Gulf, River and Local. East Coast covers the export markets on the Atlantic and feed lots and processors in the east and southeast. Gulf covers the export markets of Texas and Louisiana, as well as feed lots and processing points in the region. River covers Midwest/Mideast destination points on the Missouri, Mississippi, Illinois and Ohio Rivers, as well as Chicago. Finally, all other traffic is typically local.

Obviously, such labels are somewhat arbitrary. The aggregation of the destinations into these four market areas was made on the basis of the type of activity associated with the area as well as the relative distance of a specific location to the alternative areas. Four modes were initially examined: truck, single-car-rail, multiple-car-rail and unit train. Eventually, we eliminated unit train from consideration. This will be addressed shortly.

All data was gathered for the week of 19 October 1975. This week is well into the harvest season for corn, which is the crop selected. Answers from those elevators that only used truck to make shipments were used only to compute some average values. Since these elevators had eliminated other modes from their choice set, we could not include them in the overall choice analysis. An examination of why such firms choose not to even consider other modes will not be considered here.

As is well known, prices at the different markets reflect, to some extent, the commodity futures trading activity in the crop. Corn is traded at the Chicago Board of Trade. Prices reported in the data base had a mean value of 2.688 and a standard deviation of .234. Given this low variance, it was felt that the average regional prices from the data base would provide reasonable surrogates for the actual prices at the alternative markets. The regional prices (per bushel) were:

Gulf = 2.913
East Coast = 2.815
River = 2.663
Local = 2.605

Actual transport rates were not obtained for alternatives not chosen. Data from the data base was used to provide a regression equation to predict transport rate as a function of market, mode, and distance. In the following DG, DE, and DR are 0-1 dummies for the Gulf, East Coast and River markets, respectively, while DT, DS, and DM are 0-1 dummies for mode used: truck, single-car-rail, or multiple-car-rail, respectively. "DIST" is the distance traveled in miles. The rate equation is:

$$\text{RATE} = .057295005 + .096421958\text{DG} + .076629671\text{DE}$$

$$+ .01722646\text{DR} - .067069679\text{DT} - .0096035557\text{DS}$$

$$- .10052566\text{DM} + .53379512 \log_{10} \text{DIST}$$

R^2 for this equation was .4 with an F of 10.02. Average distances were used to compute rates for alternatives other than the one chosen. Finally, availability costs (per bushel) were zero for truck, 0.42¢ for rail (single, multiple, and unit train) when used by shippers who only use single-car-rail at most, and 0.72¢ for rail when used by shippers who use multiple-car-rail.

Estimation Results and Computed Elasticities

Table 2 displays the estimated values of the coefficients of the logit models for two runs. In the first model we allowed two modes (truck and single-car-rail) and two markets (River and Local). Thus, we had four alternatives: truck to the river (TR), truck-local (TL), single-car to the river (SR), and single-car-local (SL). The second model expanded the mode set to include multiple-car-rail. Thus, six alternatives were allowed. Runs were attempted on a four mode (unit train included) -four market (Gulf and East Coast included) model which did not converge.

The left most column of the table gives some summary statistics on the runs. Run #1 had 229 degrees of freedom, a likelihood ratio index[1] of .29 and predicted the right choice approximately 78 percent of the time. Run #2 with 416 degrees of freedom had a likelihood ratio

TABLE 2

LOGIT OUTPUT

	PRICE		TRUCK		SCR		MCR		AVAILABILITY
	River	Local	River	Local	River	Local	River	Local	
#1 .29	.0007764857 (2.35)		-.00960727 (-4.3)		-.005135358 (-3.45)		--		-.07392352 (-2.52)
227									
78.2		.0006306472 (1.79)		-.009930996 (-2.62)		-.0006564478 (-1.91)		--	
#2 .41	.0006665327 (2.41)		-.01052284 (-4.67)		-.005925606 (-3.99)		-.01332688 (-4.21)		-.06042358 (-2.24)
416									
80		.000438601 (1.49)		-.008076278 (-2.39)		-.0005457282 (-1.73)		-1 (-.001)	

index of 0.41 and predicted the right choice 80 percent of the time.

As seen in the table, almost all the coefficients are significant at the .05 level (asymptotic t-values in parentheses below each coefficient). The poor showing of the coefficient for MCR-to-local in the second model is mainly due to small sample problems.

In general, all signs are correct given that we accept the t-values. We have chosen to only compute elasticities for the first model, due to potential biases introduced in the second model as noted above. Thus, if one is willing to accept a type I error of .07 ($t \approx 1.79$) then all the coefficients in the first model are significant and have the right signs. Prices enter positively while costs (transport and availability costs) enter negatively. Note especially that the availability parameter enters very significantly in both models.

Tables 3 and 4 provide computed values of the elasticities. They were produced in the following manner. Average market prices were used for both the price at the river (PR) and the price locally (PL). Transport charges were computed, using the aforementioned rate regression, based on average distances of haul. Shipment size was taken as 3000 bushels which is 1 carload or approximately three truckloads. This is a typical shipment size. The two tables reflect the two rail availability cost values. Thus, the first table was computed for a representative SCR-shipper, i.e. one who only uses truck and single-car-rail. The second table was computed for a representative MCR-shipper, i.e. one who uses both the above <u>and</u> multiple-car-rail service.

Each table reflects both own and cross elasticities. Reading across the top, TTR, TTL, TSR, and TSL are columns for transport rate changes for TR, TL, SR, and SL movements. AV heads the column for a change in the availability value. The choices (four alternatives) are listed vertically on the left. Own elasticities are in boxes with asterisks in the upper left corner. Thus, the impact of a change in the truck rate to the river on the choice of choosing to ship to the river by truck is -2.43 for SCR-shippers and slightly less elastic (-2.1) for MCR-shippers. Cross-elasticities are in non-asterisked boxes. Thus, the impact of a change in the perceived availability of rail cost to MCR shippers on their choice of using truck for a local shipment is 0.642. Zeros are due to the immediate availability of truck (zero availability cost).

Transport rate columns individually sum to zero as do the availability columns. This is to be expected since the elasticities reflect redistributions of choices among the alternatives. It can also be shown that the individual price columns should sum to the associated price times the appropriate model coefficient. This also holds for all price columns. Thus, the tables are self-consistent and have signs reflecting properly sloping demand curves.

Elasticity Comparisons

The first obvious result to be seen is in Table 2: availability, a measure of a service characteristic that introduces risk into the

TABLE 3

ELASTICITIES - SCR

VARIABLE

CHOICE	PR	PL	TTR	TTL	TSR	TSL	AV
TR	* 4.75	-1.14	* -2.43	0.56	0.601	0.063	* 0 0.437
TL	-0.867	* 4.24	0.443	* -2.07	0.361	0.038	* 0 0.26
SR	* 5.18	-0.81	0.521	0.395	* -2.16	0.045	* -0.625 0
SL	-2.87	* 2.65	1.47	1.11	1.2	* -0.119	* -0.069 0

TABLE 4

ELASTICITIES - MCR

VARIABLE

CHOICE	PR	PL	TTR	TTL	TSR	TSL	AV
TR	*4.12	-1.65	*-2.1	0.804	0.865	0.091	*0 1.07
TL	-1.25	*3.94	0.637	*-1.92	0.519	0.055	*0 0.642
SR	*5.45	-0.599	0.385	0.292	*-2.27	0.033	*-1.21 0
SL	-2.12	*3.24	1.08	0.822	0.884	*-0.179	*-0.50 0

shipper's decision process is strongly significant. Thus, modal service is important to a shipper in his evaluation of which mode to use. Terminal elevators go so far as to lease equipment on a yearly basis so as to reduce equipment delay and related risk costs. There one would expect to see still other service characteristics become significant.

Tables 3 and 4 generally (except for the AV columns and SL/TSL values[2]) reflect own elasticities that are elastic. Thus, for example rail shipments the river tend to be more elastic than truck shipments to the river (i.e. SR/PR tends to be greater than TR/PR). This reflects a mode-market interaction. Similarly, truck shipments to local markets tend to be more elastic than rail shipments to local markets (i.e. TL/PL tends to be greater than SL/PL). This reflects the same type of mode-market interaction. Clearly, the choice of market is interacting with the choice of mode. This is very important. It is not unusual to hear the claim that modal cross-elasticities are inelastic. Typically this comes from research that has fixed markets and service levels, and has often aggregated commodities. It seems quite plausible that if service and market choice are introduced that modal cross-elasticities may in fact be elastic for some commodities and inelastic for others, all as a function of market choice and service level.

Own elasticities for the transport rates are negative and generally elastic. The only exception is that SL/TSL is very inelastic. This implies that railroads probably could raise rates on such movements and increase revenues provided that these changes are allowed by the ICC.

The cross-elasticities further expand the story of intermodal competition and market-mode interaction. In Table 3, we see that SL/TSR =1.2 and TR/TSR + TL/TSR = .962 while in Table 4, the corresponding elasticities are .884 and 1.384, respectively. These imply that the diversion of flows from SR caused by an increase in TSR would be evenly reallocated to SL and truck flows to both the river and local markets.

Again, from Table 3, TL/TTR = .443 and SR/TTR + SL/TTR = 1.96, while in Table 4, TL/TTR = .637 and SR/TTR + SL/TTR = 1.46. Thus, an increase in TTR implies that more than half of the decrease in flows on TR is reallocated to rail, mainly to SL and the rest is shifted to trucks bound for local markets.

Finally, TR/TTL = .56 and SR/TTL + SL/TTL = 1.505 from Table 3 and TR/TTL = .804 and SR/TTL + SL/TTL = 1.114 in Table 4. These imply that of the flows diverted from TL by an increase in TTL, more than half is reallocated to rail, mainly to SL, with the rest remaining on trucks to the river.

Interpreting the Results

In general, AV elasticities (own and cross) are inelastic. This is very interesting when combined with the Miklius-Casavant results. The authors found a significant divergence between the quality of service actually provided by rail and truck and shippers' perceptions of quality of service. While actual service on each mode was essentially the same, shippers perceived rail service to be inferior to truck service. This is generally taken to represent a marketing failure on the part of the railroads.

We have measured perceived availability. What we find is that on top of the marketing problem is the fact that the response is inelastic to changes in perceived availability. Thus, efforts to increase demand for rail by improving service are hampered by both the gap between perceptions and reality and the inelasticity of the response to perceived changes in service.

A second implication of our results is that deregulation will tend to increase the pressure to abandon local rail lines. On the one hand, if rail rates are made flexible, railroads would find it profitable to increase rates in markets where demands are inelastic. Our results indicate that the local markets are prime candidates for such rate increases (e.g. the TSL column). Thus, deregulating rail rates would tend to lower the traffic density in markets where abandonment is already an issue.

On the other hand, deregulation in the form of removing the backhaul restrictions on the motor carriers might also tend to exacerbate the abandonment problem. If we examine the TTR and TTL columns we see that the choice of single car rail to local is for the most part elastic. Thus, if the effect of removing backhaul restrictions is a reduction in truck rates, we would observe a decline in local rail movements.

Rates would tend to fall as a result of backhaul deregulation because of the highly competitive nature of this sector of the trucking industry. Evidence to support this claim includes the fact that truck rates in both the harvest and off-harvest seasons were not significantly different and that entry into the exempt haulage market is virtually unrestricted. Therefore, in such a competitive market where rates are very close to costs, any improvement in efficiency (e.g. unrestricted backhauls) would tend to lower rates.

SUMMARY

We recognize that extreme care ought to be exercized when interpreting the elasticities in Tables 3 and 4. Accordingly, two caveats concerning the data should be mentioned. On the one hand, the elasticities reflect the behavior of a fictitious "typical" shipper who is assumed to observe "typical" values of the exogenous variables. On the other hand, the data in Tables 3 and 4 contain random noise due to the stochastic structure of the error terms. Consequently, the real average elasticities may be quite different from those reported above.

Recognizing these caveats we have attempted to identify and interpret the general patterns that emerge from the results. In doing so we have tried to compare the conclusions that can be drawn from the data with intuitively reasonable hypotheses about shipper behavior.

In general, these conclusions are reasonable and do provide some insights concerning the shipping behavior of country elevators. In particular, we can conclude that service characteristics are important in shipping decisions. Furthermore, by accounting for the risk element that such characteristics impose on the shipper's choice index, their effects on market-mode choice can be empirically detected. Finally, we can conclude that a model such as ours that incorporates <u>both</u> market <u>and</u> mode choices in the decision process indicates the significance of markets in rail-truck competition. In particular, modal cross-elasticities may be quite important. Thus, substitution between rail and truck to alternative markets can be significant if rail rates are allowed to be flexible and both rail and truck deregulation can have adverse impacts on local rail service provision.

NOTES

1. This is l-ratio of the log likelihood at convergence to log likelihood at zero. In a weak sense it is a measure of the explanatory power of the model.

2. In referring to an elasticity, it will be convenient to refer to the elasticity by noting choice/variable. Thus SR/TTL=0.395 in Table 3.

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DERAGULATION --
REASSESSING THE ASSUMPTIONS

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In concluding that economic regulation of the motor carrier industry should be abandoned or seriously altered, advocates of deregulation tacitly or explicitly accept the view that society's economic efficiency goals and social goals for transportation services can better be achieved in the marketplace than in hearing rooms. Government intervention is seen as distorting rather than enhancing the behavior of individual carriers and the structure of the motor carrier industry thereby imposing burdens on society which could be avoided by "significant" deregulation.

The purpose of this paper is not to debunk the advocates of deregulation nor is it to bolster the defenses of those who argue that the public purpose is best served by regulation. I mean merely to ask questions, state observations, and look at some principles that may aid in the debate and I hope, to provide some different views on the justifications, and implications of the regulation-deregulation issue. Rather than quoting from the statutes or attempting to fathom "Congressional intent" concerning motor carrier regulation, the issues relating to economic regulation are set forth.

THE MOTOR CARRIER INDUSTRY AS PART OF THE INFRASTRUCTURE

The first argument in support of regulation deals with the essential nature of motor carrier transportation. The motor carrier, contrary to its virile image, has been viewed as a hand-maiden of industry. While shortages, late deliveries, divergences from product specifications, or outright refusal to enter into commercial relationships are considered private, inter-firm matters for other producers of industrial products and services, motor carriers' failures to respond to shipper expectations in such respects have been seen as cause for official concern and forced remediation. Transportation capacity and performance has, along with energy, sanitation, health care, education, and communications, been considered an infrastructure resource. Referred to also as social overhead capital, such resources are the underpinnings of successful economic development and wholesome human existence.[1]

Breakdowns in the general availability of quality of any of these services impair economic activity, the development of human capital, and the quality of life/standard of living. Biases in service, distribution, or pricing practices which are unrelated to cost conditions may be, if not allocatively distorting, politically unsettling. In other words, infrastructural inadequacies can cause the economy to fall short of its production frontier and society its welfare frontier. Because of the special significance of elements of a nation's infrastructure, its suppliers are generally either the government itself or firms which exist with specific government sanction in their service and market areas. This, so that service quantity and quality, price level, and distributive equity can be controlled in accordance with government purpose.

While an economy's (or society's) infrastructure may be seen as an instrument of national economic and social policy, rational analysis must take into account issues of short-run and long-run economic efficiency conditions. A balance must be struck between the nation's socio-political purposes and the resources which it absorbs in achieving those extra-economic goals. For our purposes, the questions are: 1) does operating the motor carrier industry as a part of the infrastructure cause carrier inefficiency to exist beyond the inefficiency that would exist in the absence of regulation? 2) if regulatory inefficiency does exceed other forms of inefficiency, is the excess justified by motor carriers' offering infrastructural values that they would not otherwise offer?

Questions that also may be asked by advocates of deregulation are: "Should motor carriers be considered part of the infrastructure?" "Should motor carriers function as instruments of national policy?" If the answers are "no" the carriers, unconstrained by regulatory dicta, will function according to self-determined (market-determined?) criteria. To answer "no" is to suggest that the economy, in general, will not be materially deflected from its allocative and equity goals by what might even be uncertain behavior of an unregulated motor carrier industry. The economy's performance would be seen as relatively independent of motor carrier performance. A more likely answer of the deregulationists is that while the economy's performance is highly dependent upon a motor carrier industry which is sensitive and responsive to the demands of industry, the motor carrier industry can best render that performance unregulated.

The deregulationist goes on; rather than induce "cross-subsidization" of places, customers and commodities, by protecting carrier markets and insisting upon fulfillment of the "common carrier obligation," national policy goals should be directly and openly subsidized from the public fund. Small towns, agricultural interests, small firms, deteriorating cities and ports, and small shipments should receive differential freight subsidies to allow them to compete successfully with their large, progressive, or prosperous opposite numbers. Under the present conditions, the argument runs, more profitable markets and freight, are "subsidizing" less profitable or loss markets and freight.

This is unjustifiably harming profitable markets and shippers of profitable freight to the detriment of allocative efficiency. If the argument is true (and we shall examine that point) the policy issues and their economic implications should be made specific and decided through the political process (Muskin, 1976).

THE STRUCTURE OF THE INDUSTRY

A motor carrier industry which is essentially competitive would be responsive to transportation needs existing and arising in the marketplace. Economic regulation, if appropriate under any conditions, should apply only to "natural monopolies" (Dewey, 1974, pp. 1-14). The deregulationists' view would be that, as the motor carrier industry is a "constant cost" industry, there is no natural tendency towards the price and output distortions that characterize industries where competitive influences are weak. In fact, the existance of regulation is said to have permitted or induced collusive behavior resulting in high rates, improper technologies, and inflexible, inadequate service yielding economic losses for the nation (Gellman, n.d., pp. 38-41). In support of this premise and proceeding from the assumption of the competitive nature of the business, the well-known Friedlaender conclusions are drawn.

Disregarding whatever data and methodological flaws may exist in the analyses of economic loss due to regulation allows us to focus on the central assumption: the fundamentally competitive character of the motor carrier industry. Those who see the motor carrier industry as "competitive' and therefore seek a normative goal of letting the magic of the marketplace rule should make note of Milton Friedman's own caveat:

> Familiarity with the subject matter of economics breeds contempt for special knowledge about it. The importance of its subject matter to every day life and to major issues of public policy impedes objectivity and promotes confusion between scientific analysis and normative judgment (Friedman, 1968, p. 45)

That is, if conclusions are to influence public policy, the assumptions underlying analysis are, if not more important than the data and the statistical methodology, at least intially crucial. Institutional insight ranks with theoretical and methodological proficiency.

The competitive nature assumption is suspect based, as it is, upon the inference in the deregulation literature that the industry is a monolith with respect to markets served and carrier types. The industry is, in fact, highly diverse in terms of markets served by segments of the industry and in terms of the diversity of the segments themselves.

Motor carrier markets can be identified along spatial lines and along transportation characteristics lines. Discriminating along spatial lines allows us to describe carriers in terms of:

(1) distance of routes

(a) long haul
(b) short haul
(c) local
(d) regional

(2) methods of services
(a) point-to-point
(b) saturation

(3) terrain and urbanization/industrialization character
(a) rate territories
e.g. Middle-Atlantic, Southern, East-Central, Rocky Mountain designate the territories within (or between) which carriers operate.
(b) location, size, concentration and type/volume of inputs and outputs of firms in the markets

(4) specific city-pair markets served

Clearly, the investment requirements, equipment and communications technologies, the managerial problems; the cost functions associated with these spatial issues indicate a diversity that reveals cracks in the monolith.

The varied transportation characteristics of shipments (i.e., shipper/receiver/product combinations) also dictate diverse equipment, facility, operational, and service responses from carriers. Some dimensions along which transportation characteristics differ are:

(1) Size and weight of individual shipping units
(2) Volume of individual shipments [Truck Load (TL)/Less Than Truck Load (LTL)]
(3) Dollar value of product
(4) Divergence in value of product at origin and its value in the destination market. (i. e. value of service)
(5) Frequency of shipments
(6) Loading/unloading facilities and services
(7) Compatability of products with others being shipped
(8) Density of freight
(9) Orientation of shipper/receiver toward "total cost" implications of transportation

The implications of accepting the competitiveness assumption are that the marketplace will produce better allocative results than will regulation and will produce them at lower social cost. Also, these preferred results will occur without regulatory lag. The contrary premise is that there are significant areas in which tendencies to concentration exist. Further, these tendencies are such that, without regulation in those areas, price excesses and service deficiencies will exceed those which exist within a regulatory regime. At the same time, there are markets that do seem to approximate the conditions required for designating them as competitive.

First, let us identify that market segment which may qualify for relief from the "regulatory yoke" based upon its competitiveness. The truckload movement of regularly moving, relatively low valued products moving in large volumes, and using standard equipment would seem to qualify for regulatory exemption. Entry barriers based upon initial costs are low. Exit from a market or the field due to inadequate profits is easy because of the mobility and adaptability of equipment. Users have no significant need to discriminate among the services of the carriers. A simple, low cost technology is available to all such carriers. Because of the simplicity of the production technology and the high divisibility of the production unit (tractor-trailer) there are probably constant returns-to-scale. In frequently served markets, sufficiently large numbers of truck operators will respond to profits associated with high rates to 1) induce rates near minimum average costs and 2) assure a flat demand curve.

In fact, economic regulation of such movements has effectively been abandoned. For evidence of this, one need merely look at the exemption from economic regulation of private carriers, agricultural haulers, and farm and shippers' cooperatives. So called "gypsy," "cheat," and "gray area" operators also populate the truckload field. Entry by contract carriers and availability of irregular route carriers operating without gateway restrictions further demonstrates the effective demise of regulation of this category of freight transportation.

A look at another segment of the market should demonstrate that conditions opposite to those required for the competitive designation exist. Consider the extreme case of the long-haul carrier of predominantly high valued LTL traffic operating between secondary city-pair markets (e.g. Detroit-Nashville, Philadelphia-Milwaukee, or Boston-Columbus, Ohio). It is argued here, that there are 1) significant entry barriers, 2) sufficiently large scale economies to restrict the number of operators to a "few," and 3) ample basis to differentiate the service (i.e. a heterogeneous product is possible, allowing firms control over their prices and domination over their markets). These are conditions for a monopoly or a differentiated oligopoly -- not for a competitive industry.

Let's examine the elements that are specified here:

(1) Significant entry barriers may be composed of high cost, high technology, and difficult to acquire resources. A list of these include:

(a) an extensive city and road fleet including surplus trailers for peak demands, traffic imbalances, and "drops" at shippers, consignees, and interlines.

(b) land extensive terminals with large parking areas in high rent areas near expressways and in the vicinity of industries which compete for land.

(c) terminal facilities composed of high cost materials handling equipment manned by a high-wage, usually unionized work force.

(d) difficult to acquire (for new firm) liability insurance, large amounts of which are required for high valued freight.

(e) sophisticated computerized communications system required for rating, billing, tracing, dispatch, and equipment assignment purposes.

(f) managers, who must be bid away from other industries, competent to operate and control the complex systems.

(2) Economists generally overlook the point that returns-to-scale refer to markets as well as cost structures. For example, the argument that the motor carrier industry is a constant cost industry relies on the definition of returns-to-scale that relates cost changes to proportionate increases in all inputs. If costs increase less than the percentage that inputs are increased the industry is said to be characterized by increasing returns to scale (i.e. it is a decreasing cost industry)(Samuelson, 1973, pp. 28-29). However, a meaningful definition of returns-to-scale must take account of the effect of the resultant industry structure upon the price and output conditions in product and factor markets. Therefore, the magnitude of demand with respect to the industry's cost curves must be taken into account. Where long run average costs fall over the range of demand in the market, the industry is one of decreasing cost, i.e., a monopoly. This is so whether the firm is a feed and seed merchant in a remote community in South Dakota or Con Edison in New York. If individual cost curves of an industry's firms incur increasing costs at output levels that are very small relative to market demand, the industry is referred to as perfectly competitive. Where cost curves allow the demand to be divided among a few firms we have an oligopoly (Samuelson, pp. 483-485).

To justify the initial investment and the fixed costs incurred to function in an LTL, high valued freight, long haul, "Secondary" city-pair market, the carrier must foresee a large market share. To continue to invest in the facilities and to support or expand the resources committed to the market, the expectation must have been borne out. The critical point here is that the cost/volume/profit relationship for each of the firms dictates a non-competitive structure. If, on the other hand, we are concerned with "primary" city-pair markets like Chicago-Detroit or Philadelphia-New York, while cost curves may be similar to those of secondary market points' the market demand curve may be sufficiently far to the right that enough competitors may "coexist" in the market to have it designated "competitive."

(3) Transportation users have diverse demands for carrier services. Some are most concerned with freight rates. Others, because of the magnitude of capital tied up in freight in-transit, are more concerned with average transit time. Shippers whose customer relationships depend upon

their products tying into their customers' production lines are preoccupied with consistency and reliability. Most are concerned with integrity of shipments, quick tracing service, rapid claims payments, and responsive carrier personnel. Some carriers falter in their efforts in fully satisfying shipper requirements. Others function satisfactorily. A few in certain markets have developed reputations for their virtuoso performances as carriers of high valued, LTL freight. Their managements have developed the ability to operate complex systems and to interact with their customers in a way that commands loyalty, market share dominance, and relatively high profitability. They have significantly differentiated their products, carving out for themselves not only preferred customers, but preferred weight categories, to points which these carriers prefer to serve.

These are the ways their customers reward them for their virtuosity. There are some interesting implications of this behavior. First, diversity of customer needs based upon value of service or total cost considerations motivates carriers to respond by applying their resources to the most profitable freight, weight, and route combinations they can achieve. Second, in the absence of rate differentials which take account of differentiated service offerings, other reward systems must arise to generate the response required by the market. Third, "lesser" carriers, unable to respond to service superiority of competitors by lowering rates, transport a disproportionately high percentage of less preferred business (i.e. freight, weight, and destinations). Fourth, the virtuoso carriers do not fulfill their "common carrier responsibilities" and users do not demand that they do so as long as <u>any</u> carrier authorized to transport the freight and serve the point will provide "adequate" service. Finally, carrier virtuosity can indeed bar city-pair markets to competitive entry. In the absence of rate regulation, such carriers could dominate and protect their markets by service virtuosity and (legal) market (rate and service) discrimination. Marginal customers (those who ship bulky freight, or small shipments, ship to off-route points or are otherwise "undesirable") would be denied service where the city-pair is dominated by one or very few carriers. Only the potential for regulatory sanctions now induces carriers in non-competitive markets to provide service to marginal customers.

A reassessment of the competitive assumption suggests that it is correct for the segment of the motor carrier industry which provides standard tractor-trailer equipment to users in the transport of relatively low valued freight. The assumption's validity for other segments of the industry needs to be examined in terms of the relevant market and carrier institutions rather than exclusively in terms of theoretical and normative principles.

THE CROSS-SUBSIDY ISSUE

A central issue in the regulation/deregulation debate is the question of cross-subsidy. Part of the regulatory tradition is that to compensate society for the grant of certificates of public convenience and necessity that allow the carriers protected markets the carriers should provide service for both profitable and "unprofitable" freight and communities without discrimination.[2] The economic rent earned in such markets should be (partly) returned by "subsidizing" marginal business. That is the common carrier obligation. Take that away, say those who defend regulation, and important social/economic values will be lost (Kahn, 1971, p. 143). Conversely, as noted earlier, the deregulationists argue that the market is the only economic justification for survival of facilities, institutions, shipment categories, and places. Further, that the government should create a condition in which economic rents might be earned creates, some argue, additional opportunities for official corruption (Posner, 1974, pp. 341-343). Finally, a flaw attributed to the "cross-subsidy" is the burden imposed upon the "high value" shippers and prosperous communities by subsidized shippers, freight, and communities.

The assumptions to be evaluated here are 1) that there is indeed a burden imposed upon profitable freight and communities, 2) that the economy would be better off in this respect under a market regime, 3) protected markets allowed by ICC grants of authority allow carriers to earn economic rents and if there are economic rents 4) they are adequately compensated by benefits shed upon society by the "protected" carriers.

To assess the economic burden assumption, a clear understanding of what is meant by "cross-subsidy" is required. Generally, the reference is to using the proceeds of business which covers its "fully allocated" costs to fill the revenue gap created by business which fails to cover its "fully allocated" costs. The subsidy inference is to the idea that the overhead portion of fully allocated costs (which are allocated to "profitable" business) would be lower in the absence of the "subsidized" business and therefore the rates charged the "subsidizing" business could be lower. This is patently untrue in the short run. Any contribution business makes to the fixed costs incurred by the carrier, in fact, reduces the overhead burden borne by any other class of business. Of course, we assume that there is no regulatory requirement that freight be transported or communities be served (for long) at rates below the marginal costs incurred because of them.

There is cross-subsidization if fixed costs are incurred on behalf of business the handling of which does not allow recovery of all costs during the life of the resources for which the fixed costs were incurred. There is a form of cross-subsidization which exists in an area which seems to have been ignored. This arises because firms will generally expand resources to carry on operations to the level of intensity at which incremental returns fail to justify further expansion. As motor carrier market alternatives are restricted by their operating certificates, all expansion is confined to the authorized markets.

Without the synthetic constraints of regulation carriers would, in all likelihood, have wider rate-of-return opportunities available to them. For example, rather than concentrating sales effort on freight of low relative profitability and acquiring the facilities and equipment to handle it, the carrier could exercise its standing with existing high profit accounts to generate additional, profitable city-pair markets at a higher rate of return. To the extent such opportunities continue to arise, the carrier could forestall the time that its marginal rate of return would fall to the minimum tolerable level. The size and stability of carriers would be enhanced. The true profitability differential between the constrained firm and the unconstrained firm would be calculated on a present value basis.

Internal subsidy arises from the pressure on the carrier who has no alternative but to exploit its market intensively. This means that low profitability freight, customers, and communities will receive better service and, because their business is competed over lower rates in the presence of restricted carrier markets. The wider implications of this are to induce less than optimal use of carrier resources in the aggregate. Capital flow to higher use transportation markets is reduced so that this segment of the market is over-charged and under-served. Further, this condition probably contributes to the low average rates of return in the over-all industry.

As a long-run matter, cross subsidies would exist only by inadvertence if market entry were unrestricted. Carriers would not acquire resources to support market segments which would not compensate the carrier adequately for the investment. Further, carriers would expand and apply resources to market opportunities that offer the highest marginal return. The public policy question remains; should the right to be served be prescribed for the entities benefited by the "subsidy?" Also, given the tendency to concentration in important parts of the motor carrier industry, will the cross-subsidy effects associated with regulation be exceeded by negative allocative effects of concentration which may exist if regulation is dropped?

Ample evidence supports the claim that grants of authority to motor carriers allow economic rents to be earned. That failing carriers can sell their businesses for sums well beyond "going concern value" (which for bankrupt carriers could be construed to equal zero) plus market value of tangible assets suggests a valuable residual; the certificate. Bare certificates and pieces of certificates also have sold for large sums of money. It seems clear that the protected right to serve certain markets promises more than normal profits, i.e. economic rents. At the same time there are certificates that go begging.

Carriers (or individuals) acquire other carriers or certificates for several reasons. One could be that the acquiring entity perceives itself as able to function more profitably within the bounds of the operating authority than does the acquired carrier. It can provide improved technological, managerial, or marketing guidance to the business. A second; so called "end-on-end" acquisitions link adjacent marketing areas to permit enhancement of marketing efforts and operating efficiency. Economies of scale are perceived not just in operations but in marketing where existing customers in both markets are offered an expanded "product line." Third, certificates are also acquired, not with the intention of providing the intensive service that the predecessor had provided but to link (or "bridge") the acquiring carrier's existing routes to key points on the acquired carrier's authority. Any combination of the foregoing reasons is a likely basis for buying operating rights and for their valuations.

The value of the rights may be considered to be the discounted present value of the flow of monopoly profits anticipated in markets protected from competition given the acquiring entity's perception of its ability compete with the few or many others also authorized in the market to the degree it sees itself as doing better than its predecessor. This valuation is appropriate for the purchase of a "free-standing" certificate; one that is not linked in any way to other certificates.

If the acquiring carrier is buying the certificate to link to others it already operates and to operate them jointly, the certificate value will be the discounted present value of the enhanced cost, revenue results of the linkage. We shall assume, here, that the intensity of operations in the resulting carrier operations is the same as existed when the carriers operated independently.

Where the acquiring carrier employs the purchased certificate to bridge its present operating territory to key points it was unauthorized to serve before, perhaps because of circuity, it may substantially alter the character of service handled by the prior owner. It may cease service to intermediate points, avoid serving marginal customers, and, assuming virtuosity, seek preference from "better" shippers in handling only their high rated, heavy LTL traffic to preferred points. Even if virtuosity is not assumed, the acquiring carrier will emphasize preferred points and avoid undesirable freight. That is, it will increase its selectivity of sales. The result will be reduced service intensity by the acquiring carrier in its new territory. The value of the certificate is calculated based not just upon the protected market and whatever cost/revenue improvements may occur, but also upon the carrier's opportunity to substitute low profitability/high intensity business in its old domain for high profitability/low intensity business in its new domains.

The "bottom line" on the valuation of certificates is that there probably is an economic rent given carriers in the form of a certificate. The high prices at which certificates are traded, however, reflect more than economic rent. They also include the value associated with releasing carriers from the market proscriptions imposed by certificates. This by allowing carriers 1) to enjoy the perceived economy of scales associated with operations and marketing and 2) to function in the expanded domain with less intensity of resource use than the previous constraints had imposed. Another way of looking at this latter point is this: a cost exacted of carriers for the protection provided by the certificate is the intensive, low return operation of that certificate. Enlarged operating domains diminish that cost and carriers will pay the capitalized value of the differential.

On the issue of society's benefiting to a degree justified by the carrier's collecting an economic rent for its protected market position, the answer lies, I believe, in the issue of "uncertainty absorption." A carrier enters a market in which its few competitors are known and their behavior patterns are either predictable or discoverable. In the midst of a plethora of uncertainties facing the carrier the certificate "absorbs" substantial uncertainties associated with competition. The carrier's business is less risky than it would otherwise be. Likewise, the user of motor carrier services. The using firm is denied the range of carrier options that might be available to it without entry regulation.

Some users will perceive that condition as being compensated by the "guarantees" provided by the common carrier obligation imposed upon the protected carrier. The guarantees are seen as absorbing risks associated with having adequate service available if needed and at a known price. This uncertainty absorption is particularly important to a user firm which has chosen a truck dependent location in an area which is not densely populated by other user firms.

Goldberg presents this concept under the heading of "administered contracts." Goldberg's thesis as it would relate to motor carriers is sketched. Because of long term relationships between carriers and users (mutual dependency) and the duration and riskiness of the financial commitments made by both with respect to the other, some form of contract must exist between them. (In the unregulated sector, Goldberg points out, the kind of relationships existing between carriers and users are, indeed, covered by contracts.) Because of the atomistic nature of most common carrier markets, individual contracts would be excessively burdensome. A blanket surrogate for the contracts exists in the form of the operating certificate. The "right to serve," which restricts the degree of market competition, protects the carrier while the user's "right to be served" is protected by the common carrier obligation. The ICC functions as agent in administering the "contract" between the relatively concentrated motor carriers on the one hand, and the atomistic shipping public on the other (Goldberg, 1976, pp. 426-447).

CONCLUSIONS

A rush to re-or deregulation will be premature until much more is known about the industry. Public policy should not be a battleground for the doctrinaire of either the regulatory or deregulatory stripe. More, I think, needs to be done to understand the motor carrier industry, its tendencies, its markets, its (likely) responses to regulation and to regulatory change.

Certainly the crucial party to the proceedings is the public exposed to the policy conclusion whatever it is. The social benefit criterion must be recognized. That it is not possible to measure it is immaterial.

Certainly if those with economic insight lay the quantified findings (based on logical assumptions supported by empirical study) before it, the public decision can be timely and correct.

- Is the industry a quasi-public good?
- Is there a tendency towards concentration?
- Is there a need to protect the right to serve and the right to be served by regulation?
- What costs are associated with regulation?
- If there are costs, are they compensated by values shed upon the public?

These are the things that need to be known. To know them requires that the right questions be asked.

NOTES

1. The analysis could also proceed along the lines of externalities theory calling upon public goods and environmental economics analogs.

2. Cross-subsidy is referred to also as internal subsidy.

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PROFITS, PRICE DISCRIMINATION, AND ENTRY: THE MOTOR CARRIER INDUSTRY IN DIFFERING REGULATORY ENVIRONMENTS

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SUMMARY

The purpose of this paper is to present an analysis of freight transport under various regulatory frameworks. Our particular emphasis is on trucking, although much of the formal analysis is in an explicitly multimodal framework. The focus of our investigation is on the phenomena of profits, price discrimination (including cross-subsidization) and entry.

In the first section of the paper we consider the nature of optimal regulation in transportation. Our model is based on work by Ronald Braeutigam (1976), who extended earlier arguments due to Boiteux (1971) and Baumol and Bradford (1970) to a framework applicable to transportation. The second section briefly considers the relationships between such optimal regulation and the current pattern under the Interstate Commerce Commission, then turns to consideration of the likely effects of profits, pricing patterns, and entry of continued ICC regulation and of deregulation of motor freight transport.

OPTIMAL REGULATION

In this section we present and analyze a formal model of regulation in the spirit of the traditional theory of regulation. We posit that the regulatory agency seeks to regulate the industry in the public interest in the sense of maximizing profits plus consumer surplus. The agency is an omniscient planner, with full knowledge of demand and cost conditions, and has the power to fix quantities or control entry and exit as well as to set prices. However, we assume that it is not able (or chooses not) to use multipart tariffs, and in parts of the analysis we will assume that certain subsectors are beyond the scope of regulation.

This analysis, even if treated as normative rather than positive economics, is clearly unrealistic. A less naive analysis, which would recognize the presence of uncertainty, the lack of complete control of even the regulated parts of the industry (and thus the possibility of regulation-induced behavior), and the costs of regulation itself, is highly desirable. Still, we believe that the present model does offer some insights into questions of regulation of the transportation industry and public policy towards it.

Our work is based on a recent important contribution by Braeutigam in which he extended the Boiteux-Baumol-Bradford analyses of socially optimal management of a multi-product firm or industry with increasing returns to scale to treat the situation of demands that are interdependent across industries. Since Braeutigam's work is both basic to our analysis and very recent, we will sketch some of his results here.

Braeutigam's model follows the tradition of welfare economics in taking the viewpoint of a regulator interested in maximizing social welfare as measured by consumer surplus plus profits. He considers a situation in which there are n goods being shipped by m modes. Service differentials are assumed between modes and play a crucial role in the analysis, since they permit one to assume that the demand price in mode i for shipment of commodity j is given by the indirect demand function $p^{ij} = p^{ij}(x_{1j}, \ldots, x_{mj})$, where x_{hj} is the amount of j being shipped on mode h. Note that the demand for transport of one good is assumed not to depend on the prices and quantities of other goods being shipped. We will further assume that no income effects exist and that the integrability condition

$$\frac{\partial p^{ij}}{\partial x_{hj}} = \frac{\partial p^{hj}}{\partial x_{ij}}$$

holds for all h, i, and j.

Mode 1 is distinguished by having a cost function $C(x_1) = C(x_{11}, \ldots, x_{1n})$ displaying decreasing average costs. The desired interpretation is that mode 1 is the railroads. The other modes are marked by constant average costs, with total costs of the form $\sum_j s^{ij} x_{ij}$ Here the examples would be trucking and perhaps barges.

The objective is to maximize net surplus, i.e., consumer plus producer surplus. Assuming no income effects, this can be written as

$$G = \sum_j \int_0^{x_{1j}} p^{1j}(w, o, \ldots, o)dw + \sum_j \int_0^{x_{2j}} p^{2j}(x_{1j}, w, o, \ldots, o)dw +$$

$$\ldots + \sum_j \int_0^{x_{mj}} p^{mj}(x_{1j}, x_{2j}, \ldots, x_{(m-1)j}, w)dw$$

$$- C(x_{11}, \ldots, x_{1n}) - \sum_{i \neq 1} \sum_j s^{ij} x_{ij} .$$

It is a classical result that maximization of G leads to prices equal to marginal costs for each mode and each good actually shipped on that mode. However, this rule would lead to the railroads' suffering deficits, since by assumption, marginal cost is less than average cost in this declining cost industry. This deficit is real, and whether public or private ownership prevails, it would have to be covered in some fashion. The ideal way is by idealized lump sum taxes, which, being independent of any economic choices, would not distort optimality. Such taxes do not appear to exist outside of economics textbooks however, and use of revenues raised via other distortionary taxes is undesirable on efficiency grounds. One might also question such taxes on equity grounds as well, since they would involve the general public subsidizing the purchasers of rail services.

This leads to consideration of maximization subject to the constraint that the railroads should at least break even, generating sufficient revenues to cover all costs, including the opportunity cost on the firms' capital. In the absence of the other modes, or if the regulator ignores the interactions between the modes, solving this problem yields the following conditions on the prices charged by the railroad:

$$\left(\frac{p^{1j}-\partial C/\partial x_{1j}}{p^{1j}}\right)\frac{1}{\eta^j_{11}} = \left(\frac{p^{1h}-\partial C/\partial x_{1h}}{p^{1h}}\right)\frac{1}{\eta^h_{11}} \quad \text{, all } j\text{ , } h\text{ ,}$$

$$\sum p^{1j}x_{1j} - C(x_1) = 0 \text{ ,}$$

where η^j_{11} denotes the own-quantity elasticity of the demand prices for railroad shipments of commodity j. (In this simple case, η^j_{11} is the inverse of the usual own-price elasticity). In words, the percentage markup of price over marginal cost for any commodity is proportional to its elasticity of demand, with that factor of proportionality being equal across commodities and chosen so that the railroad earns no excess profits.

However, if other, competing modes comes into existence, then Braeutigam's work shows that optimality requires bringing these competing modes under regulation. The corresponding conditions now require that there exists Γ such that for all commodities j,

$$\Gamma = \left(\frac{p^{1j}-\partial C/\partial x_{1j}}{p^{1j}}\right)\frac{1}{\eta^j_{11}} \text{ ,}$$

$$\Gamma = \left(\frac{p^{ij}-s^{ij}}{p^{ij}}\right)\Bigg/\left(\eta^j_{1j} - \frac{p^{ij}-s^{ij}}{p^{ij}}\right) \quad \text{, all } i \geq 2$$

and

$$\sum p^{1j} x_{1j} - C(x_1) = 0 ,$$

where η^{j}_{1i} is the elasticity of demand price in mode 1 for good j with respect to shipments in mode i of this commodity, i.e.

$$\eta^{j}_{1i} = \frac{x_{ij}}{p^{1j}} \frac{\partial p^{1j}}{\partial x_{ij}} .$$

Again, a factor of proportionality and certain elasticities, along with the zero profit condition, characterize the optimal markups.

From these conditions, we observe that social welfare (and not just the interests of the industry, require that price discrimination be practiced in all modes, that the constant cost modes earn supernormal profits and that entry be controlled into these modes. Price discrimination arises in the first mode from the desirability of departing as little as possible from the first-best optimal quantities (i.e. those quantities where price equals marginal cost). That it carries over into the other modes is a general feature of such second-best solutions: if price exceeds marginal cost in one mode, it should in other, competing modes as well. In any case, if we view different commodities as representing the shipments of different classes of customers who vary perhaps as to the size of shipments, location, frequency of shipment or whatever other factors might lead to differing elasticities, then third degree price discrimination is desirable on efficiency grounds. The profits in trucking and other regulated modes will occur in the shipment of any commodity where $\partial p^{ij}/\partial x_{ij} < 0$. If, for example, we are considering only two modes, rail and trucking, then this will obtain if the two modes offer substitute services and the own price effects are larger than the cross effects. This is perhaps the "normal" case. Finally, given that prices are set to exceed average costs in the constant cost modes, the regulator must erect barriers to entry in these modes to insure optimality.

Note further that if, as Friedlaender has suggested, we define cross-subsidization as existing whenever markups of price over marginal cost (not average cost, however, that might be defined) differ from the values that they would take under deregulation, then second-best optimal regulation probably involves cross-subsidization as well. The qualification "probably" is required since it is not completely obvious what industrial structure would emerge under deregulation. If one assumes trucking would be competitive (so price equals marginal cost) then certainly cross-subsidization is involved. At the other extreme, if trucking is completely cartelized, the profit maximizing condition is

$$\frac{p^{ij} - s^{ij}}{p^{ij}} \quad \frac{1}{\eta^{j}_{ii}} = 1,$$

and again cross-subsidization is involved in optimal regulation unless $\eta^j_{1i} = \lambda\eta^j_{i1}$, where λ is the Lagrangian multiplier associated with the breakeven constraint. If, however, some oligopolistic solution would occur it is not clear what the resulting markup would be and thus whether cross-subsidization is optimal.

What is striking about these results is that, at least qualitatively, they correspond precisely to the policies now being followed by the ICC! Price discrimination and cross-subsidization apparently prevail, the regulated highway common carriers do earn supernormal profits, and, via the certificates of public convenience and necessity, the ICC attempts to control entry into the industry.

However, before one gets too enthusiastic about the wisdom and foresight of the ICC and of Congress in bringing the motor carriers under regulation decades before Braeutigam's work, a few cautionary notes are in order.

First, while the relationships determining the optimal markups involve only local information about demands and costs, the informational and computational requirements of optimal regulation are still formidable. One finds it hard to believe that the regulators consciously try to approximate this pattern of optimal discrimination, and there appear to be no forces (such as competitive pressures) which would lead to this approximation. Indeed, the basic constraint of the railroads' breaking even is not being met! Second, the analysis takes as given the decreasing cost situation in the railroads. While currently such decreasing costs do exist, as has been argued most recently by Keeler (1976), these are a result of excess capacity. In an optimally adjusted rail system (which might be on the order of one-quarter the size of the current system) marginal and average costs would tend to coincide. The whole problem of second-best regulation considered here would then disappear: optimality would call for marginal cost pricing across the board, which one might expect to be realized in an unregulated but competitive environment. Taking the excess capacity and thus the structure of railroad costs as given means that either one is taking a relatively short-run view or else that implicitly one has introduced criteria other than efficiency into the decision. Finally, it should be noted that the ICC does not, in fact, completely control entry into the constant cost modes. The most obvious example of unregulated highway transport is the carriers of agricultural exempt commodities. However, to the extent that the service characteristics of the railroads preclude their supplying these markets, it is in fact optimal that these commodities be exempt. (Since $x_{1j}\partial p^{1j}/\partial x_{1j} = 0$ for such a commodity, optimally p^{ij} equals s^{ij}, which is the competitive, free entry outcome). A similar argument holds with regard to shipments within a single urban area: here railroads cannot compete, so there is no efficiency rationale for regulating intra-urban trucking. But more significantly, the ICC does not regulate the number of trucks used by those carriers it does regulate, only the number of such firms, and it does not regulate private haulage. Moreover, in the current political environment one must assume that, even if full deregulation of entry and exit does not occur, at least the purview of ICC regulation of these questions will not be expanded.

It thus becomes of interest to consider a variant of Braeutigam's second-best problem in which there are three modes: railroads (mode 1), which show decreasing average costs over the relevant range of shipments, the regulated motor carriers (mode 2) and unregulated private haulage (mode 3). For certain commodities (where, as before, a commodity may be distinguished not only by its physical characteristics but also by its original location, its destination, the size and frequency of shipments and the characteristics of the shipper) regulated trucking and private haulage may be very close to perfect substitutes. However, we will continue to use a system of demand prices which are assumed differentiable to describe the demand for the various modes. One could not obtain such a system in the case of perfect substitutes, but perhaps our assumption in such cases may be partially justified in terms of an <u>ad hoc</u> recognition of the costs of shifting between modes. We are thus implicitly taking a rather short-run viewpoint. Further, we will assume that firms in private haulage transfer transportation services within the firm at transfer prices equal to marginal costs, so that quantities in these markets are such that $p^{3j} = s^{3j}$. We do not, however, assume $s^{3j} = s^{2j}$.

The Lagrangian for the problem of selecting a social optimum subject to constraints insuring non-negative profits for the railroads and price equaling marginal cost in private haulage is

$$\max_{p^1,p^2,p^3} \Big[G + \lambda\big(\textstyle\sum_j p^{1j}(x_{1j}, x_{2j}, x_{3j}) - C(x_{11}, \ldots, x_{1n})\big) + \textstyle\sum_j \beta_j \, (p^{3j}(x_{1j}, x_{2j}, x_{3j}) - s^{3j})\Big] .$$

Among the first-order conditions are

$$\frac{\partial L}{x_{1j}} = p^{1j} - \frac{\partial C}{\partial x_{1j}} + \lambda\Big(x_{1j}\frac{\partial p^{1j}}{\partial x_{1j}} + p^{1j} - \frac{\partial C}{\partial x_{1j}}\Big) + \beta_j\Big(\frac{\partial p^{3j}}{\partial x_{1j}}\Big) \leq 0$$

$$\frac{\partial L}{\partial x_{2j}} = p^{2j} - s^{2j} + \lambda\Big(x_{1j}\frac{\partial p^{1j}}{\partial x_{2j}}\Big) + \beta_j\Big(\frac{\partial p^{3j}}{\partial x_{2j}}\Big) \leq 0$$

$$\frac{\partial L}{\partial x_{3j}} = p^{3j} - s^{3j} + \lambda\Big(x_{1j}\frac{\partial p^{1j}}{\partial x_{3j}}\Big) + \beta_j\Big(\frac{\partial p^{3j}}{\partial x_{3j}}\Big) \leq 0$$

$$\frac{\partial L}{\partial \beta_j} = p^{3j} - s^{3j} = 0$$

$$x_{ij}\frac{\partial L}{\partial x_{ij}} = 0\,, \quad x_{ij} \geq 0\,, \quad i = 1, 2, 3;\ j=1, \ldots, n\,.$$

Using the last two equations we can solve for $\beta j = -\lambda(x_{1j}\frac{\partial p^{1j}}{\partial x_{3j}})/\frac{\partial p^{3j}}{\partial x_{3j}}$ on the assumption that $x_{3j} > 0$.

Then, repeatedly using the Hotelling integrability conditions, $\partial p^{ij}/\partial x_{hj} = \partial p^{hj}/\partial x_{ij}$, we can obtain the following expressions characterizing the optimum:

$$\left(\frac{p^{1j} - \partial c/\partial x_{1j}}{p^{1j}}\right)\left(\frac{\eta^j_{33}}{\eta^j_{11}\eta^j_{33}-\eta^j_{31}\eta^j_{13}}\right) = \frac{-\lambda}{1+\lambda}\qquad, j=1, \ldots, n;$$

$$\frac{\dfrac{p^{2j} - s^{2j}}{p^{2j}}}{\left(\dfrac{\eta^j_{33}\eta^j_{21}-\eta^j_{31}\eta^j_{23}}{\eta^j_{33}}\right) - \left(\dfrac{p^{2j}-s^{2j}}{p^{2j}}\right)} = \frac{-\lambda}{1+\lambda}\qquad, j=1, \ldots, n;$$

$$p^{3j} - s^{3j} = 0\,,\qquad j=1, \ldots, n;$$

$$\sum_j p^{1j} x_{1j} - C(x_1) = 0\,.$$

Again, these conditions characterize the optimum, which involves price discrimination and cross-subsidization between commodities in amounts depending on various elasticities. Note, however, the escalation in the informational requirements over the situation in which all modes were controlled: checking the optimality of the regulated prices still involves only local information, but now the ICC needs to know $5n$ partial derivatives, a number which is most certainly in the hundreds of trillions, as well as marginal costs, current prices and quantities!

It is worth noting that $p^{2j} - s^{2j}$ can be shown to be positive in this case if modes 1 and 2 are substitutes for one another in transporting good j (i.e., $\partial x_{1j}/\partial p^{2j} = \partial x_{2j}/\partial p^{1j} > 0$). To see this, write

$$p^{2j} - s^{2j} = \left(\frac{-\lambda x}{\partial p^{3j}/\partial x_{3j}}\right)\left(\frac{\partial p^{1j}}{\partial x_{2j}}\,\frac{\partial p^{3j}}{\partial x_{1j}} - \frac{\partial p^{3j}}{\partial x_{2j}}\,\frac{\partial p^{1j}}{\partial x_{3j}}\right)\,.$$

The first term in parentheses is positive, since $\lambda > 0$ and $\partial p^{3j}/\partial x_{3j}$ is negative by the negative definiteness of the Antonelli matrix, A. The second term in parentheses is just $|A|$ times $\partial x_{2j}/\partial p^{1j}$ where $|A| < 0$ and $\partial x_{2j}/\partial p^{1j} < 0$, and so it too is positive. Thus, regulated trucking again makes supernormal profits in the optimal solution to this problem.

A further interesting question involves consideration of the nature of the outcome of optimal regulation, if, as is sometimes suggested by the trucking industry, there are decreasing rather than constant costs in trucking. To get a first feel for this question, let us initially ignore the service differentials between trucking and rail transport and also ignore the existence of non-regulated trucking. In that case, the demand price p^j of commodity j depends only on the total quantity shipped, $x_{1j} + x_{2j}$. The regulator now must be concerned that both modes break even. In this case, it is desirable to have the trucking industry organized monopolistically so as to capture the cost savings from the returns to scale. The regulator's optimization problem then becomes

$$\text{maximize} \quad \sum_j \int_0^{x_{1j}+x_{2j}} p^j(w)dw - C^1(x_1) - C^2(x_2)$$

subject to

$$\sum_j p^j(x_{1j}+x_{2j})x_{1j} - C^1(x_{11}, \ldots, x_{1n}) \geq 0$$

$$\sum_j p^j(x_{1j}+x_{2j})x_{2j} - C^2(x_{21}, \ldots, x_{2n}) \geq 0 \ .$$

The first order conditions for this problem (assuming $x_{1j}>0$, $x_{2j}>0$) are

$$p^j - \frac{\partial C^1}{\partial x_{1j}} + \lambda(x_{1j} \frac{\partial p^j}{\partial x_{1j}} + p^j - \frac{\partial C^1}{\partial x_{1j}}) + \beta(x_{2j} \frac{\partial p^j}{\partial x_{1j}}) = 0 \ ,$$

$$p^j - \frac{\partial C^2}{\partial x_{2j}} + \lambda(x_{1j} \frac{\partial p^j}{\partial x_{2j}}) + \beta(x_{2j} \frac{\partial p^j}{\partial x_{2j}} + p^j - \frac{\partial C^2}{\partial x_{2j}}) = 0 \ .$$

As usual, one could derive conditions describing the optimal markups in terms of the relevant elasticities, assuming that both modes are used to haul a commodity. However, it is interesting to consider the possibility of trucking earning positive economic profits as it does at the optimal solutions to the various problems posed under the constant cost assumption. If, in fact, positive profits are earned, then the constraint on profits in trucking is not binding and thus $\beta=0$. In this case, and assuming that both modes carry commodity j , we have

$$\frac{p_j - \partial C^2/\partial x_j}{p_j - \partial C^1/\partial x_j} = 1 + \lambda > 1 \ .$$

This condition cannot hold if the marginal cost in trucking exceeds that in the railroads for hauling commodity j . We thus conclude that if the trucking industry is to earn positive profits in this situation, it will carry only those commodities for which it is the lowest marginal cost producer. Of course, the same is true of the railroads. But note that by the nature of the problem both modes cannot optimally earn positive economic profits: if both did, there would be lost consumer surplus exceeding the profit level. The only situation that possibly might call for both the high marginal cost producer as well as the low cost one to be involved in shipping a particular commodity is if the high marginal cost producer is earning zero profits (i.e. no return to capital above a competitive one). Further, if trucking is uniformly the high marginal cost mode and all costs are avoidable, it will pass completely out of existence.

If the two modes are imperfect but close substitutes for one another in carrying some commodity, then the preceding results would continue to hold to the extent that the service differentials do not cancel out the cost differentials. At the other extreme, if trucking offers such superior service on some commodity that the railroads cannot compete in hauling it (i.e. $x_{1j}\partial p^{1j}/\partial x_{2j} = 0$) , then freight rates for this commodity must equal the marginal costs of carrying it by truck unless the industry is earning zero profit. Thus, if trucking is earning profits under optimal regulation, has increasing returns and enjoys the service differentials sometimes claimed for it, then it ought to be pricing those products in which it has market dominance at prices below average costs.

It is worth noting here that within the context of optimal regulation, the creation of transportation companies providing service in both modes is quite desirable. The basic reason is, of course, that the breakeven constraint is now on the whole company's multi-modal operations, rather than just on the individual modal operations, and this gives the regulator more degrees of freedom in setting optimal prices. It is a simple matter to revise the earlier analysis to introduce transportation companies, obtaining expressions for the optimal markups. In the case corresponding to Braeutigam's basic result noted above, where all sectors are served by the transportation company and no competitors exist, the optimal markups on product j in mode i are given by

$$\left(\frac{p^{ij}-\partial C^i/\partial x_{ij}}{p^{ij}}\right)\left(\frac{1}{\sum_h \eta^j_{ih}}\right) = \frac{-\lambda}{1+\lambda} ,$$

where as before, η^j_{ih} is the elasticity of the demand price for shipment of j in mode i with respect to shipments in mode h. If in addition to the transportation company there are regulated motor carriers who show constant costs, the form of the conditions on the transportation company's markups are unchanged, while the markups for the trucking companies are given by

$$\frac{(p^{3j}-s^{3j})/p^{3j}}{(\eta^j_{31}+\eta^j_{32}) - \left(\frac{p^{3j}-s^{3j}}{p^{3j}}\right)} = \frac{-\lambda}{1+\lambda}$$

where the indices 1 and 2 refer to the operations of the transportation company and the index 3 refers to regulated trucking. If this latter sector is deregulated and behaves competitively, then the conditions become considerably more complex:

$$\left(\frac{p^{1j}-\partial C^1/\partial x_{1j}}{p^{1j}}\right)\left(\frac{\eta^j_{33}}{\eta^j_{33}(\eta^j_{11}+\eta^j_{12}) - \eta^j_{13}(\eta^j_{32}+\eta^j_{31})}\right) = \frac{-\lambda}{1+\lambda} ,$$

$$\left(\frac{p^{2j}-s^{2j}}{p^{2j}}\right)\left(\frac{\eta^j_{33}}{\eta^j_{33}(\eta^j_{21}+\eta^j_{22}) - \eta^j_{23}(\eta_{31}+\eta^j_{32})}\right) = \frac{-\lambda}{1+\lambda}$$

and $\quad p^{3j} = s^{3j}$.

In any case the earlier pattern of price discrimination and cross-subsidization with markups depending on certain elasticities prevails and regulated trucking still earns positive profits (if it exists at all).

The existence of positive profits for the regulated motor carriers as is called for under optimal regulation (except, perhaps, if there are increasing returns to scale in trucking at optimal output levels), has important long-run implications. One would expect that, at least for frequent high-volume shippers, the costs of private haulage would be very close to those realized by the regulated trucking firms. Further, the quality of service that such a shipper could obtain by private haulage also ought to approximate and perhaps to surpass that available from the common carriers. Thus, in the medium-to-long-run private haulage is, again for the big, frequent shippers especially, a close to perfect substitute for shipping via the regulated carriers. This in turn means that any significant gap between prices and costs in regulated trucking will, given time to adjust, induce a movement by these shippers away from the common carriers towards private haulage. This may well be undesirable from a social point of view, both because private haulage may be more costly in real resource terms than use of the common carriers and because erosion of demand for the common carriers limits the range of policy open to the regulator in pursuing his assumed goals of achieving efficiency. In any case, it is certainly not in the interest of the common carriers, whose profits are being eroded.

The dynamic theory of the firm offers some insight into the questions raised by leakage into private haulage. In particular, consider a firm or group of firms faced with the possibility of entry of new competitors, which would erode the demand for the existing firms in a manner completely analagous to the growth of private haulage, and suppose the rate or probability of entry is a function of the markup taken by the existing firms. One alternative is to ignore the potential competition and maximize current profits. The cost of this is greatly reduced profits in the future. The other extreme policy is to push prices low enough to completely prevent entry. This clearly involves sacrifices of current profits. However, it is now fairly well established that, as one might expect, such extreme solutions are typically not optimal. Rather, the firm should adopt a strategy of pricing between the two extremes, trading off current against future profits by sacrificing the former in order to slow entry and thereby improve the latter.

One would expect that a dynamic analysis of optimal regulation would lead to a similar policy in the presence of potential entry of private haulage. Starting, for the sake of simplicity, with an initial situation without private haulage, the two extreme policies are to set short-run surplus maximizing markups, which imply rather rapid erosion of demand, or to set the prices in regulated trucking at sufficiently low levels to prevent the emergence of private haulage. This latter policy carries a cost in terms of reduced static efficiency, since essentially it corresponds to giving up the policy tool of optimally setting trucking markups so as to reduce the social cost of meeting the railroad's breakeven constraint. (The optimal prices in this context have been obtained by Braeutigam.) It seems intuitive that the optimal policy will involve a tradeoff of present versus future consumer and producer surplus, implying a policy of slowing but not preventing the growth of private haulage. It is significant that if the intuition is correct, the demand for the services of the regulated modes will be eroded over time, or, if demand in aggregate is growing, the regulated sector will get only part of the growth. An important question is then whether the optimal policy calls for uniform of differential rates of demand shifting and, if the latter is the case, whether the leakage is greatest for the cream (the big, frequent shippers) or the milk (relatively smaller, more infrequent or irregular shippers). We hope to investigate this issue, as well as the general question of the validity of the intuition that optimality involves slowing entry, in the context of an explicit dynamic optimization model in future work.

CURRENT REGULATION AND DEREGULATION

The analysis in the previous section suggests the patterns that would mark an optimally regulated transportation sector. While there are qualitative parallels between these patterns and the current pattern under ICC regulation - entry controls, excess profits in trucking, widespread price discrimination and cross-subsidization - one must doubt that current regulation in any serious, quantitative way approximates optimal regulation. Apart from the already-noted fact of railroad losses, there are several reasons for this doubt. In the first place, the ICC does not have, and for the most part, does not particularly seek to obtain the information relevant for optimal regulation, and, given the complexity of the various rules, one would hardly expect them to be met by accident. Second, even if the ICC did attempt to gather the required data, the informational, computational and administrative costs and difficulties of determining and adopting optimal prices would be overwhelming. Moreover, the ICC could presumably obtain much of this information only from the regulated firms themselves, and there would be incentives for the firms to supply distorted information. Indeed, rather than attempting to compute and institute optimal rates, the ICC tends to operate by ruling on the acceptability of tariffs proposed by the carriers. Given the exemptions of the transportation industry from anti-trust and given the existence of the rate bureaus, one would expect these proposed prices to approximate a non-cooperative solution for a duopoly with product differentiation. The ability of competitors to enter into the hearings to argue against rate reductions (i.e. to prevent price cutting that would break cartel price discipline) and the willingness of the ICC to disallow such reductions if they would cause any diversion of traffic or injury to profits (i.e. if they would have any of the effect prices are supposed to have), suggest that the rates actually approved will also look like these imperfectly competitive, profit maximizing prices. This suggestion is further supported by the use of the operating ratio as a test of reasonableness of rates. The class I carriers have had a ratio of annual revenue to capital of about 5, which with a .93 operating ratio implies a 35 percent allowed rate of return. Further, the form of entry control being exercised cannot be optimal, since it exacerbates the backhaul problem and thus increases costs, while the current pattern of price discrimination, at least to the extent that it involves relatively lower markups (not prices) for small and infrequent shippers and for shippers in low-volume areas, also seems out of line with optimality.

Many of these factors which suggest the non-optimality of current regulation also suggest the impossibility or, at least, economic undesirability of "optimal" rate setting if the costs of running the regulatory process are recognized. The question that then arises is whether imperfect regulation is preferrable to partial or complete deregulation. This involves comparative statics analysis of a form that economic theory does not presently seem capable of providing, primarily because we lack an adequate theory of informational costs and computational costs. Thus, in this section we will not attempt such an analysis. Rather, we will offer some impressionistic scenarios as to the likely paths of development of the industry under various regulatory schema and try to offer some suggestions as to the implications for the industry, its customers and regulators.

In the course of this discussion, we will focus on two aspects of the industry's structure, conduct and performance. The first of these relates to returns to scale, the size distribution of firms and the relationship of size and profitability. The second concerns the pricing policy of the industry, including patterns of price discrimination, and the impact of pricing and profits on the growth of private haulage. We will briefly examine the current situation with regard to these aspects, then attempt some prediction of the future under continued regulation and under deregulation. Since the current situation with regard to these issues is well-documented, our treatment will be very brief and far from complete.

The trucking industry is a remarkably diverse one. The general public tends to think of it in terms of its two extremes, the independent owner-operators of popular song and myth and the largest common carrier freight companies, whose rigs are such a familiar feature on American highways. This perception ignores most of the carriers under ICC regulation, of which there were 16,472 in 1975, ranging in size from relatively tiny outfits with perhaps a hundred thousand dollars in physical assets to relative giants, publicly held corporations with thousands of trucks and networks of private warehouses. Moreover, it also ignores those firms operating outside the ICC's jurisdiction, i.e. those specializing in agriculturally exempt commodities and intra-state or intra-urban operations, and the large volume of private and contract haulage. Indeed, the part of the industry under ICC common carrier regulation accounts for only a relatively small fraction of total truck shipments. In addition to the diversity in size, there is a specialization even among regulated carriers as to the products they carry. Obvious examples here are the inter-city movers of household goods, the firms specializing in fluids and those specializing in individual shipments of less-than-carload size. With this specialization goes specialization at least of the trailers and some concommitant limitations on substitutability: it is rather expensive to carry wheat on a trailer built for transporting automobiles. However, this specialization of equipment ought not to be of great significance over a period of more than a few years, since it is easily possible to buy and sell used equipment.

In an unregulated industry the persistance of such a wide diversity in firm sizes would be survivor-test evidence of the absence of significant economies or diseconomies of scale. Regulation, however, removes much of the validity or "usefulness" of such a test by dulling or altering the nature and effects of market forces. Thus, for example, while statistical studies tend to show that banking is not a constant cost industry, under regulation a diversity of sizes of firms exists that presumably could not continue under free entry and exit. In trucking there has apparently been no conclusive evidence published of the existence or absence of significant economies of scale. However, rather crude regression results based on American Trucking Associations data do show that the rate of return in regulated trucking is a strictly increasing function of capital and sales volume. This evidence, which is summarized in the Appendix, is supplemented by more recent casual observation of the industry extremes. It seems clear that, in economic opportunity cost terms, most independent owner-operators suffer losses at the best of times, while in hard times these losses are magnified into accounting losses. Thus, for example, after the rise in fuel prices and reduction in speed limits beginning in 1973, one fifth of the independents left the industry over the course of three years. At the other extreme, the eleven largest motor common carriers in 1976 averaged a 22 percent return on common equity, the second highest among U.S. industries in a Business Week study (Survey of Corporate Performance). This rate was more than 50 percent higher than the all-industry composite, and would have been significantly higher yet but for Spector Industries' dismal performance.

This pattern of profitability has three possible sources. These are not mutually exclusive, but do have quite different implications. On the one hand, it could arise from true economies of scale. Spychalski (1975) for one has suggested that while most economists tend to think of trucking as the example par excellence of a constant cost industry, since the basic unit of capacity is a "driver's license, a used truck and a rented office," this perception is really most applicable to the carriers specializing in hauling full truckloads from shipper to consignee. For those specialized in less than carload shipments, he suggests that other, less perfectly divisible and more illiquid forms of capital (including especially terminals, break-bulk facilities and information systems) represent a significant share of total non-current assets. These conceivably could represent a source of economies of scale, although one would not expect them to be so large as to account for the differential rates of profit. The second possible source is pecuniary economies and, in particular, the lower cost of borrowed capital and other financial inputs enjoyed by larger firms. These are real cost advantages to the firm, although their social significance is not so clear. Finally, the greater profitability may come from demand factors. Many of these are created or compounded by regulation. Consider a shipper who wants to ship from point A to point B, where a third point, C, lies between A and B. It is clearly to his advantage to send his shipment with a carrier with operating rights from A through to B, rather than with one having rights only as far as C. In the former case there is a better probability of speedy, safe delivery, and if anything goes wrong, one knows whom to blame, while with the second policy the goods must be transferred to another carrier, with a corresponding loss of time, increased likelihood of loss or damage, and dilution of responsibility. Moreover, if one also wants to ship to C and the first carrier also has rights from A to C, it is reasonable to deal with him for these shipments too, since using a single supplier typically results in lower transactions costs and these cannot be offset by other carriers via rate reductions in the context of regulation. This advantage on the demand side enjoyed by firms with more extensive operating rights is compounded by its effects on costs: since shippers at any location have the same incentives as the one at A, the firm with extensive rights has a better chance of finding a load for at least part of the return trip, thus reducing his incidence of empty backhauls.

This all means that, at least partially as a result of regulation, larger firms with more extensive operating rights will be more profitable. It also suggests that there is a strong incentive for firms to acquire new operating rights and that the large firms will be in the best position to do so.

The second aspect of the industry under regulation that we wish to consider relates to the adoption and continued use of railroad-style value-of-service pricing. The analysis in the previous section does indicate that marginal cost pricing in regulated trucking is <u>not</u> optimal so long as the railroads have excess capacity. It does not however, automatically suggest that current patterns, with higher markups for high-valued or dense products supplemented by regulator-induced favoritism of certain shippers on a geographic basis, is at all desirable. The relationship between optimal markups and own price elasticities, as given by the various formulae in the previous section, is a very complex one, especially when it is recognized that the quantity elasticities of demand price are not simply the reciprocals of the usual price elasticities of quantities demanded. Thus there is no obvious reason why markups that vary inversely with price elasticities (i.e. value of service pricing) should even represent the right directions of discrimination.

One major consequence of price discrimination is common both to current and optimal patterns of price discrimination, namely the loss of business to unregulated carriage. Figures given by Friedlaender (1969, p. 204) indicate that at least through the mid-sixties about 60 to 65 percent of all truck transportation rose from 10 percent in 1940 to 23 percent in 1965. The growth in the unregulated sector paralleled that of regulated trucking, so that through 1967 the immediate pre-war distribution of traffic between regulated and unregulated motor freight was maintained. However, since 1967, the percentage of unregulated traffic has fallen dramatically from the 1967 level of 64 percent to 56 percent in 1974, although unregulated ton miles did increase. This may be indicative of limit pricing by the regulated motor carriers. The big losers in all this have been, of course, the railroads.

Friedlaender (pp. 111-120) also gives an excellent discussion, based on the work of Oi and Hurter, of the nature of the shippers who have gone to private or contract haulage. This discussion indicates that, as one might expect, the incidence of private haulage increases with firm size except for the very largest firms, who apparently extract price concessions from the common carriers, and that it is highest among firms with large numbers of short hauls, with many shipment points and with high-valued commodities. Moreover, firms tend to use private haulage to handle a base level of regular shipping and rely on common carriers to handle any shipments above this.

The granting of (limited) freedom to the railroads in rate making is a basic fact which must be assumed in considering the future of trucking. However, the existing service differentials in terms of speed, certainty and safety of delivery presumably limit the cross-elasticities of demand between rail and trucking, so that any rate reductions by the railroads might well be expected to have limited impact and, consequently, perhaps never materialize. If, however, this measure of deregulation is extended by allowing rationalization of the rail system through merger and abandonment, the situation may change markedly. In particular, freed from operating unremunerative branch lines and able to realize the full economies of traffic density on a system of mainlines from which the current, costly excess capacity has been eliminated, the railroads may be able to close many of these service differentials. In particular, a revitalized, rationalized rail system would be in a position to repair roadbeds so as to allow greater speed in shipments and reduced dangers of damage. It could also afford to invest in modern, computerized information systems that would allow roads to keep better track of individual cars and shipments, thus reducing the uncertainty of delivery and the incidence of loss. The possibilities in this direction are well-illustrated by the experience of the Southern Railway and some of the other profitable lines like the Union Pacific and Missouri Pacific. Freed from the current cycle of failing service - falling demand - falling profits - inability to maintain service, the rail system might well be able to meet the competition from trucking. In the 1930's, the railroads sought to beat the trucks by forcing them, through regulation, to play the railroads' game. They have lost badly this way, but it is entirely possible that they might do much better if they play the truckers' game of speedy, certain service.

If regulation of the present form continues, one should expect that the trucking industry will be marked by a continued pattern of differential profit rates and that this will continue to spur the relative growth of the largest firms and demise of the smaller ones unless the ICC actively seeks to prevent this. To the extent that the greater profitability of the larger firms is not solely regulation-induced via the restrictions on operating rights, one would expect that this pattern would also continue under deregulation. Indeed, given that the industry is marked by substantial excess capacity (estimated by Friedlaender to be on the order of 50 percent), freedom of rate-making, entry and exit ought to be accompanied by a marked reduction in capacity. This is very unlikely to be uniformly distributed; rather, one would expect the larger, better capitalized, more professionally managed firms to come out of this shaking-out in a relatively even stronger position. Thus, the deregulated industry would likely show some significant concentration too, especially on submarkets.

However, the profits of these large firms cannot be expected to continue at current rates under deregulation. Current prices and profits reflect the combined effects of cartel pricing through the rate bureaus, the feeble competitive position of a sick railroad industry, and the actions of the ICC in controlling defections from the cartel agreements and the entry of new competitors in order to protect the regulated common carriers from one another and the forces of the market. The removal of the ICC's protection would immediately exert downward pressure on prices and presumably on profits. This pressure would be intensified if the rate bureaus were to become illegal, but it would still exist even if they survived. In an industry with such relative ease of entry, price cutting would be impossibly difficult to contain.

The existence of the current levels of excess capacity does suggest that the industry's nightmares of a re-occurence of 1930's-style destructive competition might well emerge in the wake of deregulation. The important point, however, is that this process of elimination of excess capacity is desirable from society's point of view. Once the shake-out has been completed, a process which on the basis of the time required to achieve contraction of the fringe of owner operators after 1973 one might expect to take three to five years, there is no reason to believe that the industry ought to be particularly subject to price wars. On the one hand, the cyclical dependence of demand on business conditions would encourage price wars, but this ought to be balanced by the ease of entry and exit and by the limited to non-existent economies of scale. The result should be relatively stable prices supporting competitive profit rates.

The extent to which these predictions, which are hardly novel, might be invalidated by increased concentration might be questioned. However, the basic technological data of free entry and limited economies of scale place rather tight upper limits on any appearance of oligopolistic profits.

This downward pressure on prices might be further accentuated by cost reductions made possible and even necessary by deregulation. If, as Thomas Moore has argued, the major beneficiaries of regulation now are the Teamsters (and, one might suggest, the manufacturers of trucks), deregulation would exert downward pressure on wages and truck prices and thus on costs.

Thus, deregulation presumably would bring increased concentration in the industry, but prices and profit levels that are reduced and held in check by the threat of entry as well as by competition among firms already in the industry. The pattern under continued regulation would presumably also involve increasing concentration. However, the continuation of high prices and profits would be dependent on the ability of the railroads to improve their competitive positions. The pressure from the railroads would particularly be intensified by the inevitable increases in fuel prices over the next few decades. Since railroads not only achieve many times the fuel efficiency of trucks, but also are in a better position to reconvert to more plentiful fuels, they hold a clear long-run advantage in an era of dwindling petroleum supplies.

As to the pattern of price discrimination, there is no obvious reason to suppose that it will change if current regulation continued and the railroads continue to decline. However, if the railroads do improve service markedly, they will exert the greatest pressure on long haul markets. This means that increasingly trucking will find its primary demand in short-haul markets, replacing rail branch-line service and serving as feeders to the railheads, while the long haul markets will be eroded. This pattern might be expected whether or not regulation continues in trucking.

Presumably ICC regulation would allow existing truckers to earn profits to the extent possible under new demand conditions, especially if the truckers were its only remaining constituency. This might then point to even higher prices to small, irregular or isolated shippers. This is not obviously consistent with some measure of social welfare, but it is consistent with past experience of the ICC's permitting geographical and (illegal) personal discrimination (see Friedlaender, p. 63) and with modern positive theories of the nature of regulation (e.g. Noll, 1975). The temper on this tendency under regulation would be the threat of further erosion into private haulage which, as noted, has been greatest in the short haul business that would be of increasing importance for the motor carriers, as well as pressure on the Commission from shippers.

Certainly an unregulated motor carrier industry would be in a position to attempt price discrimination, especially in those markets where rail competition was not a factor. The limitation on this would be the usual one: the possibility of entry. This suggests that it is the smallest shippers, who are in the worst position either to employ private haulage or to attract new entrants by the promise of their business, would face the greatest markups. But even here there would be checks on the extent of discrimination in the form of the growth of freight forwarders, brokers and cooperatives.

It thus seems that price discrimination is a likely outcome under either regulation or deregulation. Moreover, since many of the forces that would check discrimination are significantly stronger under deregulation, it is not clear that there would be worse discrimination in the deregulated industry than under ICC regulation. In fact, to the extent that the ICC has held down markups to certain shippers and practiced policies of cross-subsidization, one would expect that there would be higher prices for these formerly-favored shippers, but reduced price discrimination.

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APPENDIX

This appendix reports the results of some elementary statistical testing which examined the widely held belief in the American Trucking Industry: that the relative profitability of a motor carrier is related to its size.

Data was drawn from the Financial Analysis of the Motor Carrier Industry, an annual study published by the American Trucking Associations, Inc. Arbitrarily, data for the years 1966 through 1975 was used to characterize the "average firm" in each of four privately owned and the large publicly held carriers of general freight:

Carrier Group A	Annual Revenues less than $1 million
Carrier Group B	Annual Revenues $1 million to $5 millions
Carrier Group C	Annual Revenues $5 millions to $10 millions
Carrier Group D	Annual Revenues over $10 millions
Carrier Group E	Publicly held motor carriers

Certainly these five classes represent only a part of the trucking industry (although the sample accounts for gross revenues exceeding $16 billions in 1975) but restricting our attention to them allows us to deal with a consistent and homogeneous data source even though we cannot make statistical inferences about non-regulated carriers or private haulage.

We hypothesize that the profits of a regulated trucking firm are a strictly positive function of its size. Hence our statistical model is

$$P_{it} = \alpha + \beta X_{it} + e_{it} \tag{1}$$

where P_{it} is the profit of the ith firm in period t, X_{it} is a variable representing the size of the firm, β denotes the (positive) expected relation between profits and size and e_{it} is an independent stochastic term which we assume is distributed $N(0,\sigma^2)$.

The variables chosen to test (1) were Net Operating Income (freight revenues less operating expenses and depreciation) as a measure of profitability and Carrier Operating Property (Net of Depreciation) as a measure of size and capital. NOI is biased downward by excluding the very large book item depreciation which represents real income to the firm while COP (net) is understated since operating rights are not included and may have substantial value. This measure of capital, however, approximates the reported book values of the firms. Each variable was adjusted by the GNP implicit price deflator reported annually by the United States Department of Commerce.

It was not possible to estimate equation (1) directly since the model failed to satisfy the homoscedasticity requirement on the e_{it}. If the variances, σ_i^2, are proportional to λX_i the following equation can be estimated in generalized least squares form:

$$\frac{P_i}{X_i} = \frac{\alpha}{X_i} + \beta \tag{2}$$

where the dependent variable now represents the fractional profit on capital employed. Making the necessary assumption we obtained for equation (2)

$$\frac{P_i}{X_i} = \underset{(3.33)}{\frac{-9.00}{X_i}} + \underset{(.011)}{.224}$$

with the standard errors of the coefficients in brackets. It is clear that profits as a function of investment increase asymptotically up to the 22 percent range since the first term on the right hand side increases to zero as the firm's capital increases. This estimate of β lies in the range reported by industry specialists.

Correcting for heteroscedasticity reduced the Durbin-Watson statistic to 1.31, the lower boundary of the inconclusive test region at the one percent level. Although the estimated autocorrelation coefficient is small ($\hat{\rho}$ = .347), using ordinary least squares in the presence of autocorrelation could yield unbiased estimates of the coefficients but the variances of the estimates would be understated. To check the severity of this imprecision in this model we estimated a revised form of equation (2), using an estimate of the autocorrelation coefficient, ρ

$$\frac{P_{it}}{X_{it}} - \rho\frac{P_{i,t-1}}{X_{i,t-1}} = \alpha^* \left[\frac{1}{X_{it}} - \frac{\rho}{X_{i,t-1}}\right] + \beta^* (1 - \rho)$$

which yielded estimates

$$\frac{P_{it}}{X_{it}} - \hat{\rho}\frac{P_{i,t-1}}{X_{i,t-1}} = \underset{(.747)}{-1.83} \left[\frac{1}{X_{it}} - \frac{\hat{\rho}}{X_{i,t-1}}\right] \underset{(.003)}{+.026}(1 - \hat{\rho})$$

with the standard errors in brackets. This equation is more difficult to interpret since P_{it}/X_{it} depends up $P_{i,t-1}/X_{i,t-1}$ and the unknown parameter, ρ. Nevertheless, it is still true that an increasing level of investment increases net return since the first term on the right hand side increases as X_{it} increases, and the remaining terms are positive for $P_{i,t-1}>0$ and $\rho>0$.

Finally, since the variances of the estimators in (2) can be shown to be overstated because of the use of aggregated data (see Malinvaud, 1970, pp. 284-285), we use (2) with reasonable confidence to predict the direction and magnitude of the relation of capital investment to profits for the regulated motor carriers of general freight.

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SHIPPERS OF SMALL SHIPMENTS LOOK AT MOTOR CARRIER ECONOMIC REGULATION[1]

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In the realization that there will probably be a paucity of shippers presenting papers for the Workshop, this paper will endeavor to cover most of the issues as presented for consideration by the National Research Council. Accordingly, a broad treatment will necessarily be made of the multiple issues, rather than the in-depth analysis which would be deserving to any one of them separately. Moreover, since the shipper conferences are particularly concerned with LTL shipments of general commodities, the focus here will be upon regulated common carriers of such shipments.

THE EXTENT OF INTRA-MODAL PRICE COMPETITION

Narrowing the focus here to LTL shipments, there has been no significant amount of price competition among motor carriers. With the complete withdrawal of the railroads from LCL service, the motor carriers have this traffic pretty much to themselves and have not seen fit to reduce rates as a means of attracting LTL traffic from one another. Even in the area of "independent actions" (IAs), which are normally expected to produce whatever intra-modal competition there is in this industry, ironically the bulk of the so-called IAs have been to add charges or increase existing accessorial charges (e.g. inside delivery charges, COD charges, area arbitraries on LTL shipments only, etc.) rather than reducing rates.

The LTL carriers are grouped into regional rate bureaus and their joint consideration of LTL rates appears to be almost exclusively in increasing LTL rates, both generally and selectively. There are, of course, some LTL commodity rates; but they are rare and probably are moving less than 5 percent of the LTL traffic. And such LTL commodity rates as there are appear to be prompted more by the characteristics of the particular commodities than by price competition among motor carriers.

One area in which there had been some intra-modal price competition is that of volume or aggregate tender rates or "discounts" on

LTL shipments. Historically, the carriers which took the lead in that direction were fought vigorously by other carriers in the regulatory arena.[2] Perhaps in frustration, such generally unsuccessful efforts to initiate aggregate tender rates dried up several years ago. Within recent months, however, proposals for aggregate tender discounts have been received on the rate bureaus' dockets and there appeared to be a positive movement toward their publication. This is looked upon quite favorably by shippers; and, to the extent that such tariff changes could be accomplished by leaders in the motor carrier industry, the balance of the carriers would be expected to follow suit and this could be a good example of some price competition evidencing itself in the LTL field. Unfortunately, all of these proposals which have recently been voted on by the rate bureaus have been voted down.

THE EXTENT OF INTER-MODAL PRICE COMPETITION

As far as LTL shipments are concerned, there is generally no inter-modal price competition. This is because there is no other mode handling LTL freight. Some competition is present for the general commodities carriers in the form of United Parcel Service. However, UPS is limited to shipments weighing less than 50 pounds. It has carved out for itself a specialized area consisting of the smallest LTL shipments which move in packages and are susceptible to handling in conveyors. Its pricing system is distinctly different from that of the LTL general commodities carriers, as it is designed to handle only certain shipments. Because of the distinct nature of its services, UPS appears to be independent of the general commodities carriers in its pricing, and vice versa. However, it is worthy of mention that for the type of traffic it does handle UPS charges are lower than if the same shipments were made via the general commodities carriers.

Briefly reviewing what could properly be considered other "modes" (rail and air), as noted earlier the railroads have disappeared from the LCL scene and are therefore not a pricing factor. REA Express also disappeared from the scene in November, 1975.

The airlines are providing freight service for general commodities in LTL size shipments. Here, as in the case of UPS, the air freight rates are designed to meet the economics of air transportation, rather than to meet the LTL rates of the general commodities motor carriers. At common distances the air freight rates are substantially higher than the motor carrier LTL rates for a complete door-to-door service.

Though not truly a separate mode of transportation, the freight forwarders have provided some price competition to the motor carriers in limited situations. The freight forwarders' rates are generally the same as or higher than those of the motor carriers. They have provided some lower rates in the form of rates established for dock-to-dock shipments and for aggregate tenders.

To round out the picture, mention should be made of shipper associations. These are groups of shippers who have associated together, usually formed along industry product lines, to consolidate their shipments and obtain the benefits of inter-city volume rates. They use the services of the general commodities motor carriers and rail TOFC. The savings resulting from the consolidations are passed along to the members on a pro rata basis.

While these associations are limited in number and most shippers at this time probably do not belong to an association, they are the one practical means available to shippers today to obtain transportation of LTL shipments at charges below the rate bureaus' LTL rate structure. To date, the motor carrier rate bureaus do not appear to have designed any pricing structure specifically to attract the traffic being handled by the shipper associations. The initiation of aggregate tender rates and similar innovative concepts would be effective in attracting this business to the general commodities carriers.

THE EXTENT OF NON-PRICE COMPETITION OF THE INTRA-MODAL VARIETY

When rates are put to one side, the general commodities carriers of LTL shipments can be said to be highly competitive among themselves. This is particularly true in the larger cities where a number of carriers are available to handle a given shipment.

The primary elements of this intra-modal competition consist of efforts to provide: fast and reliable transit time; damage free transportation; broad point coverage, thereby minimizing the number of trucks picking up at the dock daily; prompt and fair resolution of loss and damage claims, etc.

INTER-MODAL NON-PRICE COMPETITION

The airlines provide the fastest methods of transportation of LTL shipments for long distances (e.g. 500 miles or more). Where the need is present and the value of the commodity can justify it, air freight transportation is used. However, it should be noted that the total volume of air freight is only a small percentage of the volume handled by motor common carriers. (Year 1975: Air--2,757,000,000 ton-miles vs. Gen. Com. Motor Carr.--86,078,882,000).

Freight forwarder service is primarily competitive with motor carriers on longer-haul traffic between major cities.

UPS is providing a good and reliable service for the type of small shipments which it handles. Coupling its service capacity with its own unique pricing structure, its segment of the transportation picture appears to be securely carved out. There have been some recent indications from general commodities carriers that they are considering the establishment of rates on a per package basis, somewhat modeled upon UPS' pricing structure. Inasmuch as UPS accounts for a substantial percentage[3] of the total volume handled by all the general commodities carriers, it seems realistic that they should be taking an increasing interest in becoming competitive with UPS.

THE STRUCTURE OF COSTS IN THE MOTOR CARRIER INDUSTRY

There is very little available literature on motor carrier costs. For the most part, it consists of publications by the Cost Section of the Interstate Commerce Commission. Even there, the basic literature is rather old and there has been no recent attempt to develop a new cost formula. The efforts of the Cost Section seem to have centered upon refining the existing Highway Form A formula and developing additional data to be used in applying that formula. If the formula is truly correct, this is all to the good. If it is not, then someone should be attempting to develop a new formula or at least to apply some tests to the old formula to determine its efficacy.

Beyond the publications of the Cost Section, the only widely circulated motor cost literature appears to be articles submitted for trade journals. In this vacuum, it appears that the time has come for someone to write a text on the subject of motor carrier costs.

The principal publications issued by the Cost Section on motor carrier costs for many years have been statements in pamphlet form purporting to show the average costs of groups of regionally located carriers.[4] The concept behind such publications was born of the emphasis placed many years ago on developing averages at a time when there were no computers and basic arithmetic was being performed largely by hand. The availability of a few "representative" carriers from which to calculate averages was indeed useful. With the passage of time, however, the expedient of grasping a group of carriers and designating them as "representative" has long since outlived its usefulness. What is available today and what is being done in most litigated rate cases is the development of actual costs for the carriers actually under consideration in any given regulatory situation; and the theory of probability has advanced the art of cost finding to the point where specific carriers and traffic samples can be selected on a scientific basis, rather than left to the ancient "representative" method. This outdated phenomenon of issuing averages of a few carriers and calling them the "territorial average" is archaic and productive of persistent mischief in regulatory proceedings. The ICC has been low on the funds needed for various new projects for several years and by dispensing with these so-called regional cost publications the funds could be released for truly deserving projects. It is apparent that the issuance of these publications is an inherited situation which badly needs rethinking.

As far as research goes, the ICC's Cost Section has provided leadership with respect to making or supervising continuing studies of the various elements which comprise the units costed in its Highway Form A. Unfortunately, in the past the Cost Section has embarked upon substantial research projects without consulting shipper groups to obtain their ideas and input. Thus, the shippers of small shipments were shocked several years ago to learn that a purportedly complete platform study had been collected and processed by the Cost Section without the shippers being made aware of it. Then, it was rapidly thrust upon them in rate proceedings. In an attempt to remedy that situation, the Commission has directed the Cost Section to make a new platform study and all interested parties are apparently being consulted by the Cost Section. Thus, the present practices in the research area appear to be distinctly improving.

This subject of research and development of new studies, adjustments and formulae, brings up one of the more critical issues in the regulatory arena. Consider the plight of a group of shippers which finds or claims that a particular study made by the Cost Section, such as the platform study, is defective or otherwise unacceptable. Without getting into the merits of such a claim, under present circumstances it is apparent that if such a claim were raised in the course of a Commission proceeding the only experts which the Commission has at hand to evaluate such a claim are the personnel in the Cost Section. Typically, it would be understood that the Commission would consult the case analysis branch of the Cost Section. However, such personnel may very well be supervised by or reporting to the people who initially designed the study in dispute. Without further drawing out the picture, it is an untenable situation to have the section which researches and develops new studies also responsible for evaluating their validity when placed in question in Commission proceedings.

The answer here which presents itself would be to have the case analysis branch either transferred to or established in the Office of Proceedings; and then to insulate it completely from the Cost Section. The result would be two bodies of experts within the Commission: one to develop new studies and another to independently evaluate them as they come before the Commission in litigated proceedings. If this is not already under active consideration by the Commission, it certainly deserves immediate attention.

As far as research by the motor carrier industry as to its costs is concerned, there has been an overemphasis on projects to develop costs as a basis for rate increases. There appears to be a void of research projects designed to produce cost reductions. Prospective projects such as joint terminals, joint pickup and delivery agents, conveyor systems, productivity,[5] etc., receive no discernible attention on an industry level. Instead, the "cost plus" theory of rate-making is fed by a massive system which cranks out costs for rate increase proposals. If there is any area in which rate bureaus have failed to meet their potential, it is in the apparently total disregard of their ability to provide research and leadership in cost reduction programs.

It should be apparent at this point that up-to-date research with regard to motor carrier costs is badly needed. Decisions in rate proceedings are being made without the most fundamental information necessary to reach valid judgments on current operating cost levels and standards by which to measure a fair rate of return for this industry. The following are the matters in need of most immediate attention:

(1) Completion of the new platform study.

(2) A method of developing up-to-date changes in non-labor costs, in order to dispense with the spectacle of using the Wholesale Price Index as a surrogate.
(3) The development of proper standards against which to measure the fairness of rates of return, operating ratios and related financial data.
(4) A resolution of the carried vs. through controversy by appropriate expansion of the traffic/cost sample to provide coverage of more carriers.

If the Commission does not have sufficient personnel to undertake these projects and complete them within a short time frame, then consideration should be given to contracting them out to independent consultants who have no stake in their outcome.

ENTRY RESTRICTIONS AND THE VALUE OF ROUTE CERTIFICATES

The complexity and time requirements to obtain new operating certificates remain a singular disappointment for shippers in need of new or additional service. Ways must be found both to simplify and shorten the procedure for obtaining operating authority. Indeed, the process which shortens the procedures would probably also be one which simplifies it. Recently, the ICC has been making efforts in this direction by a proposal to require the applicant carrier to submit its direct case at the time of filing its application. While there has been resistance to such a proposal by industry representatives, the industry could well find that if it were to become standard practice it would become a benefit to it. By shortening the time span, this in itself makes it more attractive to a shipper in need of additional service to support a new applicant.

Existing norms and due process have made it almost impossible for a carrier to obtain significant new general commodities operating routes. This leads to a certain complacency among the larger carriers; and, if a small or new carrier wishes to become a substantial contender in the field of motor carriage, it has been relegated to purchasing the rights or the business of an existing carrier which is on its way out of business. There should be more receptivity to awarding general commodities certificates where some need becomes apparent. This is not to suggest deregulation or unlimited right of entry, but merely some relaxation of the Commission's interpretation of the existing statutory standard of public convenience and necessity.

The value of route certificates, and with it some evidence that motor carrier profits are generally excessive, can be gleaned from the various finance proceedings in which mergers, acquisitions and control proposals are processed. Frequently the vendee is in financial trouble. Yet notwithstanding its negative net worth, a substantial premium is paid which can only be attributable to the operating certificate.

A good recent example is the courthouse sale of the operating rights of Associated Transport, a major Eastern general commodities carrier which went into bankruptcy proceedings. Its rights were sold for a reported total of $20,600,000 on July 9, 1976. Most of its rights were purchased by major regulated general commodities carriers, evidently seeking to extend their route networks. Thus, even when rights become available through sale, there is a tendency for them to be acquired by already franchised carriers rather than by new carriers, since the ability to tie them into existing routes makes them worth more to the former than to the latter.

SERVICE TO SMALL COMMUNITIES AND REGULATORY REFORM

The term "regulatory reform" is a misnomer, and a highly presumptuous one at that. The term presumes 1) that the existing statute is bad and 2) that a proposed statutory amendment is better. But one man's regulatory reform is another man's disaster. Everyone believes that there should be less regulation and less red tape, but there is little agreement on what form the "less" should take. And frequently the remedies offered would, on the one hand, excise the existing regulation and red tape and, on the other, replace it with a different form of regulation and substantially more red tape. A convenient demonstration of this can be obtained by comparing in the Code of Federal Regulations the regulations of the Interstate Commerce Commission, an agency in existence for over 90 years, with those of the Department of Transportation, created over ten years ago. While in past administrations the Department has been accustomed to criticize the Commission and point to the complexity of its regulations, it can readily be seen that in a few short years that Department has produced regulations many times more extensive and complex than those of the ICC.

While these Conferences have their own suggestions to make as to prospective statutory amendments, the point here is that it is time that the term "regulatory reform" be retired and that any group, agency or department which desires to sponsor statutory amendments should disclaim this presumptuous title and simply present their legislative program as a set of revisions. Whatever political mileage attaches to the term "regulatory reform" has long since been used up; and it is time that it be retired from the lexicon in favor of something more precise and informative.[6]

In the context of motor carrier regulation, it has been said that without Part II of the Interstate Commerce Act there would be small communities without service. There is, of course, no litmus test which can be applied to determine whether that statement is completely correct, for we have had motor carrier regulation since 1935.

Viewed from an economic standpoint, the existence of fewer competitors (which limited right of entry must presume) allows the existing traffic volume to concentrate itself in fewer hands. Where the traffic volume is thin, this could result in maintaining one or two viable carriers between points where a greater number would be fatal to all. On the other hand, perhaps the laws of economics would themselves work to limit the number of carriers.

These Conferences do not purport to have the definitive answer to the question of whether there would be adequate service to small communities in the absence of regulation. Under the present scheme, however, there does appear to be generally adequate service for small communities and, in whatever instances there are where service might be withheld by a certificated carrier, both shipper and carrier know that there is a convenient and prompt remedy available by calling the ICC's nearest District Office to look into the matter. The Commission's field offices have been cooperative, diligent and vigilant in responding to any shipper complaints and, in an era where criticism of the ICC is in vogue, it should be given credit for a job which it performs in an alert and public spirited manner.

Recognizing that some benefits are achievable through statutory revisions, NASSTRAC has developed a set of position statements and they are attached hereto for information as Appendix A. It recognizes that improvements can be made; but it is not necessary to destroy an institution in order to improve it.

THE PREVALENCE OF CROSS SUBSIDIES IN THE MOTOR CARRIER INDUSTRY

As is the case with "regulatory reform", the term "cross subsidy" has been much abused and overused in the transportation field during the past few years. Typically, it has been used as a rallying cry to justify either deregulation (the understanding being that regulation is artificially holding up the rates on some commodities in order to support other commodities which are not paying their way) or to justify rate restructures designed to substantially increase the rates on small shipments (the theory being that small shipments are being handled at a loss under the present rate structure).

Very little effort has been expended to define cross subsidy, particularly by those who use the term the most. Actually, any commodity or shipment whose rates and charges equal the variable costs of handling it is not being cross subsidized. Stated differently, on such basis the shipment is paying its own way and the rates on other shipments need not be inflated or increased because of its existence. Yet, the proponents of deregulation because of cross subsidization have yet to produce a body of traffic being handled at rates below variable costs; and the motor carrier rate bureaus, in their efforts to "restructure" the rates on small shipments, have invariably failed to present the variable costs of handling that traffic.

With respect to the issue of whether there are cross subsidies by size of shipper, that may well exist. But, rather than conceptualizing in terms of "cross subsidies" and "size of shipper" it seems more appropriate to think in terms of incentives for rate reductions or discounts which could be made available to all shippers. For example, the most costly LTL shipment to handle is one which is picked up singly. The motor carrier rate bureaus have reacted to that situation by publishing an extra charge for single shipment pickup. On the other hand, no comparable incentive or discount generally exists for the multiple shipment pickup. Thus, to take a hypothetical example, a shipper tendering 5 or more shipments to a single carrier at the same time could be offered a discount of $1 per shipment in the tariff. On its face, this would seem to hold out a promise to the larger shipper which is unavailable to the small shipper. On the other hand, the small shipper may elect to aggregate his shipments by having them picked up only once or twice a week, thereby obtaining the benefit of the discount. The net result is more efficient and less costly transportation, savings which can and should be passed along to the shippers in the form of the rate incentive or discount.

As noted previously, a common context in which the term "cross subsidization" is used is the assertion that larger shipments are sub-subsidizing the small shipments. There is no hard evidence to support that proposition. What small shipments are faced with is a monopoly situation. As developed earlier, there is no inter-modal competition for small shipments and intra-modally there is no price competition. On the other hand, the same general commodities carriers which handle small shipments are also transporting truckload and large LTL shipments. On the latter shipments, and most intensely on TL shipments, there is price competition from other modes and from private carriage. The latter is particularly important in holding rates down on truckload shipments.

Faced with the foregoing situation, there is an obvious tendency and bias for the carriers to inflate the rates on small shipments while deflating the rates on the larger shipments. Thus, a case for rate regulation can be made on small shipments where the rates might otherwise get out of hand because of the monopoly held by the motor common carriers. Yet, under regulation there has been a proliferation of "restructures" during the past few years. Perhaps the worst example of this alarming program is Central States Motor Freight Bureau, which has actually made effective through regulatory channels a total of 5 restructures on small shipments during as many years (a cumulative increase of over 27 percent on shipments under 500 lbs). The Central States restructure has become an annual event, with no end in sight.

While it is beyond the scope of this paper to argue the merits of any particular restructure, there is one common thread to all of them. The aforementioned platform study, which inflates the operating ratios on small shipments in the magnitude of 20 percent, has been used time and again to present relatively poor operating ratios on a segment of traffic which would otherwise show substantial profits. While no discussion will here be made of the platform study (for the reason, inter alia, that it is involved in litigation), the point here is that the general assertion that small shipment rates are so low that this traffic is being subsidized by larger shipments is at least questionable. Moreover, none of the rate bureaus "justifying" restructures on small shipments in recent years has presented the variable costs of handling small shipments.

The last issue raised as to "cross subsidies" is whether they exist as between routes. The apparent implication here is that the heavier density routes on a carrier's system might be subsidizing the lighter routes or, stated differently, that the traffic moving to and from the big cities might be subsidizing that to or from the small cities and towns.

It is not immediately evident that this is so. Economies of scale, as such, are not present in the motor carrier industry as they are in manufacturing industries. And in some instances there are inverse economies of scale. For example, the cost per intercity load between A and B, where there are ten loads per day, is the same as between C and D where there is only one load per day. This is because one truck and one driver are needed for each trip. Moreover, if A and B are large cities and C and D small cities, the terminal costs per unit at the former could exceed those at the latter because of street congestion, distances between terminal location and shipper's plant, and the fact that larger terminals require longer movements across the platform between the road unit and the pickup and delivery trucks.

One rather clear situation of "cross subsidy" obtains as between single line and joint line shipments. The rate structure makes no distinction between such shipments. Yet, at equal distances the transportation of a joint line shipment entails two extra platform handlings plus a crosstown transfer run between the docks of the two carriers involved. Computer printouts supplied in rate proceedings by the rate bureaus have indicated a difference of about 30 points in the operating ratios as between single line and joint line shipments. Thus, a weight bracket which is shown to produce a loss may well be showing a profit on its single line shipments.

What follows from this from a regulatory standpoint is that operating rights proposals to initiate single line service where only joint service is available should be favorably considered for economic reasons. Also, since many carriers are deliberately interlining LTL shipments to smaller cities and towns which they are authorized to serve directly, in calculating costs for "restructures" and general rate increases the proponents should be required to cost such shipments as if they moved in single line service. This would be an effective means of restoring service to small communities as well as preventing the carrier rewards and shipper burdens which result from the higher rates predicated on unnecessary interlining.

THE RELATIONSHIP OF THE 4R ACT TO THE MOTOR CARRIER INDUSTRY

The 4R Act should have little direct impact upon the motor carrier industry. In essence, it provides for the railroads 1) freedom to reduce or increase rates by 7 percent in 1976 and another 7 percent in 1977; 2) freedom to increase rates an unlimited amount where they do not have market dominance; 3) an easier route toward abandonments; 4) a federal fund to help rehabilitate needy railroads; and 5) a revision of authorized rate bureau activities.[7]

In all of the above, there is nothing to adversely impact upon the motor carrier industry. There have been no known instances where the railroads have reduced rates under its provisions and none appear to be at hand. To the extent that it eases the way for the railroads to increase rates on specific commodities, this would only drive additional traffic into the hands of the motor carriers. A proliferation of abandonments would also aid the motor carriers, in that affected shippers would have to route more traffic via motor if they are to survive. As far as federal funding is concerned, in the long range view this should also benefit the motor carriers. By propping up roads which might otherwise go under, the Act promotes the survival of shippers which are also shipping via motor.

Perhaps the most significant implication of the 4R Act would be whether or not similar legislation might be in store for the motor carriers. From its impact on most shippers, other than for the funding provision there was nothing in the 4R Act to benefit shippers and much to cause them concern. Giving the railroads freedom to reduce rates 7 percent and to increase them an unlimited amount presents a seriously unbalanced scale, particularly in an inflationary era. To the extent that there was "justification" for the ratemaking provisions of the 4R Act (if there was any), it would have to be found in the fact that the railroads were a declining or failing industry. Conversely, the motor carriers present a picture of growth and prosperity. And there is no need to rescue them. Thus, the only conceivable trade for extending rate "freedom" to the motor carrier industry would be to take down the fence and allow unlimited freedom of entry. The motor carriers don't want to see the industry reverted to the conditions of the thirties which led to the passage of the Motor Carrier Act; and neither do many shippers.

APPENDIX A

LEGISLATIVE POSITION
THE NATIONAL SMALL SHIPMENTS TRAFFIC CONFERENCE

The National Small Shipment Traffic Conference advocates the continuation of existing regulatory authority over surface transportation within the Interstate Commerce Commission modified as may be deemed necessary to achieve the improvements outlined below.

Position Statements

1. Rate Bureaus should not be able to file for suspensions of member carrier's independent actions.
2. Bureau members should only be able to vote on traffic handled by them.
3. Bureau members' votes should be available to the public.
4. The ICC should be able to require motor carriers to participate in through rates and routes.
5. Shippers should be able to obtain refunds for motor carrier rate increases found unlawful.
6. All merger and acquisition proceedings for motor carriers should offer shippers continuing route and service protection.
7. NASSTRAC is in favor of the establishment of a Commission on Regulatory Reform, provided that no member of any Commission serves on it, that the Commission have a realistic time limit as to when it would be expected to submit its report, and that members of both houses of Congress be represented on the Commission.
8. Carriers should provide allowances for shippers and receivers willing to truck to and from carrier docks.
9. Carriers should provide incentive rates for shipments tendered in multiple lots.
10. The ICC should issue new regulations providing: (a) that carriers must file justification statements for increases in classifications (specifying the dollar impact); (b) that Classification Boards make quarterly reports of published changes showing the aggregated impact in dollars in terms of increases and reductions; and (c) that all such increases be identified, quantified and subtracted from each general increase.
11. The ICC Commissioners, appropriately qualified by experience, should be given life-time appointments.
12. Before appointment, ICC Commissioners should agree not to accept, for a period of five years after leaving the ICC, employment or consulting positions with any industry which they have regulated.

13. NASSTRAC is opposed, in principle, to the establishment of fragmented or special increases on specific traffic or extra charges to apply most heavily on LTL shipments or selected traffic. We advocate a searching scutiny by the regulatory agencies of all such proposals to develop an irrefutable showing of most unusual circumstances and extraordinary need for such increases.
14. NASSTRAC supports legislation which would afford the public an additional 15 days notice on air carrier rate changes.
15. The CAB should institute proceedings to disallow the use of posting dates on air tariff revisions.
16. The CAB should institute proceedings to discontinue the two tariff system.
17. The CAB should require carriers to submit copies of their justification statements with each and every tariff revision.
18. NASSTRAC supports legislation that would allow railroads and all carriers to rid themselves of archaic work rules and non-productive jobs.
19. Congress should modify the Interstate Commerce Act to allow the ICC to speed the agency's procedings.
20. As carrier rates are increased, released values should be increased commensurately.
21. The ICC should be given the authority to require more intermodal cooperation, including permitting the establishment of rates between regulated carriers and private carriers. NASSTRAC is opposed to any policy that restricts intermodal common control, forbidding operations by a carrier in more than one mode, or inhibiting intermodal routing.
22. The ICC should not use "territorial average" costs as a basis for determining minimum rate levels. Cost based on lower cost carriers should be used.
23. All rate bureau meetings and discussions should be open to the public.
24. NASSTRAC supports continuation of the Highway Trust Fund.
25. All modes of transportation should be allowed to contract with shippers for the guarantee of certain services, so shippers will be in a better position to invest in plant and equipment.
26. NASSTRAC supports legislation that would allow private carriers to haul for subsidiaries for compensation.
27. After accurate costs are developed on all classes of mail, rates should be restructured so that all classes pay their fair share without the USPS being subsidized.

NOTES

1. This paper was prepared on behalf of the National Small Shipments Traffic Conference (NASSTRAC) and the Drug and Toilet Preparation Traffic Conference. Both are action-oriented associations of shippers which regularly appear before the Interstate Commerce Commission and state regulatory agencies in matters involving regulation of motor carrier rates and services. Their members are both large and small companies which are primarily shipping LTL shipments. Individual members could differ from some of the views stated, as unanimous action is not required for the policies of these Conferences. This paper was prepared by Richard A. Stuart, a member of both Conferences and the immediate past President of NASSTRAC, as well as by their companies counsel, Daniel J. Sweeney, an attorney in Washington, D. C.

2. In a leading case, Aggregate Rates on Wearing Apparel - Ry. Exp. Agency, 326 ICC 92 (1965), REA's proposal was opposed by NMFTA and several motor carrier rate bureaus.

3. In 1975 the regulated UPS companies had total operating revenue of $1,605,110,000. The LTL Intercity Freight Revenue in 1975 for Class I and II General Commodities Carriers was $6,296,416,000 (TRINC's Bluebook).

4. The following is a complete list of all the publications issued by the Cost Section since January 1, 1976. Notably, it consists entirely of territorial average cost statements:

   Statement No. 1C1-73, Railroad Carload Cost Scales--1973

   Statement No. 1C1-74, Railroad Carload Cost Scales--1974

   Statement No. 2C15-73, Cost of Transporting Freight--Class I and II Motor Common Carriers of General Commodities--1972, (Transcontinental Territory, Rocky Mountain, Midwest, Southwest, and Pacific Regions)

   Statement No. 2C1-75, Cost of Transporting Freight--Class I and II Motor Common Carriers of General Commodities--1975.

5. On this matter of productivity, the motor carriers take the position that they enjoy no increases in productivity despite the fact that the private business sector has had increased productivity of 2 to

3 percent per year for the past 29 years (Economic Report of the President, 1977, p. 45).

6. Mention the term "regulatory reform" to a trucker or a railroad and it conjures up the image of faster rate increases; but mention the same term to a shipper and it conjures up the concept of easier right of entry, exactly the opposite of what the carriers have in mind.

7. In 1975 all regulated motor carriers performed 218 billion ton-miles as compared with 852 billion ton-miles for the railroads. During that same year, while the railroads operated at a $61,701,000 net loss the motor carriers had a net income of $379,965,000 (U.S. Interstate Commerce Commission, 1976).

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DISCUSSANT'S COMMENTS

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Let me, in my very small amount of time, make brief comments about the papers we have heard this morning, and then make a few other observations. Regarding the Roberts and Simmie paper, they attempted to answer the question, or at least discuss the question regarding imperfect regulation -- "Is it preferable to partial or complete deregulation?" I do not think they came to a definite conclusion, which of course one would expect. It is a very difficult and complex issue.

They did look at economies of scale, and I might point out, although Roberts did not have time to mention it, they did indicate that they clearly appear to exist on the demand side. I think most of us, at least, regarding the line haul portion of trucking, would not argue that to run a truck from A to B, a large company cannot do it any better than a small company can, or vice versa. But what certainly appears to be true is that the large companies, because they offer one-carrier service, better tracing, less loss and damage, and these types of preferred services, do, in fact, have higher load factors. They tend to get more in a truck that is running from A to B, and of course if they get more in a truck that is running from A to B, then their cost per pound of freight produced is in fact lower.

In their paper, they also mentioned that it was their belief that without regulation, there would be a trend toward concentration in the trucking industry. I completely agree. I believe there are some -- I don't know if you want to call them economies of scale -- but large truckers have very definite advantages on the demand side, and it is my feeling that without regulation we would have a significant amount of concentration in the trucking industry.

Finally, they indicated that without entry control there would be price wars initially, and then after excess capacity was dissipated there would then be no price wars. My reaction to that would be -- I am not sure. In fact, history would indicate quite the reverse. In the 1920's, which were "good times" economically, we had price wars; we had had some chaos. In the early 1930's, which by anybody's estimation were "bad times," we continued to have the same pattern. So, I am not at all sure that there is not something very definitely there in this chaos argument.

Today we look at the cattle haulers. There appear to be some problems. More recently, the Florida agricultural groups are complaining about reliability of service, lack of service availability, etc.

Let me say as a general statement, I thought the paper was a very fine one and I enjoyed reading it.

The paper by Daughety and Inaba dealt with market choice by country elevators. The paper, frankly, was very complex. I am not an econometrician, and I do not feel qualified to discuss it.

The Muskin paper attempted to ask questions, state observations, etc. I found it a very interesting paper. The question was raised regarding the importance of transportation as part of the infrastructure of the economic system. In other words, much of the rest of the economic system is necessarily dependent upon it. I personally, very definitely, believe that. That is the clear differentiation between why a trucking company or a railroad is a quasi-public utility, as opposed to a furniture company. If the furniture industry is chaotic, it does not have broad ramifications throughout the rest of the economy; whereas instability in the trucking companies will have tremendous ramifications on other aspects of the economy.

Muskin presented a very fine paper. I would recommend it to you very highly.

Finally, there was the paper by Mr. Sweeney. Again, I think it presents a very fine overview of the small shipment situation. He stated that it is "almost impossible" to obtain significant new general operating rights. I do not know what he means by significant, but apparently the ICC is becoming more liberal in regard to awarding new operating rights to prospective carriers that did not previously have operating rights.

In a recent speech, ex-Chairman Stafford pointed out that in 1975 there were 4,643 new grants of operating authority issued by the Interstate Commerce Commission, and of this number, approximately 12 percent went to new applicants that had no motor carrier affiliations. In other words, they apparently became new carriers.

He did mention something that some of my research has indicated and that is that the small communities and the small shippers basically are receiving good service. In some cases they think they should have better service, but most of them are fairly well satisfied with the service they are now receiving.

In summary, I thought Mr. Sweeney's paper did a very fine job of looking at the small shipment situation.

Just a few general comments -- I think the assertion has been made both today and yesterday that in some cases the ICC is "in bed" economically with the motor carrier industry. I would really take exception to this position. I think in many cases they are not. I would point out to you the recent multiple shipment rate decreases which the commission has gone along with and, again, the 12 percent of new certificates going to non-carriers, also the increase in the commercial zones and the gateway eliminations. These actions indicate that the commission is not completely at the mercy of the industry and is trying to encourage competition.

Let me make just one concluding statement. I think I have the solution to all of the problems we have talked about. There have been basically four groups that have discussed the issues. These are the labor unions, the shippers, the carriers, and the teachers.

The labor unions, the shippers, and the carriers all appear, with, of course, some exceptions, to not want to change the system. I propose that we can satisfy everybody -- and I don't mean to be sarcastic -- by basically not changing things too drastically. But how do we keep the teachers happy? Well, there are enough funded research projects available addressing unresolved motor carrier issues that do need to be conducted and this will keep the teachers happy. Therefore, we will have everybody satisfied -- with no problems.

DISCUSSANT'S COMMENTS

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For policy purposes, perhaps the most pressing question is the extent and magnitude of the cross-subsidy from large shippers in urban areas with high-density routes to small shippers in rural communities with low-density routes. Thus, although I found all of the papers in this session interesting, I was disappointed that none of them addressed the issue directly. Therefore, instead of commenting upon each of the papers specifically, I would like to address the cross-subsidy issue and consider both the policy problem it poses and some empirical evidence that we have recently developed that is relevant to the question.

Before turning to the policy problem posed by the existence of cross-subsidies, it is useful to define the term cross-subsidy. In their papers, Muskin and Sweeney use the conventional definition: a cross-subsidy is said to exist in the long run if some traffic fails to cover its fully distributed cost, thus making it necessary for other traffic to earn more than fully distributed costs to ensure the long-run viability of the firm. Thus, it is claimed, since small shippers in light-density areas are charged rates below fully distributed costs, a cross-subsidy exists between large shippers on high-density routes to small shippers on low-density routes, and from urban areas to rural areas.

The use of the term "fully distributed" costs should serve as a warning flag, however, since it is well known that average costs have no meaning in multiple output technologies with joint and common costs. Trucking is clearly such an industry, and trucking firms are generally engaged in both profitable high-density service and unprofitable low-density service. Thus we cannot measure average costs of different types of shipments over the network of a given trucking firm. Therefore, as conventionally defined, the cross-subsidy issue is totally unoperational and not subject to verification.

We can, however, redefine cross-subsidy in a way that is subject to verification. Thus I would like to say that a cross-subsidy exists between traffic A and B if the price-marginal cost ratio of traffic A relative to traffic B is less than it would be in the absence of regulation. This definition is in the spirit of the analysis of Roberts and Simmie, and under certain simplifying assumptions it can be related to efficient losses. On an intuitive level it is appealing and states that a cross-subsidy exists whenever regulation affects the rate structure, and causes relative prices or rates to shift in favor of the subsidized traffic. In this context, we do not need to make any statements about the profitability of the relevant traffic. Indeed, using the definition a cross-subsidy could exist if all traffic did in fact cover fully distributed costs as long as the existing rate structure was significantly different from the profit maximizing rate structure. Note that this definition stresses relative rather than absolute prices, which, of course, is entirely consistent with traditional incidence theory.

Using this definition, it should be possible to assess the magnitude of the existing cross-subsidy. Marginal costs, prices, and elasticities of demand are quantifiable. Thus we should be able to measure the price-marginal cost ratios that exist before and after deregulation on the relevant traffic and see whether cross-subsidies do in fact exist.

One can think of two polar cases in which cross-subsidies exist. In case I, trucking firms face the same elasticity of demand for and charge the same rate on all traffic, but the marginal cost of light-density traffic is greater than that of high-density traffic. Under present regulatory practices, the price/marginal cost ratio on light-density traffic is lower than that of the price-marginal cost ratio of high-density traffic. In the absence of regulation, rates on low-density traffic would presumably rise relative to those on high-density traffic. In case II, all traffic has the same marginal cost and is charged the same rate, but the elasticity of demand for low-density traffic is substantially less than that of high-density traffic. Under present regulatory practices, each type of traffic has the same price/marginal cost ratio, but in the absence of regulation, the price/marginal cost ratio of the low-density traffic would rise relative to the high-density traffic.

These examples highlight the importance of relative marginal costs and relative elasticities of demand in determining the existence of cross-subsidies. If the marginal costs of light-density traffic are substantially higher and if the elasticities of demand are substantially lower on light-density traffic, then in the absence of regulation, we could expect to see a rise in the rates facing small shippers in rural areas relative to the rates facing large shippers in urban areas.

While Daughety and Inaba give some information on elasticities, their analysis is unfortunately not structured in such a way as to shed much light on this question. Their analysis seems to indicate that the point elasticities of multiple car users with respect to single car rail rates and truck rates is somewhat higher than that of single car users. In the absence of any information on the standard errors, however, it is impossible to know whether these differences are significant. Given the relatively small magnitude of these differences, however, I would be surprised if they were in fact significant.

More generally, Daughety and Inaba are presumably only dealing with small, light-density shippers and do not have the data to address the cross-subsidy issue directly. If true, this is unfortunate because we clearly need to know whether significant differences exist in the elasticities of demand for light-density and high-density shippers. If, on the other hand, their data can be stratified to yield some insights into these differential elasticities, I would urge them to try to estimate them. Without this knowledge, we cannot really say anything definite about the existence of the cross-subsidy.

The information concerning differentials in marginal costs between light-density service and high-density service is equally sparce. Although our research group at MIT has been doing work to estimate the cost differentials associated with different shipment characteristics, we unfortunately do not have sufficient data to determine whether significant differentials in marginal costs exist between light-density service and high-density service. Nevertheless, we do have some information that may give some clues about these differentials.

Our research indicates that costs vary significantly with average shipment size, average length of haul, average load, the percentage of traffic shippped by LTL and the composition of output. In particular, we have estimated the following elasticities of trucking cost with respect to shipment characteristics, for firms facing average factor prices and having average shipment characteristics:

Characteristic	Elasticity
Size	-.0321
Haul	-.4294
Load	-.2149
LTL	1.0314
Insurance (This serves as a proxy for value of shipments)	.2205

Thus a 10 percent reduction in average load will increase costs by approximately 2 percent; a 10 percent reduction in average length of haul will increase costs by approximately 4 percent; a 10 percent reduction in size of shipment will increase costs by .3 percent; and a 10 percent increase in the share of LTL traffic will increase costs by 10 percent.

Note that these elasticities are evaluated at the mean. Thus for firms whose shipment characteristics are skewed toward small shipments, small loads, short hauls, and large percentage of LTL traffic, these elasticities would all be greater in absolute value. Thus these findings indicate that firms whose traffic is predominantly concentrated in short hauls, small loads, small shipments, and high LTL traffic will have substantially higher costs than those whose traffic has the opposite characteristics.

Of course, these findings do not in themselves imply that firms concentrating in light-density traffic would have greater costs than those concentrating in high-density traffic. To show this, we would not only have to demonstrate that this traffic presently has characteristics that would imply greater costs, but also would have those characteristics in the absence of regulation. As I have argued elsewhere, present regulatory practices imply that firms with diverse operating rights should have lower costs than firms with more circumscribed operating rights. However, in a world of free entry and free operating rights, it is not clear that these differentials would exist.

Thus before we can demonstrate that a cross-subsidy exists, we must demonstrate that light-density traffic has lower elasticities of demand and/or higher marginal costs than high-density traffic. While the available evidence is mildly supportive of this hypothesis, we clearly need considerably more evidence concerning the elasticities of demand and the marginal costs of light-density traffic relative to high-density traffic before we can draw firm conclusions about the nature and extent of any cross-subsidy.

Finally, even if we could demonstrate the existence of cross-subsidies, the policy response is not clear. As Muskin has indicated, one response is to stress efficiency considerations and to argue that the existing subsidy represents a welfare loss that should be corrected, regardless of its distributional implications. At the other extreme, one can argue that since existing locational patterns were based on the subsidy, to remove it without compensation would be grossly unjust. Clearly both positions have a point.

Thus I will close by straddling the fence and simply say that economic policy generally involves a tradeoff between efficiency and equity. Therefore before any clear decision can be made about the desirability of continuing present policies, we must have a clear indication of the efficiency losses associated with the present policies and the income losses associated with changing them. I would argue that more attention be paid toward the nitty gritty analysis required to answer these questions. The analytical techniques to answer them are available. What is lacking is the hard and tedious work required to yield the needed answers.

CHAIRMAN'S COMMENTS

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In the brief time available it will be possible to review only a few of the points made in the interesting papers which have just been presented. I should like to comment, first, on some features of Mr. Sweeney's paper. His major concern is to demonstrate that small shipments are not being cross-subsidized by other traffic. After citing various alleged deficiencies of the ICC motor carrier cost studies Sweeney asserts that there is no hard evidence to support the contention that large shipments are subsidizing small shipments. On the contrary, he maintains that "there is an obvious tendancy and bias for carriers to inflate the rates on small shipments while deflating rates on the larger shipments" because there is little or no competition in the handling of the former and a great deal of competition in the handling of the latter. Therefore, he favors continuing regulation in order to check this tendency.

However, I do not find Mr. Sweeney's arguments concerning the absence of cross-subsidy for small shipments entirely convincing, for two reasons. First, while he holds that existing cost data are unreliable for determining whether there is cross-subsidization he offers no alternative empirical evidence to demonstrate the absence of cross-subsidy. Second, he holds that "any commodity of shipment whose rates and charges equal the variable cost of handling it is not being cross-susidized." On the contrary, I believe that almost all economists would hold that traffic is being cross-subsidized unless it makes some contribution to the fixed costs in addition to covering variable costs.

I would also like to call attention to one topic discussed by both Professors Muskin and Roberts, namely, the diverse structure of the motor carrier industry and its bearing upon the probable performance of the industry under deregulation. In the literature of transport economics the motor carrier industry has, with rare exceptions, been treated not only as having structural characteristics approximating those required for pure competition, but implicitly as also being a homogeneous industry having these characteristics throughout. Furthermore, advocates of deregulation have, again with rare exceptions, rested their case on the same assumptions. In my opinion, therefore, the present papers perform an important service in demonstrating that the motor carrier industry is in fact very heterogeneous, that important segments of the industry depart significantly from the purely competitive model, and that the performance of the industry under deregulation may be affected by these structural variations.

Thus on the one hand firms specializing in truckload movements of packaged or bulk commodities and serving relatively few customers can operate with a small investment and make relatively rapid adaptations in capacity because their capital assets consist of very little besides trucks. This segment of the industry therefore approximates a purely competitive structure. On the other hand, firms handling some truckload but predominantly less-than-truckload shipments of general freight, or small package shipments, require substantial investments in terminals and communication systems, these items often accounting for half or more of their total investment. Hence these firms conform less well to the purely competitive model because of their higher entry and threshold costs and the less fluid character of their assets. Furthermore, Professor Roberts recognizes that tendencies toward concentration would exist in the motor carrier industry even in the absence of regulation because of differences in service quality among firms and the fact that service quality appears to be positively correlated with increasing size of operations.

I wish to comment, finally on the defense of discriminatory rate structures presented in the paper by Professors Roberts and Simmie. The The authors start with the familiar prepositions that where decreasing cost conditions prevail, as in the case of railroads, adoption of marginal cost pricing would result in failure to cover full cost, and that in this situation resort to discrimination is a second-best alternative that would permit the covering of full cost with the least practicable departure from the outputs that would prevail under marginal cost pricing. It is then argued that if this type of pricing is applied to railroads consideraitons of allocational efficiency dictate that the same pricing principle also be applied to competing modes of transportation even though these modes may not operate under decreasing cost conditions. Furthermore, since application of this rule permits the earning of above-normal profits by modes of transportation which operate under constant cost conditions, as may be the case in at least some segments of trucking, entry into those modes must be restricted in order to make the rule effective.

On the basis of the foregoing analysis the authors conclude that, in principle, the present policy of maintaining discriminatory rate structures and entry controls for both rail and motor carriers, and consequent above-normal profits for the latter, is appropriate from an economic efficienvy standpoint. They are careful to point out that this conclusion recognizes that existing rate structures are not optimal, that the present arrangements are justified as a second-best approach to the ideal of marginal cost pricing.

However, discriminatory rate structures, particularly when used for both railroads and motor carriers, have two seriously adverse effects that cause the present arrangements to depart further from the optimum that Professors Roberts and Simmie appear to recognize. First, discriminatory freight rates result in prices of goods to ultimate consumers that do not reflect their respective marginal costs of production and distribution and thus distort the allocative process throughout the economy. Second, when discriminatory rate structures are applied to traffic for which there is active intermodal competition there is no assurance that goods will in all cases be shipped by the low-cost mode, since the rates charged do not necessarily reflect the relative costs of the competing modes.

There is clear evidence that the motor carriers have in fact captured a large volume of high-rated traffic that could be carried at lower cost by rail, even after making generous allowance for the added costs to shippers resulting from the lower quality of rail service as compared with that by truck. The precise money cost of this misallocation of traffic is disputed, but may run into hundreds of millions of dollars annually. In addition, the fact that existing rate structures have resulted in a great expansion of private motor carriage at the expense of regulated motor carriers suggests the probability of some further misallocation of traffic. Improvements in rail service can do no more than mitigate these economic losses. The losses are fundamentally the result of maintaining discriminatory rate structures for competing modes of transportation having very different cost structures. Certainly it has not been shown that the problems would be solved merely by replacing the existing pattern of discrimination with the type of discrimination held to be optimal by the authors.

In conclusion, it is relevant to note that the transport policies of the United States have from the beginning reflected, explicitly or implicitly, various economic and social objectives in addition to the efficiency standard of competitive pricing; indeed, the latter has influenced policy only incidentally and to the extent that its distributional effects have been regarded as preferable to those of unregulated monopoly or oligopoly. Hence I would suggest that discriminatory pricing, and the related but distinct practice of cross-subsidization, be evaluated in terms of the degree to which they permit the achievement of desired social goals with a minimum sacrifice of economic efficiency.

Prior to World War I discriminatory pricing by the railroads accomplished a tolerably satisfactory compromise between social goals and considerations of economic efficiency. Discrimination enabled the railroads to reduce costs and rates by permitting fuller utilization of plant, while at the same time satisfying the demands of politically influential regional and shipper interests and advancing the national policy of promoting rapid development of the West.

However, as just explained, the situation has been completely different since the adoption of a discriminatory rate structure by the motor carriers and its use under conditions of intermodal competition. It is therefore high time to inquire whether there are any social objectives served by maintaining discriminatory rail and motor rate structures that justify the very heavy loss in economic efficiency involved, and, if not, to explore alternative methods of attaining such objectives that might involve a lesser sacrifice of economic efficiency. In this way it may be possible to achieve a more satisfactory trade-off between economic efficiency and other relevant goals than currently prevails.

SESSION IV

POLICY ALTERNATIVES AND THE EFFECTS OF REGULATORY CHANGES

Chairman: Daryl Wyckoff

INTERMODAL RATE COMPETITION UNDER THE QUAD-R ACT OF 1976

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PREFACE

The very title of the Railroad Revitalization and Regulatory Reform Act of 1976 testifies to a singular legislative focus on the economic viability of the nation's railroads. But to the extent that improvements in rail profitability involve significant relationships between railroads and their intermodal competitors, the "Quad-R" Act (so styled by many) may prove as keenly relevant to those competitors as to the railroads.

On their face, various provisions of the act are seemingly directed to a major reformulation of the rules governing intermodal competitive pricing by railroads. The purpose of this paper is to consider the likely impact of those provisions on the regulation of intermodal rate competition under the Interstate Commerce Act. A major thesis of the paper, however, is that experience under prior legislation constitutes an essential background for any consideration of the subject.

A BRIEF HISTORICAL VIEW OF REGULATORY STANDARDS AND POLICIES GOVERNING INTERMODAL RATE COMPETITION

Introduction: Marginal Cost Pricing by Railroads Under Conditions of Intermodal Competition - The Ultimate Policy Issue

A dominant concern throughout the history of railroad rate regulation has been the downside control of demand induced marginal cost based price levels. Whether in the context of price discrimination or intermodal competition, a major goal in justification of such regulation is the efficient use of economic resources. The regulation of price discrimination may importantly relate to the best use of non-transport resources. In comparison, the regulation of intermodal competition more directly involves the efficient allocation of transportation resources. But this formal separation is less than airtight, particularly when non-transport interests find it advantageous to seek common cause with one or another of the transport competitors. Whether or not legally cognizable issues of price discrimination are involved on a particular proceeding, most often at the core of any intermodal rate controversy are the distinctive economic characteristics of the railroads and their competitors.

The rail industry is characterized both by high fixed costs and a great diversity of markets subject to widely differing demand conditions. Accordingly, from their inception, railroads have sought to utilize demand related marginal cost pricing in order to gain from separable markets maximum revenue contributions to "sunken" or overhead costs. Conversely, they have sought to avoid the constraints of average cost pricing to which varying demand conditions must necessarily be subordinated.

Competition from other surface modes has long provided railroads with one of their most compelling inducements to selective marginal cost based departures from established "average cost" rate structures. Prior to the development of motor carriage, geographically sporadic water competition was a major factor in the appearance of long-short haul discrimination in the railroad rate structure. Although the impact of motor carriage on railroad traffic is spread more evenly, it also spurs substantial, even if less dramatic forms of, selective price cutting in particular markets. Combination movements by motor and water also provide increasingly important stimuli to selective rail pricing.

Relative to rail carriage, motor and water carriage are characterized by low fixed costs and high marginal, or variable, costs. Total costs, and therefore average costs, tend to vary much more directly with increases or decreases in traffic. Accordingly, both modes largely lack the incentive and capability to effect downward price adjustments financially beneficial to themselves in response to rail competition in particular markets. It follows, therefore, that the broad issue in the regulation of intermodal rate competition is the extent to which, and the circumstances in which, railroads are permitted to depart from their established rate structures through selective price cutting (1) necessitated by intermodal competition in particular markets and (2) productive of revenues in excess of marginal costs.

As implied in the preceding statement, the actual need for the price adjustment and the realization of some revenue in excess of marginal costs provide the first critical standards for evaluating the legitimacy of marginal cost based price reductions founded on motor and water competition. If either of these factors is absent, the very purpose of price cutting from the standpoint of the rail proponent itself must be seriously questioned.

First, it is generally irrational for the carrier to reduce an existing rate that does, and will continue to, generate net revenues in the particular market higher than those resulting from a reduced rate. Specifically, therefore, in adjusting to intermodal competition only the presence, or real threat, of successful competition at existing rate levels can justify rate reductions in the affected market for the purpose of enhancing net revenues. Thus, if a purportedly competitive rate cut is proposed in the absence of any demonstrable competitive compulsion, it may be assumed that (1) the rail proponent has erred in its assessment of competitive forces, or (2) it seeks voluntarily to confer a favor for reasons unrelated to the movement of traffic in the particular market. While this latter motivation could prove economically "rational" to the rail proponent from the standpoint of reciprocal benefits to be realized from other markets, or perhaps of inducing non-traffic related institutional benefits, it seems likely that such calculated favoritism will result in resource misallocation in both markets or may constitute an impermissible "bribe".

Even in the face of compelling competition, however, price cutting that fails to generate added revenues in excess of relevant marginal costs is in itself nonproductive and self-defeating. Unless a competitive price adjustment results in at least a modicum of revenues above marginal costs, the railroad is as well, or better, off without it. Where projected incremental revenues are shown to fall below projected marginal costs most likely the railroad either (1) has erred in its revenue/cost calculations, and thus must be "saved" from itself, or (2) seeks, whether or not with any real chance of success, to eliminate competition in the particular market over the longer term at the cost of losses in the shorter term.

The absence of compelling competition as the motivating force for the proposed rate level <u>or</u> any likely realization of revenues in excess of marginal costs thus provides the easy case for rejecting selective price cutting proposals in competitive markets. It is the presence of both factors, however, that has spawned the greatest controversies over the regulation of marginal cost pricing by railroads under conditions of intermodal competition.

Indeed, as the question might be put by a railroad manager, if a given price cut dictated by actual competition is essential to holding or gaining traffic in a given market and if the new price level does in fact maximize the contribution of the particular market to revenues in excess of relevant marginal costs, how can any regulatory rejection of such price cut ever be justified?

As regards the wholly rational and legitimate interests of its rail proponent, there is no basis for denying this type of competitive price reduction. The presence or absence of a presumption that rail carriers are acting rationally in their own self-interest may, of course, significantly affect the burden of proof placed on respective participants in a contested proceeding. Moreover, the ability of a rail proponent to establish that added revenues exceed marginal costs will depend on what formulas for the determination of relevant costs are required or permitted. Of particular importance in this process is the feasibility of developing precise cost formulations in the context of specific transportation services; and, as occasionally suggested, whether such formulations, even if otherwise justified, should be rejected in favor of other less precise formulations that perhaps better meet the administrative tests of simplicity and uniformity.

Assuming, however, that the two critical tests of competitive necessity and revenue/cost relationship are met, there remains the ultimate issue of whether the legitimate entrepreneurial interests of the rail proponent of a price cut are to be given decisive effect; or whether public policy goals extrinsic to those interests should be given overriding effect; and if so, what goals and under what circumstances?

Certainly one of the most significant public policy variables influencing the degree of constraint imposed on otherwise "legitimate" marginal cost pricing by railroads has been the extent of public concern for the economic well being of their intermodal competitors. The rationale for such a concern may be simply that the benefits of continuing competition in particular markets are presumed to require the maintenance of existing competitors, even at the immediate cost of higher rates.

In other cases, a regulatory decision to maintain competition in a particular market may begin with the perception that the overall financial viability of the intermodal competitor requires its continued participation in that market. This concern gains added weight if the continued existence of the competitor is deemed to be of some unique importance to the general economy or to serve some special need such as that of national defense.

The brief historical summary that follows is directed to the character of public concern for intermodal competitors as a factor in the regulation of marginal cost pricing by railroads. It is included here as a framework for considering the status of this critical public policy factor in the context of the Quad-R Act.

Experience Under Prior Legislation

The Act of 1887: 1887-1920

In the legislative debates preceding the act of 1887, concern was frequently expressed over the potentially destructive impact of discriminatory rail pricing on water transportation.[1] The act itself, however, failed to include any expression of such concerns (Hillman, pp. 27-28).

During this period the most critical question of intermodal competition before the Interstate Commerce Commission was whether, without prior ICC approval, regulated railroads should be permitted to engage in long-short haul discrimination in response to compelling water competition. Under Section 4 of the act of 1887, prior approval was required only if the short and long haul were handled "under substantially similar circumstances and conditions." The commission concluded that "actual competition of controlling force" provided by independent water carriers would constitute dissimilar circumstances and conditions justifying a Section 4 departure without prior approval; but, in contrast, that railroad competition could justify such departures only in "rare and peculiar cases" (Sharfman, pp. 29-31; Dewey, pp. 65-74; Hillman, pp. 66-73).

At this time the ICC lacked power to prescribe minimum rates for the future. However, under Section 1 of the act it was empowered to find an existing charge "unjust or unreasonable", whether too high or low, and to direct its cancellation. In defining the limits on selective rate cutting to meet localized water competition, the commission concluded merely "that it is wholly inadmissible to press competition to a point where expenses are increased beyond the increase of income" (Hillman, p. 70). Thus, in this early period marked by the absence of any statutory solicitude for the economic welfare of water transportation, only the least controversial constraint, that added revenues could not fall below marginal costs, was imposed on selective rate cuts induced by intermodal competitors.[2]

The Transportation Act of 1920

Together with its conferral of minimum rate powers on the ICC, the 1920 act also required that long haul rates (where authorized to fall below short haul rates) be "reasonably compensatory" (41 Stat. 456).[3] At the same time, the "policy of Congress" was first announced "to promote, encourage, and develop water transportation, service, and facilities in connection with the commerce of the United States, and to foster and preserve in full vigor both rail and water transportation" (41 Stat. 499).[4] Faced with the need to define "reasonably compensatory" in the context of the new policy declaration, the commission acted promptly to impose limitations on railroad long haul rate reductions far more restrictive than its simple proscription under the act of 1887. In addition to the requirement that it "cover and more than cover the extra or additional expenses incurred in handling the traffic to which it applies," a rate, to be "reasonably compensatory", could be "no lower than necessary to meet existing competition" and not be "so low as to threaten the extinction of legitimate competition by water carriers... ."[5] Clearly, the standards of "meeting" rather than displacing competition and the avoidance of "the extinction of legitimate competition" look to the <u>sharing</u> of traffic in competitive markets. They are not the standards of "hard" competition under which the advantages of lower marginal costs may be effectively utilized toward the possible monopolization of the relevant market (at least until the rail rate is raised and competition reenters the field).[6]

Thus, there developed a sharp contrast under the 1887 and 1920 acts in the ICC's regulation of selective rail rate reductions to meet water competition. In the earlier period the proponent's own entrepreneurial advantage in the form of net revenue realization (whether maximal or not) provided the sole test for judging an intermodal competitive rate reduction. Conversely, under the later act, any benefit to the rail proponent was merely a factor to be weighed against adverse impact on the intermodal competitor.

The Transportation Act of 1940: Intermodal Coordination Under the National Transportation Policy[7]

Incorporating, as it did, the Motor Carrier Act of 1935 (49 Stat. 543), the Transportation Act of 1940 (54 Stat. 898) in its entirety was directed to the coordination of all major modes of surface transportation, with railroads placed under Part I of the amended Interstate Commerce Act, motor carriers under Part II and water carriers under Part III. The legislative history amply established a basic intent to put the three modes on a regulatory parity, with the economic viability of each to be of equal concern in the administration of the act.[8] Equality, however, perhaps even more than beauty, is perceived in the eye of the beholder. It thus was left to the ICC to try to bring the various modal visions into a single clear focus.

The provisions of the 1940 act bearing most directly on intermodal competitive rate making were the declaration of national transportation policy and the amended rule of rate making, made applicable to each modal competitor by incorporation in Parts I, II and III. Foregoing any effort to resolve the critical economic issues of intermodal coordination, the policy declaration, through inclusion of the following goals relevant to our inquiry, seemed mainly to reassure all regulated modes of a benevolent congressional concern for their mutual welfare:

(1) To provide for fair and impartial regulation of all modes of transportation subject to the provisions of this act, so administered as to recognize and preserve the inherent advantages of each;

(2) To foster sound economic conditions among the several carriers;

(3) To encourage reasonable charges for transportation services without unfair or destructive competitive practices; and

(4) All to the end of developing, coordinating and preserving a national transportation system by water, highway, and rail adequate to meet the needs of the commerce of the United States, of the Postal Service, and of the national defense.

In order to promote the effective incorporation of these standards into ICC and court decisions, Congress accepted a floor amendment to the policy declaration that added this final sentence: "All of the provisions of this act shall be administered and enforced with a view to carrying out the above declaration of policy."

With regard to the "ultimate" issue of marginal cost pricing by railroads under conditions of intermodal competition (as discussed above), the national transportation policy itself surely provides no mandate for installing net revenue maximization in the relevant market as the decisive factor in evaluating the legality of a rail carrier's competitive price proposals. On the contrary, as related to intermodal rate competition, the national transportation policy makes more sense as an effort to maintain a delicate political equilibrium among competitors than it does as an intended source of ascertainable and enforceable economic standards. It thus may be read most accurately as an invitation to regulatory independence and seen most clearly as an open door to outright economic equivocation.[9]

Congress did attempt to deal more directly, however, with the issue of intermodal rate competition in the Interstate Commerce Act itself. It did so in two ways. First, the amended rule of rate making provided that in establishing rates for either rail, motor or water carriers, the ICC was to consider "the effect of rates on the movement of traffic by the carrier or carriers for which the rates are prescribed" (54 Stat. 912, 925, 938 [1940]); (underlined language added by the amendment).[10] While the restated rule could clearly sustain the inference that the impact of a proponent's rates on its competitor's traffic was irrelevant to the reasonableness of a rate proposal, the ICC was prompt to derive a different meaning more congenial to its preferred uses of national transportation policy. It thus read the rule to the effect that "no carrier should be required to maintain rates that would be unreasonable, judged by other standards, for the purpose of protecting the traffic of a competitor" (Seatrain Lines v. Akron, C. & Y. Ry., 1940).[11] Stated more baldly, henceforth no carrier could be made to charge otherwise illegally high rates to protect a competitor's traffic.

Ironically, in its context of a case in which a carrier was permitted to maintain equalized competitive rates despite its service advantage, this interpretation was initially viewed by many as a significant impetus for more vigorous competitive pricing. In retrospect, however, the pronouncement may be better assessed as a more memorable platitude in the annals of public rhetoric.

The second method of dealing with intermodal rate competition in the provisions of the act itself had reference to the regulation of price discrimination. In each part of the act the broad prohibitions against the imposition of undue or unreasonable prejudice or disadvantage were statutorily construed as not applying "to discrimination, prejudice or disadvantage to the traffic of any other carrier of whatever description" (54 Stat. 902, 924, 935 [1940]).[12] In other words, intermodal rate competition, as it affects the interests of competitors, was to be judged solely by standards of reasonableness, as construed under the provisions of the national transportation policy.

To what extent then under the 1940 act did the ICC proceed to evaluate competitive rate proposals from the standpoint of their impact on competitors rather than in terms of their contribution to the net revenues of their rail proponents? A distillation of the views of competent authorities who have assessed the work of the commission in the period 1940-58 suggest the following conclusions:[13]

(1) Whether a competitively induced rate proposal was just and reasonable was not to be judged alone by its remunerativeness to the proponent, but as much by the resultant traffic diversion from intermodal competitors in the relevant market;

(2) Even where remunerative to its proponent, a competitive rate proposal that attracted more than an ICC determined "fair share" of traffic in the relevant market might be viewed not only as being less than a reasonable minimum rate, but also as an "unfair and destructive competitive practice."; and

(3) Competitive rate proposals that prevented an intermodal competitor from adequate participation

> in the relevant market, as determined by the ICC, could be viewed further as a denial to that competitor of its "inherent (modal) advantages," and could be rejected even if in excess of the rail proponent's fully distributed costs.

The general thrust of these conclusions is perhaps best tested against the commission's decision in New Automobiles in Interstate Commerce (1945), that is commonly viewed as an early source of the most permissive definition of the lawfulness of selective railroad pricing under conditions of intermodal competition. Most notably, the commission did in fact fleetingly define "a reasonably compensatory rate" as "one that is remunerative, i.e. covers the out-of-pocket costs, as hereinbefore defined, of handling the particular traffic under consideration, including a proper return on investment." It also professed to find "no warrant for believing that rail rates, for example, should be held up to a particular level to preserve a motor rate structure or vice versa."

Leaving for further discussion the bothersome question of whether the commission's out-of-pocket formula provided a realistic economic measure of remuneration, other portions of the decision provide an unmistakable basis for future departures from these stated principles. For in the context of the record before it, the commission further observed:

> Within reasonable limits the public is entitled to the reduced rates brought by competition. There is no showing that the rate structures under consideration threaten the financial stability of the carriers [i.e. motor carrier competitors] (259 ICC 538-9; emphasis supplied).

Thus, New Automobiles itself can be read to require a balancing of interests among intermodal competitors in the evaluation of competitive rate reductions at the possible sacrifice by consumers of lower remunerative rates in the relevant market. It should be noted, however, consistent with the emphasis in the national transportation policy on the well-being of regulated competitors, that the ICC was, and remains, far more inclined to apply the single test of remunerativeness to rail carrier proposals directed to competition from non-regulated motor carriers.[14] As to regulated competitors, however, in intermodal competitive rate proceedings under the 1940 act the ICC chose in the end to apply with vigor the substance of the "reasonably compensatory" standards first developed for the regulation of long haul discrimination under the 1920 act.

The Transportation Act of 1958: The Continuing Sway of National Transportation Policy.

Like the Quad-R Act, the Transportation Act of 1958 (72 Stat. 568) was directed to the problem of railroad finances. In 1958 Congress had not as yet suffered the fuller measure of mental trauma that was to grow out of the northeast quadrant rail crisis of the early 1970's. But as various commentators have agreed, the 1958 act in essence was responsive both to "the temporary distress of the railroads in the depression of 1957-58, and a quickening of the industry's rate of decline."[15] That the prevailing mood was more of broad concern than acute crisis, however, is suggested in the legislative resolution of the intermodal rate making controversy.

Again, the details of the legislative history of the amended intermodal rate making rule need no repetition here.[16] It will suffice for our present purpose to note that from a genesis in the Presidential Advisory Weeks Committee on Transport Policy and Organization, (1955), the proposed "three shall-nots," the standard applicable to railroad rate reductions in the context of intermodal competition was amended by the addition of the following sentence to the substance of the existing rule: "Rates of a carrier shall not be held up to protect the traffic of any other mode of transportation, giving due consideration to the objectives of national transportation policy." Since those objectives included (1) the recognition and preservation of the "inherent advantages" of each mode, (2) the promotion of "sound economic conditions" ... among the several carriers," and (3) the avoidance of "unfair or destructive competitive practices," it clearly may be seen, certainly in retrospect, that the amended rule imposed no new technical legal restraints on any commission proclivities toward "administered" traffic allocation among intermodal competitors (that, as a widely perceived practice, for some time had been assigned by critics the pejorative label of "umbrella rate making").

Not only did the literal terms of the amended rule remove any mandate for basic change in the ICC's regulation of intermodal competitive pricing by railroads, but a comparison of those terms with the original "three shall-nots" rejected by Congress could only reinforce the commission's own perception that any initial "heat" for change had surely moderated.

These "shall-nots" would have required that the commission, in determining whether a proposed change was less than a "reasonable minimum" charge, should not consider (1) the effect of the charge on any other mode of transportation; (2) the relation of the charge to the charge of any other mode; or (3) whether the charge was lower than necessary to meet the competition of any other mode. The first two "shall-nots" seem sufficiently specific in the context of intermodal competition to render inappropriate any consideration of traffic allocation or "inherent advantage" related cost comparisons in determining a reasonable minimum charge for rail services. The third proscription would not only have eliminated the burden of proof on a rail proponent to establish that the rate reduction was no lower than necessary to meet competition, but it would have removed the entire issue from the commission's calculus. The not uncommon practice by the ICC of substituting its judgment for the rail carrier's in determining what rate level particular traffic should bear in order to assure its adequate contribution to railroad revenues, and thereby to avoid an "undue burden" on other traffic, was a major source of discontent by railroads.[17] In total, the contrast between the amended Section 15(a)(3) rule of rate making and the three "shall-nots" was striking enough to be appreciated by a regulatory agency that had sought doggedly to retain the broad discretion vested in it under the 1940 act standards.[18]

Following several years of experience under the 1958 act, various careful and qualified students of the commission's decisions were essentially agreed that even in the context of some initial reversions to the dominant theme of the New Automobile case, the ICC on balance chose to assert its pre-1958 market allocation interpretation of the requirements of national transportation policy as applied to railroad rate reductions in response to intermodal competition.[19]

In addition to this summary of views, however, it is also instructive to distill the essence of the two proceedings under the 1958 act that elicited major interpretive pronouncements from the Supreme Court.

ICC v. New York, N.H. & H.R., 1963 (Sea-Land) was the first case in which the court dealt with the new rule of Section 15(a)(3). The competition in Sea-Land was for traffic between points in Texas and various eastern destinations. The primary competitors were railroads and common carriers by water. The latter had established rates for combination movements involving an intercoastal water movement with prior and subsequent hauls, in one case by motor, and the other by rail. The all-rail movement was through TOFC services.

In essence, the railroads sought to respond to the initiation of the improved water based service by newly published TOFC rates "substantially on a parity" with the water based rates. The railroad movement involved the use of both leased double-trailer flat cars and rail owned single-trailer flatcars. Under its then effective costing formula, the ICC found the proposed rail rates to exceed out-of-pocket rail costs on all of the 66 separate movements except six. (These six were withdrawn.) It also found that the proposed rates equaled or exceeded fully distributed costs on 43 of the 66 movements by the leased flatcars and on 14 of the 66 by rail owned flatcars.

While finding further that the out-of-pocket and fully distributed costs of the water carriers were generally below rail costs, the commission declined to decide whether the inherent advantage was in rail or water transport. It did find, however, that in view of the relative quality of service, any rate parity would result in the elimination of the water movement from the market. Moreover, the rail rate reductions were deemed an initial step that threatened the existence of the entire intercoastal water carrier industry. Since the water carrier services were viewed as important to national defense and the broader economy, the commission determined that rail rates below a level of about 6 percent over the water rates would constitute "destructive competition," contrary to the requirements of national transportation policy. "Cost," the commission noted, "is only one of the elements that may be appropriately considered in passing upon the lawfulness of rates."

In particular circumstances before it the Supreme Court rejected the commission's requirement that a rail-water rate differential be maintained for the purpose of allocating traffic between the competing modes. Essentially, the court concluded that the record did not warrant recourse to the national transportation policy factors relied on by the commission.

As to the needs of national defense and commerce, the court found "reliance on these factors not supported by adequate findings or substantial evidence." Unlike the District Court, however, the Supreme Court did declare those objectives to constitute relevant elements of "operative policy."

More basic to its holding, and more significant for the future, was its determination that the "primary reason for the reference to National Transportation Policy in Section 15(a)(3) was to confirm the commission's power to protect the inherent advantages of all carriers from destructive competition." Accordingly, the exercise of that power was clearly dependent on a prior determination of inherent advantage. In the absence of any prior guidance from the commission, the court disavowed its own function "to decide in advance precisely how either carrier's inherent advantages should be measured or protected."

It is especially noteworthy for our analysis of the Quad-R Act that the court expressly negated any implication that the "broad policy factors" of the national transportation policy, such as national defense, "may be applied so freely as to nullify either the more particularized mandates of [that policy] or the clear congressional design embodied in Section 15(a)(3) (emphasis supplied).[20] To justify the basing of a rate decision on such "broad policy factors" alone would require a showing "that the proposed rates in themselves genuinely threaten the continued existence of a transportation service that is uniquely capable of filling a transcendent national defense or other public need."

But if the commission was to be denied the use of "national defense" or the needs of commerce as a magic wand to summon support for efforts at market allocation, the court, as noted, left intact the commission's power "to protect the inherent advantages of all carriers from destructive competition."

It was that power upon which the ICC successfully drew in American Commercial Lines, Inc. v. Louisville & Nashville Railroad Co., 1968, commonly known as Ingot Molds. There, in essence, the commission held unlawful a rail rate reduced to the level of a regulated combination barge-truck rate, where, once again as in Sea-land, the rail rate was significantly above the ICC determined out-of-pocket rail costs. In this case, however, the commission found the inherent cost advantage to lie with the barge-truck service because its fully distributed costs were substantially lower than those for the rail service. At least tentatively, the commission purported to find in the ambiguities of Section 15(a)(3) a congressional intent to utilize fully distributed costs as the standard of inherent cost advantage on particular movements. It further concluded that the railroads should not be permitted to cut rates to a level that would require the "lower cost" mode to reduce its own rates below its fully distributed costs in order to share in the traffic. Since at equalized rates the service advantages of rail would attract all of the traffic, the commission held that the railroads should be required to maintain rates in excess of the barge-truck rate, that was found to approximate the fully distributed cost of that service.

In affirming the commission's order, the Supreme Court put no final imprimatur on the use of fully distributed costs as a measure of inherent cost advantage. It noted the tentative resolution of the issue by the commission itself in view of the commission's emphasis in its report on the pendency before it of a rule making proceeding on intermodal competitive cost standards. Because of this continuing consideration of the issue, the commission had observed that "a radical departure from the fully distributed cost norm" would not be justified. It was only in assessing the commission's grounds for the interim use of this controlling presumption that the court concluded "the commission adequately articulated its reasons for determining that the railroads' rate would impair the inherent advantage enjoyed by the barge-truck service."

So while it may be said that the critical issues of rail pricing under conditions of intermodal competition had not yet been settled under Section 15(a)(3), neither had anything changed from the pre-1958 standards applied by the commission. It was essentially in this context that the applicable rules were once again amended in the Quad-R Act.

THE "QUAD-R" AMENDMENTS AFFECTING MARGINAL COST BASED PRICING BY RAILROADS UNDER CONDITIONS OF INTERMODAL COMPETITION

The Formal Statutory Provisions

The substantive provisions of the Quad-R Act primarily and directly pertinent to the present topic are contained in Title II, Sections 202 and 205 (PL 94-210; 90 Stat. 31).[21] The purpose in this portion of this paper is to set out these provisions, leaving the matters of their interrelationships, legislative background and general significance for subsequent discussion.

The "Just and Reasonable Minimum Rate" Standard

Section 202 first amends Section 1(5) of the Interstate Commerce Act (49 U.S.C.A. Section 1(5)) by reconstituting the prior existing paragraph as Section 1(5)(a), by declaring the newly designated subdivision (a) inapplicable to railroads and by creating a new Section 1 (5)(b). As it affects intermodal rate competition, this new subdivision defines with greater specificity a "just and reasonable minimum rate."

In essence, the definition provides that:

(1) any rate that does or would contribute to a railroad's "going concern value" shall not be deemed to be below a just and reasonable minimum;

(2) any rate that "equals or exceeds the variable costs" of providing the service to which it applies, "as determined through formulas prescribed by the commission," shall be presumed to contribute to the going concern value of the proponent rail carrier, subject to the presumption being rebutted by clear and convincing evidence;

(3) in determining such variable costs, the commission is required, upon request by the proponent carrier, to determine only those costs of the specific service rendered by the specific proponent, except where the necessary information is not available; and

(4) further, in determining variable costs (whether by general formula or by exclusive reference to the specific relevant costs of the specific proponent), the commission is barred from including any expenses "which do not vary directly with the level of service provided under the rate in question."

Rate Suspensions

Other directly relevant amendments to the Interstate Commerce Act effected by Section 202 of the Quad-R Act are (1) the rendering of the prior existing provisions of Section 15(7) governing the suspension of proposed rates inapplicable to railroads and (2) the application of special rate suspension procedures and standards to railroads under a new Section 15(8), consisting of subdivisions (a) - (f).

The material changes affecting the suspension of proposed rate <u>decreases</u> under Section 15(8) are the following:[22]

(1) Under subdivision (a) a final decision must be rendered within a maximum seven month suspension period, subject to an extension to 10 months for suspension and final decision if the commission reports in writing to Congress, "with a full explanation of the reason for the delay," that it is unable to render a decision within the earlier period.

(2) Subdivision (d) bars suspensions unless it appears from a verified complaint that without suspension the rate decrease will cause substantial injury to the complainant and that the complainant will "likely ... prevail on the merits." The burden of proof is put on the complainant to establish these matters.

(3) Presumably to encourage interim shipper use of the services to which a suspended rate decrease proposal applies, subdivision (e) authorizes the proponent rail carrier to refund any part of the decrease ultimately found lawful on an equal basis to all shippers who participated in the rate during the suspension period.

(4) Subdivision (f) provides that in any hearing under the new Section 15(8) of the Interstate Commerce Act the burden of proof remains on the proponent rail carrier to show a rate proposal is just and

reasonable (subject, of course, to the revised substantive standards under Section 1(5)(b) of the Interstate Commerce Act, supra, governing a just and reasonable minimum rate).

(5) Subdivision (f) also requires specific consideration by the commission of proof of any "significantly adverse effect" of a rate increase or decrease, in violation of Section 2 or 3 of the Interstate Commerce Act, "on the competitive posture of shippers or consignees affected thereby." No reference is made to any consideration of such effects on other competitors of whatever mode.

(6) Finally, subdivision (f) of Section 15(8) requires hearings and decisions on proposed railroad rate changes (i.e., increases or decreases) to be given preference over all other pending railroad matters and directs the commission to "make its decision at the earliest practicable time."

Statutory Rule of Construction of Section 202 of the Quad-R Act

Paragraph (f) of Section 202 of the Quad-R Act (not to be confused with subdivision (f) of the new Section 15(8) of the Interstate Commerce Act) is not incorporated as part of the Interstate Commerce Act. However, it does apply interpretive standards to the foregoing Interstate Commerce Act amendments under Section 202. Of particular relevance here are the provisions of Paragraphs (f)(1) and (2) which state that nothing in the amendments under Section 202 of the Quad-R Act shall be construed:

(1) to modify the application of Sections 2, 3, or 4 of the Interstate Commerce Act in determining the lawfulness of any rate, and

(2) to make lawful any competitive practice that is unfair, destructive, predatory, or <u>otherwise undermines competition that is necessary in the public interest</u>. (Emphasis supplied)

DOT and ICC Impact Studies

Paragraph (g) of Section 202 suggests the potentially tentative character of Section 202 of the Quad-R Act. Specifically, paragraph (g) requires separate studies by the Secretary of Transportation and the ICC of the effect of the Section 202 amendments "on the development of an efficient and financially stable railway systems." These studies are to include an analysis of the impact of the amendments on shippers and "carriers in all modes of transportation." The studies must be submitted by October 5, 1977 (20 months following the Quad-R Act) and must further include any proposals for regulatory and legislative changes deemed necessary by either agency.

Rule of Rate Making

Section 205 of the Quad-R Act amends the "Rule of Rate Making" under Section 15a of the Interstate Commerce Act. Prior existing paragraphs (2) and (3) are made inapplicable to railroads, that are then uniquely made subject to the provisions of a new Paragraph 15a(4).

In rendering Paragraph (3) inapplicable to railroad rates in the circumstances of intermodal competition, the amendment eliminates as to railroads the controversial rate making rule derived from the 1958 act. Accordingly, it is no longer an express requirement of the rule of rate making applicable to railroads that due consideration be given to the objectives of national transportation policy in applying the primary principle that "rates of a carrier shall not be held up to a particular level to protect the traffic of any other mode of transportation."[23]

The main thrust of the new Section 15a(4) is toward the commission's development of standards and procedures for the establishment of adequate revenue levels sufficient to attract necessary private sector capital. It is therefore in the general context of meeting railroad revenue needs that the following new rule of rate making governing intermodal competitive pricing by railroads is incorporated as the final sentence of paragraph (4):

> No rate of a common carrier by railroad shall be held up to a particular level to protect the traffic of any other carrier or mode of transportation, unless the commission finds that such rate reduces or would reduce the going concern value of the carrier charging the rate.

Construed literally, this sentence makes little sense. That is to say, where the commission finds that a proposed rate would reduce the going concern value of the proponent carrier (i.e., that the service provided under the proposed rate would contribute less than before to net revenues in excess of variable costs), it would presumably reject the rate (particularly in the context of paragraph (4)) in the interest of the rail proponent's own financial status and not primarily to protect any other carrier. The rule suggests, however, that where a rate reduction would both lessen the proponent's own going concern value <u>and</u> divert traffic from its competitor, rejection of the rate may be based on both grounds.

The Likely Impact of the Quad-R Act Amendments on Marginal Cost Based Pricing by Railroads Under Conditions of Intermodal Competition

It is not my purpose here to take sides in the economic controversy which for decades has enveloped the issue of railroad marginal cost pricing in the context of intermodal rate competition. The more modest aim is to consider whether the Quad-R amendments relevent to that controversy are likely to lead to any greater freedom in rail pricing, whether for better or worse.

Experience under the 1920, 1940, and 1958 Transportation Acts suggests a pattern in which, while Congress ambiguously proposes, the ICC more purposefully disposes. So stated, this is not to suggest that the commission has been a willful child unmindful of its parental directives. In the past, whenever confronted with an inescapable need to address the pesky issue, Congress itself preferred to pass to the commission the politically unrewarding task of defining as well as effecting intermodal economic coordination. The question then is whether anything has changed. We might first consider whether the commission since Ingot Molds may have come to modify its own perception of the relative merits of "hard" competition versus "controlled" competition. Secondly, whatever the answer to that inquiry, are the Quad-R standards governing intermodal competition sufficiently rigorous to deprive a commission subject to judicial review of any effective choice in the matter.

The Current Views of the ICC

The direct sources of Sections 202 and 205 of the Quad-R Act, as reported from conference, are Section 103 of S.2718, and Sections 301 and 302 of H.R. 10979, 94th Congress, 1st Session.[24] In turn, H.R. 10979 derives from H.R. 7681, 94th Congress, 1st Session, that was the subject of hearings during July, 1975 (Committee on Interstate and Foreign Commerce, Railroad Revitalization: Hearings before the Subcommittee on Transportation and Commerce; hereafter cited as Hearings). The statement and testimony of ICC Chairman Stafford at these hearings (Hearings, pp. 224-265), together with the agency's further comments on the "intermediate" draft of H.R. 9802, through then Acting, and now Chairman O'Neal (Committee on Interstate and Foreign Commerce, H. Rept. 94-725, pp. 236-239), provide a useful summary of the commission's views regarding the general thrust of the pending proposals.

H.R. 7681 provided that no rate that was "compensatory" could be found unjust or unreasonable on the grounds that it was too low. Further, a compensatory rate of any one mode could not be held up to protect the traffic of another mode. Finally, any rate in excess of the variable cost of the service to which it applied was deemed compensatory. Unlike the Quad-R Act provisions, H.R. 7681 contained no explicit exceptions to these standards based on violations of Section 2, 3, or 4 or any unlawful competitive practice (Hearings, pp. 33-34).

H.R. 7681 also provided the model for the rate suspension provisions of the Quad-R Act, but there were notable differences. Under this earlier bill the possibility of unlawful competition provided no explicit basis for suspension of decreases. In general, however, it would be possible, following complaint, to suspend a proposed decrease on the findings that the change would cause immediate and irreparable injury to complainant, that complainant was likely to prevail on the merits and that suspension was "in the public interest" (Hearings, pp.45-49). Chairman Stafford's testimony and statement on behalf of the commission at the H.R. 7681 hearings were directed to those specific proposals. Principle objections were on the following grounds:

(1) The entire issue of rate reduction suspensions was immaterial in view of the commission's having

suspended in the past four years a total of only 87 proposed rate reductions. Of these only eight tariffs were suspended "as being unreasonably low, which tariffs contained rate reductions to a level above variable costs" (Hearings, pp. 201-225). It was in fact asserted that "for years" the commission's practice had been "not to suspend rate decreases to levels above variable costs as long as no other violation of law appears. ..." (emphasis supplied) (Hearings, p. 216). (What Chairman Stafford did not clarify at this point, however, is whether a rate in excess of variable costs might nevertheless be deemed unlawful and thus suspended on grounds that it might constitute "destructive competition" or deprive an inter-modal competitor of an "inherent advantage".)

(2) As construed by the commission in its statement, the bill could bar the commission from suspending rate decreases "no matter how great or how far under the variable cost floor" otherwise established in the bill. The commission's statement on this point reflected its continuing perception of a pervasive illegitimacy in the motives of railroads for much of their marginal cost based pricing. Thus the assertion was made that in this respect H.R. 7681 displayed "a complete lack of under-standing of the potential carrier abuses that can be brought about by uncontrolled selective price cutting". Without threat of suspension, the chairman observed, "railroads can institute ... massive rate reductions designed to destroy competition", that "obviously would wreak havoc on the nation's transportation system" (Hearings, pp. 207-08, 249-250).

(3) The burden of proof placed on a complainant to show in support of a requested suspension that it "is likely to prevail on the merits" was said to be impractical, if not impossible to meet (Hearings, p. 244). (With respect to point (2) above, however, the commission's statement made no reference to its authority under the bill to suspend on the finding of "public interest". While the burden of proof to support such finding would fall on a complainant, the possibility seems to contradict the commission's view that under no circumstances would it have been able to suspend even rates below variable costs) (Hearings, p. 45).

(4) The commission objected in particular to being deprived of authority to suspend rate proposals on its own motion (Hearings, p. 249).

The commission's opposition to any significant erosion of its suspension authority could be construed to relate solely to rate making procedures rather than to substantive standards. However, its further response to the basic H.R. 7681 proposal that variable costs provide the only rate floor was clearly derived from a persisting conviction of the need to judge rail competitive price proposals by their impact on competitors as well as by their remunerativeness to proponents.

The commission's central concern was that a "flat prohibition against maintaining any intermodally competitive rates above a 'compensatory' or 'variable costs' level provides no way to preserve the inherent advantages of a given mode of transportation." It envisioned as a possibility "the drastic effect of eliminating an entire mode if, for example, the railroads could hold their water competitive rates at a barebones level long enough to drive out the competitive water carriers" (Hearings, p. 260). The commission observed that "a much better approach" is to insure it the flexibility "to maintain the lowest level of intermodally competitive rates consistent with the preservation of the advantages of each mode" (Hearings, pp. 260-61).

As one possible means of implementing this principle, the commission referred to the 1973 proposals of its Administrative Law Judge in Cost Standards in Intermodal Rate Proceedings, Docket No. 34013 (Sub. No. 1). As characterized by the Administrative Law Judge, that rule making proceeding was begun in 1969 for the purpose of "the formulation of an appropriate standard or measure of costs through which the commission will, in future proceedings, be able to identify the mode possessing the inherent cost advantage."

The principal conclusion in his "Initial Decision" served May 3, 1963 was that "variable cost" was properly "determinative of low cost carrier on specific traffic as between carriers of different modes." He concluded further, however, that the issue of preserving inherent cost advantages could not always be resolved by sole reference to the specific traffic in issue. In particular, where the loss of specific traffic by a particular carrier would result in its "complete cessation of operations," further consideration must be given to the overall service needs filled by such intermodal competitor. Where the services of the affected competitor are "considered necessary to the adequate transportation requirements of the national transportation policy" the commission should be permitted to condemn the initial rate cut "in full compliance with Section 15a(3) and the national transportation policy." The standard of public need to which the Judge adverted more specifically was that provided in the Sea-Land case, supra: i.e., that the service be found "uniquely capable of fulfilling a transcendent public need." Such service, he observed, must be protected "regardless of the cost consideration." (emphasis supplied)

One way of interpreting the Administrative Law Judge's proposal is that, where necessary to protect an essential competitor, the standard of "inherent cost advantage," based on variable costs in a particular market, should be superseded by a standard of "inherent advantage" predicated on overall public need (including cost and service) in the totality of markets served by the affected competitor.

The commission, while professing some sympathy with the substance of his proposal, chose to describe it as advocating the use of "a fully allocated cost standard" for the protection of an essential competitor (Hearings, p. 259). Since the Judge's recommendation of protection was based wholly on the practical need to protect a given competitor "regardless of the cost considerations," the commission's suggested recourse to the use of fully allocated costs may be questioned.

Nevertheless, the most significant aspect of the commission's favorable comments relate to the Judge's recommendation that, as to any single market, "the carrier that can provide the lowest rates that are not detrimental to its own revenue requirements, i.e., cover the variable cost ... has the inherent cost advantage on such traffic." If applied in Ingot Molds, this recommendation would have produced a different result, there having been no "transcendent need" finding with regard to the truck-barge competitor.

It is not clear whether the commission's approving nod toward its Judge's basic recommendation during the hearings on H.R. 7681 reflected a real shift of substance or a tactical maneuver.[25] We have already noted evidence of some continuing commission suspicion of the motives underlying the intermodal competitive rate practices of railroads. As to the basic self-interest served by such practices, Chairman Stafford saw as "an obvious problem" in applying the "variable costs" standard that "if maintained on a system-wide basis" rates based on such cost levels "are simply not compensatory." (Hearings, p. 255).

The necessary implication here is of a commission belief that railroads derive some special satisfaction from basing rates on variable costs, even where demand conditions permit the recovery of fully allocated costs or more. While H.R. 7681 sought to treat "variable costs" as a rate floor in the circumstances of competition, the commission purported to see in "variable costs" a general cost standard that rails would prefer to meet independent of competitive necessity or other demand related factors.

In his comments on H.9802, Acting Chairman O'Neal restated this concern (H. Rept. 94-725, p. 237). Of more specific interest here, however, was his observation that while "the commission does not engage in 'umbrella rate making,' the need remains to preserve commission authority to 'take action against destructive competitive practices.'" To this end he urged retention of the Section 15a(3) requirement of "due consideration to the objectives of the national transportation policy." As an alternative, however, he recommended "a clear statement in the legislative history that the commission's authority to take action against destructive competitive practices is not diminished . . ."

As we have seen, the final congressional response was to give the commission more than was included in this particular request; for a still broader definition of an "unlawful competitive practice" was ultimately incorporated in the act itself.

In general, as regards intermodal competitive pricing, the commission seems to evince a pronounced lack of confidence both in the motives of railroads and in their capacity to identify their own self-interest. The remaining question, then, is the extent to which the Quad-R Act might operate to limit the use of commission discretion shaped by these views.

Statutory Restraints on Commission Discretion: An Analysis

The policy declaration of Section 101 of the Quad-R Act bespeaks an intent to move toward more vigorous intermodal rate competition. To the purposes of restoring the financial stability of the U.S. rail system and assuring continued rail viability in the private sector of the economy, the first listed means among several is "rate making and regulatory reform." The policy of Congress is further declared to "foster competition among all carriers by railroad and other modes" and "to permit railroads greater freedom to raise or lower rates for rail services in competitive markets."

While the intended legislative thrust seems clear enough, no general policy directive can serve as proxy for operative standards that embody calculated ambiguities or that signal an intended primary reliance on administrative discretion for the resolution of hard issues.[26]

For this reason it is especially useful to compare the relative clarity of intermodal rate standards in earlier bills and the final act, as it emerged from the political crucible. This last section of the paper will include such comparisons, where significant, in the review of four major aspects of the intermodal rate making provisions of the Quad-R Act: a) rate suspensions, b) the "just and reasonable" minimum rate standard, c) the definition of "variable costs" and d) the amended rule of rate making.

<u>Rate Suspensions</u> The previously described rate suspension provisions of Section 202 of the act derive solely from House bills. As passed by the House, the rate suspension provisions of Section 302 of H.R. 10979 were partially responsive to commission concerns.

It was not until the first conference report, however, that there was added as a grounds of suspension, consistent with the general rule of construction of Section 202(f), that "such rate change constitutes a competitive practice that is unfair, destructive, predatory or otherwise undermines competition that is necessary in the public interest" (S. Rept. 94-585, p. 6). Such suspension could be based on complaint only, however, and not on commission initiative. The net effect, therefore, of subsequent amendments to the initial suspension provisions of H.R. 7681 was to restore the commission's full discretion to suspend proposed rate decreases on complaint that the proposed rate constitutes an "unlawful competitive practice."

Given the views of the commission regarding the importance of precluding the initial effectiveness of competitive rates deemed to be predatory and destructive, this added ground for rate suspensions provides a handy basis for suspending rate reductions that otherwise meet the act's new "just and reasonable minimum rate" standard. (However, as will be discussed, this same clause may have net greater import in its role as a general rule of construction under Section 202(f)).

The "Just and Reasonable Minimum" Rate Standard The competitive intermodal rate making provisions of the final House and Senate Bills (H.R. 10979 and S. 2718, 94th Congress, 1st Session) presented the conference committee with a substantial task of reconciliation. The final House bill emerged from a model that reflected the DOT/Administration effort to maximize downside rail pricing flexibility by exclusive reliance on a "variable cost" floor. Conversely, the Senate bill, while aimed toward the same general goal of greater downside pricing flexibility, incorporated a "going concern value" concept for fixing rate floors. This standard was perceived to be less precise than the single variable cost standard and was opposed by DOT.[27] An examination of the accommodation that was finally reached, after two separate conference procedures on the Quad-R Act[28] is instructive on the degree of constraint imposed on commission discretion in regulating downside price adjustments under conditions of intermodal competition.

Under S. 2718 the substantive rules applying to rail pricing in the context of intermodal competition were essentially as follows (S. Rept. 94-499, pp. 213-215):

(1) No rate contributing to going concern value could be found to be below a just and reasonable minimum.
(2) Any rate equalling or exceeding variable costs, as determined through commission prescribed formulas, would be presumed to contribute to going concern value, unless the presumption were rebutted by clear and convincing evidence.
(3) As expressly stated in the bill, these foregoing provisions could not be construed to
    (a) nullify application of the national transportation policy to each of the provisions of the act;
    (b) modify the application of Sections 2, 3, and 4 in determining the lawfulness of any rate; or
    (c) make lawful any competitive practice that is unfair, destructive, predatory, or otherwise undermines competition that is necessary in the public interest.

Literally read, S.2718, while purporting to establish an independent standard for determining a "just and reasonable minimum rate," could potentially render the entire standard irrelevant through the continuing exposure of competitive pricing to all of the other standards of the national transportation policy, and also the separately stated and uniquely broad rule of construction relating to unlawful competitive practices.

The Senate Committee was not insensitive to this potential evisceration of the "just and reasonable minimum rate" standard by the remaining competitive rate making provisions of its bill. A statement of general intent, therefore, was included in its report (S. Rept. 94-499, pp. 46-50).

The committee disavowed any intended ratification or endorsement of "the commission's practice" under Section 15a(3) "of allocating 'fair shares' of the transportation market among several modes." The emphasis on "going concern value" reflected "the committee's intention" that the commission "put less emphasis upon the process of analyzing the varying costs of service for the different modes of transportation to determine the 'low cost mode'." Here, again, was an apparent rejection of the doctrine of Ingot Molds, involving straight "cost comparisons" as the basis for determining "inherent advantage."

As for destructive or predatory competition, the committee viewed as falling within the concept a rate that "reduces the net revenues of the proponent (sic) carrier or carriers or if the rate has as its purpose or effect the selective destruction of a competing carrier."

Of these two separate standards, the latter strongly suggests that actual destruction of a competitive carrier rather than its mere loss of traffic in a single competitive market would constitute the relevant test. While consistent with the committee's distaste for the allocation of "fair shares" in particular markets, it does leave open for commission determination the issue of overall impact on particular competitors. The first standard could also prove a source of substantial controversy in any given rate proceeding in that it renders a rail carrier's assessment of the impact of demand factors on its revenues in a particular market the subject of independent commission determinations. As noted above, however, where revenues exceeded variable costs (as determined by commission formula), the rail carrier would have the benefit of a presumption that the rate contributed to "going concern value," subject to rebuttal only by "clear and convincing evidence."

The committee's proposed adoption of the "going concern value" standard was intended in part to obviate any need "to deal with the whole structure of resources, as variable cost requires . . . ." In essence, the contribution to going concern value was to be measured by "net cash flow" under which "expected revenue change" would be compared to "expected outlay change," both properly discounted.

The committee's discussion did not indicate any particular intended time span for the measurement of "net cash flow." However, a period exceeding the short-term was implied by the suggested relationship between going concern value and predatory competition. As stated by the committee: ". . . if a carrier has in mind pricing at a loss initially and then after the competition is driven out raising rates, it will be revealed in the attempt to show positive net cash flows." Such a rate would be both predatory and below a just and reasonable minimum rate (as distinguished from those categories of rates under S.2781 that, although definitionally above a just and reasonable minimum, might nevertheless be deemed an unlawful competitive practice, or otherwise in violation of national transportation policy).

H.R. 10979, while retaining the basic "variable cost" floor standard, had evolved from the "pure" DOT model toward the accommodation of commission concerns. Its basic substantive standards were as follows (H. Rept. 94-725, p. 11):

(1) A compensatory rate, defined as equalling or exceeding the variable costs of the specific transportation to which the rate applies, could not be found unjust or unreasonable because of being too low.

(2) The commission would be barred from holding up a rail rate to a particular level to protect the traffic of another mode, if the proposed rate were compensatory.

(3) The foregoing standards could not be construed "to modify the application of Section 2, 3, or 4 of the act . . . or make lawful any competitive practice that is unfair, destructive, predatory, or otherwise undermines competition that is in the public interest."

Through this last "rule of construction," opponents of greater competitive rate making flexibility had left their mark on the House, as well as on the Senate bill. (If anything, the actual text of the House bill, by omitting "necessary" as a modifier of "in the public interest," gave added breadth to this exception to the basic "variable cost" floor standard).

The committee's discussion, however, reveals a perplexing lack of focus on the significance of the exception. While noting an intent "to inaugurate a new era of competitive pricing," the committee expressed its opposition to "predatory or unfair conduct"(H. Rept. 94-725, pp. 69-71). It then observed that the "specific language" of the "unlawful competitive practice" standard would prevent such conduct and that "the specific reference to rates below variable cost gives definite shape to these hard-to-define terms."

That "definite shape," however, is rendered somewhat amorphous by the fact that any rates below variable costs would be barred in any case by falling below the just and reasonable minimum rate standard of the House bill. If this were all that was intended, therefore, the reference to "unfair, destructive, predatory" competition was mere excess verbiage.[29] Moreover, what the committee failed to discuss at all was the potential significance of the phrase "<u>or otherwise</u> undermines competition that is in the public interest" (emphasis supplied). Clearly, an even more permissive exception to the variable cost standard is implied by this undefined concept of "otherwise." The paucity of discussion on this issue by the House and Senate committees suggests (in addition to the pressures of time under which the reports were necessarily prepared) that the new standard was more responsive to a generally felt political need than to any clearly defined economic principle.

In any case the Quad-R Act finally incorporated the "going concern value" standard of the Senate bill rather than the "variable cost" floor of the House bill, subject, however, to the rebuttable presumption that a rate equal to or exceeding variable costs would contribute to "going concern value."

The final conference report comments further on the intended meaning of this new concept in the Interstate Commerce Act (H. Rept. 94-781, pp. 147-148). It suggests that the commission's proper inquiry will be "to whether the rate change improved the going concern value of the carrier as compared to what it would have been had the rate not been changed." That is, the impact of a rate reduction on the proponent's going concern value need not be an actual increase over the situation prevailing prior to the competitive circumstance to which a rate proposal is responsive. The test would be met where the rail proponent is able to retain "as much contribution to going concern value as is possible in the given competitive situation" (emphasis supplied). Here, again, however, emphasis is placed on the rate being no lower than necessary to maximize going concern value, or net revenue contribution, from the relevant market.

Also included in the Quad-R Act, as previously noted, is the Senate version of the same potentially critical proviso in both bills that nothing in the foregoing intermodal competitive rate making provision shall be construed to make lawful not only "unfair, destructive, predatory" competitive prices, but also any competitive practices that "otherwise undermines competition that is necessary in the public interest." In the absence of any specific focus on this phrase by the House, Senate or Conference Committee, the matter of interpretation and application is technically committed to the commission's sole discretion, subject to court review. While courts may ultimately derive a more precise meaning for this standard from the general purposes of the Quad-R Act, the commission may be excused in the circumstances if it chooses initially to move freely within its broad contours. Perhaps the Supreme Court's formulation in Sea-Land of a "transportation service that is uniquely capable of filling a transcendent . . . public need" will ultimately prevail, as more likely was intended, even if not fully articulated, by the committees. There can, however, be no certainty in this matter. Indeed, such "informal" legislative history regarding this rule of construction as may exist suggests a reluctant, but purposeful, effort to becloud the intended thrust of the Quad-R Act's competitive rate making provisions. Thus it appears that the drafters of the bills, for good and sufficient reason, were persuaded of a need to incorporate the phrase in issue in order to placate a prominent, respected, intrepid and influential foe of competitive rate deregulation.[30] But the question remains: What is meant by a competitive practice that is not predatory, that is not unfair and that is not destructive -- but that is nevertheless unlawful because it "otherwise undermines competition which is necessary in the public interest?" (emphasis supplied). What opportunities may it afford to an administrative agency that might remain inclined to place premiums on the presumed benefits of regulated market allocation?

The Definition of "Variable Costs" Should the commission choose to make the fullest possible use of the "unlawful competitive practice" proviso, the particular meaning ascribed to "variable costs" may prove less important in determining minimum levels for competitive rate pricing. A given rate level, after all, will have the identical impact on competition whether it is above or below any given formulation of variable costs. Nevertheless, the concept retains great formal significance as the level at or above which a proposed competitive rate is presumed to contribute to going concern value.

The proper determination of variable costs has long been a major arena of battle in the intermodal rate controversy. The central question, of course, has been whether the commission's formula for ascertaining so-called "out-of-pocket" costs has satisfied the economic criteria for measuring marginal or variable costs. Without belaboring the issue here,[31] it may be noted that the commission itself has not sought to defend its own formulation as the perfect equivalent of an economic definition of marginal or variable costs. For one thing, there is the inherent difficulty in determining the appropriate time span for determining marginal costs in relation to any particular operational change. To use too short a period is to ignore forseeable longer term cost additions required to accommodate to a stabilized increase in particular service units. To use too long a period is to encounter the principle that over a long enough term all costs are variable. To use system-wide averages is to ignore the highly individualized, if not unique, cost characteristics of particular operations. To engage in individualized cost studies may lead to more precision, but perhaps only to a degree not justified by the required time and expense.

The commission has in fact conceded the "arbitrary" elements in its formula by applying formulaic "average" standards in circumstances of regulated intermodal competition, while permitting more precise calculations productive of lower cost levels in circumstances of unregulated intermodal competition. In both cases, however, the ostensible test has been whether a proposed rate is economically compensatory in that "added" revenues exceed "added" costs.[32] More recently, the commission has amended its cost standards to exclude certain cost categories most obviously inappropriate to any true "marginal" cost concept (Interstate Commerce Commission 1970).[33] But as with any system-average formula, the question remains of whether the new criteria can generate results corresponding to an economic definition of marginal costs appropriate to a particular transport function.

In the Quad-R Act an effort is made to relate the definition of "variable costs" to its intended economic essence. Thus, as we have noted, the commission is directed not to include in variable costs "any expenses that do not vary directly with the level of service provided under the rate in question." In addition, a rail proponent is given the option of having its relevant variable costs determined solely with reference to its own costs "of the specific service in question." In the face of such request, the commission is excused from making this more refined cost determination only where the necessary information is unavailable.

S. 2718 had also provided (as does the Quad-R Act) that the "variable costs" standard for raising a rebuttable presumption of going concern value should be those costs "as determined through formulas prescribed by the commission." In adding the "variable cost" standards of the House bill, however, the conference committee failed to meld them with the provisions of the Senate bill. As the act now literally reads, therefore, a rate that exceeds "variable costs," as determined by the specific costs of the proponent carrier, but not as determined by the commission's formula, would not enjoy the presumption of its contribution to going concern value. Since this anomaly could well be the inadvertent result of an understandable drafting lapse, it may yet be construed so as to give consistent overall effect to the significance of rates that equal or exceed "variable costs," whichever way determined in accordance with the act.[34] In any case, the Quad-R Act would seem to impose on the commission an unavoidable duty to review its most recent reformulation of "variable costs" to assure compliance with the new statutory cost standards.[35]

The Amended Rule of Rate Making If all the foregoing statutory changes were made, but Section 15a(3) had been left intact, an even more monumental task of reconciling conflicting statutory provisions would have faced the commission and the courts.

S. 2718 addressed this problem by proposing to amend the final sentence of Section 15a(3) in the manner finally enacted.[36] H. 10979 would have included no separate rule of rate making governing intermodal competition in the restated rule of the new Section 15a(4) dealing with "adequate revenue levels" and applicable to railroads generally (H. Rept. 94-725, pp. 14-15). The Conference Committee, however, chose to append the Senate proposal to the substance of the House provisions. The question is whether the inclusion of the "going concern value" standard in the context of a rate making rule generally directed to assuring "adequate revenue levels" will invite fuller review by the commission of a rail carrier's initial judgment of whether a proposed rate is lower than necessary in the circumstances.

CONCLUSION

Experience under the intermodal competitive rate making standards in the Transportation Act of 1958 should caution us that predictive efforts at best are highly speculative. Moreover, that same experience suggests that the commission's initial response in this early stage following enactment of the Quad-R Act may not set the direction for its ultimate reconciliation of broad legislative purposes and specific statutory standards.[37] But having come this far, we might consider some of the more plausible interpretive possibilities.

First, how does the Quad-R Act deal with what previously has been termed the "ultimate policy?" That is, where a rail proponent of a competitively induced rate decrease can demonstrate both competitive necessity and the realization of added revenues equal to or exceeding variable costs, will its own entrepreneurial advantage be dispositive in any contested proceeding? Or will the issue of disadvantage to an intermodal competitor remain a relevant factor?

Clearly, the Quad-R Act preserves the relevance of impact on competitors. In fact it does so through the promulgation of a concept of "unlawful competitive practice" that, literally read, has greater breadth than the customary standards of "unfair, destructive or predatory" competition. By committing to commission interpretive discretion, in addition to these established concepts, the category of a "competitive practice" that "otherwise undermines competition that is necessary in the public interest," the Quad-R might be construed to allow the commission to maintain competitors in particular markets as the essential means of preserving competition viewed by the commission as "necessary" in that market. Should the commission, with judicial support, use its expertise to ascertain the necessity for maintaining actual competition in particular markets, the impact of Quad-R on intermodal competitive rate making could prove miniscule. Whatever may have been the contrary intent of the committees, the inclusion of this statutory "rule of construction" in Section 202(f) of the Quad-R Act exposes to its potentially superseding standards of lawfulness the critical (though rebuttable) presumption that a rate equal to or exceeding variable costs contributes to "going concern value."

The legislative history does not in explicit terms bar this interpretation. In total context, however, (including, perhaps, the commission's comments supportive of the reference by the Administrative Law Judge to the Sea-Land Doctrine in Cost Standards in Intermodal Rate Proceedings) the more reasonable interpretation would seem to be that the amorphous "unlawful competitive practice" standards in their entirety are intended at most to deal with the preservation of competitors serving a transcendent public need," whose total loss of a particular market would threaten their overall viability. In short, the major target of the entire legislative exercise could well be viewed as Ingot Molds, whose doctrine Chairman Stafford possibly, but not unequivocally, disavowed in the commission's statement to the House committee.[38]

But as noted, the "possible" disavowal was related technically to the commission's construction of the "inherent advantage" comparative cost standard applied in that case. The question that persists, therefore, is whether the expanded "unlawful competitive practice" standard provides a handy new bottle for some rather old wine.

The "going concern value" test may also present significant possibilities for attacking rates productive of revenues in excess of variable costs. First, as also noted, it is not entirely clear whether the presumption of going concern value in such circumstances relates only to variable costs as determined by commission formula, or includes variable costs based on the specific costs of the particular rail proponent.[39]

But even when this issue is resolved, there remains the broader issue of how the presumption may be rebutted. The second conference report appears to set out a test of whether the proposed rate provides "as much contribution to going concern value as is possible in the given competitive situation." If so applied by the commission, the initial presumption could be overcome by evidence that the rail proponent has erred in its assessment of demand factors and that a higher rate (i.e., a lesser decrease) would be productive of a greater contribution. This possibility is reinforced by the inclusion of the "going concern value" standard in the provisions of the new rule of rate making for railroads in Section 15a(4) of the Interstate Commerce Act, whose dominant aim is the realization of adequate revenue levels.

In economic terms there ordinarily can be no justification for rail pricing below the level of actual competitive necessity. Thus, if the commission's staff is inclined toward "second guessing" carriers' judgments on this issue, the scene would be set for protracted evidentiary skirmishes.

In seeking to make sense of the complex provisions of Sections 202 and 205 of the Quad-R Act to his colleagues following conference, Representative Devine, ranking minority member of the House Commerce Committee, explained on the floor (Congressional Record, 1976, H. 402):

> Stated simply, railroads are given the freedom to compete with motor carriers and water carriers, but they are not given the freedom to destroy their competition.

Considering the ambiguities of the intermodal competitive rate provisions of the act, this far from novel litany that engenders a certain déja vu may come as close as possible to a fair summary of its intent. Clearly the statement contemplates a number of large blanks yet to be filled in. Whether reflecting a "brave face" or true conviction, in the light of its expressed concerns to Congress the commission's own public assessment of the final provisions of Section 202 and 205 may be instructive on how the blanks are to be filled. It notes that "the final regulatory reform bill as enacted ... eliminated most of the objectionable features of the DOT bill." (Interstate Commerce Commission's 90th Ann. Rep., 1976, p. 87)

How the commission will proceed in the context of that view cannot yet be foretold. On the one hand, language and legislative history combine to bespeak a Congressional "repeal" of Ingot Molds. Conversely, the courts and the commission have an adequate basis for deriving an overall intent to evaluate competitive impact, if not in terms of traffic allocation in particular markets, at least in terms of the continued overall viability of competitors deemed essential in the public interest. Moreover, even in regard to traffic allocation in particular markets, a determinedly "protectionist" commission may eventually choose to test the ultimate limits of the newly adopted concept of a competitive practice that "otherwise undermines competition that is necessary in the public interest."[40]

NOTES

1. The subject matter covered in the entire survey that follows (1887-1976) is treated too voluminously in existing literature to warrant anything more than a summary of episodes and concepts particularly relevant to this paper.

For further references to the specific issues noted in the periods 1887-1920 and 1920-1940, see Dewey 1935, pp. 144, 151-3, 260; Sharfman 1931, vol. 1, 28-32, 203-07; Locklin 1972, pp. 497-500, 503-05; and Hillman 1968, pp. 66-73, 108.

As related to intermodal rate competition, the more significant studies of the statutory provisions and administrative implementation of the Transportation Act of 1940 include Oppenheim 1945; Langdon 1955; Williams 1957; Fulda 1961, Ch. 11: and Friendly 1962, pp. 106-40.

Professor Fulda and Judge Friendly also consider the intermodal rate amendments of the Transportation Act of 1958. More recent commentaries that provide analyses of experience under that act includes Boies 1968, Hilton 1969, Harbeson 1962, Note 1969, and Rose 1971.

2. Preceding the 1920 Act, the present provisions of Section 4(2) of the Interstate Commerce Act (49 U.S.C.) were enacted as part of the Mann-Elkins Act of 1910. Literally, its provisions would have required the maintenance of depressed long haul rates where subsequent proposed increases were based on the elimination of water competition. Noting that a literal construction would tend toward the permanent elimination of water competition and maintenance of discriminatory rates, the Supreme Court held that the provisions were not intended to apply to long haul rates initially reduced with commission approval. Since Section 4 had been also amended in Mann-Elkins to require prior commission approval for all long haul discrimination, what is now Section 4(2) became largely a nullity. Actually, the proponents of the rate increases before the court were not the railroads, but the intermountain interests to whose traffic the higher short haul rates applied. Skinner & Eddy v. U.S., 1919.

3. This special statutory competitive rate standard applicable to long haul discrimination remains today as Section 4(1) of the Interstate Commerce Act.

4. This policy statement remains as Section 142 of the Interstate Commerce Act.

5. A fourth standard also sought to prevent "an undue burden on other traffic" of the rail proponent and jeopardy to "its appropriate return." This standard was not applied, however, so as to promote maximum

contributions to fixed costs from competitive markets at the price of impairing the preservation of "legitimate competition." Dewey, pp. 144, 148-53.

6. In a non-section 4 intermodal rail-water rate proceeding, the Supreme Court affirmed the ICC's approval of rail rate reductions on sugar under which revenues exceeded out-of-pocket costs. Alluding to the 1920 Act water policy, the court noted that "the admonition does not mean that carriers by rail shall be required to maintain a rate that is too high for fear that through the change they may cut into the profits of carriers by water." However, mere profit reduction cannot be equated with the elimination of water carriers from the market. Far from bringing into question the ICC's "reasonably compensatory" standards in Section 4 cases, the court emphasized that in the present case the principal water competitor did not allege any injury. Mississippi Valley Barge Co. v. U.S., 1934.

7. See 54 Stat. 899 (1940), and 49 U.S.C. preceding Sections 1, 301, 901, and 1001.

8. In particular, see Oppenheim, Ch. 1.

9. Notwithstanding, and consistent with its concluding sentence, the national transportation policy has been viewed by the Supreme Court as imposing operative decisional standards on the ICC and the federal courts in proceedings under the Interstate Commerce Act. Eastern-Central Motor Carriers Assn. v. U.S., 1944, and McLean Trucking Co. v. U.S., 1944.

10. Cf. 49 U.S.C. 15(a)(2), 316(i), 907(f).

11. Also see Langdon, pp. 61-3.

The rule of rate making also required commission consideration of "the need in the public interest of adequate and efficient service at the lowest cost consistent with the furnishing of such service ..." This standard could also be construed to encourage the public benefits of lower costs derived from remunerative competitively compelled marginal cost pricing. Again, however, the commission was faced with the need to accommodate this particular standard to the national transportation policy and to effect its application to all three modes along with the related goal of "adequate and efficient service."

12. Cf. 49 U.S.C., Sections 3(1), 316(d), and 905(c). However, the general ban under Section 3(4) of the Interstate Commerce Act of discrimination by railroads against connecting carriers extends to their treatment of connecting water carriers subject to Part III as well as to other railroads. See ICC v. Mechling, 1947, and U.S. Interstate Commerce Commission 1975.

13. See, especially, Friendly, pp. 126-31; Boies, pp. 618-23; Fulda, pp. 350-60; Langdon, pp. 61-91; Williams, pp. 56-91 and pp. 213-14. See also Hilton, pp. 22-28.

14. For examples of this broadly established principle, see Williams, pp. 38-43, and Interstate Commerce Commission 1965a. See also Boies, pp. 646-47, and sources cited. As for water competition, however, the still effective provisions of the Transportation Act of 1920 (41 Stat. 499) water policy statement make no distinction between regulated and non-regulated water transportation. Supra, n. 4 and related text. Nevertheless, in practice, a distinction is sometimes made between the impact on regulated or non-regulated carriers, particularly in the case of private carriers. Interstate Commerce Commission 1939. The distinction between an adverse impact on regulated or non-regulated intermodal competitors has similarly been an important factor in the regulatory evaluation of selective pricing proposals involving issues of discrimination. Generally, see Hillman, pp. 129-38.

15. Hilton, pp. 3, 10-14.

16. A frequently cited resume is again found in Hilton. In particular, see pp. 22-34. The District Court opinion in the New Haven case summarizes various aspects of the legislative history bearing on the discussion that follows. New York, N.H. & H.R. Co., 1961. See also Harbeson 1959.

17. Langdon, pp. 81-3. See, generally, Boies, pp. 648-50, and authorities cited. But, contra, see Interstate Commerce Commission 1976.

18. Throughout the legislative proceedings, the ICC had opposed any major changes in the applicable rate making standard and had argued that in quantitative terms the issue had been grossly inflated in importance. Hilton, pp. 28-30.

19. See Hilton, pp. 48-78 and 190-193; Harbeson 1962, p. 304; Boies, pp. 627-28; Fulda, pp. 360-71; Friendly, pp. 136-40; Rose, pp. 1013-20. These commentators were not always critical of the commission's performance as a matter of statutory interpretation. To the extent that criticism was levelled at the economic substance of the commission's regulation in this area, the responsibility was laid as much at the steps of Congress.

20. The court's reference was to those significant elements of the legislative history that suggested (apart from the equivocating language finally adopted) that the initial raison d'etre for even considering the subject was the widespread thought that the constraints on rail pricing under conditions of intermodal competition should be eased.

21. By reference to those amendments "primarily and directly pertinent to the present topic," it is intended to exclude from consideration other Quad-R Act rate making amendments sharing a general aim of permitting greater rail pricing flexibility, both upside and downside. While potentially having some impact on intermodal rate competition, these other amendments are not mainly directed to that specific issue. In

general, see Section 208, "Rate Bureaus;" Section 202(b) and (c), "Market Dominance," as related to rail rate increases; Section 202(e), establishing for two years a 7 percent per annum zone of relative rate freedom (i.e., so-called "Yo-Yo" rates); Section 202(d), "Seasonal, Regional and Peak Period Rates" and "Separate Rates for Distinct Rail Services;" and Section 206, "Rate Incentives for Capital Investment."

22. Many of the provisions of Section 15(8) apply alike to proposed rate increases and decreases. However, the sole focus here is on rate decreases.

23. It should be noted that the technical device of preserving prior provisions of law applicable to non-rail carriers (e.g., Sections 1(5), 15(7) and 15a(2) and (3)), while creating new provisions uniquely applicable to rail carriers, is a result of jurisdictional divisions among House committees. In particular, the Committee on Interstate and Foreign Commerce and its Subcommittee on Surface Transportation were barred from considering any amendments affecting pipelines, also subject to Part I.

24. The Quad-R Act was enacted as S. 2718.

25. In his statement at the hearings, while appearing to find some usefulness in the judge's initial decision, Chairman Stafford was also explicit in noting (as of July 16, 1975) that the matter was still under consideration by the commission. (Hearings, p. 319)

Following enactment of the revised intermodal rate making standards of the Quad-R Act, the commission by notice and order of April 1 and October 21, 1976, respectively, terminated proceedings in Cost Standards in Intermodal Rate Proceedings, Docket No. 34013 (Sub. No. 1). While the proceeding in theory had covered cost standards for all carriers in intermodal rate proceedings and the Quad-R amendments related only to railroads, the commission observed that "As a practical matter, however, the commission is not aware of any intermodal rate situation not involving a railroad that gave rise to, or is likely to give rise to, the kind of costing problems for which this proceeding was expected to provide the solution." (Notice, April 1, 1976, p. 3) The commission's action could also suggest its conclusion that the Quad-R Act had rendered irrelevant the "inherent advantage" standard, as applied in Ingot Molds.

26. The same truism applies to more assertive statements plucked from the total context of a legislative history.

27. See letter of Secretary Coleman, Nov. 18, 1975, to Commerce Committee Chairman Magnuson. Committee on Commerce, S. Rept. 94-499, p. 316.

28. The Quad-R Act was the unusual subject of two conference reports, notwithstanding the approval by both Houses of the initial report. The problem was one of prospective presidential veto in the face of critical

time constraints. See Committee on Interstate and Foreign Commerce, H. Rept. 94-781, p. 133; Congressional Record, 94th Cong., 2nd sess., S. 741 and H. 401, pp. 48, 51-4, 56.

29. Moreover, the same view of "predatory" was repeated in the committee's discussion of the suspension provisions of its bill. H. Rept. 94-725, p. 71.

30. This circumstance may explain why neither the House or Senate or the Conference Committees dealt specifically with the intended meaning of an unlawful competitive practice that "otherwise" undermines "necessary" competition, as distinguished from the traditional concepts of "unfair," "destructive" or "unfair" competition. To do so candidly might have been self-defeating. Nevertheless there are statements in the reports that suggest an intended equation between the newly formulated standard and the traditional standards. See H. Rept. 94-725; supra, n. 29 and related text; S. Rept. 94-781, pp. 134, 148; and S. Rept. 94-499, pp. 47-8.

31. For brief, but useful, references to the commission's "out-of-pocket" cost formula, see: American Commercial Lines v. Louisville and N.R. Ingot Molds), 1968; and Rose, p. 1014.

32. Cf. Interstate Commerce Commission 1959b, 1960, and 1962.

33. Also see Rose, op. cit.

34. H. 10979 had defined "variable costs" to mean "as defined by the commission." H. Rept. 94-725, p. 4. The definition finally enacted was not included in the first conference committee report. S. Rept. 94-585, pp. 3-4. The strong implication, therefore, is that the enacted "variable cost" definition was ultimately adopted in the final negotiations between DOT and the conferees. See no. 28 supra and sources cited.

As to the issue of what formulation of "variable costs" is to be used in determining the existence of a presumption of "going concern value," the noted ambiquity is heightened by contradictory statements in the conference report. Cf. H. Rept. 94-781, p. 134, suggesting the test of "variable costs," whether determined under amended Section 1(5) of the Interstate Commerce Act with reference to commission formula or the proponents' specific costs, and at 147, suggesting the sole test of "variable costs, as determined by formulas established by the commission."

However, the better view is that this second reference, in its particular context, was simply taken directly from the bill, while the earlier explanation more accurately expresses the actual intent. Moreover, if the determination were limited to commission formula, in any proceeding in which a rail proponent exercised its statutory option to request specific cost determinations, it nevertheless would be necessary to use both in order to determine the existence of a presumption. This result would work strongly against the basic purpose of encouraging specific cost determinations.

35. In its Cost Evidence proceeding (supra, n. 32), the commission redesignated "out-of-pocket" costs as "variable costs."

36. See text following n. 23.

37. Cf. Interstate Commerce Commission 1959a and 1965b.

38. The plausibility of Ingot Molds being the intended "victim" of these rate making amendments is reinforced by the previously noted ultimate exclusion in the act's provisions of any reference to the requirements of the national transportation policy. That policy, of course, remains in force (including its directive that all provisions of the Interstate Commerce Act be administered and enforced with a view to its implementation). Nevertheless, the considered and deliberate exclusion from the Quad-R Act of earlier explicit references to the policy supports the conclusion that the act is intended to undo the application of the "inherent advantage" standard of the policy as interpreted in Ingot Molds. The rendering of Section 15a(3) inapplicable to intermodal competitive pricing by railroads is especially significant in this respect.

39. But see n. 34.

40. In assessing the nature of the political equilibrium that this phrase was intended to reflect, it may be noteworthy that the principal rail industry witness at the House hearings on H.R. 7681 observed "In view of ...spiraling costs and inflationary climate, obtaining the right to reduce rates with greater ease is of much less relative importance to the railroads than was the case even just a few years ago." Hearings, pp. 564-5. It is these continuing conditions that probably best explain why there has not as yet been any real testing of these Quad-R Act amendments.

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INTERMODAL COMPETITION AND THE MEASUREMENT OF SERVICE DIFFERENTIALS

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PREFACE

I am going to discuss the calculation of "service differentials." The idea behind the numbers called "service differentials" is that different modes of transport do not offer identical services; thus, to analyze intermodal competition for freight traffic, one must adjust the price or cost of one mode to make it comparable to the dollar quotes for the other mode. Traditionally, this adjustment has been made to railroad costs or prices to make them comparable to motor carrier figures, although in principle this method could be used to compare any two modes or any two competing services or products.

The major point I would like to make is that true service differentials are far more difficult to calculate than past researchers have supposed. Even then, service differentials are strictly valid only for single shippers. The aggregation problem makes it virtually impossible to estimate service differentials for economically interesting market groupings. In short, we cannot predict aggregate traffic shifts between rail and road using service differentials; nor can we find an economically optimal allocation of freight traffic by comparing the service-adjusted costs of each mode of transport.

INTRODUCTION

To begin, I would like to state a theorem, make a list, and tell a story.

The theorem is: the average value of a function of several variables is not (in general) equal to the value of the function at the mean of each variable. In mathematical terms, for a three variable function:

$$\sum_{i=1}^{n} \frac{f(X_i, Y_i, Z_i)}{n} \neq f\left(\frac{\sum_{i=1}^{n} X_i}{n}, \frac{\sum_{i=1}^{n} Y_i}{n}, \frac{\sum_{i=1}^{n} Z_i}{n}\right) \qquad 1.$$

This theorem is at the heart of the aggregation problem, well known to those who have tried to find microeconomic foundations for macroeconomic behavior.

My list is of several items from the National Motor Freight classification:

Item	Description
18430	Automotive carpet or rug cushioning or lining, felted fibre in molded or preformed shapes, other than flat goods cut to configuration, in packages.
43000	Ammonium chloride, in cloth or fine-ply paper bags, in packages 201 or 202, or in bulk in bands or boxes.
67220	Ginger Root Residue, having value only for animal or poultry feed mixtures; LTL, in bags, barrels or boxes; TL, in bulk or in packages.
101180	Mop wringers, without pails, in packages.

I trust that I do not have to reproduce the entire classification to demonstrate the fantastic variety of products--raw, intermediate, finished, and waste--that are lumped under the word "freight." These goods differ from each other in many ways other than value per pound.

My story comes from my visit to Germany last December. I was there to learn about a government program to use heavy taxation to halt the growth of private trucking. In my talks with an official of the German Federal Railways, I asked about the feasibility of winning traffic from the highways through rate reductions. My best translation of what he said is this: "Herr Boyer, you are asking about the cross elasticity of demand. We have never tried to measure it. In the case of bulk goods, I suspect we could do it. But, especially for private trucking where price is not the only object, I'm afraid that would be impossible."

Why is it that demand elasticities should be more difficult to calculate if price is not the only object? In other branches of economics we don't give up the attempt to measure the degree to which two goods, for example, pork and beef, are substitutable merely because to people who buy meat, price is not the only object. What the German railway official seemed to be saying was that only where the differential costs that a shipper incurs by using different quality services are negligible, hence 'price the only object', can an accurate prediction about the effects of rate changes be made. Only when the service differential is small can demand be estimated. Truck costs minus the small service differential tell you about rail demand.

Now, this idea that the demand for one firm's goods or services can be estimated by looking at competitors' costs disagrees with supply and demand analysis. Demand deals only with buyers; supply deals only with sellers. The demand for transport services is, thus, properly investigated by studying shippers, not carriers. Carrier costs are only incidentally interesting. After the demand relation has been estimated, knowing a competitor's costs can help predict his pricing behavior, that in turn will affect your own quantity demanded. From the point of view of intermodal competition, this is the only reason for being interested in a competitor's costs. (Or rather, in the absence of regulation, it would be so. As it stands now, if you know competitors' costs, you can sometimes get the ICC to prevent him from behaving as he wishes).

Nevertheless, in the United States carrier costs have played a central role in the study of intermodal competition. I think the reason for this is that the first major quantitative study of intermodal competition (Meyer et al. 1959) approached the subject by trying to find a minimum cost allocation of freight among the different modes of transport. This required, of course, calculating haulage costs for each mode. This also required adjusting these costs for service quality factors. For example, the extra warehousing required for the slower rail service is a real social cost; to ignore these costs and allocate freight to the mode with the lowest haulage costs would not lead to an optimal traffic distribution.

Thus arose the service differential--essentially an unobservable surcharge on rail freight costs. If the rail costs plus service quality surcharge exceed truck costs for any class of traffic, a minimum cost allocation would give that traffic to motor carriers. Similarly, to minimize costs a shipper would always choose rail transport if the sum of the rail rate and this imaginary surcharge were lower than the motor carrier rate.

The authors of the early study on intermodal competition and those that followed (the best known are Harbeson 1969, Friedlaender 1969 and Woods and Domencich 1971) were very careful to get the best possible estimate of costs for rail, motor carrier, water carrier, etc. They were less concerned about the accuracy of their services differential calculations. Here, I believe, they made a serious error. I will show that when properly calculated, these surcharges can be very large indeed. By not appreciating the complexity of calculating service differentials, the authors have led many academic economists to overestimate both how much traffic the railroads would win from the highways through rate reductions, and how much traffic is misallocated between road and rail. Both of these questions require knowledge of cross elasticities of demand, and neither cost calculations nor service differentials estimates can give us reliable answers. The comparative cost method is inadequate for dealing with intermodal competition.

THE OLD PROBLEM AND WHAT IT IMPLIES

Econometric historian Fogel (1967) calculated service differentials when he attempted to measure the effect of the railroad on United States economic growth. He tries to show that virtually all railroad freight traffic in 1890 could have been carried on canals for not much more social outlays for transportation and transport-related services. Basic haulage costs would have been cheaper by water than rail, he argues. However, when additional costs of using canals were added in, total costs favored the railroads. These costs were neglected cargo losses, added transshipment costs, supplementary wagon haulage, neglected capital costs, inventory costs on slower canal hauls added inventory costs from canals that were blocked several months per year, et cetera. The study has been severely criticized for incorrect technological assumptions and incorrect economic analysis.

Modern studies of intermodal competition use essentially the same method to calculate the economic consequences of traffic transfers between truck and rail, but consider many fewer shipper cost categories. Since most studies of present day intermodal competition follow Meyer et al's formulas for calculating the unobservable surcharge for rail/road transfers, I will present their method in detail.

The standard service differential formula is composed of two halves: one half calculates the added in-transit inventory due to shipping by rail rather than road. When allowance is made for the average number of classifications and terminal movements per box car mile, the difference in transit time between truck and rail is taken to be 48 hours plus the equivalent of 10 miles per hour. With an interest rate of 10 percent/year and a haul of 500 miles, this translates into an unobservable surcharge of 4 mills per ton-mile for goods valued at $2000/ton or 4/10 of a mill per ton-mile for goods worth $200 per ton-mile. These are surcharges of 20 percent and 2 percent respectively on typical rail freight rates of about 2 cents per ton-mile.

The second half of Meyer et al's service differential is supposed to account for the fact that railway cars have a larger volume than truck trailers. It is of a still more modest order of magnitude. The formula used for this adjustment is:

$$S_d = \left(\frac{CI + K}{2Y}\right) \quad (Q_r - Q_t) + S\left(\frac{1}{Q_r} - \frac{1}{Q_t}\right) \qquad 2.$$

where:

S_d = the service differential per ton shipped due to different shipment size on truck and rail.

Y = expected yearly shipments in ton-miles.

Q_r = most economical shipment size for rails in tons.

Q_t = most economical shipment size for truck.

K = annual storage cost.

S = order costs.

I = cost of interest, risk and obsolescence as a percent of value

C = value of merchandise per ton

To give an idea of the magnitude of the adjustment to the rail rate called for by this formula, we follow Meyer et al and set rail carloads of 34 tons, truckloads of 17 tons and yearly inbound shipments of 2.5 million ton-miles. Those who have used this formula assume that interest, risk and obsolescence cost the shipper 10 percent of the value of his stock per year; annual storage costs between $30 and $100 per year; order costs between $1 and $10 per order; and that the merchandise is worth between $60 and $2000 per ton. Using these figures, the unobservable surcharge ranges from a high of about 2 percent to below zero percent of rail rates. (For very low value goods the increased order cost for more frequent shipments outweighs the cost savings of holding a smaller inventory if you ship by truck).

In most comparative cost analyses of truck/rail competition, the service differential varies between 1 percent and 25 percent of rail rates. The average is about 3 percent. With numbers like these, it is small wonder that comparative cost studies have found so much traffic misallocation. If you estimate rail costs to be half truck costs, slapping a 3 percent surcharge on rail costs to account for poorer service quality will not give very different conclusions than if you had ignored service differences completely. The corollary is that small rail rate changes should effect large shifts from truck to rail traffic.

My impression is that the unobservable surcharges calculated by most authors who have used the comparative cost technique are far too small. In the last decade we have seen large, uncoordinated general rate increases by railroads and motor carriers without the highly unstable market shares that a small service differential would imply. Part of the reason is that the figure used for inventory carrying costs, 10 percent, is too low. If we used 25 percent of value per year (Alford and Bangs 1955) as the cost of interest, obsolescence and depreciation, we would more than double the size of the unobservable surcharge. But even this would leave the average service differential quite small.

The basic problem, in economic terminology, is incomplete enumeration of the shipper's cost function. Modes of transport differ by far more than size of vehicles and the average transit time. We shall see that when other modal characteristics are taken into account, the unobservable surcharge for using poorer quality service may be quite sizeable.

THE COSTS OF PHYSICAL DISTRIBUTION AND SUPPLY

The comparative cost method of analyses intermodal competition recognizes that not all the costs of physical distribution and supply are paid to carriers. Some of these costs--loading and unloading costs and order processing costs, for example--are, in principle, easily quantified. Others are more probabilistic: for example, tracing of lost shipments or processing of loss and damage claims. For costs that cannot be predicted with certainty, we must work with expected costs.

The most difficult part of making reliable estimates of the service advantage of one mode over another turns out to be calculating the effects of uncertainty on the size of inventories.

In contrast, the standard two-part approach to measuring the size of the service differential assumes nonrandom transit times and a constant use rate of the product.

The model of inventory-holding implicit in Equation 2 above, is of arrival-averaging stockpiling. If a good was used at a constant rate, produced at the moment of loading (that is, averaging is required by the receiver of the goods, not by the shipper) and shipped with a constant transit time, then the model used would be appropriate. Once the possibility is allowed of varying transit times or of consumption at a rate with a stochastic component, the model used in the comparative cost procedures loses its theoretical justification.

The emphasis placed by the comparative cost model on the receiver rather than the shipper of the good is probably justified on two grounds. First, the right of routing a shipment legally belongs to the party that pays the freight charges. In most cases, this is the consignee. When making a decision on mode of shipment, the receiver will adjust transport rates for his own inventory costs and ignore those of the shipper. Second, we notice that in Equation 2 the cost of carrying an averaging inventory is a fixed number of dollars per year, and is proportional to the difference in shipment sizes for the two modes of transport. Since the service differential is quoted in cents per ton-mile, the yearly dollar cost is divided by the annual ton-miles. (For a very large firm, or for high volume items, this half of the service differential will vanish; the opposite occurs for those items that a firm does not use rapidly). If we assume that the producer ships many more tons (or ton-miles) of an item in question than are received by a single consignee, the cost of carrying an averaging inventory will be relatively less important to the shipper. Ignoring, then, the effects that mode choice will have on the sender's inventory decisions, we will consider mode of transportation selection from the point of view of the receiver.

The standard calculation of the service differential is illustrated in Figures 1a, 1b, and 1c. In Figure 1a the solid sawtooth line shows the level of inventory at any time. The vertical jumps correspond to arrivals of vehicles; the height of each tooth corresponds to the number of items per vehicle-load. The constant downward slope of the line correspond to the assumption of a constant use rate. The area under the dotted line represents, in item-days, the size of the averaging inventory. Multiply the number of item-days per year of such inventory by the carrying cost per item-day and you have the cost per year of carrying this kind of inventory.

The dashed sawtooth in Figure 1a shows the pattern of inventory holding if vehicles carry twice the number of items. This line, for rail cars for example, will always be higher than the dotted line (for truckloads) and thus, the item-days per year of averaging inventory will be greater. Add the cross-hatched area for the entire year, multiply by the carrying cost per item-day, and divide by the yearly

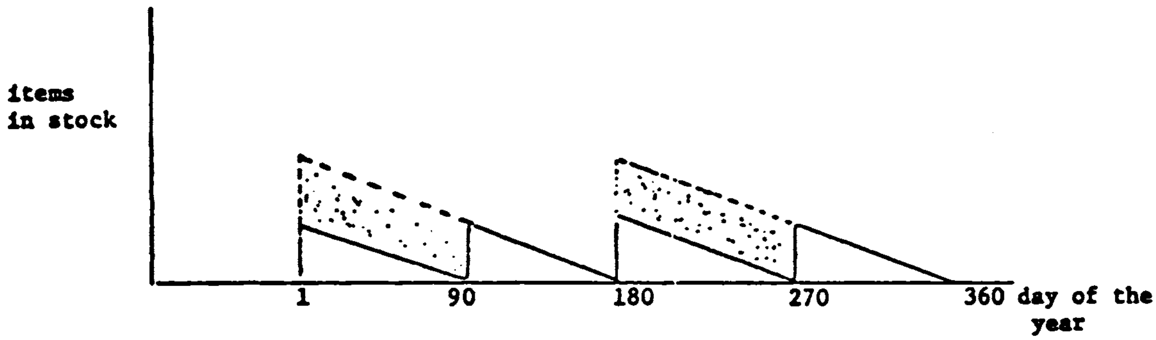

FIGURE 1a

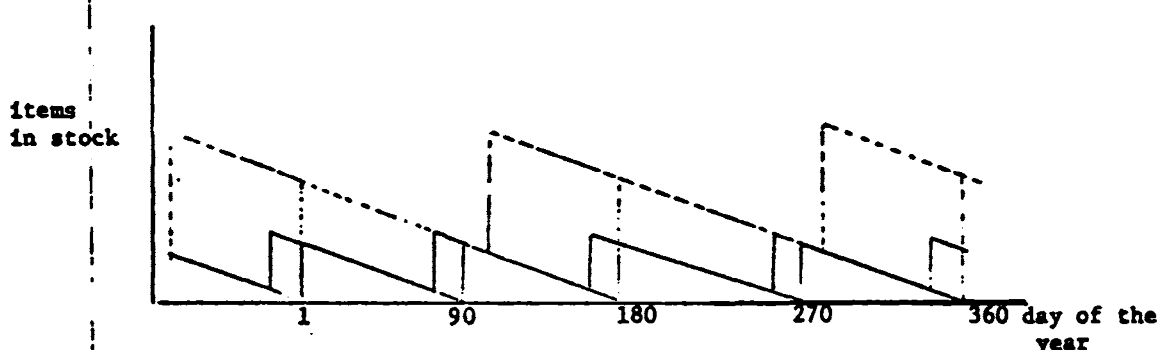

FIGURE 1b

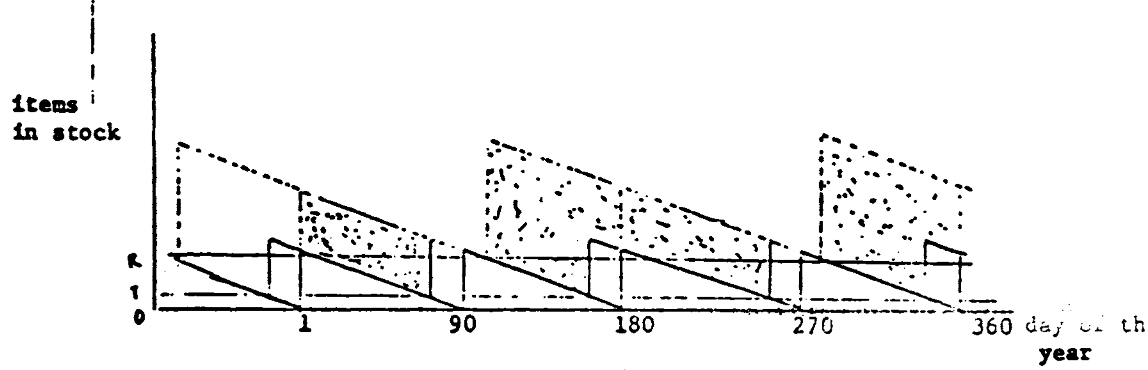

FIGURE 1c

ton-miles and the result is the second half of the service differential, calculated by the traditional method.[1]

Figure 1b shows the first half of the service differential calculation. Goods must be transported before they are warehoused. Therefore, goods must be ordered before the inventory falls to zero. Carrying costs must be paid on this in-transit inventory. The in-transit inventory, measured by item-days, is given by the area of the rhombuses in the middle panel. The large rhombuses correspond to rail shipments and the small to truck traffic. Since we assume that carloads have twice as many items as truckloads, the rail rhombuses are twice as high.

The width of each measures the days of transit time. The truck rhombuses are narrower since trucks are faster. The first half of the service differential is equal to the sum of the rail in-transit item-days minus the sum of the corresponding truck rhombuses for an entire year, multiplied by carrying costs per item-day, and divided by the annual ton-mile.

Figure 1c combines the two halves of the service differential calculation. The shaded area shows the total extra yearly item-days that must be carried if goods are received by rail rather than truck. The number of items represented by the distance OR is called the trigger level for rail, since inventory falling to this level triggers the order of another carload. OT is the reorder level if truck transport is used.

To recapitulate, the standard calculation of the service differential takes the shaded area in Figure 1c, multiplies it by the cost of carrying one item for one day, and divides by the annual ton-miles. The numbers that result from this calculation are, as previously mentioned, quite small relative to rail or motor carrier rates.

A MORE REALISTIC VIEW OF PHYSICAL DISTRIBUTION AND SUPPLY

A good model of economic decision-making is one that strips away all minor, unimportant, or irrelevant factors, and focuses attention on the essence of the problem. I argue that traditional service differential calculation, however, dwells on trivialities and ignores the important parts of the physical distribution and supply problem. While I am not prepared to offer an alternative formula, I can show that eliminating certain apparently minor factors leads to large errors in the measurement of service differentials.

I wish to view the movement of a good from producer to consumer as a four-stage process. In Stage 1, a truck trailer or freight car is filled with a truckload shipment of a good and hauled to the receiver's unloading dock. In Stage 2, the receiver empties the vehicle and places the contents in a long-term warehouse. In Stage 3, a production run's worth of the good is removed from the warehouse and placed temporarily next to the machine that will use the good. In the last stage, items of the good are removed from temporary storage and fed into the machine. If Stage 4 represents purchase by a consumer, then Stage 3 is retailing and Stage 2 is wholesaling. While there is usually a transportation link between the wholesaler and the retailer, this is typically carried out by less-than-truckload or private trucking; such a haul is lost to rails and thus we can, if our interest is truck/rail competition, assume that transport only occurs in Stage 1. In contrast, the comparative cost calculations illustrated in Figures 1a, 1b, and 1c implicitly use a three-stage model: transportation, warehousing, and consumption.

If we wished to make a complete accounting of the excess costs to a shipper from using rail rather than motor carrier service, we would have to take into account at least the following twelve factors:

(1) Rail carloads are at least twice as large as truckloads;

(2) Rail transit time is on the average slower than truck transit time, with rail's relative disadvantage diminishing with distance shipped.

(3) Rail transit time is much more erratic than truck transit time.

(4) The consignee must pay a demurrage penalty if he holds a rail car longer than 48 hours after placement of the car. Demurrage penalties don't apply to motor carrier shipments.

(5) It is possible to monitor continuously the progress of a truck shipment, but this is usually not possible for a rail shipment.

(6) More dunnage and protective packaging is required with rail shipments than with truck shipments.

(7) The likelihood of damaged arrival is much higher with rail shipments than with road shipments; thus there is a much greater likelihood of filing a loss-and-damage claim against a rail carrier than a motor carrier.

(8) In addition to extra dunnage, shipments by rail and road may require different loading costs. The materials-handling cost differential will vary from commodity to commodity, with train shipments requiring less handling in some cases, and road shipments requiring less handling in others; in some cases railroads may provide specialized cars, that reduce handling costs.

(9) Stage 2, long-term storage, involves much more than interest charges; materials handling costs, obsolescence, depreciation, spoilage, risk, and bookkeeping figures must be added to basic inventory costs. Depending on the commodity, these costs may be much smaller or much greater than interest costs of inventory carrying.

(10) Stage 3, short-term storage, involves at least bookkeeping and materials handling costs.

(11) Stage 4, final use, must allow for varying rates of consumption; in almost all cases, there will be a stochastic component of demand.

(12) Should desired consumption be thwarted due to lack of inventory, stockout penalities will be applied. More than any other factor, the exact nature of the outage penalties are difficult to estimate. For some commodities, for example, those that are likely to have a "custom made" character to them, out-of-stock situations are typical; for such goods, outage penalties must be minimal. Where Stage 4 is a large production process and the good in question is an essential component, the stockout penalties will be measured by the cost of idling the factory; here the stockout penalties may be very large relative to the value of the good under consideration.

To demonstrate that the standard calculation of the rail/truck service differential is not based on a totally realistic model of physical distribution and supply decision-making is not to show that the standard method is wrong. All economic models are abstractions. In a good model, neglected factors are small and cancel each other out. The question is whether, in the standard procedure for estimating rail transport's unobservable surcharge, neglected factors are small and whether they tend to cancel or reenforce each other. I will demonstrate that at least one neglected aspect - the random property of demand and transit time - is far from negligible. I would suggest in addition, that most of the neglected aspects will, far from counterbalancing each other, consistently favor the choice of road transport. If this is true, the standard calculation will underestimate the true service differential.

OPTIMAL INVENTORY STRATEGIES

I wish to develop optimal inventory strategies for a shipper using first, rail transport and second, motor carriage. Following the procedure illustrated in Figures 1a, 1b, and 1c, I will subtract the yearly nontransport costs for the truck strategy from those for the rail strategy and then divide by the yearly ton-miles to estimate the service differential. My analysis differs from that presented earlier only in that it allows a random component to transit time and demand.

In the longest run, physical distribution and supply decisions merge into location theory, as the manufacturer (or wholesaler) decides where to build his factories and warehouses. Transportation and location advantages (e.g., a cheap labor supply or inexpensive local raw materials) are to some extent substitutable. I assume for this analysis that these decisions already have been made.

Assume that consumption is a random variable with a known distribution. Orders for a batch of items are sent to the factory where, with a random delay having a known distribution, orders are filled and shipped. Transit time is likewise random with known distribution. The problem of the receiver of the goods is to determine when to order what quantity of the good. He must take into account that if his lot size is too small he will have to pay LTL rates and thus higher per-unit transport costs. Imagine also that per-unit order costs decline as lot size increases. If lot size is too large, however, this will increase average inventory levels and thus increase costs that vary with the average size of inventory (interest costs, depreciation, etc.)

A typical strategy is to order a predetermined lot size of an item when the inventory falls below a certain reorder point or trigger level; a typical trigger level would be 20 percent of an order lot size. If the trigger is set too high, unneeded inventory carrying costs will be incurred; if the trigger is too low, stockout penalties will be paid too often. Clearly, the optimal trigger level will be determined by balancing expected carrying costs and expected stockout penalties: the more serious an out-of-stock situation would be to the firm, the higher will be the trigger level; the higher are carrying charges, the lower the trigger level.

The lot size and trigger level determinations have been presented here as sequential decisions while they are, in practice, found simultaneously. It is apparently a two-dimensional optimization problem of this sort: find lot size and trigger level that minimize the expected sum of transportation charges; demurrage payments; dunnage and packaging costs; materials handling costs; order, bookkeeping, and expected tracing, and loss-and-damage claims; in-transit carrying costs (including interest costs, expected spoilage or breakage, etc.); in-warehouse carrying costs (including materials handling costs, interest, obsolescence, spoilage, breakage, risk and insurance); and out-of-stock penalties. This is a constrained minimization problem where for railroads, lot size must be at least a carload, and for truckload carriage, the minimum lot size is a truckload.

If we assume that for rail, lot size is constrained to a carload, and for road carriage, lot size is a truckload (equal in size to half a carload) then the minimization problem is simply one of finding the optimal trigger level. Once this has been done, we may use this value to predict expected stockout penalties and average inventory levels, and thus be able to compute the sum of all terms just listed. Expected annual nontransport costs can be calculated first for rail transport and then for a reorder strategy that assumes that motor carriage will be used. Dividing the difference by the annual ton-miles will yield a service differential.

While the "trigger" model is the most widely used model of inventory management, it is by no means the only one. For some commodities, the least cost solution is apparently to ship a fixed amount at fixed intervals regardless of current inventories. For other commodities, multiple triggers are required. Some firms use a mixed strategy: below one trigger, place an order for a carload, shipped by rail; if a lower trigger is reached, place an order for a smaller lot to be shipped by a faster mode of transportation-less-than-truckload carriage or air freight. We could think of hitting the lower trigger as a kind of out-of-stock situation, with the costs of using the faster mode of transportation as a stockout penalty; we would use mathematics similar to basic problem outlined above to find optimal trigger points. If it is possible to monitor the shipment as it progresses and thus improve from day to day the prediction of arrival, the trigger levels could be set lower, thus reducing average inventory levels and related costs.

MODAL ATTRIBUTES AND INVENTORY COSTS

Service differential calculations that do not allow for stochastic demand and transit time ignore the more interesting part of the inventory-holding problem. The model focuses on the in-transit inventory interest costs, and the need to hold an averaging inventory. Thus, the model diverts attention from more important effects--the slower transit time and larger lot sizes characteristic of rail services. When demand is not constant, some stockpiling is necessary. If the time between the "sale" or use of a good and its replacement in the warehouse is consistent and short, only a small stockpile is necessary to guard against an out-of-stock situation. For a given probability of demand for an item, to maintain a given likelihood of having that item in stock, the longer the expected interval between removing an item from inventory and replacing it, the higher the trigger level must be set. Setting a higher trigger level will raise average inventory levels and increase holding costs.

Figures 2a, 2b, and 2c illustrate this principle. The solid line represents inventory on hand for sale, while the dashed line includes in-transit inventory. Figure 2a represents one order cycle assuming a constant use rate and transit time. The reorder point should be set at OC items. The straight downward sloping solid line reflects the constant item per day demand. In Figure 2b the solid line is no longer straight, but has a varying slope, although the expected slope (or expected number of items per day), is still the same over the order cycle. In the period represented by Figure 2b, the reorder point OC had let the receiver run out of stock; in other months, of course, the new order might arrive before his inventory was depleted. If he must pay out-of-stock penalties, his obvious response to stochastic demand is to raise the reorder point, say to OR in Figure 2c. Because he raised the trigger level, he will increase the size of his expected inventory. This additional inventory is sometimes called a safety stock. The size of the best safety stock clearly depends on the variance of demand and on the severity of stock-out penalties; but it will also depend on transit time. If transit time is one day and a receiver carries a safety stock of S items, a transit time of n days will require that he carry approximately $\sqrt{n}$ S items to maintain the same likelihood of an out-of-stock situation.[2]

If use is rapid relative to transit time, the trigger level may be set at more than a single lot size. To allow for stochastic demand, the receiver may use multiple reorder points. Increasing the number of reorder points will, in general, reduce expected inventory for a given level of protection against stock-outs. The main effect of a smaller lot size (other than allowing a smaller averaging inventory) is that is makes possible more frequent reorder points and thereby a smaller

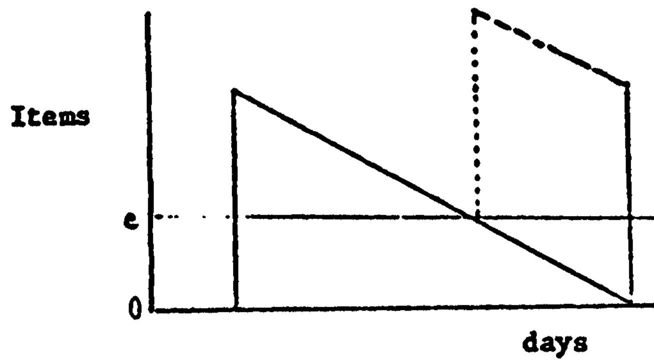

FIGURE 2a

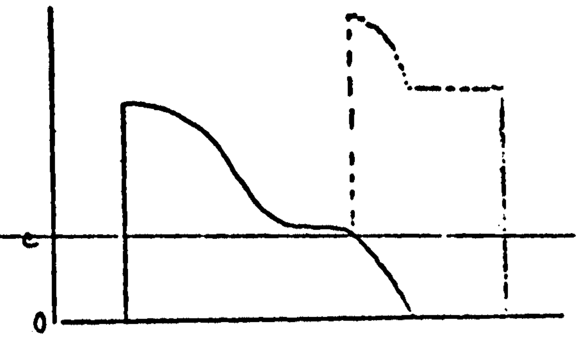

FIGURE 2b

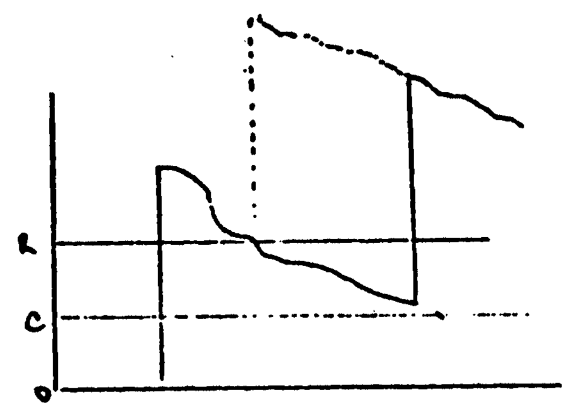

FIGURE 2c

expected number of annual items-days on which the receiver must pay inventory carrying costs.

This problem of determining how much higher reorder points must be set to provide an optimum safety stock is easy. If, however, transit time is also stochastic (as it always is), the problem becomes vastly more complicated. While I am not an operations research specialist, I have made a search of the literature and consulted some people in the field. I do not believe that the general problem of optimal reorder points with stochastic demand and transit time has yet been solved.[3] It is, however, not necessary to have a general solution. I wish only to get a general idea of what effect stochastic transit times will have on reorder points and hence on optimum inventory levels and service differentials. A numerical example will provide a general idea.[4]

Assume that a good is shipped from a factory to a warehouse, a distance of 500 miles. Assume that, when all factors are taken into account, mean rail transit time is five days and mean truck transit time one day. If the good is shipped by rail, the lot size is 20 tons; if by truck, the lot size is 10 tons. A truckload contains five items, a carload 10 items. I assume that all costs vary with the value of the good and can be included in a carrying cost that is identical for in-transit and in-warehouse time, of 25 percent per year on the value of the good. Both transit time and demand have a Poisson distribution. Stockout penalties are proportional to the length of the out-of-stock period. The inventory strategy allowed by the example is this: carry an integral multiple of transit lot size (whole truckloads or carloads) as maximum inventory and place an order equal to one lot size every time the inventory level falls below another integral multiple of lot size.[5] Thus, if trucking is used, and the maximum inventory is four truckloads, the strategy calls for ordering another truckload every time the inventory level falls below three, two, one or zero truckloads. No sales are made if there are no items in stock.

If we make these assumptions, the mathematics is relatively simple, and we can get expected outage percentages and expected average inventory levels for different maximum inventory strategies. By comparing the costs of each strategy, we can pick out the best decision for using each mode of transportation. Such a strategy might be, for example, to aim for a maximum of three truckloads (assuming road transportation is used) and to reorder if the inventory falls below two, one, or zero truckloads. (I consider here only three costs: first, in-transit carrying costs, second, stock-out penalties, and third, in-warehouse carrying costs of the computed optimal average inventory level). Having chosen the minimum cost strategies for each mode, we can compare the nonrate costs of using rail and road transportation. Following the standard approach, I subtract these costs for truck and for rail and deflate the difference by ton-miles.

The results of these calculations are presented in Table 1. I have used a number of different parameters for average demand (measured as items per day), for the value per ton, and stock-out penalties (measured as dollars per day). Average demand of 0.1 corresponds to one box car every 100 days; of 5.0 corresponds to one boxcar every two days and average demand of 20.0 implies two boxcars per day on average.

Inspecting Table 1, several things become immediately clear: first, the calculated advantage of trucks over trains is extremely sensitive to parameter specifications, varying by a factor of 5000 depending on demand conditions, value density and the seriousness of an outage. Second, the orders of magnitude of the necessary adjustments may well be large compared with typical rail and truck rates of several cents per ton-mile. For goods of moderate value, service differentials can be as low as 10-15 percent, but they may also be 50 or 100 percent of rail rates or even higher. Finally, according to Table 1, trucks have their biggest advantage on commodities where only a few truckloads per month or per year are received, on high value merchandise, and in situations where outage penalties are severe. These results conform to our a priori expectations.

These figures will be accurate only under the very restrictive assumptions upon which they are based. The most important assumption is that costs vary with the value of the commodity and are equal to 25 percent per year of the commodity value. We have not allowed at all for the possibility of carrying costs varying according to anything other than the value of the good.

Another simplifying assumption that has affected the figures in Table 1 is the set of permissible strategies. Prohibited are mixed strategies, like ship by rail if one trigger is reached, by truck if a lower trigger is reached, and by air freight at a third reorder point. The possibility of mixed strategies would probably reduce the calculated advantage of trucks over rails. Likewise, requiring triggers to be integral multiples of lot size rules out clearly superior strategies in some cases; for example, when demand is very small relative to a lot size, the trigger should be a small fraction of a lot size. At the other extreme, where demand requires several lot sizes per day, the maximum of four lot sizes that our model provides, rules out the higher inventory levels that probably are preferable. It is not clear whether changing our model to allow these last two strategies would benefit rail transportation more than road transportation or vice versa.

I must mention other problems with the model: first, I have assumed that penalties for being out-of-stock are proportional to the duration of the situation. There are, however, many other possibilities: a fixed penalty is incurred each time the situation occurs; penalties are more or less than proportional to the length of time the inventory is zero; stock-out costs could be an increasing or decreasing function of the number of times per year that inventory goes to zero. Any assumption other than the one I used to prepare Table 1, however, leads to very complicated mathematics.

A second problem concerns the probability distribution of demand and transit time. By assuming Poisson distributions for each, I have assumed that the variance of transit times equals the mean transit time; I cannot increase the variance of demand without increasing mean demand. This is a serioud drawback in the model since we would like to know, for example, the effect that increased service reliability, independently of decreasing average transit times, would have on the distribution of traffic between rail and road. We would also like to investigate

TABLE 1
OPTIMAL INVENTORY STRATEGIES FOR A SIMPLE SYSTEM

Average Demand (items per day)	Value per Ton (dollars per ton)	Stock-out Penalties (dollars per day)	Truck: Mean Inventory (items)	Truck: Expected Outage (%)	Rail: Mean Inventory (items)	Rail: Expected Outage (%)	Service Differential (cents per ton-mile)
0.1	50	1	7.9	0.0	15.0	0.0	0.48
		1000	7.9	0.0	15.0	0.0	0.48
	500	1	7.9	0.0	15.0	0.0	5.1
		1000	7.9	0.0	15.0	0.0	5.1
	2000	1	7.9	0.0	15.0	0.0	20.6
		1000	7.9	0.0	15.0	0.0	20.6
1	50	1	7.0	0.3	10.9	3.9	0.06
		100	7.0	0.3	20.5	0.1	0.10
		1000	12.0	0.0	30.5	0.0	0.15
	500	10	7.0	0.3	10.9	3.9	0.57
		1000	7.0	0.3	20.5	0.1	0.96
	2000	10	7.0	0.3	10.9	3.9	2.19
		1000	7.0	0.3	20.5	0.1	4.59
5	50	1	4.2	16.7	4.0	45.8	0.03
		10	8.2	3.1	13.9	11.7	0.05
		100	13.0	0.3	13.9	11.7	0.26
	500	1	4.2	6.7	4.0	45.8	0.28
		100	8.2	3.1	13.9	11.7	0.31
		1000	13.0	0.3	13.9	11.7	2.6
	2000	10	4.2	16.7	4.0	45.8	1.2
		100	8.2	3.1	7.8	24.9	1.5
		1000	13.0	0.3	13.9	11.7	3.4
20	50	100	4.6	30.0	3.0	64.6	0.20
	200	100	4.6	30.0	3.0	64.6	0.28
	2000	100	4.6	30.0	3.0	64.6	1.25

the properties of a system that consumes an item rapidly but with low variance (typical, perhaps, of many intermediate goods in manufacturing processes). This model will not permit me to do either. The mathematics of calculating probabilities and average inventory levels is straightforward (but nevertheless complicated) only for Poisson distributions; only here can we calculate the probability that inventory level is zero without using calculations with Markhov chains, involving all previous states of the system.

OMITTED VARIABLES AND THE SERVICE DIFFERENTIAL CALCULATION

The numerical example presented shows that there are important factors neglected by the traditional method for measuring the unobservable surcharge on rail rates. Once we allow demand and consumption to be random, service differentials come out larger by orders of magnitude. The standard two step calculation of modal service advantages is misleading; it is based on a bad model because it ignores important aspects of economic decision-making.

But the numerical example is only one part of the story. It still assumes that, in receivers' eyes, the only difference between modes of transport is the amount of inventory holding that modal characteristics induce, and it assumes that inventory carrying costs are a constant 25 percent per year. The model assumes that modes do not differ in carrying cost or in handling, packaging, and bookkeeping costs. I think that these assumptions, too, hide important modal advantages and disadvantages.

If the variance of transit time and consumption are sufficiently small, it is possible to eliminate Stage 2 (intermediate warehousing) in our four-stage process and thereby save the handling and bookkeeping costs of storing and retrieving an item. These costs may be large in relation to transport charges. For example, assume a 200 lb. item is to be shipped 500 miles. It might cost three cents per ton-mile to ship it by rail and four cents per ton-mile to haul it by truck. Thus, there is a 50 cents per item saving by using rail shipment. Ignoring bookkeeping costs, if warehousing services, (labor and machines together) cost $10 per hour, it requires only one minute per item of placement and removal costs to wipe out the 50 cents per item saving; for some goods, one minute per item may be an unrealistically short handling time, for others unrealistically long.

It is possible to skip long term storage only if arrivals and consumption can be predicted accurately and if deliveries can be made in lot sizes as small as production runs. The carload size and high variance of rail transit times usually precludes this possibility; because demurrage charges must be paid if a car is held more than 48 hours after placement, simply using the rail cars as a warehouse, removing items from the car and moving them directly to machine side when needed, is likely to be a poor strategy. Thus, bookkeeping and handling costs may interact with lot size and the randomness of transit times to favor motor carriage over rail transport in ways accounted for by neither the standard computation nor my numerical example.

COST BASED DEMAND ELASTICITIES?

I have tried to show why I distrust cost-based analyses of intermodal competition. By not appreciating the complexities of physical distribution and supply, these analyses have misled economists into thinking that costs paid to carriers are more important to modal choice than they actually are. I have tried to show that the standard formula has consistently failed to measure true service differentials.

I also believe that more complex formulas will not help us measure unobservable surcharges or cross-elasticities of demand for economically interesting aggregates. Economists are interested in knowing the response of groups of shippers--say the chemical industry--to a general rate change. The German transport official, mentioned earlier, indicated that cross-elasticities of demand can be estimated by calculating the nonrate costs of physical distribution and supply systems suited to each mode of transport. This is certainly the tradition among academic transport economists on this side of the Atlantic. I should mention, however, that in no other branch of economics is demand measured from the costs of suppliers.

It is impossible to get accurate cost-based service differential measurements for transport aggregates due to the tremendous information requirements. Service differentials are properly calculated for individual commodities of individual receivers. For each good and each factory or warehouse, we would have to know at least the value of the good, the carrying costs, handling and clerical costs, the probability distribution of transit times and of usage. We could not try to find a "typical" shipping situation and then expand the results of that one calculation for the whole population. The shipping situations are likely to be too diverse. I tried to indicate by the list of goods at the beginning of this paper just how heterogeneous are the goods shipped; and variation in commodity characteristic is only one element of the variation in shipping situations.

It would be tempting to work with average values for the parameters of the physical distribution and supply problem. But remembering the mathematical theorem started before, the average value of the service differential will not be equal to the service differential calculated from average value per ton, average transit time and variance, average variance of use and so on. Only if the service differential is a linear function of those parameters will this be true; the numerical example shows that the problem is nowhere close to linear.

Service differentials for groups of shippers, if they are to be estimated on the basis of shipper costs, require information on each individual shipper. Furthermore, not only will parameter values differ from shipper to shipper, but the formulas will differ too. For example, some will use a system of reorder points, others regular ordering regardless of inventory on hand; some may be able to bypass intermediate warehousing (that almost necessitates the use of trucks) while still others may find this impractical. My point is that not only is the service differential sensitive to the exact parameters of the optimization problem, but the problem itself may be different, depending on the individual industry and firm.

The only reliable and practical approach to estimating service differential is one based on prices rather than costs. If truck rates are 4¢/ton-mile and rail rates 3¢/ton-mile and the shipper chooses truck transport, the service differential is more than 1¢/ton-mile. If he chooses rail, the service differential is less than 1¢/ton-mile. All other economists use prices rather than costs to estimate demand elasticities. I think it is time transport economists did too.

NOTES

1. This ignores clerical costs per order, that are included in Equation 2. Except in rare cases, these costs will be very much smaller than inventory carrying costs.

2. This is exactly true if day-to-day consumption is statistically independent. However, since maintaining a constant probability of outage becomes costly for long transit times, longer transit times would cause a shipper to choose a new expected outage percentage by balancing inventory costs and stock-out penalties.

3. The piece of work that comes closest to being a solution to the problem we are interested in is Kaplan 1970.

4. The example below is based on Morse 1958, pp. 153-56.

5. In this exercise, a maximum of four carloads or truckloads was considered; computing probabilities involved with a maximum inventory of more than four lot sizes would have required calculations involving numbers too large for the computer used.

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SOME ASPECTS OF REGULATORY REFORM OF THE U.S. TRUCKING INDUSTRY

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BACKGROUND

Many transportation analysts feel that the system of economic regulation of the trucking industry in the United States has failed to live up to its expectations and should be either discontinued or greatly modified. For example, Moore (1976) argues that one of the original objectives, the protection of the railroad system, has not been met. He claims the prices charged for trucking services are higher than they would be under no regulation and that the service provided to many areas is lower under regulation than it would be with a deregulated industry. Finally, he argues, the stability of the trucking industry after deregulation would not be a problem since, in other countries where a previously regulated trucking industry has been deregulated, there has been a short period of increased entry followed by a period of greater stability.

Others, for example Friedlaender (1971), Wilson (1969), and Sloss (1970) argue that the cost to the economy of regulation exceeds its benefits. That is, the inefficiency imposed on the trucking industry by restrictions on entry, rates, commodities, backhauls, and use of gateways causes higher costs and therefore, higher prices than would prevail under a more efficient, deregulated industry. In fact, Wilson concludes that this cost amounts to four billion dollars annually. Similar estimates have been made by the others.

Some have even argued that the basic problem is the Interstate Commerce Commission itself, and that its abolishment would serve to eliminate the problem (Hilton 1973).

The commission obviously finds itself on the side of continued regulation. It defends its position by noting that the original objectives of the Interstate Commerce Act were equity, stability and the nationwide provision of adequate transport service. It argues that certain conflicts are inevitable but that the regulated system is providing these services at a minimum of cost (U.S. ICC 1975).

Likewise, the American Trucking Associations (ATA) and other industry lobbying groups have argued that deregulation would produce a condition of chaos in the regular route common carrier industry and that many small towns and lightly population areas would be inadequately served in a deregulated environment. The argument is made that the rate competition that would ensue would lead to a lack of stability, inadequate profits to provide replacement equipment and eventually the destruction of the industry (Hoekenga 1972).

It is apparent that there is considerable disagreement over both the nature of the problem and what to do about it. There are, it seems, as many different points of view as there are actors in the system. Our concern in this paper is to understand the nature of the problem more clearly and to understand the impacts of one or more of the possible regulatory reform options.

DIMENSIONS OF REGULATION

It should be noted at the outset that several aspects of the trucking industry are actually regulated. These include entry, exit, routes, rates, ownership, financial transactions, and a variety of less important factors. Thus, when one talks of deregulation, it is important to describe the nature of the deregulation that is being proposed. For example, in Sweden, a country generally described as being only lightly regulated, the entry into the industry is rather strictly controlled. In Germany, that is reported to have a heavily regulated trucking industry, joint ownership of modes is allowed. Thus, a regulatory reform proposal that eliminated the entry requirements but still required common carrier firms to publish tariffs and to conform to the nature of the current restrictions on rates might be quite different from the outcome of a proposal in which entry was controlled but rates were not. Unfortunately, the charged political and emotional atmosphere surrounding regulatory reform leads immediately to a discussion of the extremes by the pro and con parties involved. That is, deregulation has been taken to mean "total elimination of control" while continued regulation has come to mean "no change from the status quo." Both positions are probably unrealistic in view of the various interests that have to be protected.

In addition to the dimensionality of the problem, there is also the influence that the present structure of the industry and its current dynamics will impose upon any change. The industry structure will, of course, not change overnight even if the regulatory system does change. Unionized labor, large consolidation terminals and specialized equipment, for example, will not be abandoned just because of a shift in the laws governing regulation. Some aspects of the present industry structure and its current changes are the direct result of the economics of its various elements. To the degree that the economics of the industry are changed by regulation, these elements will, over time, begin to shift. Likewise, as the economics and the structure change, there will be a corresponding shift in the pattern of demand for the various services offered by the industry. Thus, there is a set of dynamics that go along with any change in regulatory structure. These dynamics have to be considered along with the regulatory shift itself.

What I am suggesting, is a careful examination of each proposed pattern of regulatory reform, both in terms of the shifts implied by the economics and in the time scale of these dynamics. This is not a simple thing to do. But the stakes to the U.S. economy are enormous. If we are to understand in detail what regulatory reform means, then more comprehensive studies will have to be undertaken than have been done to-date.

I cannot undertake such a dynamic analysis here. I can, however, describe what some of the features of the system are and the shifts that are currently in progress. I can algo give my impressions of what the outcome of one possible pattern of deregulation might be and sketch out an analysis whereby the quantitative impacts could eventually be determined. That is the objective of the work described here.

CURRENT STRUCTURE OF THE TRUCKING INDUSTRY

The existing transportation regulatory system in the United States has led to a structure of the trucking industry that has six basic segments, each distinguished by the type of operating authority (or lack of it) by which they operate. They are:

- regular route common carriers of general freight
- irregular route special commodity carriers
- contract carriers
- intrastate and local carriers
- exempt agricultural haulers
- private carriers

In addition, there are uncertified goods haulers (owner operators) that can operate in one or more of the categories above. These independents typically own and operate their own vehicle and lease themselves with their vehicle when they carry regulated commodities. Each of the above categories is characterized by a particular mode of operations and/or restrictions. See Figure 1, that summarizes the principle characteristics of each segment and illustrates by means of a diagrammatic sketch the nature of its typical operating authority.

Although each segment is well understood by the industry itself and by the ICC, the characteristic differences between them is not completely appreciated by "outsiders," even those analysts working on various aspects of regulatory reform. Also, there is a dirth of comprehensive statistics that allow the relative sizes of the segments to be compared. The figures in parentheses in Figure 1 are my estimates of the percent of total ton-miles in each segment of the industry. Note that owner operators have been included as a category although they always work in one or more of the other segments. The nature of the functioning of each of the segments is described below.

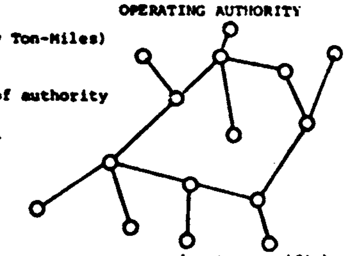
FIGURE 1. CHARACTERISTICS OF THE INDIVIDUAL SEGMENTS MAKING UP THE U.S. TRUCKING INDUSTRY

FOR HIRE CARRIERS — REGULATED CARRIERS — ICC REGULATED CARRIERS

CHARACTERISTICS	TYPICAL MAP OF OPERATING AUTHORITY

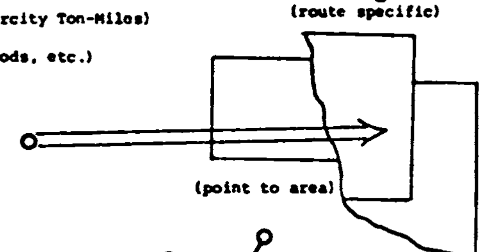
Regular Route Common Carriers of General Freight (20% of Intercity Ton-Miles)

- General Commodities
- Points served and routes travelled specified in detailed map of authority
- Regular Service an obligation
- Consolidation terminals and pickup and delivery fleets typical
- Heavily unionized in both drivers and dock workers
- Typically a party to the teamster Master Freight Agreement
- Large Portion of revenue from LTL shipments
- Not much use of owner operators


(route specific)

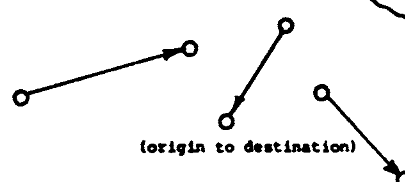
Irregular Route Special Commodity Carriers (22% of Intercity Ton-Miles)

- Special Commodities (petroleum autos, household goods, etc.)
- Point to area definition of authority
- Irregular service on demand
- No consolidation terminals
- Full truckload operations
- Non-unionized work force
- Heavy use of owner operators


(point to area)

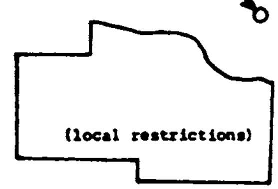
Contract Carriers (6% of Intercity Ton-Miles)

- Specialized service
- Limit on number contracts (8-12)
- Dedicated equipment
- Long-term of commitment
- Some use of owner operators


(origin to destination)

Intrastate and Local Carriers (10% of Intercity Ton-Miles)

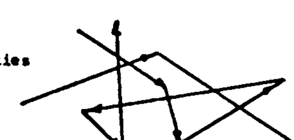
- Regulated by state or local P.U.C.
- Limited area of service
- Local cartage operations typical
- Highly diverse operations
- Frequently specialized (sand and gravel, concrete, etc.)


(local restrictions)

UNREGULATED CARRIERS

Exempt Agricultural Haulers (11% of Intercity Ton-Miles)

- Limited to special products
- Agricultural cooperatives can haul some regulated commodities
- Anyone can provide service
- Anywhere in U.S.
- Typically full truckload
- Owner operators typical


(anywhere)

Owner Operators (Involved in more than 20% of Intercity Ton-Miles in Other Categories)

(none)

- Own their own vehicle (or lease it)
- Can always work as agricultural exempt hauler
- Frequently lease themselves and vehicle to Irregular Route Carrier or Contract Carrier
- Illegal to lease to private carrier
- Independent entrepreneur, typically 75/25 percent revenue split
- Typically high equipment utilization and low costs

OWN ACCOUNT

Private Carriers (31% of Total Ton-Miles)

(own account)

- Own or lease vehicles (Illegal to lease vehicles with drivers)
- Can haul only products they own
- Cannot haul for other corporate subsidiaries
- Both union and non-union labor typical
- Tremendous diversity in manner of operation
- May lease equipment to regulated carriers

Regular Route Common Carriers of General Freight

This portion of the industry is what is normally thought of as the regulated trucking industry. The authority granted for their operations by the ICC specifics both the points of possible origin and destination of freight and the particular routes between cities over which they may travel. These firms normally use large urban consolidation terminals and pickup and delivery fleets to accumulate freight for movement over their scheduled line-haul, intercity truck routes. These firms employ unionized drivers and dock workers with labor rates and working conditions set by a master union contract negotiated periodically with trucking industry management representatives. Although many of these firms carry full truckload shipments, the bulk of their revenue typically comes from less than truckload lot shipments. As a result, they are frequently referred to as the LTL trucking segment.

Irregular Route Special Commodity Carriers

This segment of the industry consists of those carriers authorized by the ICC to handle specific commodities requiring specialized equipment, such as petroleum products, liquid chemicals, refrigerated commodities, automobiles, and household goods. The nature of the irregular route operating authority granted to these carriers is quite different from the authority typically held by the regular route carriers. Basically, it specifies the specific commodity to be carried from a single point of origin (typically a plant, group of plants, county or small urban area) to all points in a state, group of states or region. In order to operate economically, a carrier must typically obtain a number of operating authorities for use simultaneously.

This segment of the trucking industry also tends to make heavy use of owner operators. Approximately 42 percent of the total ton-miles of the special commodity carriers are performed by owner operators. A significant number of the firms in what is normally classified as the regular route portion of the industry also hold some irregular route operating authority. Because of the incompatibility of operating full truckload irregular route authority using owner operators in conjunction with the LTL, unionized operations, many of these carriers have formed what they refer to as a "special commodity division" for handling full truckload traffic moving under this type of authority.

Growth in the irregular route, special commodities portion of the industry has been extremely high, averaging eight percent per year over the past few years. This is in contrast to two percent per year for the regular route carriers (Tye et al. 1977). In fact, in terms of ton-miles, the irregular route, special commodity carriers are now the largest segment in the regulated portion of the industry. See Figure 1.

The special commodities haulers are grouped by the ICC into 16 different categories according to the commodity hauled and a catch-all category labeled, "A-17, Special Commodities Not Subgrouped." This subgroup has grown the most. In a series of reports for the Association of American Railroads, Taff and Rodriguez (1975, 1976a, 1976b) have traced the rapid growth of the special commodity haulers and contract carriers. Their investigations showed that revenues of the 10 top firms grew by an average of 213 percent from 1970 to 1974. The fastest growing were the carriers in the A-17 category.

Contract Carriers

This segment of the industry offers a very specialized transportation service to a relatively small number of firms who sign long-term contracts for services at a price agreed upon ahead of time. In the past, the ICC has limited the total number of contracts that can be held by a single carrier to eight. The grant of authority is approved by the ICC hearing process and it has normally been necessary for the applicant to demonstrate that both specialized and dedicated equipment are required.

Contract carriers frequently use owner operators to perform the services required under their contract. In many ways, there is little else to distinguish them from a firm's own private equipment fleet. In fact, there have been some cases in which the private truck fleet of a firm has broken itself away from the firm, applied for and been granted contract operating authority and then signed a long-term transportation services contract with the parent firm. Ostensibly, the purpose of such a maneuver is to allow the fleet to carry "for hire" the regulated goods of other firms that would be illegal as a private fleet. This would of course improve the fleet's average load factor and overall economic performance.

Intrastate and Local Carriers

Each state has the right to license and regulate the carriers that operate in intrastate carriage. Most states do this through their State Public Utility Commission. The PUC normally handles other transport licensing and regulatory matters as well, such as truck size-weight restrictions. For large states, such as California and Texas, many intercity carriers are affected since there is a fairly active intrastate trade to be serviced. California is well known for the permissive entry requirements in its intrastate truck fleet. For the smaller eastern states, a larger proportion of the intercity markets are interstate. This means that to be useful, operating authority must be obtained from the ICC. The result is that the intrastate and local carriers are primarily those involved in intracity trade such as concrete trucks, sand and gravel haulers, milk trucks, urban pickup and delivery services, etc.

Exempt Agricultural Haulers

The 1935 revisions to the Interstate Commerce Act specifically exempted the carriage of unprocessed agricultural goods by truck, though they are still regulated when carried by rail. This includes frozen fish, chickens and other "slightly" processed agricultural products. These exempt goods may be hauled by any carrier regulated or unregulated. They become the principle product hauled by many owner operators working primarily as exempt agricultural haulers and a good source for filling empty backhaul for both private fleets and some special commodity carriers. Regular route common carriers do not ordinarily rely on agricultural hauls for filling backhaul since they are typically rendered in full truckload lots and since they cannot be mixed with regulated commodities except by haulers working for an agricultural cooperative.

The fresh fruit and vegetable markets in the United States are a key factor in this segment of the industry. During the summer, produce markets exist in most of the major urbanized regions. Local and long distance hauls to meet the market demands are handled by both farm trucks and by other carriers. In the winter the growing regions are centered in southern Florida, the Texas Valley and southern California. Winter produce markets in Pompano Beach, Florida and Nogales, Arizona become focal points for buying and selling winter produce (Roberts 1974). Sales are made in truckload and carload quantities. For shipment by truck, the buyer contacts a truck broker. The truck broker solicits independent haulers to transport the product to the city of destination using a rate freely negotiated between the broker and the independent trucker. The freight charges will depend only upon the supply of the trucks and the demand for transport.

The geographical dispersion between the population concentrations in the North and East of the United States and the agricultural production of the midwest and south and, in particular, California make the haulage of exempt agricultural products an important portion of the total ton-miles of truck transport in the country. As it currently stands, the market is already totally unregulated.

Owner Operators

Over the past few years, the independent owner operator has moved from a position of relative obscurity to somewhat of a folk hero. Because there are no statistics on these unregulated operators, no one knows exactly how many owner operators there are or exactly where they work. It is clear, however, that many function as agricultural exempt haulers or lease themselves with their equipment to regulated carriers. Some also work for contract carriers and it must be assumed that still others work for, or as, intrastate and local carriers. There must also be instances where owner operators work for private carriers through this is strictly illegal.

Owner operators are reported to have extremely low operating costs because of their high equipment utilization and reputedly low wage rates (Wyckoff and Maister 1975). Some independents will drive as many as 200,000 miles per year. The results are costs that are clearly lower than common carrier trucking and even competitive with railroads. See Figure 2. The low wage rates are sometimes accounted for by the fact that even though some independents are teamster members, there is no union representation between the independent and the entity for whom he provides transport services (either the truck broker or the regulated carrier).

With costs low enough to compete with some rail rates, it was inevitable that the competition between rail and truck would develop since the service times for truck are inherently better except in very special situations. The mechanism for this competition between rail and truck has been the special commodity carrier. By filing for a special commodity permit to haul regulated commodities, the carrier can develop the market for a group of independents that lease to the carrier. The revenues are then split 75 percent to the owner operator and 25 percent to the carrier. The areas of highest growth cited previously are in those areas where unspecialized or only slightly specialized equipment are involved (i.e. refrigerated, flat bed, or cloth top trailers).

The owner operator has also begun to exert some competitive pressure on the regular route common carrier as well. The establishment of the special commodity division within some regular route carriers is one sign of this pressure. Since special commodity rates are likely to be lower than general commodity rates (even in truckload lots), there must be some loss of traffic to irregular route carriers, especially during recessionary times. Some indication of this competitive pressure should be evident in the extent to which union locals have negotiated local wage contracts that are lower than the national motor freight agreement.

Private Carriers

The final segment is the private carrier. Private carriers are, of course, the residual. Many firms maintain a fleet of trucks to haul their own commodities. These trucks may haul either inputs or outputs, in fact, anything to which the company holds title, but may haul nothing for anyone else for hire. The private fleet may be big or small, may operate with consolidation terminals, but more frequently without them, and may have either unionized or non-unionized employees. They may not hire owner operators, however.

The use of private fleets is widespread and growing. The regulated carriers have tended to view their continued growth as a threat and the ICC has ruled in such a manner as not to favor them. However, they continue to exist wherever firms need special transportation services that are either not offered or where the firm feels that it can perform the services at a lower cost. A typical strategy is to

FIGURE 2. COMPARATIVE COSTS PER TON-MILE

Owner Operators (1973)	Class I and II ICC Regulated Carriers of General Freight (1971)	Class I Railroads (1973)
1.93-3.02	7.60	1.74

SOURCE: Wyckoff and Maister, 1975.

haul the higher rated commodities and the regular hauls, but to leave the lower-rated commodities and the overflow for the regulated carrier.

THE IMPACT OF GROWTH IN THESE SEGMENTS ON OVERALL INDUSTRY STRUCTURE

The size of the various components of the regulated portion of the trucking industry as reported by Trinc's for 1975 (Trinc Transportation Consultants 1976), is shown in Figure 3. Until recently, very little attention has been drawn to the use of owner operators but this figure is reported in Trinc's under "vehicle miles using leased vehicle with driver." This is presented in the table in parenthesis under vehicle miles. The surprising thing is the large proportion of the total that this segment represents.

Using Trinc's figures for 1965, 1970 and 1975, the overall growth of the special commodities carriers can be placed into perspective with regular route trucking. Since 1965, intercity ton-miles for regular route carriers have grown by only 19 percent while irregular route carriers using non-specialized equipment have increased by 213 percent. Specific commodity carriers as a whole have increased by 183 percent.

This information is presented in graphical form in Figure 4. Here the rate at which each of the categories is overtaking the regular route industry become apparent. As previously mentioned, the growth of irregular route carriers using non-specialized equipment is growing at an average annual rate of about eight percent while regular route trucking is growing at an annual rate of slightly less than two percent. Note also that total ton-miles for specific commodity carriers exceeds that for regular route carriers. However, it should be noted that this figure compares only the large Class I and II carriers and does not include the 12,000 or so smaller Class III carriers.

THE GRANTING OF ROUTE AUTHORITY AS THE MECHANISM OF CHANGE

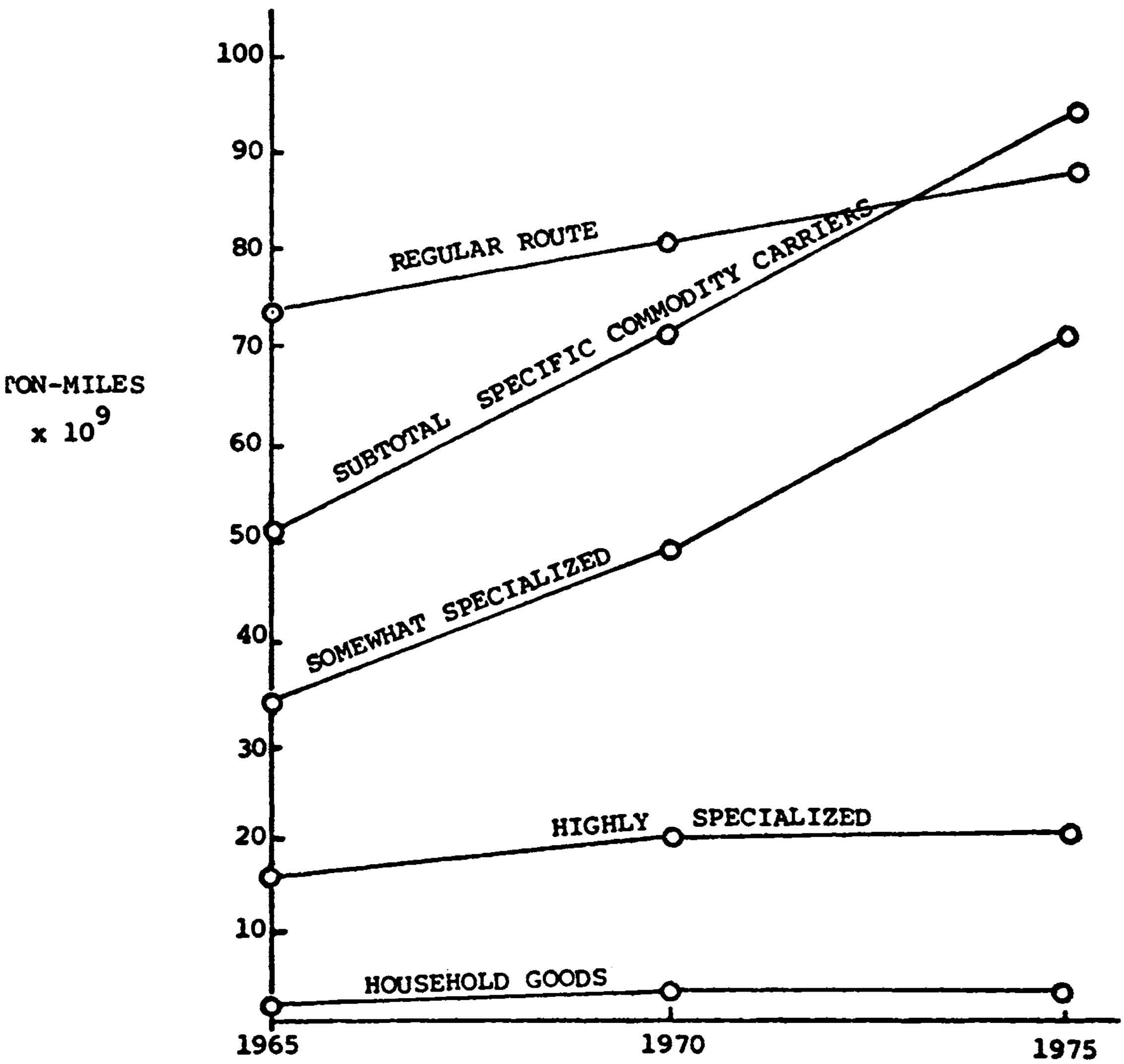
The mechanism by which this dramatic change is coming to the trucking industry must be of interest. In 1974, some 4762 applications for route authority were filed with the ICC. Of this total, approximately 82 percent of the applications were requesting irregular route authority, and 82 percent of these were finally granted. The preponderance of grants in the irregular route area is perhaps explainable in terms of the nature of the ICC proceedings themselves. Since the hearings require that an applicant prove "convenience and necessity" before new authority will be granted and since this is not easily done in the face of many protestants without help from shippers and other supporters, the proceedings tend to be self-selecting. That is, for irregular route special commodity authority where applications are easy to get, many are granted. For regular route authority, where opposition to the granting of new authority by carriers already serving the market is severe, the easy way to acquire authority is to buy from, or merge with someone who already holds it.

FIGURE 3. OPERATING CHARACTERISTICS OF THE ICC REGULATED MOTOR CARRIER

	Regular Route Common Carriers of General Freight	Specific Commodity Carriers Requiring Highly Specialized Equipment		Specific Commodity Carriers Using Somewhat Specialized or Non-Specialized Equipment					Sub-total Specific Commodity Carriers	Total U.S. ICC Regulated Carriers
		Petroleum Products Carriers	Automobile Carriers	Refrigerated Products Carriers	Agricultural Products Carriers	Building Materials Carriers	Other Special Commodities	Household Goods Carriers*		
	1	2	3	4	5	6	7	8	9	10
Firms	971	178	44	128	105	122	925	161	1663	2634
Total Freight Revenues $ x 10^6	11986	987	661	909	256	383	3510	838*	7544	19530
% of Freight Revenues**	61.4	5.1	3.4	4.7	1.3	2	18	4.3	38.6	100
Vehicle Miles x 10^6	6810 (658)+	1103 (252)	632 (19)	1202 (740)	368 (112)	518 (216)	3727 (1492)	682 (620)	8232 (3451)	15042 (4109)
% of Vehicle Miles	45.3	7.3	4.2	8	2.4	3.4	24.8	4.5	54.6	100
Ton Miles x 10^6	86079	15237	4228	17695	4502	7283	39916	2657	91518	177597
% of Ton Miles	48.5	8.6	2.4	10	2.5	4.1	22.5	1.5	51.5	100

Source: Trinc Transportation Consultants 1976, pp. 5-3,5-4, 5-5, 5-7.
*Intercity; **from Column 10; + numbers in parentheses indicate vehicles rented with driver.

FIGURE 4. TON-MILES FOR THE VARIOUS SUBGROUPS OF ICC REGULATED CLASS I & II CARRIERS



Source: Charles River Associates and Cambridge Systematics 1977.

If this explanation is correct, irregular route authority is easy to get precisely because it is so restricted. The service provided is for a single shipper or at most a narrow group of industries and gives the shipper low, truckload rates for very specialized transportation services.

THE IMPLICATIONS OF THESE CHANGES ON THE FUTURE OF THE INDUSTRY

The implications must now be clear. The intercity trucking industry is changing rapidly and dramatically. The regular route common carrier of predominately less than truckload freight with urban pick and delivery operations, consolidation terminals and unionized labor is being outpaced in its growth by full truckload, irregular route, specialized commodity carriers using owner operators. This growing proportion of the industry does not use terminals or perform consolidation functions but needs help only to make the arrangements. The operation is virtually all "line-haul" and is extremely low cost. Because of the relatively large shipment size requirements, these carriers are very competitive with rail carload and piggyback traffic. The magnitude of the impact on future rail traffic can only be guessed but diversion appears inevitable.

The implications for future intercity transportation generally and for regulation in particular are interesting to speculate on. Transport revenues per ton-mile in this segment will obviously be lower than for regular route general commodity carriers. The danger to the rail industry is apparent. The deteriorated nature of the nation's railway and roadbed and equipment heightens the threat of low cost trucking. The highway maintenance cost issues of carrying this traffic have not yet been addressed.

Still another implication of the observed change is a slow shift away from unionization in the trucking industry. In the labor-management environment that is emerging, unions will have less power. As the growth continues, and there don't seem to be natural barriers to the continued growth of the specialized carriers short of saturation of the freight market, the regular route LTL carriers will be forced to raise their rates on LTL shipments, thereby further reducing the size of this market. The regular route carriers could find themselves in something of a profit squeeze.

In one sense, the industry is becoming less regulated and more competitive since as the irregular route special commodity carrier grows, this portion of the industry that is only "lightly" regulated tends to become a larger share of the total. The rates are published, not fluctuating like those in the exempt markets, but clearly competitive and easily adjusted up and down as conditions change.

The implications for the small shipper, however, are less rosy. Generally speaking, the only freight service available to the small shipper is offered by the LTL regular route carrier. The special commodity carrier, the railroad and private carriage are only available to the large shipper. Likewise, barge and pipeline are exclusive to large shippers.

POSSIBLE IMPACTS OF ONE PATTERN OF DEREGULATION

Let us turn now to examine the impacts of changes in the regulatory pattern on the structure of the industry. As we have indicated previously, the structural changes that will occur in the U.S. trucking industry are a function of both the pattern of regulatory changes that are made and its interaction with the existing structure of the trucking industry. Since there are any number of possible patterns of changes in regulation that might actually be followed, the investigation of all alternatives would be quite large. However, if we were to assume only one such pattern, a qualitative picture of the results might be sketched out.

The pattern that I shall describe is one that might be referred to as complete deregulation. Both entry controls and restrictions on rates would be dropped. There would be no restrictions on routes, on the publishing of tariffs and ownership or financial management. Only the safety regulations would be maintained. It is assumed, however, that the railroads would remain regulated and that ownership of trucklines by railroads is still constrained as it is today.

Note that this is only one possible pattern of deregulation. A variety of others are possible. It is also thoroughly unlikely that a pattern of such complete deregulation would be followed through, since it is rather extreme. Also, the timing of the proposed changes is important. It is assumed here that the deregulation is instant, rather than being phased in over some longer time frame. There will, of course, be a time period required for the full impact of the change to be assimilated and the industry structure to change in response. Although this time frame cannot be traced out in detail here, it will be briefly mentioned.

It is my expectation that over the long run (three to five years), the industry will consolidate into four basic segments. These are:

- less than truckload consolidators
- specialized carriers
- truckload brokers
- private and contract carriers

Each of the seven existing segments of the industry will be combined and amalgamated into one of these four classes or disappear altogether. We will briefly cover the characteristics of each of these segments of the deregulated industry.

Less Than Truckload Consolidators

There is a basic need for shipping commodities in less than truckload lots. This need cannot be met economically by carriers working in single truck, direct-haul firms. That is, the operations must be broken down into pickup and delivery, terminal consolidation operations and intercity line-haul operations. Even in those foreign countries that are completely deregulated (such as Great Britain and

Australia), the less than truckload portion of the industry is handled in this same way. It may, however, use cooperatives and individual owner operators for the collection and distribution process. In the United States, the existence of the regular route general commodity carriers, suggests that the basic industry form that exists today will continue.

Specialized Carriers

There will still continue to be specialized carriers. The distributive nature of some commodities such as refined petroleum products, bulk fluid milk, chemicals, etc. requires that specialized equipment be used. Those carriers who are currently equipped and have the knowledge required to participate in these markets can be expected to continue to do so. Entry into these areas would be discouraged by both the capital requirements and the specialized knowledge and market advantage that these firms already hold.

My expectation is that this category of carriers will be made up primarily of the irregular route special commodity carriers that use very specialized equipment. That is, tank haulers, auto carriers, etc. The more generalized equipment such as flat bed trucks used for hauling steel and building materials and refrigerated equipment will become too generalized to continue to exist in this specialized market. I might add, however, that I feel that the "edges" of such a specialized market will always be rather fuzzy and the distinction between the various types of carriers as I have defined them here will be somewhat arbitrary.

Truckload Brokers

Without the protection of both entry and rates afforded by regulation, it may become difficult for irregular route special commodity carriers to continue to exist. In fact, there is some evidence to indicate that in California, where trucking entry and rates are relatively unregulated, that the special commodity division of regular route trucking companies have tended to have an on-again, off-again character, depending upon the state of the economy. During periods of economic prosperity, these firms seem to be able to exist, while during periods of economic decline, these special commodities divisions are frequently dropped.

Most of the big, irregular route special commodity carriers using owner operators are located in the midwest or south. There are none in Texas because of the intrastate regulations that exist in that state.

If there are no more irregular route special commodity carriers to develop and hold the markets for truckload traffic by independent operators, one could expect that a brokerage type market will spring up to offer the needed marketing services. Such a truck brokering service would work very similar to the way in which fresh fruit and vegetable markets are currently handled. Truck brokers in each area would be contacted by both people with loads to send and truckers in need of a load to haul. A freely negotiated market price would be quickly determined and the product delivered and the trucker paid when he delivers the product at the other end. This industry structure has worked quite well in the fresh fruit and vegetable hauling business. There seems to be no reason why it would not work with regulated products as well. The agricultural exempt truck broker is typically paid a percentage of the total transport charges in almost exactly the same manner as the irregular route special commodity carrier is currently paid.

Private and Contract Carriage

Once the regulatory restrictions are removed, there will be virtually no difference between private and contract carriage. The only distinction will be whether a firm uses its own personnel and equipment or whether it leases from a carrier offering "for-hire" services. There will undoubtedly be a full range of possible financial arrangements between persons offering equipment and service for hire, and the use of the firm's own personnel and equipment. Some of these firms will undoubtedly offer consolidation services as well as truckload haulage. In fact, the distinction between the LTL consolidator and this category of private and contract carriage may be hard to define.

THE SUPPORTING LOGIC

The industry structure that will eventually emerge after deregulation is dependent upon a number of things as previously described, principally the current industry structure and the size and strength of the various parts, the nature of the regulatory reform legislation as to both content and timing and the relative economics of the various industry segments and firm sizes. The question of what will happen when an industry is deregulated is, of course, a classic question addressed by the economic literature. A fundamental concern is whether the industry will begin to concentrate itself into a single monopolistic supplier, a set of very large oligopolistic firms, or an atomistic and highly competitive freely functioning market. The question of whether there will be concentration in the industry is addressed theoretically by examining the Long-Run-Average-Cost (LRAC) curve of the firms in a market. If the LRAC curve is downward sloping throughout, the larger firms will have lower costs, and since prices will be deregulated will be in a position to exercise their market advantages. Likewise, if there are no increasing returns to scale, the ubiquitous entry of small firms should prevent a large firm from leveraging its larger economic base in many markets to destructively price below cost against smaller competitors. The available literature on economies of scale in the trucking industry should be useful in assessing incipient changes in the various segments of the industry. It will be necessary to examine the segments separately, however, since there may be nonregulatory barriers to entry, labor constraints and other market imperfections to be dealt with for some segments.

Regular Route Common Carriers of General Freight

What happens when this segment of the industry is deregulated is fundamentally important to the entire trucking sector, though it is only a part of the whole. With deregulation, the existing firms would no longer be confined to their routes. They could open new terminals in new places. They could price differentially for expedited service or for deferred service and they could now compete on the basis of price rather than primarily service. The more efficient firms should have an economic advantage. They would, however, still be unionized. They would still have their consolidation terminals and urban pickup and delivery fleets. They would still provide the LTL service that cannot be provided by the truckload brokers. Pricing for LTL services would, on the other hand, probably be adjusted to more nearly reflect its true costs. Pickup and delivery services might, for example, be priced differentially. The LTL segment of the industry would undoubtedly be very competitive and a "dog-eat-dog" condition could develop quickly.

Although it would not be difficult to enter the market in the LTL segment of the industry at the small end, it might be difficult to compete effectively without consolidation terminals and pickup and delivery fleets. Service from part of one large urban area to part of another provided by a fly-by-night operator would have little appeal to the shipper. Likewise, for the carrier, confining the LTL pickups to a small destination area would penalize him economically, since for the same fixed costs of making the call he could have picked up considerably more freight if he had offered service to many areas. The carrier would probably seek larger and larger loads and would therefore drift to the truckload segment of the industry.

To enter at a larger scale would be even more difficult. There would be significant nonregulatory barriers to entry including:

- large capital requirements for terminals, equipment and working capital
- large labor force
- complex operations
- closely tied markets

The capital for terminals and equipment might be obtained fairly easily since chattel mortgages would be available but working capital would be difficult. The large labor force would have to be hired, put into place and taught how to deal with the complex operations of the trucking industry while marketing of freight was begun. Computer control systems, terminal operating procedures, maintenance policies and dispatching would all have to be evolved in a short time. The prospect of break-even operations would appear remote to most investors. It would be infinitely wiser to take an existing organization (a financially distressed carrier, or a proprietary fleet) and attempt to perform the financial and management surgery required to produce a viable operation. I therefore conclude that there would be almost no entry at the multi-terminal scale.

The competitive environment then, would appear to consist primarily of the current regular route LTL carriers plus some large proprietary fleets. Which carriers would have the competitive advantage? Would it be the large, long-haul carriers, the regional carriers, or the small carriers? The answer to this question is sought in the literature that has been developed on economies of scale in the trucking industry.

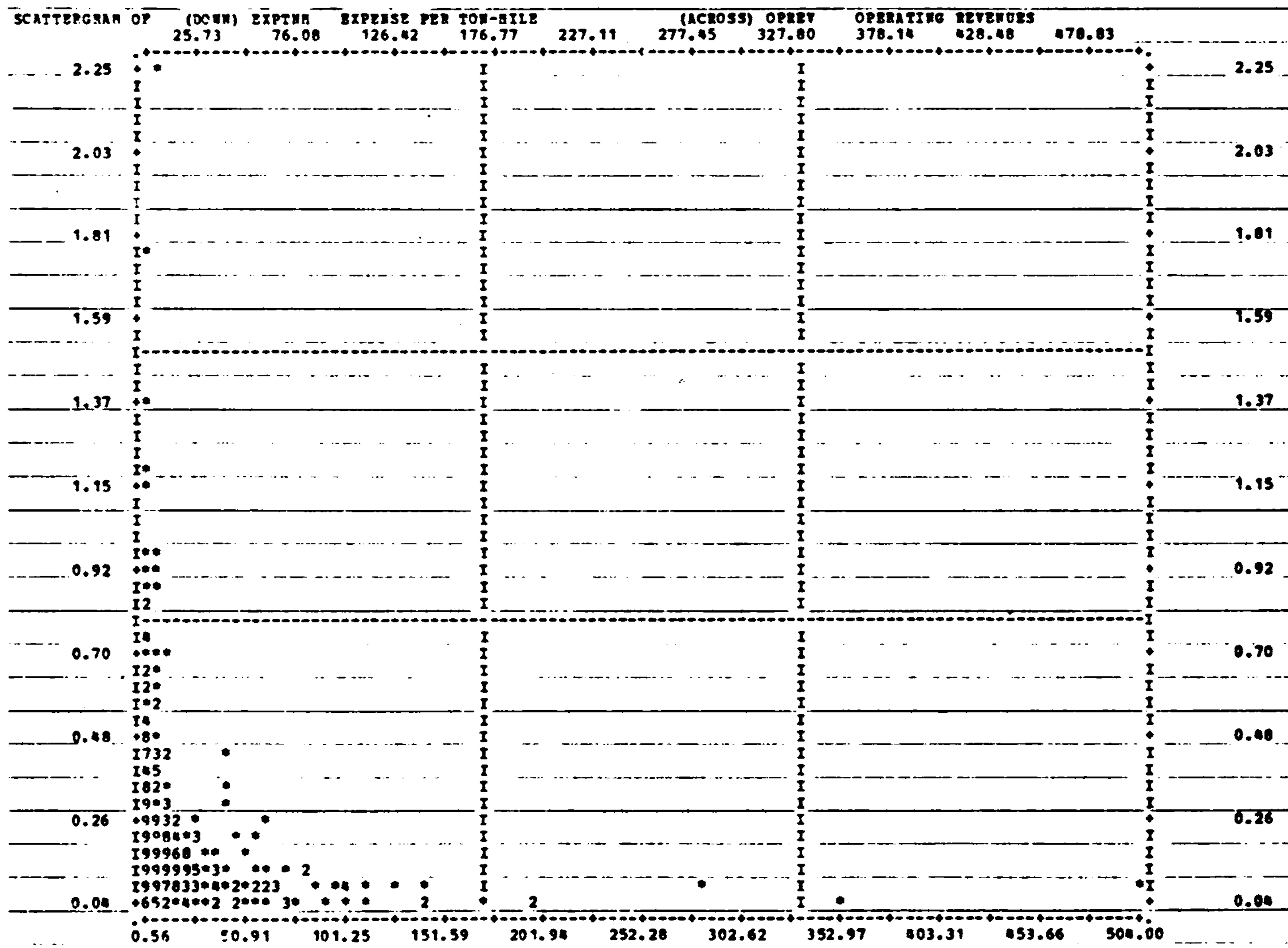
The question of economies of scale in the regular route trucking industry has been investigated by a number of researchers. Kneafsey has summarized this research and concludes that the results are still mixed though "More recent studies in the motor trucking industry. . . have suggested the possibility of increasing returns to scale" (Kneafsey 1975). The mixed results continue to come in. Lawrence, in a recent paper to the Transportation Research Forum claims increasing returns to scale for all sizes of firms once the appropriate adjustments for service have been made (Lawrence 1976). He points out some of the pitfalls that have hampered previous researchers. Spady and Friedlaender are currently involved in work on a sample of carriers taken from the central, mid-atlantic and New England trucking regions using hedonic cost functions that purports to show that there are not substantial economies of scale and there may even be diseconomies of scale (Spady and Friedlaender 1976).

The mixed results can be partly explained by the perverse nature of the data. One observes small firms operating at all expense levels. Medium sized firms have less variability and a somewhat lower average cost level. Large firms appear to have even lower average costs but still less scatter. The nature of these relationships between size (as measured by revenues) and expenses per ton-mile are shown in a scattergram of 450 firms in the general freight category taken from Trinc's. See Figure 5. The carriers are from all regions and are all General Freight Carriers taken from the 971 Class I and II carriers reporting to the ICC in 1974. Part of the problems that some researchers have had is undoubtedly attributable to the difficulty of fitting various mathematical forms to this pattern of observations.

It is clear from working with this data and from examining the work of others that there are several characteristics of commodity transport by truck that have an important impact on operating costs. These include: 1) length of haul, 2) size of shipment and 3) commodity density. Pricing structures for most products already reflect these differences. In fact, full truckload sized shipments generally carry significantly lower transport charges to reflect the lower costs incurred when a shipment does not have to be handled through the consolidation terminal. These variables are typically included as independent variables in econometric estimates of the cost function to account for variations in costs due to these factors. Other factors being equal, it is more cost efficient for a firm to have longer haul lengths, larger shipment sizes and a higher percentage of truckload traffic.

These variables are not directly controllable by management, however. There is no way to directly control a firms' average length of haul or shipment size. If, for example, a carrier decides to participate in the Chicago to Houston market, the length of haul is fixed, not a choice variable to be decided by management. Management

FIGURE 5. EXPENSE PER TON-MILE vs. OPERATING REVENUES



can indirectly influence these variables by controlling size. Moreover, size can be controlled more or less directly through number and location of terminals. Of course, authority to serve these areas must be obtained through acquisition or merger. The relation between size (as measured by revenues) and number of terminals is striking. A scattergram showing this relationship has also been prepared using the data from Trinc's. See Figure 6.

This same data set can be used to examine the relation between size as measured by the number of terminals and the other variables mentioned above. The most important is length of haul. See Figure 7. Note that as the number of terminals goes up, so does the length of haul. Likewise, the percent of all shipments that are truckload seems to be positively related to number of terminals. See Figure 8. Average density is not available in the Trinc's data but average load per vehicle can be observed. See Figure 9. Note that the trucks of the larger carriers have consistently larger loads. It is difficult to tell whether average size of shipment rises or fall with number of terminals. See Figure 10. It probably does not matter much since most rates are tapered to reflect the decrease in costs for larger shipment sizes. There is some evidence that for shipments traveling the same distance, firms with more terminals receive larger shipments (Wyckoff 1974a, p. 52).

Thus, there appears to be a direct correlation between average length of haul, shipment size, percent truckload and size as measured by number of terminals. In fact, the collinearity between them may also explain why there has been some difficulty in obtaining good mathematical relationships econometrically. For management, however, there would appear to be no ambiguity. The message is clear that "big is beautiful." Both return on investment and profits per ton increase with size. See Figures 11 and 12.

This may help to explain why trucking has since World War II pursued mergers and acquisitions so fervently. In recent years, there have been hundreds of mergers per year. An aggressive policy of growth by merger or acquisition has been the stated objective of all of the currently large firms. Likewise, concentration of the industry has been observed in both Great Britain and Australia upon deregulation (Wyckoff 1974).

The regulation of the system currently affects the competitive environment influencing operations. Since for regulated commodities the price for moving goods is the same for all carriers hauling a shipment of the same commodity and size between the same points, the competition between carriers is on the basis of service not price. This suggests that more efficient carriers may be using their competitive edge to offer better service. There are, therefore, some risks in using observations drawn from the currently regulated environment to predict how the industry might act in the future in a deregulated environment. One must be acutely aware of the way in which regulation distorts the current system. If these price-service distortions are to be accounted for properly, then only markets offering comparable levels of service can be tested for returns to scale.

FIGURE 6. NUMBER OF TERMINALS vs. OPERATING REVENUES

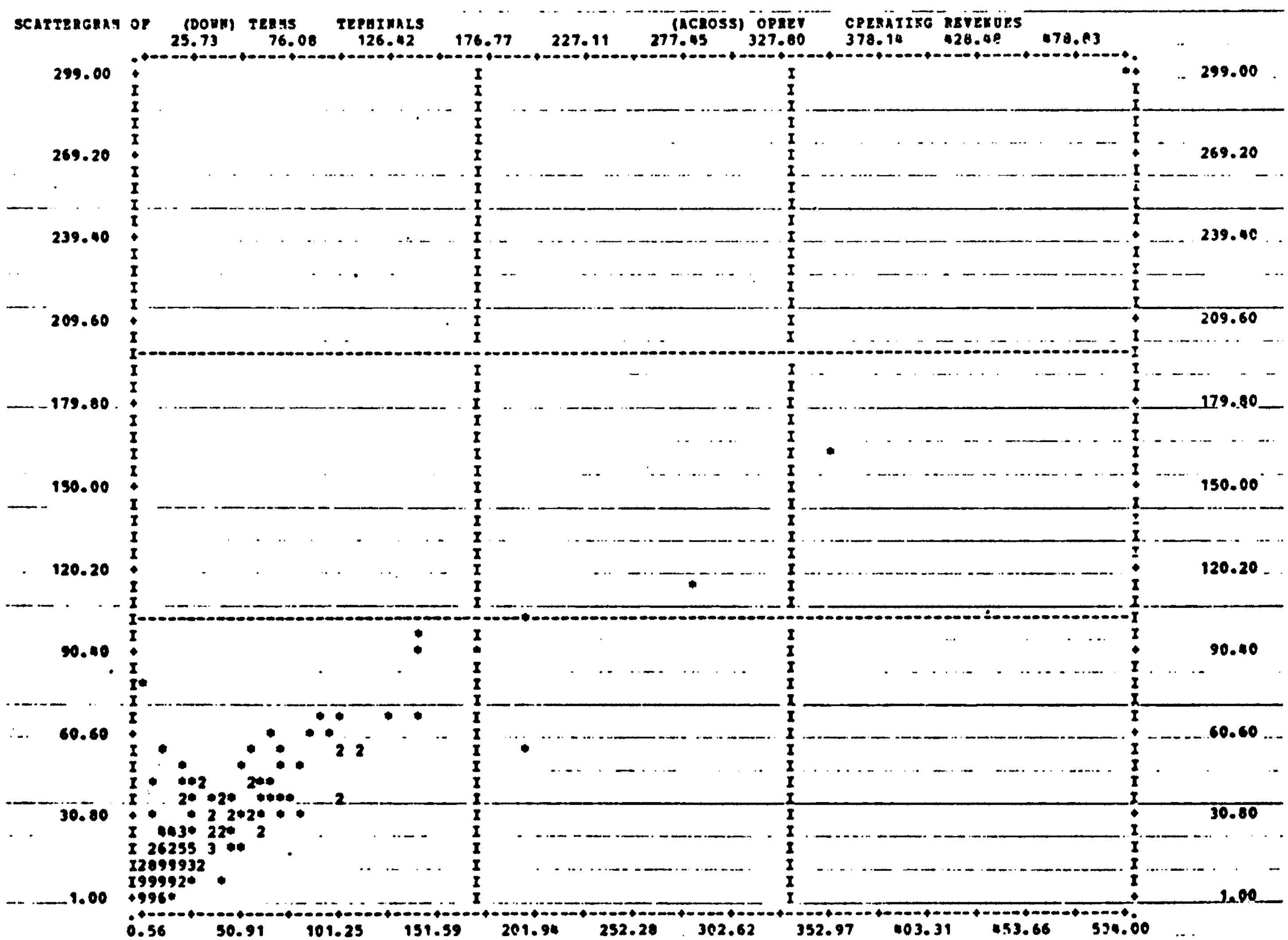


FIGURE 7. AVERAGE LENGTH OF HAUL vs. NUMBER OF TERMINALS

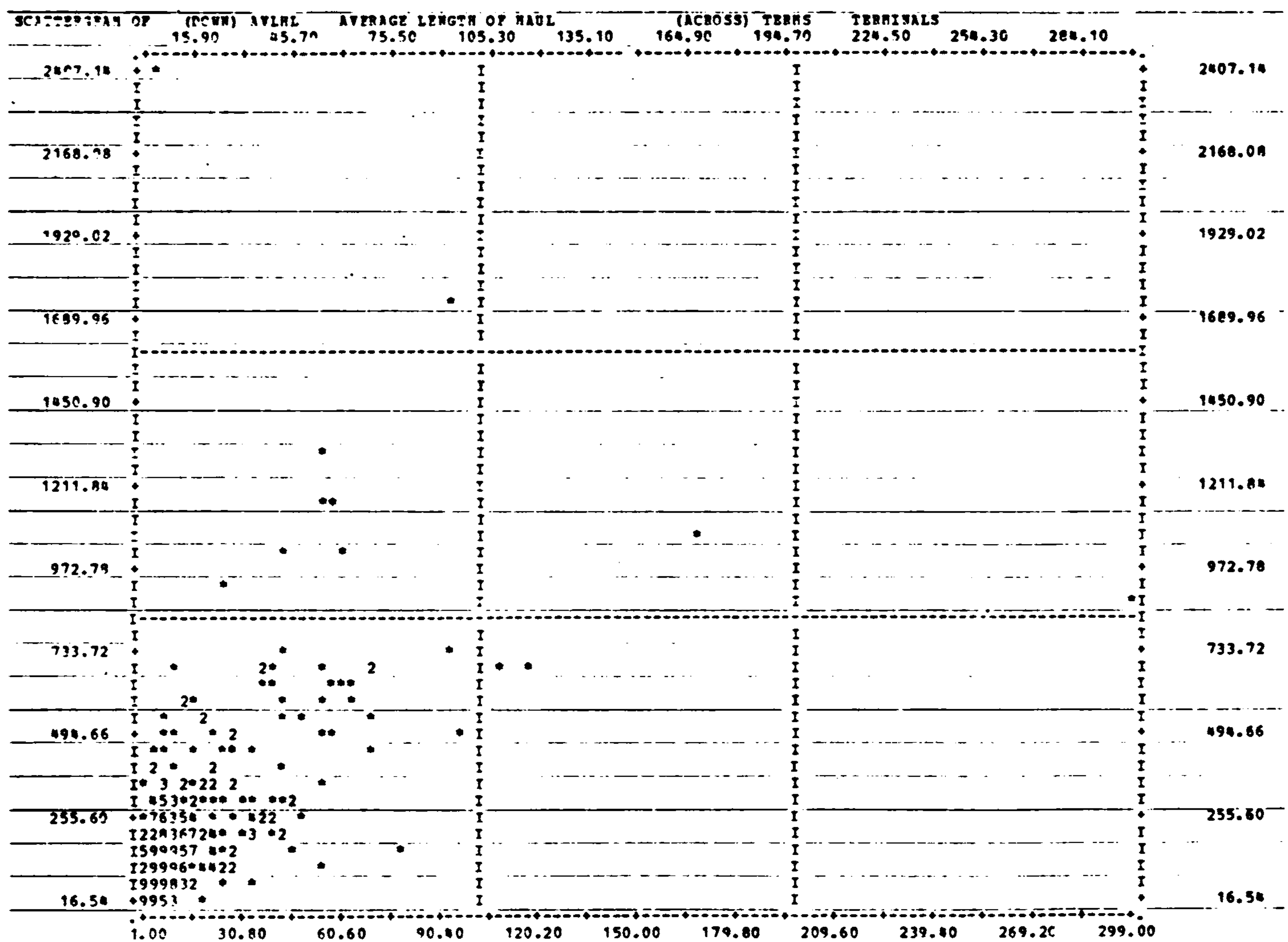


FIGURE 8. PERCENT TRUCKLOAD vs. NUMBER OF TERMINALS

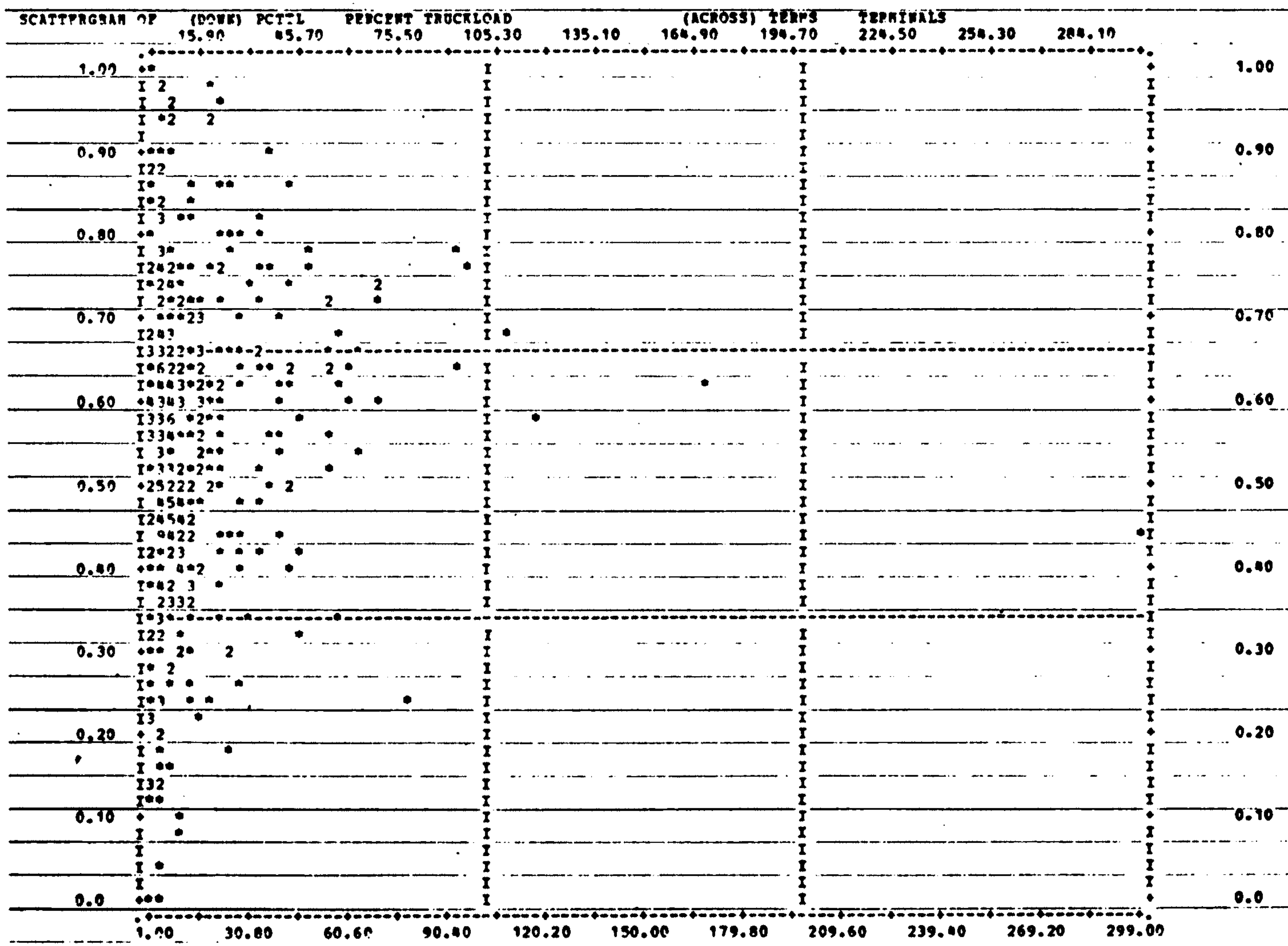


FIGURE 9. AVERAGE LOAD vs. NUMBER OF TERMINALS

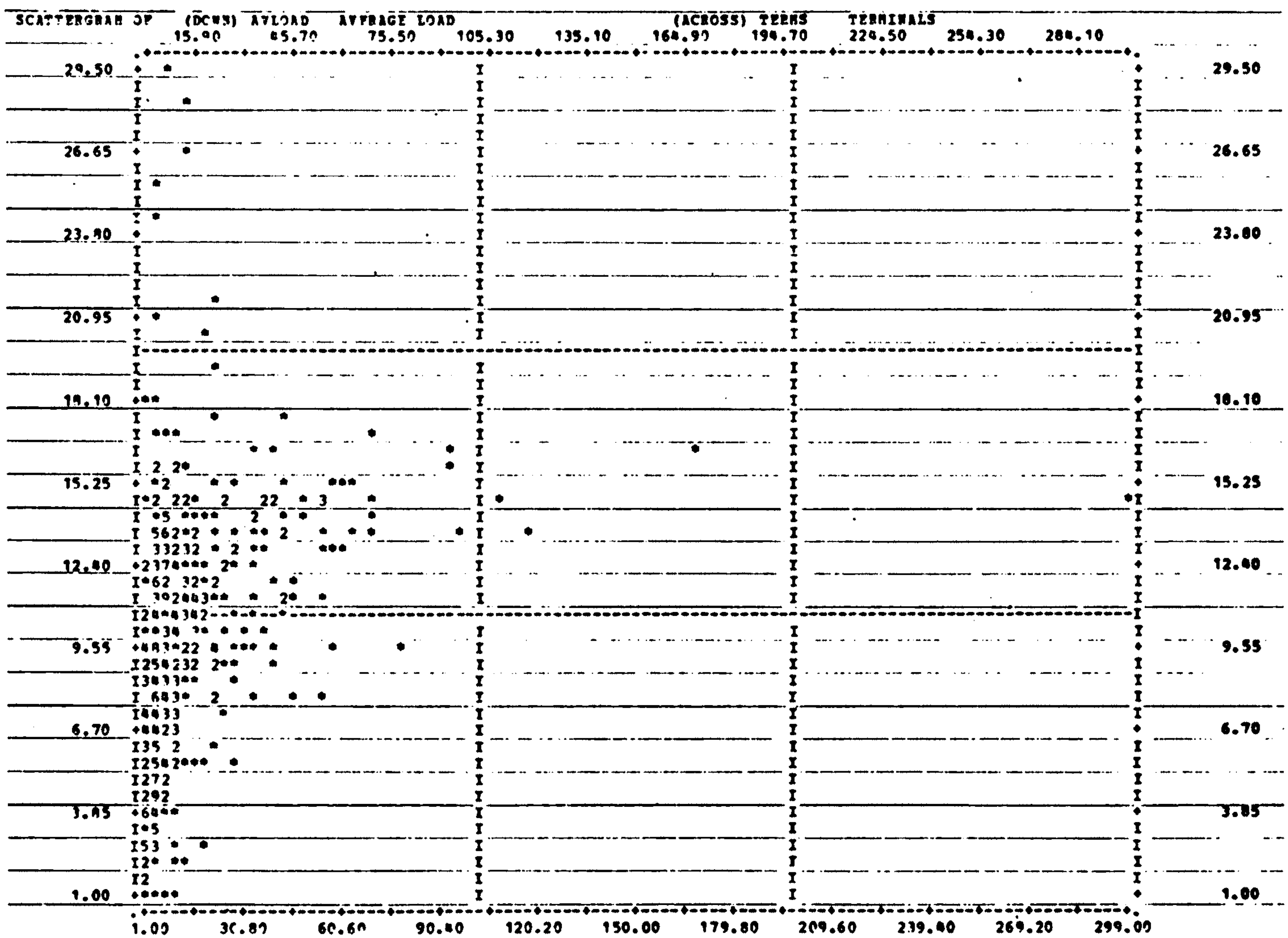


FIGURE 10. AVERAGE SHIPMENT SIZE vs. NUMBER OF TERMINALS

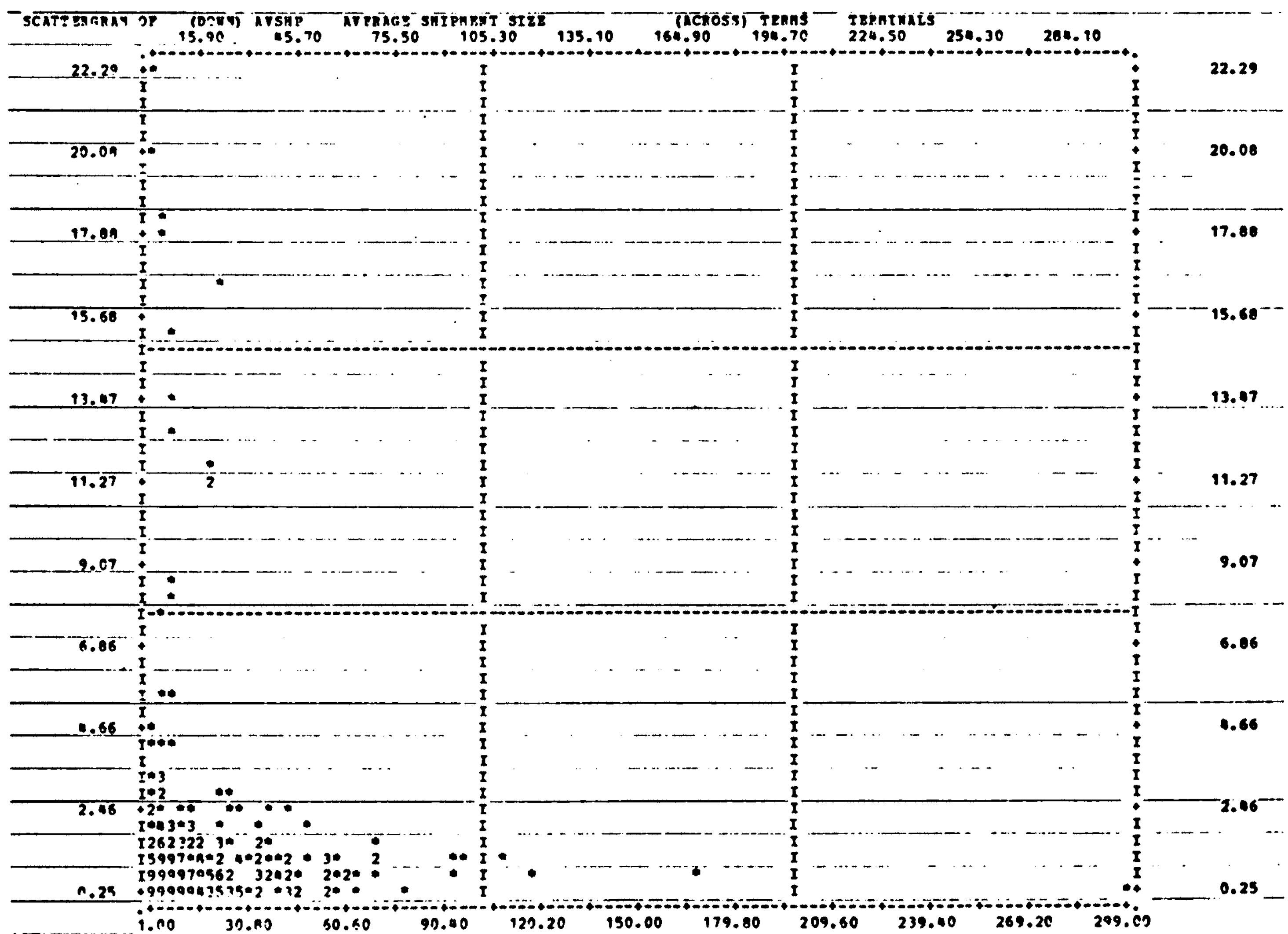


FIGURE 11. RETURN ON INVESTMENT vs. OPERATING REVENUES

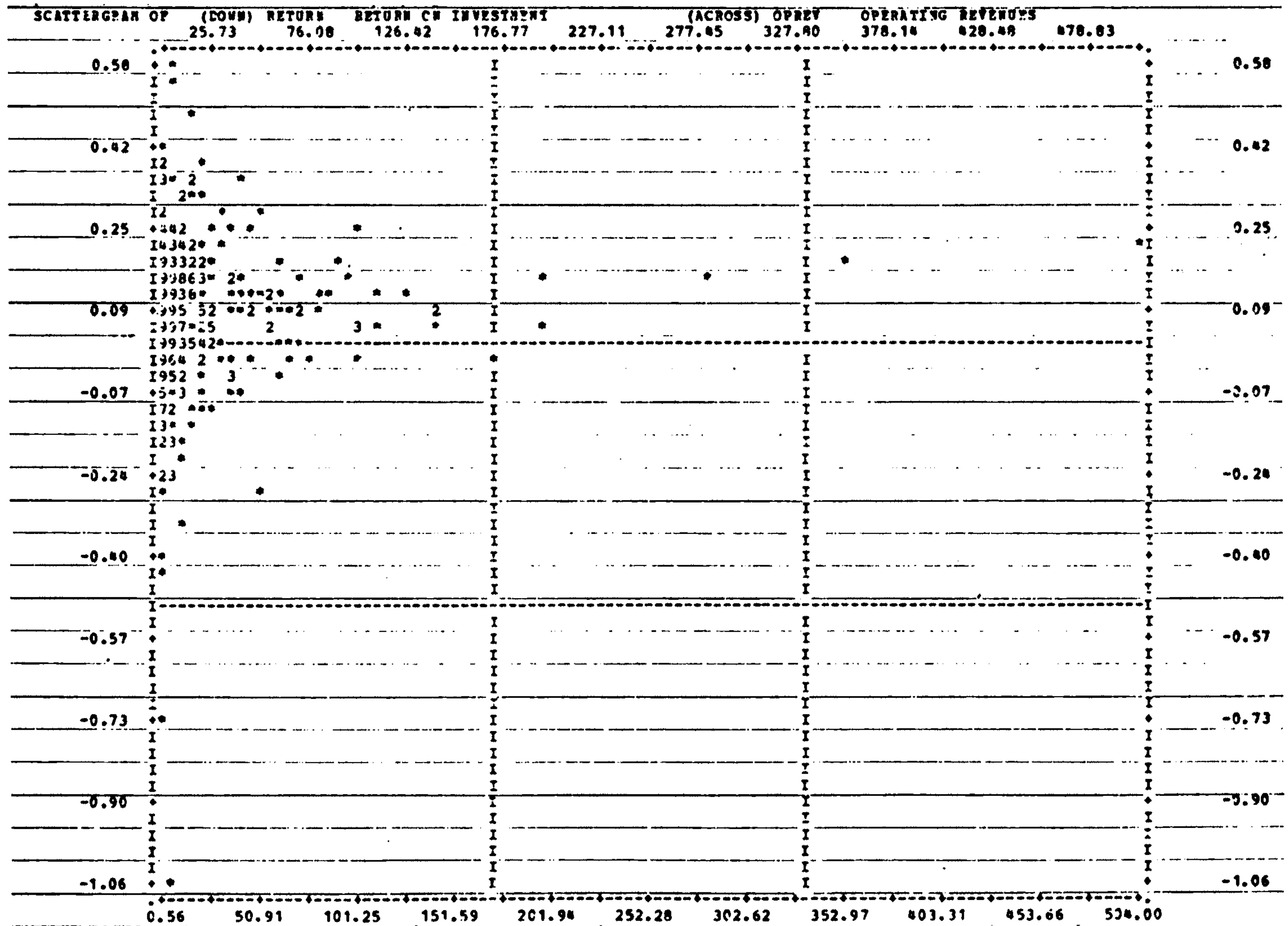
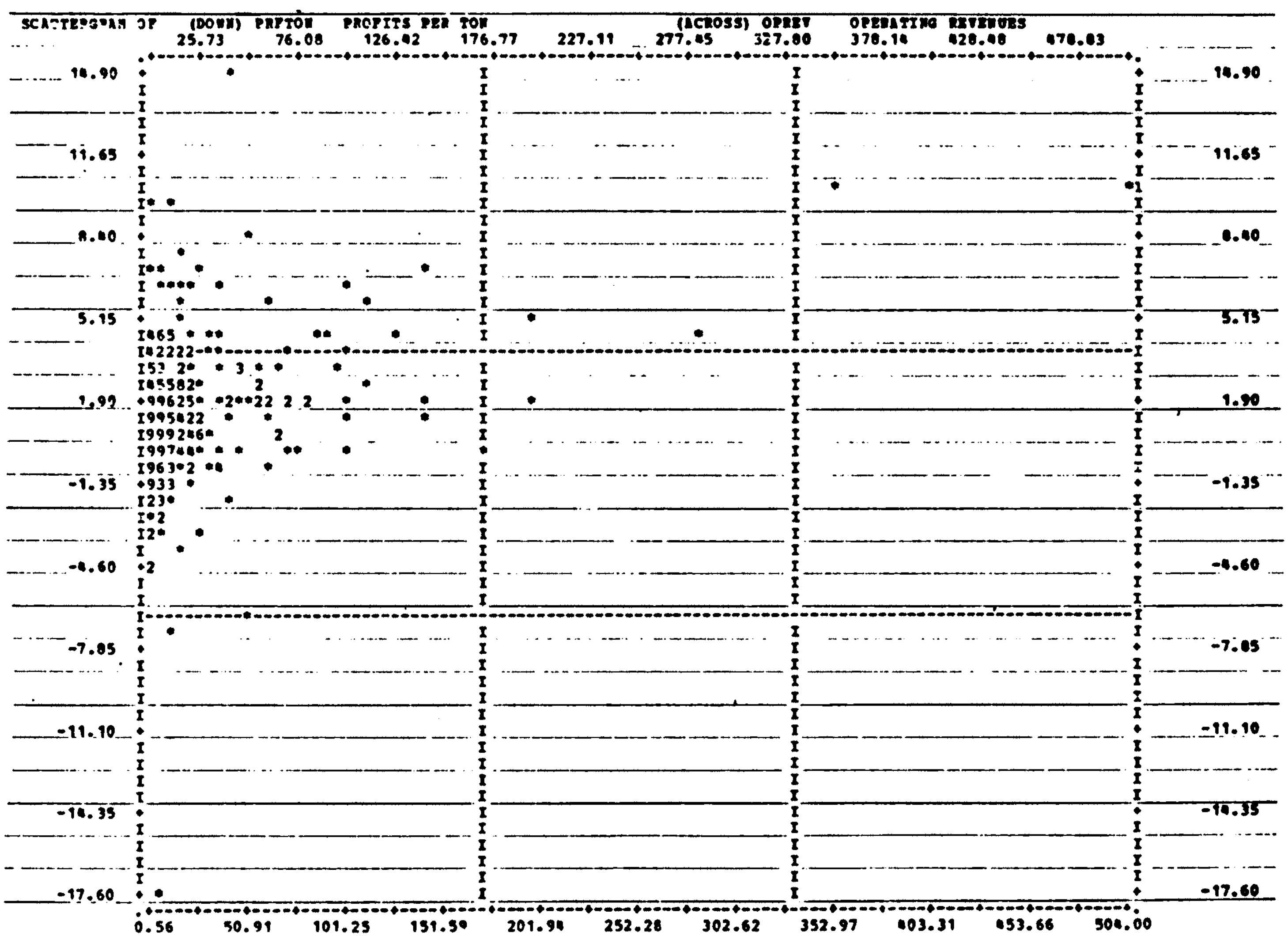


FIGURE 12. PROFITS PER TON vs. OPERATING REVENUES



The variables describing level of service can be determined from demand models. They include trip time and reliability, loss and damage, required minimum shipment size to qualify for the quoted transport tariff charges and any out-of-pocket expenses involved in making a shipment (Roberts 1976). For a firm considered as a whole, the aggregate measures of service level might be approximated by the ratio of standard shipment times for the firm to the industry average, the percent "on-time" shipments (a statistic like that maintained and published in the air passenger industry) and some measure of loss and damage performance averaged over the firm's markets. Since prices for comparable shipments are the same, they don't need to be included. Some measure of market coverage (such as number of terminals) might also be included since it is clearly an advantage to a shipper to be able to deal with less carriers that have authorization to carry goods to and from more places. This reduces congestion at the shipper's dock, minimizes problems with tracing payment, and involves dealing with fewer people.

To test for returns to scale in markets offering comparable services is hard since the demand side variables are difficult to secure firm by firm. Friedlaender and Spady have used hedonic cost functions to adjust for the quality of shipments made (quality here is measured from the viewpoint of the carrier, namely, average shipment size, average length of haul, and percent LTL). As pointed out above, these factors are important determinants of cost, but to use them to adjust for comparable service rather than as independent variables constitutes a serious misspecification. They are, as we pointed out above, merely a proxy for size so it is not surprising to get results using them that show no economies of scale. A definitive analysis that does adjust for different levels of service still remains to be done.

There appear to be advantages to both very small and very large firms. Though it is difficult for the independent owner operator to function in the LTL shipping business without a consolidation terminal, he might in some instances find a profitable niche as a subcontractor to a larger carrier handling pickup and delivery functions. In Europe, several countries have independents organized into cooperatives that offer this service (Moore 1976). Likewise, at the larger end of the scale, the very large companies seem to have considerable power in the market. They typically achieve higher load factors, longer hauls and larger shipment sizes.

In the mid-range, there appear to be companies that suffer the growing pains of adolesence. These carriers frequently face a crisis of management as they become too large to be controlled directly (Wyckoff 1974a). This implies a threshold size or kink in the LRAC curve that it may be difficult to get over. It also suggests that concentration of the larger firms will take place without inordinate competition from new entrants.

Irregular Route Special Commodity Carriers

This segment of the industry consists of two basic portions: 1) those carriers that use very specialized equipment (auto carriers, tankers, etc.) and 2) those that use relatively unspecialized equipment (household movers, refrigerated carriers and steel haulers). The nonregulatory barriers to entry faced by competitors to the first group is quite different than for the second group. It seems likely that the first group can survive deregulation with relatively little change since the specialized knowledge, specialized equipment and the marketing barriers facing a potential competitor could be large. It is this relatively more specialized group that I believe will make up the majority of the specialized carriers group after deregulation.

The less specialized carriers will find competition more difficult. Without entry protection new, one-truck firms can enter against them directly working through a truck broker. The extremely low cost of the independent owner operator would bring those rates that were above marginal cost down to that level. Unless the service being offered were quite specialized, it would be difficult to continue to hold the market. I believe that once a recessionary cut back is faced by this segment of the industry that it will begin to function on a more or less atomistic basis through truck brokers that serve as locators and contact points with the market. Thus, a major segment (80 percent or so) of the irregular route special commodity carriers would begin to function as that segment of the industry that I have identified as the truckload brokers.

Neither the carriers using specialized equipment or those without it have been studied econometrically. It would be interesting to determine whether there are economies of scale in this segment of the industry. Clearly, the more overlapping operating authority that is held, the more probable it is to find a return load. However, once the protective cover of regulation is removed, it may be hard to hold onto these markets. This does suggest that a computer automated brokerage service (much like the carpool matching programs used in some states) may have advantages for both buyers and sellers of transportation.

Contract Carriers

Contract carriers could well continue to function in the same way they now perform. They would, however, not be restricted to a limited number of contracts as they currently are. Since there is so little difference between contract carriers and private carriers, I have combined them into a single deregulated segment.

Intrastate and Local Carriers

It seems likely that the same legislation that established deregulation would also eliminate intrastate and local carrier regulation, since an unregulated interstate carrier would be difficult to discriminate in intrastate trade. I do not intend to address it in detail in any event. But, if the regulatory reform legislation failed to establish the proper ground rules then state regulation could be expected to become predominant. The lack of uniformity between states could then be extremely disruptive.

Exempt Agricultural Haulers

This category of haulers would also cease to exist and would be combined with the truckload brokers in my classification scheme. The deregulatory change would, of course, have a minimum impact on this category beyond the change in demand for trucks by the other segments.

It is interesting, however, to examine the performance of this segment of the industry for clues as to the operation of the new, larger truckload brokers segment that I have hypothesized will develop after deregulation. In comparison to the rate stability that exists in the present special commodity portion of the industry, the rates in the new truckload brokers portion of the industry will appear to be wildly fluctuating if vegetable haulers' rates are any indicator. During times of over-supply of trucks, they will drop to the level of short-term marginal costs with attrition from the industry as owner operators' equipment wears out. During expansionary periods, prices will be extremely high and profits will be commensurate. The industry will "turn over" truckers as they enter and exit at a somewhat higher rate than has the regulated industry.

Private Fleets

Of all the segments of the trucking industry, the private or proprietary carriers are the most difficult to predict under deregulation. There are companies that would continue to provide their own transportation. Some would offer themselves for-hire, especially on empty backhauls. In fact, there would be, through the truckload brokers, a rather efficient way to accomplish this. The private trucker might be looking for a rather specific destination, however, and might seek special brokerage services or attempt to arrange scheduled loads on his own initiative.

Other private carriers would undoubtedly hire owner operators to work for them on long-term contracts, or even on a trip-lease basis. The distribution between the private carrier as a broker of services and a user of brokeraged services would be imprecise. Although some private carriers might actually enter the LTL consolidation business, I think that is unlikely once the original "shakeout" of service offerings is complete.

The picture I paint of the private carriage segment is one of diversity. I believe that it will shrink to some extent, maybe even dramatically. However, it is an area about which there is no quantitative evidence. Further investigation of this segment appears to be in order.

SUMMARY AND CONCLUSIONS

The findings in this paper are preliminary, based on the quantitative information that is currently available and the analysis that has been done with it. There are many possible patterns of deregulation. This paper has examined only one. The pattern examined was one of total and immediate deregulation of the entire trucking industry. This pattern is so extreme and unlikely that the findings must be viewed with care. The dynamics of such a pattern of complete deregulation have been examined in only a cursory fashion. Much work remains to be done to complete the picture and to fill in the details.

The anticipated response to a pattern of total deregulation, is a consolidation of the current industry structure into four basic segments: 1) LTL consolidators, 2) specialized carriers, 3) truckload brokers, 4) private and contract carriage.

The LTL consolidator segment is made up of the regular route common carriers of general freight less existing truckload traffic competed away by the truckload brokers. Although the evidence is incomplete, it appears that there will be consolidation of the industry because of the advantages that accrue to larger carriers. There could be destructive competition to achieve the consolidated markets.

The truckload brokers would consist of the present agricultural exempt haulers plus those specialized commodity carriers who do not use very specialized equipment, and any new entrants into the trucking industry from the outside. The market would fluctuate depending upon the economy. Rates could vary dramatically. Entry and exit for the trucking industry would be much higher than with the present industry.

The industry structure and operations that I have sketched out here are obviously speculative, based upon the information that is available. However, much work remains to be done before they can be verified. Other patterns of deregulation also need to be studied and discussed. In particular, work on level-of-service adjusted cost functions needs to be undertaken for each segment of the industry, in particular, the regular route common carriers, the special commodity carriers, and the private carriers. The interactions with other elements of the transport system, namely the railroads and the airlines must also be considered. Here, the dynamics of the demand response to various service offerings and pricing structures need to be investigated. The choice of mode may become a crucial element in the dynamics of this demand response.

Better statistics on each of the industries must also be obtained. Statistics for owner operators are still unrecorded as are private fleet operations. Various strategies for sampling the industry as it performs its work must be undertaken. A better understanding of the current industry make-up will greatly assist in prognostications on the future impacts of deregulation.

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CAN THE MOTOR CARRIER INDUSTRY BE REGULATED?

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This paper is not concerned with safety regulation, although this has obvious economic effects and overtones. Nor is it concerned with the possibility that the Citizen's Band has done for speed limits what various forces have been suspected of doing, from time to time, to weight limits. Rather, it is concerned with a more specialized proposition: is economic regulation of the motor carrier industry possible? Note that the question being posed is not whether economic regulation of motor carriers is "bad" or "good." The question is not whether economic regulation constitutes wise social policy or unwise social policy, wise economic policy or unwise economic policy. The question is much more basic than that. Can so-called economic regulation of the motor carrier industry, or any portion thereof, be carried out in any form which would be recognizable in other regulated industries? And if the answer is hesitant or even negative, given the present institutional structure of both regulation and of the industry which is engaged in the motor carriage of freight, could any institutional rearrangement be effected which would not produce the economically most malign by-product of regulatory processes: to make the industry fit the regulation, as a substitute for making the regulation fit the industry?

For purposes of exposition, this paper will be organized with the most sweeping proposition first, and the least sweeping last. The first rough cut consists of raising the question: is any effective governmental economic regulation possible in the U.S. economy or any other economy resembling it? The next stage will refine the argument by addressing the question: is any special or differential (or, if you please, discriminatory) economic regulation possible, under U.S. conditions, in the field or transportation--with very special and particular reference to freight transportation? And finally, the argument will proceed as rapidly as possible to what one hopes might be the ultimate refinement: is so-called "economic regulation" of the U.S. industry of motor carriage of freight at one with the false front in Western films and the Potemkin village? In short, is so-called economic regulation simply an exercise in mutual self-deception? Is economic reality being totally subordinated to a pure legal fiction?

Please note that affirmative answers at all stages are necessary, if a case for the mere existence of regulation is to be established. Please note, in addition, that affirmative answers at any one stage are not sufficient to prove the effective existence of economic regulation. Unlike a chain which is no stronger than its weakest link, this particular chain or reasoning can partake of the cumulative weaknesses of all links taken together. Please note, also, that even though the final result of this exercise may be to re-affirm the dictum, "Yes, Virginia, there is a Santa Claus," considerable evidence may nevertheless accumulate that St. Nicholas of Asia Minor, 1,500 years ago, had very little in common with Kris Kringle as he emerged from Teutonic folklore.

After all our efforts to accentuate the negative, it may still appear that the affirmative possibility of achieving economic results by motor carrier regulation nonetheless survives. But this affirmative possibility may survive as a pure hypothesis, which could achieve reality only with a totally different Interstate Commerce Commission, or a totally different Congress, or a totally different kind of internal combustion engine. Thus, at every stage, we must combine the economically possible with the politically possible. A second question must therefore be appended to our primary economic question.

This second question is: granted that economic regulation of the motor carriage of freight is possible, would this require the use of a steam-hammer to crack a nut? For example, a completely Communist government of the United States could presumably, on paper, do anything it wanted to about motor common carriage. But history must already have proved that what Communist governments can do on paper bears no necessary resemblance to what they can do in reality. And one would hope that the future unrolling of the historical scroll in the United States would include nothing so absurd as a Communist revolution inspired solely by a desire for really effective economic regulation of the motor carriage industry. As those subjected to this paper will doubtless agree, I try increasingly to balance deficiencies in memory by strenuous exercise of the imagination. But, as for a Truckers' Internationale: my imagination cannot begin to reach that far.

So let us now return to the simple question of whether any economic regulation by government agencies is possible.

ON THE PROPOSITION THAT ECONOMIC REGULATION BY GOVERNMENTS IS SIMPLY A NEW FALSE FACE FOR THE SAME OLD ANARCHY.

Let us first of all not confuse form with substance. No one can deny the enormous physical bulk of an I.C.C. docket on any important regulatory proceeding; in fact, as any user of the docket room is well aware, the physical bulk has now reached such a point that the cumulative product must be warehoused, not filed on shelves in simple library fashion. But this enormous physical bulk should not conceal the fact that a weight of paper has no more economic significance than a paperweight.

In trying to answer this central questions, we may first refer to the famous statistical reductio ad absurdum of the apes--who, in principle, could rewrite all the books now contained in the British Museum. Given the theory of permutations and combinations, there are bound to be collisions between words (or numbers) and reality on certain occasions, no matter what the underlying logical relationship between the two may be. But what matters is systematic causal relationships. Is the process of economic regulation, as we know it in the United States, systematically and causally related to the industries which are supposedly being regulated? Moreover, can and does the relationship run on at least some occasions from regulatory causes to economic effects?

Let us now proceed to The Case for the Negative:

(1) The essence of entrepreneurship is capacity not only to deal with sudden and unpredictable change, but also to cause sudden and unpredictable change.[1] The essence of regulation is to proceed in a straight line, at the same speed, in the same direction, etc., unless acted upon by some outside force. Therefore regulation, by its essential character, is (a) reactive; (b) tangential, in a cumulative way which must, in an economy which is continually changing speed and direction, eventually make it (c) economically irrelevant.

(2) This regulatory tendency to carve more deeply into the channels of the past is greatly accentuated, in the United States, by the uniquely American phenomenon of the dominance in so many areas of American economic and social life of the U.S. Supreme Court. One of the more interesting paradoxes of American life is the combination of a unique popular respect for the highest court in the land and for its decisions on all manner of important questions, on the one hand, and unique public disrespect for almost any practical aspect or embodiment of the law--as exemplified by crime rates which are beyond the understanding of any other civilized community, by extreme public cynicism with respect to the efficiency of the whole legal system, and so on.

No mere economist can attempt to explain this paradox. But one partial explanation may be that the U.S. Supreme Court is, in the strict meaning of the word, the most profoundly reactionary institution in the Western world. To a remarkable degree, it reflects the politics, the ideologies, the habits of thought, and the views of right and wrong which were fashionable a generation before any given decision. Amid all the fads of American culture there is also a lasting strain of nostalgia. We all maintain a substratum of the attitudes which were accepted during our senior years in college. Many of the decisions of the Warren Court faithfully translated the received opinions of my college days, in the mid-1930s, into the law of the land. We are now beginning to catch up with God and Man at Yale, which was a landmark of the youthful conservatism of the early 1950s. And I will be fortunate enough to have passed from the scene by the time we attain a Supreme Court which reflects the Yippies and hippies of the late 1960s. Meanwhile the Interstate Commerce Commission and all other economic regulatory bodies must not only contend with the world of transportation as it actually exists. They must also contend with an outdated classroom model of the world of economic regulation.

The most familiar transportation example of this extra source of intellectual regulatory lag is, of course, the Supreme Court's decision in the Ingot Molds case (American Commercial Lines v. Louisville & Nashville Railroad Co., 1968). The internal evidence indicates that the opinion in the case is a product of some very careful reading of economics texts. But the same internal evidence also indicates that these texts must have appeared before the following dates: 1890 (the first edition of Alfred Marshall's Principles of Economics); the 1860s (the earlier writings of that exemplary economist who wrote on both transportation and general topics, W. Stanley Jevons), the 1850s (the writings on railway economics of the Reverend Dionysius Lardner), or the 1840s (the writings on transportation economics of Jules Dupuit). The Ingot Molds decision derives from a sub-species of economic literature and analysis which bears about the same relationship to the science of economics as Harriet Martineau bore to David Ricardo: a popularized, best-seller approach, of a kind which would appeal to intelligent and well-educated amateurs, vs. the strenuous grapplings of a tough mind with real and weighty issues. Economists aimed too high in criticizing the Supreme Court's views as stated in Ingot Molds. The real target should be not the decision itself, which was not and is not worth shooting at, but the naivete on the part of the Supreme Court justices which would lead them to believe that, given their schedules, their staffing, their degree of expertise in technical economics, and their research facilities, they would even be in a position to give rational consideration to the issues raised by Ingot Molds.

Hence a second and very fundamental source of regulatory lag: a Court of Last Resort still capable, long after the end of World War II, of basing its opinions on doctrines whose logical fallacies had already been pointed out a century or more before. Any foreigner, examining Ingot Molds, would have to ask not "Why does this say what it says?", but "Why was this written at all?" The answer should probably mention not only John Marshall, but also the fact that geology and most other modern sciences were still in the hands of theologians at the time of John Marshall's death.

(3) This kind of argument gets us perilously close to the special characteristics of American history and American institutions. So let us move back again toward the more general vistas provided by regulation as a concept, quite irrespective of space or time:

(a) The first perfectly general characteristic is that regulation is intrinsically negative. To claim that the use of the word "not" is an automatic bar to affirmative policy formation would be to play on words: after all, the Ten Commandments are presented as a string of negatives, and if they lack influence over human conduct, the reason obviously cannot be sought in grammatical structure. But the function of regulation is still essentially to say "No"; the function of the word "No" is to establish boundaries and constraints; and, admitting that one can go faster with the assurance provided by good brakes, one cannot go faster when the brakes are actually set, nor can the brakes provide propulsion, acceleration, direction, or any of the other desired attributes of the vehicle's operation. Two aspects of the affirmative deficiencies of regulation were long ago summed up in the observations that "You can lead a horse to water, but you can't make him drink" and "Money makes the mare go." Dynamic economies operate on the basis of affirmative actions. Regulation may on occasion channel such actions, or inhibit them. But it cannot cause them.

(b) The second perfectly general characteristic of regulation may be illustrated by the sign on a Presidential desk which has become a part of American folk wisdom; Harry S. Truman's "The buck stops here." Performance of the entrepreneurial function, and hence initiation and guidance of economic activity, requires clearly-understood answers to two questions: the Truman, or managerial, answer of "The buck stops here," and the fiscal or budgetary answer of "The buck starts here." Without clear channels of authority, and in particular without clear channels of financial authority, regulatory power may not even provide a set of evenly-balanced brakes. Institutionally, of course, explicit promotional powers including powers over certain aspects of financial support have been provided to regulatory bodies. Witness the C.A.B.'s position with respect to local service air lines. Witness also the I.C.C.'s loan guarantee authorities under the Transportation Act of 1958. Witness, finally, the long continuance of the regulatory and the promotional under double harness in the form of the old Atomic Energy Commission. But the history of each of these forced marriages should add more to the point being presented here than to its opposite. The distinction between the regulatory and the promotional has always been recognized in principle. Combining powers never meant to be in the same hands has always caused uneasiness in many quarters. And, with respect to both atomic energy and the provision of surface transportation subsidies, the recent tendency has been very obviously and strongly to sharpen the distinction between government regulation and the semi-entrepreneurial role of government financial support.

And so we have the basic outlines of the case. No matter what the legal fictions, and no matter how many pieces of paper are scattered about, economic regulation is impossible first of all, because in its relatively few affirmative aspects it stresses the formal at the expense of the substantive and the precedent at the expense of the emergent economic problem (externally-imposed or self-created). Second, regulation is much too credulous in accepting the adage that two heads are better than one. If this is to have any bearing on economic matters, then the owner of one of the heads must have some positive goals in mind; he must have some ultimate power of decision; and he must have some kind of positive rapport with the second head on the proposition that economic regulation involves economic decision-making in accordance with economic rules designed to proceed from economic causes to economic effects. For example, it is politically often possible to redistribute surpluses within the economy, by political (including regulatory) processes. But this requires an economic cause: the surpluses must exist. Such re-distribution also requires decision-making, on a number of points: that these surpluses should not be left with their present possessors; that certain other specified groups have special prescriptive rights to such surpluses; that certain specified policy measures are the most efficient economic methods of redistributing the surpluses; and so on. Absent any or all of these requirements, which cannot be fully met except by a fully-responsible entrepreneur with adequate availability of budgetary resources, the regulatory process degenerates into a political charade. Clear thinking would be advanced by labelling any politically redistributive process without rational economic content as exactly what it is and neither more nor less.

ON THE PROPOSITION THAT SPECIAL OR DIFFERENTIAL ECONOMIC REGULATION IS IMPOSSIBLE IN THE FIELD OF TRANSPORTATION IN THE UNITED STATES

(1) The economic and political theory of economic regulation has always perched on a knife-edge: on the one hand, if special economic processes are required, and special economic results are to be achieved which cannot be achieved by private ownership and in fact require public funds, why not have public ownership or at least insert the public funds directly? On the other hand, if no such special processes are required or no such results are to be achieved, why bother with trying to regulate the private market?

The "market" solution, seasoned to taste with public funds, has always been employed in the United States for most if not all waterway movements (even today, "regulated" tonnage is a very small fraction of total tonnage), and for a considerable proportion of road transportation. (There has always been a distinction between "public funds" and "subsidy," as is exemplified in today's difference between intercity highway finance and waterway finance.) Public assistance, in practically all possible forms, was used to encourage the construction of railroads in many parts of the United States. Rights-of-way and way and structure could be, and were, owned by public bodies just as canals could be and were in most cases also owned by public bodies. So the outstanding American transportation peculiarity of twentieth-century transportation, which consists in the fact that railroads alone are expected both to own and to finance their own rights-of-way and way and structure, was by no means universally true in the nineteenth century. The federal government helped for a while; many states helped for a longer while; even more localities helped, or at least invested in anticipation of a return in some form or other, for yet a longer while.

So the "public-or-market" alternative appeared very early in American transportation history, and has never left the scene.

How, then, could the "regulated private ownership without public financial assistance" or "regulated market" alternative manage to be practically universal for all railroads until recently (recent exceptions: State of Vermont; AMTRAK; plus the possible exception of Con-Rail)?

The "unassisted private ownership" aspect of this question undoubtedly owes something to ideology. The great age of public investment in American railroads was during the period of development, when massive new infusions of capital were required and the geography of the final system was yet to be determined. There was a general interest in hastening the investment process; and there were a myriad of particular local interests in preventing the process from bypassing particular localities or areas. During this period, unassisted private ownership was adopted as the solution only in those settled and industrialized parts of the country where both commerce and geography indicated eventual success for private efforts. Once the "new investment era" began to change into the "operating era" as the industry's rate of extensive growth declined, the merits of public participation in the form of the consequential spur to investment began to pale before the supposed demerits of public participation in the form of the problems of direct public employment of operating labor, direct public sale of the product, etc. In the late nineteenth century, there was considerable ideological support for municipal public ownership of local utilities in the United States (note, again, the distinction between capital-intensive periods of rapid growth and less capital-intensive periods of maturity), but there was limited and declining support for state and national public ownership of utility-type enterprises which typically extended beyond municipal boundaries.

This ideology has managed to maintain itself, in the absence of financial losses which private enterprise is unable or unwilling to meet, because there has also been an absence of inductive evidence of the superior operating efficiency of public enterprise, whether the public enterprise concerned is a foreign railroad or an American government service. Even during the last period of fervent support for more extensive operation of public enterprises in the United States, which occurred during the 1930s, the case for organizations such as the Tennessee Valley Authority was stated in terms of economic and social externalities which only a public enterprise could internalize, or of "yardstick" aspects which would at least serve to embarrass the least efficient private enterprises, or even in terms of the connection between public ownership and possible anti-recessionary public investment policy. It was not stated, very loudly or very often, in terms of the superior efficiency of the best that could be achieved under public operation as compared with the best that could be achieved under private operation.

Therefore, as a general proposition, ardor for public enterprise in the field of transportation tends to wane with any decline in investment and financing problems, especially if these are accompanied by a decline in the geographical significance of where these problems occur. Acceptance of public ownership, if not ardor for it, may revive if the only obvious economic solution to transportation difficulties seems in any case to involve substantial infusions of public funds. But, historically and even now, American ideology and implicit American assumptions about relative public and private operating efficiencies have combined to point toward the conclusion: if it can operate as a private enterprise, let it do so. Economic proof of the merits of this position is not easy, because public and private enterprises are fairly sharply-differentiated in most parts of the world, industry by industry, and experience in foreign countries is not likely to be accepted as automatically valid in the United States. But British experience with the nationalization of road haulage made no new converts for public transport in the United States, and apparently made few in Britain. The record of the Canadian National is no longer used as an argument against public ownership in transportation, but it has also not been used on any scale in support of arguments in favor of it. And here, pending the further historical development of ConRail, the matter now rests.

If the "public ownership" alternative in transportation has attracted supporters only as the sole feasible basis for having any transportation service at all, the "unregulated private market" alternative has become very fashionable among economists and by no means disregarded by politicians, public officials, and others. If a case cannot be made for public benefits from transportation, and in particular for public operation of transportation, then why condone any special public meddling at all?

The first answer is very partial and very specialized. It is that even the use of public funds, without the existence of public operation, may require some public supervision for political if not economic reasons. But the existence of public supervision may imply supervision of the type exercised by the General Accounting Office or by the Office of Management and Budget; it need have nothing whatever to do with the activities of the Interstate Commerce Commission.

The second answer is much broader and more general. It is, in fact, the traditional answer whenever transport regulation is called into question. This answer is either that "the market" in transportation could never be depended upon to be workably competitive, or that, while competition in transport might be workable with respect to the internal aspects of the transport market, such competition would generate economically, socially, or politically undesirable externalities.[2]

In the nineteenth century, industries were either "competitive" or they were not. Firms were either prone to engage in "undue preference and prejudice," or they were not. Transportation seemed to provide especially important examples of the "non-competitive" and "undue preference" because transportation relied more heavily on railroads than it now does, and railroads themselves seemed then to be more truly exceptional not only because of the large scale of railroad firms, but also because the word "competitive" was used much more loosely than it now is. The word "oligopoly" makes no very great contribution to the euphony of the English language. But it does make a most important contribution to the accuracy and specificity of micro-economic analysis. It is not only useful as a partial antidote to loose statements such as "the railroads once had a transportation monopoly"; it is also useful as a very general label for the vast economic spectrum which stretches from pure monopoly to pure competition. Moreover, although it is perfectly possible to imagine and even to cite examples of pure oligopoly, in situations where all firms sell the same thing at the same price in all quantities to all buyers, the very idea of oligopoly is hospitable to the further ideas of differentiation and discrimination. The smaller the number of firms, the greater the possibility that each firm may have certain unique attributes or certain special advantages or disadvantages in particular sub-markets. Therefore, the smaller the number of firms in _any_ industry, the greater the possibility that these firms will partake of the supposedly distinctive railroad attribute of differentiated and potentially discriminatory oligopoly.

But the decline of the separate argument for economic regulation of transportation stems from causes much more basic than the mere refinement of the economic vocabulary by the introduction of words like "oligopoly," or the general shift of the non-transport economy from the dominance of purely-competitive agriculture a hundred years ago to the even greater dominance of less competitive industries today. The decline of the separate argument is, of course, a product of the decline of the railroads _within_ the field of transportation, and of the very different economic and technical characteristics of the competitive modes which have been responsible for this decline. The consequences of this decline and of these differences will be explored in the next section. Meanwhile, it must suffice to note that the peculiarities of railroads with respect to market dominance have, _in general_, been greatly reduced if not erased over the last hundred years.

So far, of course, all we have shown in this section is that the _peculiar_ and _particular case_ for railroad regulation which existed before the rise of intermodal competition, and of oligopolistic industries generally, is much weaker than it used to be due to developments in both economic theory and the economy itself. This does not mean that a general case for regulation of all forms of transport may not exist. For that matter, perhaps the answer which would best equalize misallocation would be even-handed regulation of everything. Nor does it mean that a particular case for some kind of transport regulation has entirely disappeared. So far, all that we can say is that the case is less convincing than it once was.

(2) This somewhat bland conclusion is greatly sharpened if we turn our attention from the general case for _some_ kind of economic regulation to the specific issues which arise once one asks oneself what _any_ kind of economic regulation is supposed to accomplish. In the process of asking ourselves this question, we must also ask ourselves two further questions: what would be likely to happen _without_ regulation? And what difference, if any, can regulation make?

First, then, it becomes clear that regulation can achieve _any_ economic effect only if _individual_ regulated firms, in the absence of regulation, would enjoy at least some room for maneuver. (Note that regulatory bodies do not directly regulate industries, except at one remove. What they do regulate is individual firms--separately or collectively.) If all factor and product markets were perfectly competitive, economic regulation dependent upon market factors alone (i.e., excluding rationing and other allocative devices) could accomplish nothing.

Second, regulation can achieve economic effects only if regulatory actions relate to the parameters with respect to which firms have room for maneuver. If there is no way that a regulated firm can be expected to carry on its present business on anything like its present scale and still make a normal profit, then regulation of rate of return becomes merely confusing and superfluous. Returns may be held down to even less than market factors would allow; but if they are, then sooner or later more subsidies must be found, or more abandonments of facilities and service must be permitted, than would otherwise be the case. If rates of return which would be subnormal without regulation are further depressed by regulation, then the regulatory authority is in fact operating as a taxing body or imposing a negative public subsidy. It is determining, furthermore, that net investment in the regulated industry should eventually shrink (since the industry is not earning the opportunity cost of the capital employed--barring the exceptional case of specialized or geographically-fixed assets with indefinite economic lives whose opportunity cost in fact approaches zero). And it is determining, finally, that net investment in the regulated industry should shrink faster than market forces would otherwise dictate. If this kind of regulation is combined with public subsidy, then the public is in effect feeding the cow and milking it at the same time. The difficulty is that, in this case, the milk and the feed are identical--and there are inefficiencies in the conversion process.

This question of rate-of-return creates a profound difference between railroad regulation and "public utility regulation" as it is understood in the electricity, natural gas, or telephone industries. All of these latter are assumed to be in a position to earn abnormally high rates of return. In fact, they are typically protected against entry of new competition even if they should earn abnormally high rates of return. Therefore the regulatory body has both the economic opportunity and the economic and political responsibility to substitute its own judgment on rate of return for that of the company. Regulators are not thereby absolved from preventing regulated public utilities from competing in capital markets, or from forcing the utility to fall short of a normal rate of return as defined by some other standard.

The question of rate-of-return also relates directly to the main topic of this paper. If "cost of service" does not include full, normal "cost of capital," how much does it or should it include? If the permitted rate-of-return is zero, then where is the capital needed by the enterprise to come from, or how is it to be retained? And if, as a matter of policy, the enterprise is expected to shrink its physical plant as capital is squeezed out of it by the direct and indirect pressures exerted by subnormal returns, how is the requisite rate of shrinkage to be calibrated to the permitted rate of return? In fact, in an industry whose shrinkage cannot take place evenly and simultaneously right across the map, is there any rational basis for discussing a policy with respect to "the economics of shrinkage"? And, to the extent that there is not, can we avoid the conclusion that one or another subnormal return in this environment of the fortuitous is purely an attempt to reach what is in any event an irrational objective by pursuing what cannot be a rational route?

Third, both the point and even the propriety of regulation may be questioned unless it is possible to be fairly specific as to what difference is made by regulation, to whom, in what specific way, where, when, and with relation to what.

And it is precisely here that regulation of freight charges and service differs from regulation of passenger charges and service.

Passenger service is like residential utility service. Both the supplier and the regulator can determine who the final consumers are, where they are, and if the occasion requires, what their incomes are, how much of the service they will consume on the basis of different price schedules, and so on. Public utilities have certain technical advantages because the service rendered is more standardized than transportation, and for this and other reasons more easily quantified. But, for residential users of public utility services (who usually require the utility to incur more of its costs than any other group), regulatory bodies are dealing with problems of ultimate incidence. Whatever the economic merits of lifeline rates, or straight line rates, or for that matter any other line of rates, the economic impacts of any change in regulatory constraints may be traced right through to the final user.

The same is not true for freight. Who is the ultimate beneficiary of a lower railroad rate on steel girders which may go, more or less indifferently, into new factory construction, construction of new office buildings, or construction of new bridges on new superhighways? Who is injured by a higher rate on sand and gravel? Where are the ultimate consumers of the final product, and can they be described in any way which will permit "economic merit" for regulatory purposes to be distinguished from "economic demerit"--i.e., to what extent is it possible really to think about undue preference and prejudice?

In short, when one is dealing with intermediate products (as is true for all modes engaged in moving freight, except possibly movers of household goods for individuals who are moving from one place of retirement to another), there is simply no direct way to establish what the ultimate incidence of any commodity action may be.

The same is true, if perhaps to a lesser degree, of the geographical impacts of regulatory policy. The Interstate Commerce Commission is traditionally chosen with great care from the standpoint of geographical representation. Each major region of the country is supposed to have its own member. Yet this system has not been combined with equally great care relative to the geographical impact of specific rate policies. Do cheap rates for timber out of the northwest help northwest timber producers, or northeastern timber consumers? If they help northwest timber producers, do they also to some extent help the competitors of aircraft manufacturers who are also themselves situated in the northwest by lowering housing costs, and hence living costs, and hence possibly wage costs, elsewhere in the country? In any case, is this a particularly easy example because an aircraft producer can deliver his product on essentially an f.o.b. basis, and let the customer take it from there? And, more generally, does it make any sense to assume, _a priori_, that rate levels dominate over rate structures (or conversely), or that alteration of either necessarily helps "producing areas," or "consuming areas," or both?

Some of the extremely complicated economic questions which are being raised in this paragraph can at least be approached with the assistance of modern computer technology in ways that they have not been approached before. But to what extent can the _form_ and _structure_ of the regulatory process, with its ultimate dependence on the judgments of highly-intelligent amateurs who are justices of the U.S. Supreme Court, ever come to terms with the awesome flood of numbers which has been hinted at above?

So: if one doesn't know whether buyer or seller is immediately benefiting--or, if both, in what proportions--and if one could not determine the ultimate beneficiary in any case, what is the point? Even more basically, suppose that one particular group can be identified as the sole final consumers, and sole final beneficiaries, with respect to a given rate which is to be reduced by regulatory action. Economically speaking, and quite apart from the fact that people who ultimately gain from cheaper sand and gravel are doubtless, on the average, just as nice as all other people, what case can be made for benefiting them _via sand and gravel_?

Fourth, regulation has a tendency to forget itself and thereby to achieve--if any results at all--results which are precisely contrary to the logic on which the original introduction of regulation was based.

Specifically, why have _economic_ regulation of any one industry or sector of the economy? Because, given the nature of cost curves of the firms in their geographical context, a given firm can always handle an increment of new business over a plant of given physical or geographical extension without a proportionate increase in its costs: i.e., marginal are below average costs as density of output per unit of physical distance of input factors increases; hence average costs are declining; hence new firms have great difficulty in trying to establish themselves in the industry in competition with old firms; hence the small number of firms serving given routes or areas; hence the danger of temporary cut-throat competition if new firms do try to enter, and so on through the standard textbook list.

No matter how this model is approached, there is one feature which simply cannot be avoided: a firm with costs of this kind is the _last possible candidate_ for sale of _any_ of its output below marginal costs. The classic entrepreneurial problem for this kind of firm is therefore: how to develop a price structure or a series of tariffs which are enough attuned to relative demand elasticities of different buyers of the service to enable the firm to cover _average_ as well as _marginal_ costs? And the classic regulatory problem has always been considered to consist, _not_ of how to avoid "discrimination," but of how to prevent "unjust" discrimination, or "undue" preference and prejudice. _A firm whose average costs are above its marginal costs is the worst possible candidate for being forced to sell any output at less than marginal cost_. Economically speaking, such sales always represent "unjust" discrimination in any industry. The injustice, or unjustness, must simply be enhanced if the firm would have to differentiate its prices to some extent even if it made no sales at less than marginal cost.

Therefore, if the definition of "cross-subsidization" begins, as it must, with reference to some sales below marginal cost, then the very idea of cross-subsidization is peculiarly inappropriate to a firm subject to economic regulation. Yet this same idea of cross-subsidization is peculiarly appropriate to the regulatory process. Hence, whenever a regulatory body forces cross-subsidization on a regulated firm, it is employing what is in any event an irrational economic device in the worst possible context, and running precisely counter to the reason for the very existence of economic regulation.

Fifth, there have always been logical incongruities related to the twin pursuits in the field of transportation of regulation and competition. American policy has never come out whole-heartedly for either. It has never attempted to spell out, in detail, what the interrelationships and relative roles of the two should be. Certainly the Preamble to the Transportation Act of 1940 does not aid in clarifying these issues. So, whatever the economic irrationalities inherent in regulation itself, they are certainly not reduced by the fact that regulation is apparently expected to work in double harness with a quite different and even incompatible concept called "competition." The paradoxes which have been created by this expectation are almost endless. To save time, they will be illustrated by the classic railroad problem of strong and weak roads.

The first aspect of this problem related to the textbook examples of strong and weak roads which are parallel and therefore to some extent competitive. Without entering into any detailed inquiry with respect to the criteria to be used in sorting the strong from the weak, it should be evident that parallel routes between major traffic points are likely to engage in competition in some form and to some degree unless they are prevented by some extreme action--such as merger--from doing so. It should also be evident that, for a number of reasons, this competition is not likely to leave them equally well off. One will have lower operating or capital costs per unit of traffic than the other, or one will have more volume than the other, or one will have more, or more profitable, intermediate traffic than the other, and so on. So the question then becomes--as it became for those who drafted the Transportation Act of 1920--how to equalize the economic position (and presumably also the competitive strength) of these various carriers? Although the "Recapture Clause" was not aimed specifically at the parallel-railroad problem, the Congressional history of the Act of 1920 shows that this parallel-railroad problem was a prime ingredient in the thinking which went into the act and its passage.

The failure of the "Recapture Clause" is a matter of historical record. Some of the reasons are still of interest. The first, which has already been discussed, is that the idea of the strong helping the weak loses its attractiveness and economic rationale if no one is really very strong and many are very weak. The second is that truly competitive firms will go to almost any lengths to avoid having to pay over portions of their earnings to a direct competitor. The Recapture Clause was perfectly compatible with the idea of pooling--permission for which was in fact granted by the act of 1920, with I.C.C. consent. Regulation is also perfectly compatible with the idea of pooling. But the effect of pooling is not just to redistribute the tonnages or the earnings which would otherwise have been allocated in a competitive market. It is to reduce the attractiveness of competition. Thus the contradiction in trying on the one hand to retain competition between major terminals and on the other to share profits which are in part derived precisely from supposedly competitive traffic between these terminal points.

Finally, the Recapture Clause revealed the economics of "regulation as an end in itself" in its worst possible light. Assuming that the idea of regulation implies some idea of an appropriate rate of return; and assuming that the existence of direct competition between unequal competitors prevents one or both from earning what would be an appropriate return on the average; then the economic answer would not be to force a merger solely to gain regulatory advantage from the fact that the average return now becomes the return for the sole remaining firm. This conclusion converts the economics of regulation into the regulation of economics.

So much, then, for the parallel-railroad aspects of the strong-and-weak road problem. There has always been, and still is, a regional, or end-to-end, aspect to the problem. Historically, most railroads in official territory were stronger than their opposite numbers in the South and West. Since World War II, the relationship has been almost the exact reverse. But, in both eras (beginning in 1920), the Interstate Commerce Commission has had powers to do something about rectifying the situation through its legal controls over divisions. A glance at any publication of the I.C.C. would reveal that the commission has been intensely active as an arbitrator in divisions cases. But, aside from the New England railroads, the record stands practically mute with respect to any commission role as an originator of ex parte divisions cases.[3]

Why the difference between the law and the facts? There are doubtless many possible explanations. But one would certainly be that a railroad which originates an exceptionally large volume of profitable freight holds a whip over its connections. This is especially obvious when the railroad would be short-hauling itself if it turned over freight to some other carrier. But it is also true even in strictly end-to-end situations. Given this commercial fact of life, a regulatory body either in effect takes over the entrepreneurial function by allocating traffic (which is what control of relative profitability by use of divisions would finally have to come down to), or, in general, takes as little initiative as possible. The Interstate Commerce Commission has chosen the true "regulatory" (as opposed to entrepreneurial) route--to do as little as possible.

THE MOTOR CARRIER AS A SINGULARLY INAPPROPRIATE OBJECT OF ECONOMIC REGULATION

It should be evident, by now, that the case for the economic effectiveness and rationality of transport regulation would contain a number of weaknesses even if no one had ever invented the internal combustion engine or built a modern highway. But the great paradox of regulation of motor carriers in the United States has been that the very technological innovations whose thrust should have been entirely toward reducing railroad regulation have instead been employed as an excuse for retaining or even increasing motor carrier regulation. Even by the loose kind of logic which has always characterized American attitudes toward railroads-we want regulation and competition--then the appearance on the scene of a major new source of potential competition should have weakened the previous case for regulation.

Moreover, American motor carrier regulation has always suffered from a failure to decide what it is intended to accomplish. Specifically, as viewed from the carrier's standpoint, it might rationally be expected to do one of two things: to give artificial support to the earnings and the competitive position of the railroad industry, or to increase the earnings of the motor carrier industry as a whole. From the consumers' standpoint, it might be expected to concentrate on specific areas where modes--and, in particular, individual firms--retain market dominance in spite of enhanced intermodal competition.

As the following paragraphs will indicate, the U.S. regulatory approach has managed to accomplish either the opposite of the "rational carriers' goal," or at most to accomplish results which are only accidentally related to it. Until the passage of the Four-R Act of 1976, it had never faced up in a general way to the consumers' goal even with respect to railroads. It has still paid practically no attention to this goal with respect to motor carriers.

First, for the "rational carriers' goal." In many foreign countries, regulation of motor carriers has one frank and professed objective: to protect the railroads. This object was clearly an important influence behind the passage of the Motor Carrier Act in the U.S. in 1935; but it has never been frankly professed, and it has certainly never been rationally or consistently pursued. Since the railroads are the only 100%-regulated form of ground transportation, protection of railroads would have been compatible with, and in fact necessary to, protection of regulation. Given the actual course of congressional enactments and regulatory policy, the actual result has been the undermining of regulation by deliberate failure to pass legislation which would permit the regulation of those motor carriers most competitive with the railroads. Specifically, a U.S. policy of protection of both railroads and regulation as such would require the following:

-- The regulation of all rates and service by other modes with respect to those bulk commodities, and main-line hauls, for which the railroads in any event have the comparative advantage (economic rationale: to enable the railroads to cover the massive gap between marginal and average cost most efficiently). But, as embodied in actual legislation, policy has been to exempt agricultural commodities moving by motor carrier in whatever volume; in effect, to exempt most so-called "common carrier" barge movements from rate control; to exempt private trucking (which must have special appeal for certain bulk shippers of manufactured goods); to apply less restrictive rules with respect to one or another aspect of regulation to those regulated trucking enterprises which compete most directly with railroads (contract carriers; irregular-route common carriers), than to those motor carriers which compete least directly with railroads. Contrariwise, regulation which was really designed to protect the railroads would forbid private carriage, eliminate exempt commodities for both motor and barge carriers, and so on, until finally it would apply least regulation to regular-route motor carriers of general commodities who specialize in less-than-truck-load shipments which the railroads are in any case technically incapable of handling efficiently. Moreover, it would exert an upward tendency on all motor carrier and barge rates by placing rigid limits on motor carrier and barge capacity. But, in U.S. motor carrier cases, the idea of "entry" relates to firms and to specific commodities, or routes, etc., whereas effective regulation, from the railroad standpoint, would relate to over-all capital plant employed in alternative modes of carriage, and possibly to over-all labor force.

Obviously, if protection of the railroads was ever visualized as a result of I.C.C. regulation of motor carriers, that idea was lost somewhere along the way between 1935 and the present. A description of what regulation could hypothetically do to protect the railroads if it were permitted to do so is almost the exact opposite of a description of regulation as it has in fact developed in the United States since 1935. The explanation, of course, lies far beyond anything the Interstate Commerce Commission has done, or has failed to do, or legally could do. Basically, the American public would never have stood for the kind of regulation outlined above, and would certainly not stand for it now. This is in spite of increasing solicitude on the part of both Congress and the general public with respect to the future and eventual fate of freight-carrying railroads. Whatever the American public finally decides to do about the financial and operating problems of the American railroads, with respect to any geographical area or any service, it will not expect to achieve any significant or useful results from either the continuation or stiffening of motor carrier regulation. This is not an economic statement. It cuts more deeply than a political statement. It simply describes one aspect of the good sense of the American public.

If actual U.S. regulatory legislation and regulatory practice have been largely the opposite of what one would expect if the object were to protect the railroads or advance their interests, then how does one explain the record of motor carrier regulation since 1935?

The answer cannot be found, in general, in protection for the trucking industry as such, although official spokesmen for the regulated motor carrier industry would doubtless strenuously dispute this contention--as they always have. The answer to this apparent paradox of strenuous support for the useless or even harmful must be found in several directions.

It must be found, first of all, in the distinction between public relations and economic reality. Any organization whose functions and personnel are oriented toward Washington, D.C. must draw part of its life and its raison-d'être from Washington, D.C. Thus, although the allegation that regulators are the captive of those who are regulated must be viewed with a skeptical eye, there can be no question that those who are regulated are the captives, or at least the willing accomplices of the regulators. Regulation may not improve the economic position of the regulated industry in any discernible way, but it certainly improves the position of those who manage the inter-relationships between the industry and the regulators.

Second, this support must be a consequence of the fact that regulation of the motor carrier industry tends in some respects to create what it professes to regulate--and, in the process of creation, to create pockets of special economic favor for individual firms regardless of the over-all relationship of such pockets to the interests of all motor carriers or of the general public. For example, there is no reason why the unregulated, competitive motor-carrier movement of any or all commodities in truckload lots should ever produce any significant degree of price discrimination with respect to shippers or consignees who ship or receive truckload lots, or with respect to localities or areas within which, or between which and the rest of the country, truckload movements are reasonably frequent. The function of regulation of rates, in this environment, must therefore be to create discrimination, not to diminish or eliminate it. Therefore the regulatory goal of eliminating "unjust" discrimination of "undue" preference and prejudice involves an economic contradiction in terms. The adjective would be unnecessary if the noun had not already been brought into existence by regulation itself. The only sure way to eliminate the "unjust" or the "undue" is clearly to eliminate all discrimination, and all preference and prejudice--which would be largely accomplished by free competition in movement of truckload lots. This free competition would also, of course, have a substantial influence on markets for less-than-truckload movements.

Moreover, the method in which entry controls are operated by U.S. regulatory law and practice also serves to create the same kind of discrimination--in this case between firms. If regulation took the form solely of over-all limits on carrier capacity, then every firm would presumably have an equal chance as far as the regulatory authorities were concerned to reach most efficient size, scale, and geographical extent of operations, maximize profits, and so on. As long as operating rights are related not to total capacity but to specific commodities, or routes, etc., then carriers with more extensive rights are bound to have at least potential advantages over carriers with less extensive rights, as long as "operating right" is not fully counterbalanced by "operating duty." The idea of "common carrier responsibilities" is much discussed in regulatory circles. For passenger traffic, this idea may have a good deal of economic content, because quality of service may at least be defined in general terms via requirements as to frequency, average speed, percentage of on-time performance, cleanliness and safety of equipment employed, and so on. For freight, some of these service standards are irrelevant, and none is really enforceable without the dispatch of an army of inspectors to every loading dock. Moreover, large motor carriers of freight cannot be economically structured to specialize in the needs of out-of-the-way places, or the requirements imposed by small shippers of infrequent shipments. Therefore regulation which really did achieve special results with respect to such localities, shippers, and shipments would bear most heavily on small local carriers and least heavily on large national carriers.

But, even in the absence of I.C.C. Inspectors General in every village in America, the present system of regulation is adequate to give large firms with extensive operating rights the opportunity to be more profitable (and more selective in freight solicitation and freight service) than small firms with less extensive operating rights. Large firms can offer shippers a wider range of through services. Even if freight does not have to move through intermediate terminals, mere transfer from one carrier to another both increases carrier costs and reduces the quality of the service rendered to the shipper. Therefore a system of regulation which compels small local firms to remain small and local unless they can obtain regulatory permission for expansion (or try to compete, however unavailingly, against larger firms in the purchase of existing operating rights), creates a form of "strong-and-weak-road" problem not only as between individual trucking concerns but possibly even as between classes or size groups of trucking concerns. The railroad strong-and-weak-road problem largely grew up before regulation and has continued and in some respects worsened perhaps partially in spite of regulation. The motor carrier strong-and-weak problem has grown up after regulation. It is, in fact, a product of regulation. So, as with rate discrimination, the problem of dealing with the economic consequences of regulatory discrimination as between motor carriers involves a self-inflicted wound. The problem was created by regulatory action, and cannot be markedly reduced without--at the very least--a revolutionary shift in the basis on which access to the common carrier motor freight industry is controlled in the United States.

Third, purely in terms of its economic, financial, and technical characteristics, the motor carrier industry is singularly hard to regulate unless regulation is made an end in itself regardless of economic consequences. The merest summary must suffice:

-- The motor carrier industry differs fundamentally from the railroad industry in inherent financial strength. There can be no question of the ability of regulated motor carriers as a whole to earn whatever return they are permitted to earn. But, from the administrative and bureaucratic standpoint, there are exceptionally difficult questions with respect to the relationship between allowed return and actual rates charged.

The problem lies partly in the number and importance of small firms in the industry. For small family firms, reported rates-of-return on capital investment are notoriously unreliable for all industries even in the absence of regulation, for reasons having to do with income tax legislation and changes therein, determination of "appropriate" or "normal" rates of pay for family members employed in the enterprise or of "normal" yields on capital controlled by family members but not directly subject to regulatory scrutiny, and so on.

A further contributing factor is the fact that the shipments covered by the rates filed by individual rate bureaus, which are the rates on which the Interstate Commerce Commission must act in general rate cases, do not directly correspond to the shipments made by individual firms. Some large motor carriers handle shipments subject to rates filed by a number of rate bureaus, while many small carriers are completely encompassed by the jurisdiction of only one. There can be no realistic way of splitting up the finances of the "multi-rate-bureau" firms into their geographical components, or even of pinning some of their profits or losses down to the rates filed by <u>any</u> one rate bureau. Therefore there can be no realistic way even of determining how specific rate decisions relate to the financial needs of the industry (as opposed to the duplicated""needs" and "resources" of large carriers whose financial results show up in more than one presentation for rate increases). Thus, in effect, there is not even a realistic way of relating regulatory rate policy specifically to the question of whether the authorization of specific rates will make regulated motor carriers a strong or weak <u>industry</u>. Rates are not filed, or considered, on an industry-wide basis, and therefore cannot be compared with industry-wide finances.

Finally, the regulated motor carrier industry is capital-<u>non</u>-intensive (and labor-intensive) to a degree which is probably unique among regulated industries. In an industry where both costs for labor and the quality of service for which this labor is largely responsible are both so subject to variation, and where independent determination and enforcement of service standards would be almost impossibly difficult even if it were economically productive, rate-of-return control of the kind which is commonplace for electric or telephone utilities takes place against a background which replaces the "givens" of electric or telephone utilities with what may amount almost to "unknowns." Motor carriers not only have a small capital investment per dollar of revenues relative to other regulated industries; they also turn the major single component of this investment with unusual rapidity, and can dispose of unneeded capital with unusual ease and rapidity in a very extensive used-truck market. All of these attributes make rate-of-return regulation of motor carriers more difficult than rate-of-return regulation in other fields where such regulation is economically feasible.

Where does this leave us? Most of all, with the conclusion that economists, in asserting that the motor carrier industry is a singularly poor candidate for regulation, are better scientists than even they themselves may realize. The motor carrier industry is, in fact, such a singularly poor candidate for regulation, that, in the United States at least, it is to most <u>economic</u> intents and purposes not in fact regulated. The very extensive portion of the motor carrier industry which is totally unregulated even by legal standards must exert enormous pressure toward relaxation in the supposedly "regulated" area; and there is no sign that the I.C.C. pleas to Congress for extensive new regulatory authority will achieve any substantial change in this situation.

Even within the regulated sector of the trucking industry, "full-line" regulation of the railroad type tends to be confined to that portion of the industry whose commercial and economic charac- terictics are least like those of the railroads--regular route motor common carriers of general commodities. So the railroad analogies which abound both in the Interstate Commerce Act and Interstate Commerce Commision decisions tend to verge on the irrelevant.

Moreover, somewhere along the way the whole relationship of motor carrier regulation to motor carrier economics has been turned topsy-turvy. Rate structures must supposedly be controlled to prevent unjust discrimination, whereas complete absence of control would largely prevent any discrimination; rate levels are adjusted with an eye to the fortunes of weak carriers, who may be weak in part because they have been discriminated against by the regulatory process itself in the distribution of operating rights, and so on. Underlying all of this is a kind of regulatory Parkinson's Law: regardless of the under- lying economic characteristics of an industry, or its initial suitabil- ity for government economic regulation, the regulation itself will be not only self-justifying but self-extending because it will tend to create a number of new economic evils (rate discrimination, differential rates-of-return, etc.) which will, in turn, require further regulation-- not for their eradication; just for their control.

CONCLUSIONS

This brief section will consist less of "conclusions" in the usual sense than of a summary of the overlapping and interlocking arguments which have already been advanced.

But, before this is attempted, we must face up to the obvious fact that the Interstate Commerce Commission has existed for ninety years; at present, its powers and duties are being expanded. This expansive vigor may seem hard to reconcile with what has been said in this paper.

So what is the affirmative case for economic regulation, as exemplified by the Interstate Commerce Commission?

The affirmative case must be, simply and obviously, that it has not been economic regulation at all, and was perhaps never intended to be. The Interstate Commerce Commission has been a continuing political success because that has always been the role it has been expected to play. The idea of an "independent regulatory commission" makes con- siderable sense if it is viewed from the standpoint of the executive branch of the government (although controls still exist, via the appointment process and the budgetary process). But it makes no sense at all if viewed from the standpoint of either Congress or the Supreme

Court. The Interstate Commerce Commission has survived and even prospered precisely because it is a dependent agency, not an independent agency. It is dependent on today's politics, as exemplified by Congress and its committees, and on yesterday's politics, as exemplified by the Supreme Court. The leading strings are very much in place; but they should not be sought in the direction of the economics profession.

Furthermore, this dependence fits in with the supposed idea of Interstate Commerce Commission expertise. A cursory examination of the backgrounds of any group of commissioners at any period of the I.C.C. history would reveal that the expertise which is sought is political expertise, not economic expertise. In fact, since the days of Winthrop M. Daniels the emphasis on knowledge of economics on the commission has considerably declined. For an industry with certain decreasing cost characteristics, such as the railroad industry, there must inevitably be a political flavor to the process of ratemaking--especially when the industry is still highly dynamic, and when the industry, as such, still has enough of a monopoly to enjoy great room for maneuver in terms of rate structures and profitability. This inevitably political flavor is combined with a myriad of technical details which individual congressmen cannot be expected to master, and which would simply overwhelm Congress if they ever got out on the House or Senate floor. What is needed, therefore, is a kind of expert who has shown keen political interests, good political aptitudes, and excellent practical judgment as to which way the political cat is likely to jump--not in terms of over-all national ideology, but in terms of the kind of micro-economic issue which concerns a Chamber of Commerce, a port authority, a group of carriers, or a class of shipper. This is pretty much the kind of expert that the I.C.C. has attracted. The results permeate the whole regulatory process; administrative judges, unlike Supreme Court justices, cannot be expected to be independent.

Thus, in the Interstate Commerce Commission, the Congress must have obtained pretty much what it has asked for. There is no arguing with success. But what Congress has asked for has been regulation, not economic regulation. And what Congress has often asked for, in whispers that can be heard by the Interstate Commerce Commission if not by the general public, is "regulation" (the semblance or outward signs of regulation), not regulation in any real or realistic form.

But even this affirmative case has special applicability to railroad regulation as it existed relative to the railroad industry of the United States in 1929 or earlier years. It has little or nothing to do with the motor carrier industry. In 1935, the "cross-elasticity" and "analogy" arguments might seem to make sense. It could be maintained that there was an increasing degree of cross-elasticity between shippers' demands for rail and for motor carrier service, and that, on the demand side, motor carriers should be regulated "like the railroads." But, on the supply side, motor carriers are not railroads and cannot be made into railroads. No one would seriously propose any effort in this direction. So the net result is that the growth of the trucking industry has weakened the case for most railroad regulation, because motor carriers have been a major factor in eliminating any prospect of regulation of over-all railroad rates of return; they have been a major factor, in the past, on railroad rate structures; and they have been a very major factor in creating an entirely new mode of transportation, with service characteristics superior to those of most railroad service. There is only one area in which the growth of the trucking industry may have strengthened the case for any kind of regulation. This area pertains to motor carriers with nationwide operating rights with respect to less-than-truckload shipments of general freight.

Otherwise, the summation must be that economic regulation in the United States does not, cannot, and is not meant to approach the kinds of goals, the kinds of methodology, and the kinds of reasoning which are appropriate to the word "economic"; that transportation regulation has special difficulties, from this standpoint, which are not present in public utility regulation; and that, if motor carrier competition has made the economic aspects of most railroad regulation obsolete, it has created almost no economic case for regulation of motor carriers.

NOTES

1. The reader will note that this sentence is a vulgarization of perhaps the best-known doctrines of Joseph A. Schumpeter, outlined definitively in Business cycles (1939), Vol. 1, 72-129.

2. The general case for continued regulation that is indicated by these brief comments is spelled out, in detail, in a paper by the present Chairman of the Interstate Commerce Commission, A. Daniel O'Neal (1975). The article contains the following editorial footnote:

> On October 15, 1974, Chairman O'Neal publicly noted that the premise of 'no clamor for deregulation' advanced by the title no longer seemed as solid as it did at the time of his February remarks before the American Enterprise Institute.

Chairman O'Neal's more recent comments have amply borne out this change in appraisal.

3. In spite of the voluminous literature on class rate cases and their concern (inter alia) with territorial rate scales, it remains true that (1) this concern is limited, in its direct application, to class rates (which have become a trivial source of railroad freight revenues); and (2) this concern has apparently long since departed from the kind of issue that was among those uppermost in New England Divisions (U.S. Interstate Commerce Commission, 1922). As the very title indicates, the ICC approached the New England problem as a territorial problem. Compare the testimony of George M. Stafford, who was then Chairman of the Interstate Commerce Commission, before a Congressional subcommittee in 1975 (U.S. Congress, House, Committee on Interstate and Foreign Commerce, 1975, p. 203):

> The contention is advanced that regulation is largely responsible for the plight of those railroads that are in economic difficulty and that this bill will remove a major roadblock to profitability. We dispute the premise that regulation has had a substantial impact on the economic troubles of some railroads. We note that numerous factors--the unavailability of long-haul traffic in the northeast and the relatively high cost of doing business in that region, the effects of the present major recession, the unequal subsidization of other modes of transportation, archaic work rules, management problems, et cetera--have contributed to the financial weakness of most of the railroads in the northeast and some in the midwest.

> But we do not believe that there has been any persuasive showing made that regulation has substantially contributed to the plight of railroads in this region. On the contrary, the overall relative health and stability of the other railroads outside of the region suggest that the root causes of the problem are those factors specifically applicable to the weak northeastern and midwestern railroads, rather than across-the-board commission regulatory policies.

What this seems to say is that the Interstate Commerce Commission of 1975 had no interest in specifically territorial problems.

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LOAD FACTORS OF MOTOR CARRIERS ON THE INTERSTATE HIGHWAY SYSTEM: CONSEQUENCES FOR REGULATORY POLICY

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SUMMARY

The Interstate Commerce Commission (ICC) has recently completed a large survey of load factors of trucks with three axles or more on the Interstate system. These data are important because they correct some of the survey design features of the best load factor data previously available, the Federal Highway Administration loadometer studies (U.S. Department of Transportation 1975) and the Bureau of the Census Truck inventory and use survey (1972). Much criticism of the effects of regulation on empty mileage was based on the Census and FHWA data,[1] but the previous data have been criticized as inadequate (Bisselle 1976; Interstate Commerce Commission 1975).[2] The preliminary data presented in the present paper are based on only the first six months of the ICC survey. Nevertheless, they warrant the following tentative conclusions, subject to confirmation with publication of the full year's data by the ICC:

(1) Carriers experienced empty mileage in unspecialized vans ranging from 12.8 percent for non-owner/operators operating under ICC authority to 30.3 percent for exempt carriers. Other unspecialized equipment (refrigerated vans and flats) experienced similar ranges of empty mileage.

(2) All classes of carriers had similar empty mileage, approximately 40 percent, for the specialized equipment category, "Tank, Bulk, and Other."
(3) Exempt and private carriers experienced materially higher percentages of empty miles in unspecialized equipment than did carriers operating under ICC authority.
(4) Owner/operators and non-owner/operators operating under ICC authority had similar percentages of empty miles and load factors averaged over all equipment types. However, owner/operators performed worse than non-owner/operators in the unspecialized van category, where they appeared to be most handicapped by lack of operating authority. Owner/operators had fewer empty miles than non-owner/operators for flats and refrigerated vans operating under ICC authority.
(5) Private carriers are somewhat more concentrated in specialized equipment and experienced significantly shorter trips than did ICC-regulated carriers.
(6) The ICC data do not differ fundamentally from the FHWA or Census data in their implications for the consequences of economic regulatory change, despite lower estimates of empty miles for some categories of traffic in the ICC data.
(7) If one assumes an objective of minimizing empty mileage, the data support regulatory changes to eliminate or modify some of the operating authority restrictions that handicap private carriers -- tripleasing to common carriers, restrictions on intercorporate carriage, and restrictions on mixing contract and common carrier authority with private carriage.

The preliminary ICC data have indicated that all classes of carriers are experiencing relatively high percentages of empty miles. Had highways other than the Interstate system been included in the sample frame, with more short-haul traffic and more specialized vehicles, even higher percentages would have been observed. The empty mileage problem is significant for all carriers and deserves attention as a priority issue for regulatory policy.

A. STATISTICAL PROFILE OF THE MOTOR CARRIER INDUSTRY

A complete and consistent data source of the vital statistics of the intercity motor carrier industry (vehicle miles, ton miles, load factors and length of haul) is not currently available. This paper uses the ICC Motor Carrier Empty/Loaded Survey to develop a data set for evaluation of proposed regulatory changes.

Survey Design

The 1976 ICC Motor Carrier Empty/Loaded Survey has been conducted by the Bureau of Economics of the ICC. It consists of a series of questionnaire interviews with the drivers of motor vehicles with three or more axles who are involved in truck movements at 221 segments on the Interstate Highway System. These 221 segments were chosen to represent the intercity portion of the system.[3]

Sampling only interstate traffic probably tends to sample more heavily longer distance traffic, that is less likely to be served by private carriers. Thus, the actual percentage of intercity truck traffic represented by private carriage is greater than that reported here. The sample, however, is a good representation of traffic most likely to be affected by changes in economic regulation of interstate motor carriers.

At the end of the second quarter of 1976, 6,300 observations had been recorded. The interviews were conducted by ICC personnel by stopping the trucks selected for sampling on the segments and questioning the driver. The questionnaire requested the name and location of the carrier, a description of the equipment, the license number and issuing state, the type of fuel used by the vehicle, whether the truck or tractor was leased, the operating authority under which the carrier is operating, the origin and destination of the vehicle, the points enroute, whether the vehicle was empty or loaded, the commodity being carried and its weight, and remarks concerning the reasons why the truck is empty or partially loaded. At the time of the preparation of this study, the survey had been completed only for the first two quarters of the year, a winter and spring period. Analysis of the third and fourth quarter data after the computations indicates that the data are representative of the year as well. Nevertheless, final conclusions must await the publication of the annual data by the ICC.

By special request, the information was aggregated by ICC personnel to show the type of carrier, the type of equipment, its loading, and whether the vehicle was leased with or without a driver. The questionnaire did not identify whether the ICC authorized carriers were regular route carriers or irregular route carriers. However, it is possible to discriminate between general purpose vans operated by owner/operators, who operate primarily under irregular route authority, and general purpose vans operated by non-owner/operators, who typically operate under regular route general commodity authority. There are some owner/operators working in all segments of the industry, however, and the distinction is clearly not absolute.[4] The other equipment types are heavily represented by irregular route authority for both types of operators.

ICC Data on Empty Miles and Load Factors on the Interstate System

The basic data obtained from the ICC on the number of trucks observed in each category are presented in Table 1. This table shows the load factor for each equipment type for each class of carrier authorization.

TABLE 1
SPACE UTILIZATION ICC MOTOR CARRIER EMPTY/LOADED SURVEY BY TYPE OF EQUIPMENT AND TYPE OF CARRIER
(Quarters 1 and 2, 1976)

(Percent of Truck Space Used[4])

ICC AUTHORIZED	0	25	50	75	100	Total	Average Load Factor[3]
Van							
OO,[1] number	89	35	30	36	240	430	.676
OO, percent	20.6	8.1	7.0	8.4	55.3	100.0	
NOO,[2] number	181	59	85	109	981	1415	.792
NOO, percent	12.8	4.2	6.0	7.7	69.3	100.0	
Ref. Van							
OO, number	25	3	7	12	191	238	.858
OO, percent	10.5	1.3	2.9	5.0	80.3	100.0	
NOO, number	42	8	16	12	161	239	.753
NOO, percent	17.6	3.3	6.7	5.0	67.4	100.0	
Flat							
OO, number	71	9	7	23	285	395	.780
OO, percent	18.0	2.3	1.8	5.8	72.1	100.0	
NOO, number	65	4	4	7	149	229	.687
NOO, percent	28.4	1.7	1.7	3.1	65.1	100.0	
Tank + Bulk + Other							
OO, number	41	1	2	7	54	105	.576
OO, percent	39.0	1.0	1.9	6.7	51.4	100.0	
NOO, number	142	5	12	31	172	362	.559
NOO, percent	39.2	1.4	3.3	8.6	47.5	100.0	
Total							
OO, number	226	48	46	78	770	1168	.739
OO, percent	19.3	4.1	3.9	6.7	65.9	100.0	
NOO, number	430	76	117	159	1463	2245	.739
NOO, percent	19.1	3.4	5.2	7.1	66.2	100.0	

Table continued on following page.

TABLE 1 (Continued)
SPACE UTILIZATION ICC MOTOR CARRIER EMPTY/LOADED SURVEY BY TYPE OF EQUIPMENT AND TYPE OF CARRIER
(Quarters 1 and 2, 1976)

(Percent of Truck Space Used[4])

	0	25	50	75	100	Total	Average Load Factor
EXEMPT							
Van							
OO, number	10	1	0	3	19	33	.650
OO, percent	30.3	3.0	0	9.1	57.6	100.0	
NOO, number	50	7	12	7	102	176	.646
NOO, percent	26.1	3.9	7.3	3.9	57.3	100.0	
Total		5	12	10	121	211	.647
Ref..Van							
OO, number	8	1	3	3	41	56	.804
OO, percent	14.3	1.8	5.4	5.4	73.2	100.0	
NOO, number	43	4	4	6	180	237	.791
NOO, percent	18.1	1.7	1.7	2.6	75.9	100.0	
Total		5	7	9	121	293	
Flat							
OO, number	1	0	0	0	8	9	.889
OO, percent	11.1	0	0	0	88.9	100.0	
NOO, number	13	0	1	0	24	38	.645
NOO, percent	34.2	0	2.6	0	63.2	100.0	
Total			1	0	32	47	.691
Tank + Bulk + Other							
OO, number	1	0	0	0	6	7	.857
OO, percent	14.3	0	0	0	85.7	100.0	
NOO, number	50	0	2	8	71	131	.595
NOO, percent	38.2	0	1.5	6.1	54.2	100.0	

Table continued on following page.

TABLE 1 (Continued)
SPACE UTILIZATION ICC MOTOR CARRIER EMPTY/LOADED SURVEY BY TYPE OF EQUIPMENT AND TYPE OF CARRIER
(Quarters 1 and 2, 1976)

(Percent of Truck Space Used[4])

	0	25	50	75	100	Total	Average Load Factor
Total							
OO, number	20	2	3	6	74	105	.767
OO, percent	19.0	1.9	2.9	5.7	70.5	100.0	
NOO, number	156	11	19	21	377	584	.693
NOO, percent	26.7	1.9	3.3	3.6	64.6	100.0	
Total number		13	22	27	451	689	.704
PRIVATE							
Van							
number	301	74	84	71	587	1117	.627
percent	26.9	6.6	7.5	6.4	52.6	100.0	
Ref. Van							
number	71	21	19	33	134	278	.624
percent	25.5	7.6	6.8	11.9	48.2	100.0	
Flat							
number	127	10	11	11	249	408	.650
percent	31.1	2.5	2.7	2.7	61.0	100.0	
Tank + Bulk + Other							
number	162	7	11	22	193	395	.548
percent	41.0	1.8	2.8	5.6	48.9	100.0	
Total							
number	661	112	125	137	1163	2198	.617
percent	30.1	5.1	5.7	6.2	52.9	100.0	

[1]OO - Owner/operator, vehicle is leased with driver.

[2]NOO - Non owner/operator, equipment owned or leased without driver.

[3]Defined by a weighted average of truck space used.

[4]Defined by the percent of floor space covered with cargo.

In order to determine the average trip length of the various types of carriers, a one in twenty systematic random sample totaling 326 questionnaires was selected from the first and second quarters by ICC personnel. The origin and destination cities specified on the questionnaire form were used to determine the trip length shown in Table 2 and illustrated in Figure 1. The probability of selecting a truck in the sample is related to the length of the trip, the density of traffic and the distance between exits. Under the assumption that the probability of being selected is directly proportional to the trip length, the average distance of all movements should be estimated by the use of harmonic means. The simple average does not account for the fact that longer trips are more likely to be sampled.

The totals are reorganized by equipment type in Table 3. These are then summarized to produce the relative number of vehicles and space utilization in each class shown in Table 4. By comparing the results of Table 4 with Table 1 and Table 3, the following conclusions may be tentatively drawn based on the first six months' data:

(1) Owner/operators and non-owner/operators do not materially differ in percent of vehicle-miles that are empty or average load factor in the aggregate for all equipment types moving under ICC authority.

(2) Owner/operators travel empty more often and generally have lower load factors than non-owner/operators in the carriage of the ICC authorized movements in vans. (See Table 3) However, owner/operators have decidedly better performance for refrigerated vans and flats.

(3) Exempt carriers travel empty materially more often than do ICC regulated carriers, particularly for unspecialized equipment types.

(4) Owner/operators appear to travel empty less often than do non-owner/operators in exempt carrier service.

(5) Private carriers travel empty more often and have lower load factors than both regulated and exempt carriers for all equipment types averaged.

(6) Unspecialized equipment types (vans, refrigerated vans, and flats) have a substantially lower percentage of empty mileage than does specialized equipment.

(7) Long distance hauls are more typically full than are short trips and private carriage trips are shorter than trips by regulated carriers.[5] (Empty trips are more likely to be shorter trips, because the motivation to find backhaul cargo is less on shorter trips and empty miles are often incurred on short trips from the destination to the location of a backhaul load).

(8) The owner/operator accounts for approximately one in five of all vehicles on the Interstate system.

TABLE 2
SIMPLE AVERAGE AND HARMONIC MEAN TRIP LENGTH FOR
TYPE OF CARRIER AND PERCENT FULL

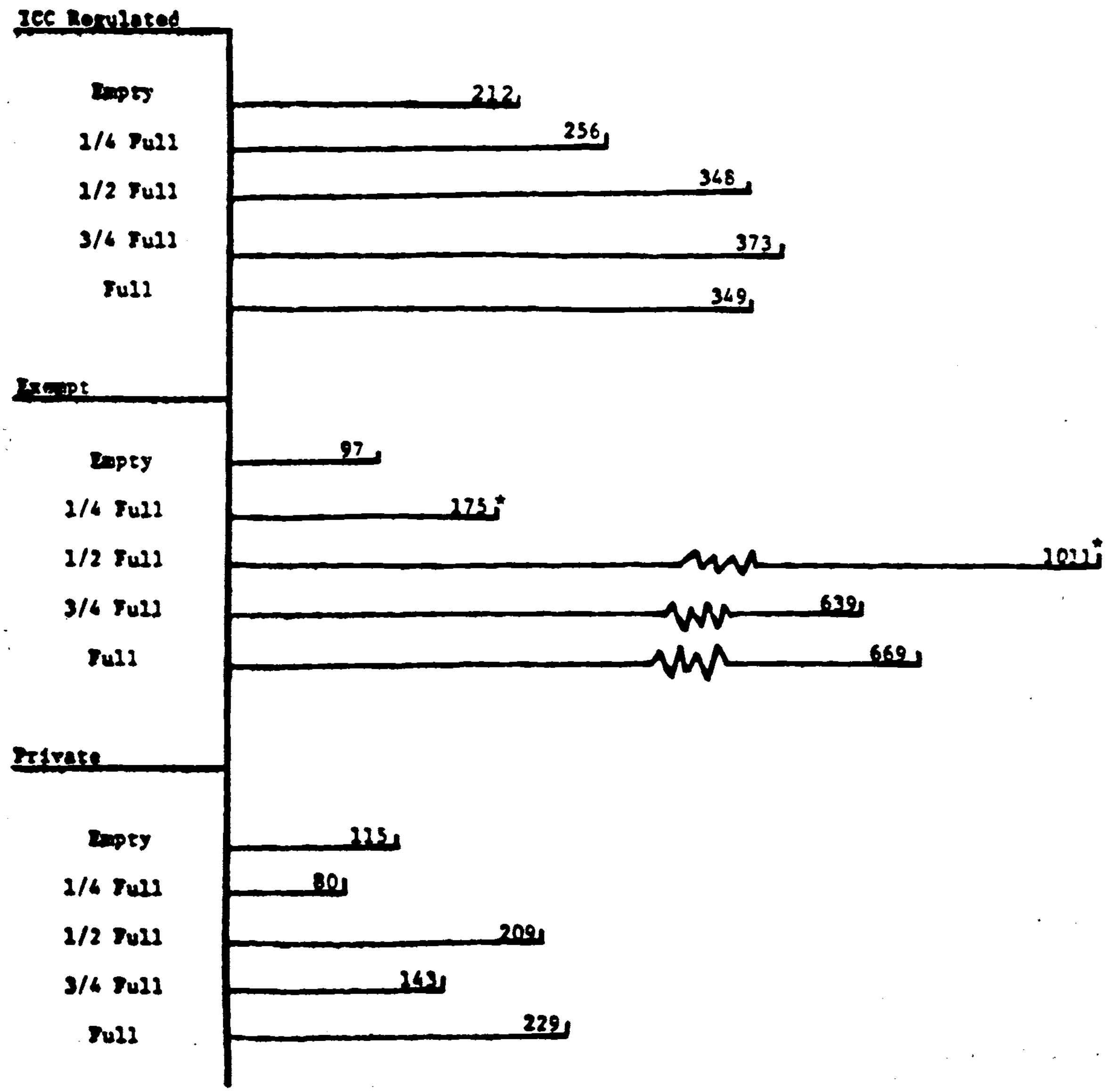
	Percent of Space Used				
ICC Regulated	0	25	50	75	100
Harmonic Mean	212.28	256.29	348.16	373.06	349.54
Average	290.79	559.67	714.7	1087.0	715.56
Exempt					
Harmonic Mean	97.46	175*	1010.66*	639.56	668.55
Average	240.00	175*	1231.50*	951.0	1670.20
Private					
Harmonic Mean	115.51	80.23*	209.18	143.60	229.52
Average	286.91	255.40*	494.33	679.00	660.55

*Denotes small sample size.

Source: Data provided from ICC 1976 Empty/Loaded Survey, first and second quarter.

Comment: The sampling locations were designed by the ICC to be representative of intercity truck traffic. Based on this assumption, the percent of trucks falling into each cell is a measure of the percent of vehicle-miles falling into each cell. To correct for bias, the sample should be weighted to account for traffic density and length of segment.

FIGURE 1
HARMONIC MEAN TRIP LENGTH FOR EACH TYPE OF
AUTHORITY AND VEHICLE LOADING



SOURCE: Table 2.

*Denotes small sample

TABLE 3
SPACE UTILIZATION FOR EACH EQUIPMENT TYPE

Percent of Truck Space Used

Van	0	25	50	75	100	Total	Load Factor
ICC OO, number	89	35	30	36	240	430	.676
ICC OO, percent	20.6	8.1	7.0	8.4	55.8	100.0	
Exempt OO, number	10	1	0	3	19	33	.650
Exempt OO, percent	30.3	3.0	0	9.1	57.6	100.0	
ICC NOO, number	181	59	85	109		1415	.792
ICC NOO, percent	12.8	4.2	6.0	7.7	69.3	100.0	
Exempt NOO, number	50	7	12	7	102	178	.646
Exempt NOO, percent	28.1	3.9	7.3	3.9	57.3	100.0	
Private, number	301	74	84	71	587	1117	.627
Private, percent	26.9	6.6	7.5	6.4	52.6	100.0	
Ref. Van							
ICC OO, number	25	3	7	12	191	238	.858
ICC OO, percent	10.5	1.3	2.9	5.0	80.3	100.0	
Exempt OO, number	8	1	3	3	41	56	.804
Exempt OO, percent	14.3	1.8	5.4	5.4	73.2	100.0	
ICC NOO, number	42	8	16	12	161	239	.753
ICC NOO, percent	17.6	3.3	6.7	5.0	67.4	100.0	
Exempt NOO, number	43	4	4	6	180	237	.791
Exempt NOO, percent	18.1	1.7	1.7	2.6	75.9	100.0	
Private, number	71	21	19	33	134	278	.624
Private, percent	25.5	7.6	6.8	11.9	48.2	100.0	
Flat							
ICC OO, number	71	9	7	23	285	395	.780
ICC OO, percent	18.0	2.3	1.8	5.8	72.1	100.0	
Exempt OO, number	1	0	0	0	8	9	.889
Exempt OO, percent	11.1	0	0	0	88.9	100.0	

Table continued on following page.

TABLE 3 (Continued)
SPACE UTILIZATION FOR EACH EQUIPMENT TYPE

Percent of Truck Space Used

	0	25	50	75	100	Total	Load Factor
ICC NOO, number	65	4	4	7	149	229	.687
ICC NOO, percent	28.4	1.7	1.7	3.1	65.1	100.0	
Exempt NOO, number	13	0	1	0	24	38	.645
Exempt NOO, percent	34.2	0	2.6	0	63.2	100.0	
Private, number	127	10	11	11	249	408	.650
Private, percent	31.1	2.5	2.7	2.7	61.0	100.0	
Tank + Bulk + Other							
ICC OO, number	41	1	2	7	54	105	.576
ICC OO, percent	39.0	1.0	1.9	6.7	51.4	100.0	
Exempt OO, number	1	0	0	0	7	7	.857
Exempt OO, percent	14.3	0	0	0	85.7	100.0	
ICC NOO, number	142	5	12	31	172	362	.559
ICC NOO, percent	39.2	1.4	3.3	8.6	47.5	100.0	
Exempt NOO, number	50	0	2	8	71	131	.595
Exempt NOO, percent	38.2	0	1.5	6.1	54.2	100.0	
Private, number	162	7	11	22	193	395	.548
Private, percent	41.0	1.8	2.8	5.6	48.9	100.0	
Total Less Tank							
ICC OO, number	185	47	44	71	716	1063	.755
ICC OO, percent	17.4	4.4	4.1	6.7	67.4	100.0	
Exempt OO, number	19	2	3	6	68	98	.760
Exempt OO, percent	19.4	2.0	3.1	6.1	69.4	100.0	
ICC NOO, number	288	71	105	128	12[illegible]	1883	.774
ICC NOO, percent	15.3	27.7	5.6	6.8	68.5	100.0	
Exempt NOO, number	106	11	17	13	306	453	.722
Exempt NOO, percent	23.4	2.4	3.8	2.9	67.5	100.0	
Private, number	499	106	114	115	970	1803	.632
Private, percent	27.7	5.9	6.3	6.4	53.8	100.0	

TABLE 4
PERCENTAGE DISTRIBUTION OF TRUCKS OBSERVED IN ICC DATA SET FOR ALL EQUIPMENT TYPES

PERCENT OF SPACE USED

	0	25	50	75	100	Total	Percent of Total Vehicles	Average Load Factor
ICC OO, number	226	48	46	78	770	1168	18.54	.73929
ICC OO, percent	19.4	4.1	3.9	6.7	65.9	100.0		
Exempt OO, number	20	2	3	6	74	105	1.67	.7667
Exempt OO, percent	19.0	1.9	2.9	5.7	70.5	100.0		
ICC NOO, number	430	76	117	159	1463	2245	35.63	.73931
ICC NOO, percent	19.1	3.4	5.2	7.1	65.2	100.0		
Exempt NOO, number	156	11	19	21	377	584	9.27	.6935
Exempt NOO, percent	26.7	1.9	3.2	3.6	64.6	100.0		
Private, number	661	113	125	137	1163	2198	34.89	.6172
Private, percent	30.1	5.1	5.7	6.2	52.9	100.0		
	1493	250	310	401	3847	6300	100.0	.6929
Exempt Combined number	176	13	22	27	451	689		.7046
percent	25.5	1.9	3.2	3.9	65.5	100.0		

Source: Computed from Table 3.

The overall load factor results are illustrated in Figure 2. The figure shows that both classes of ICC regulated vehicles have similar average load factors. Load factors differ significantly across equipment types for owner/operators and non-owner/operators. Also, the load factors for ICC-regulated vehicles are consistently above those for exempt and private carriage.

Calculation of Ton-Miles and Vehicle-Miles by Class of Carrier

The total number of vehicle-miles in intercity motor carriage is allocated to each of the classes of carriers in Table 5 by employing the assumption that the ICC sample is representative of the composition of traffic for all intercity highways. The total number of vehicle-miles is inferred from the data on load factor, intercity ton-miles from U.S. DOT National Transportation Statistics 1976 and an assumed 20 ton payload capacity per truck.[6]

The distribution of ton-miles for each class of carrier is developed by multiplying respective vehicle-miles in Table 5 times average tonnage found in a fully loaded vehicle times the respective load factor. Vehicle capacity has been assumed to be 20 tons. The results of this computation are shown in Table 6.

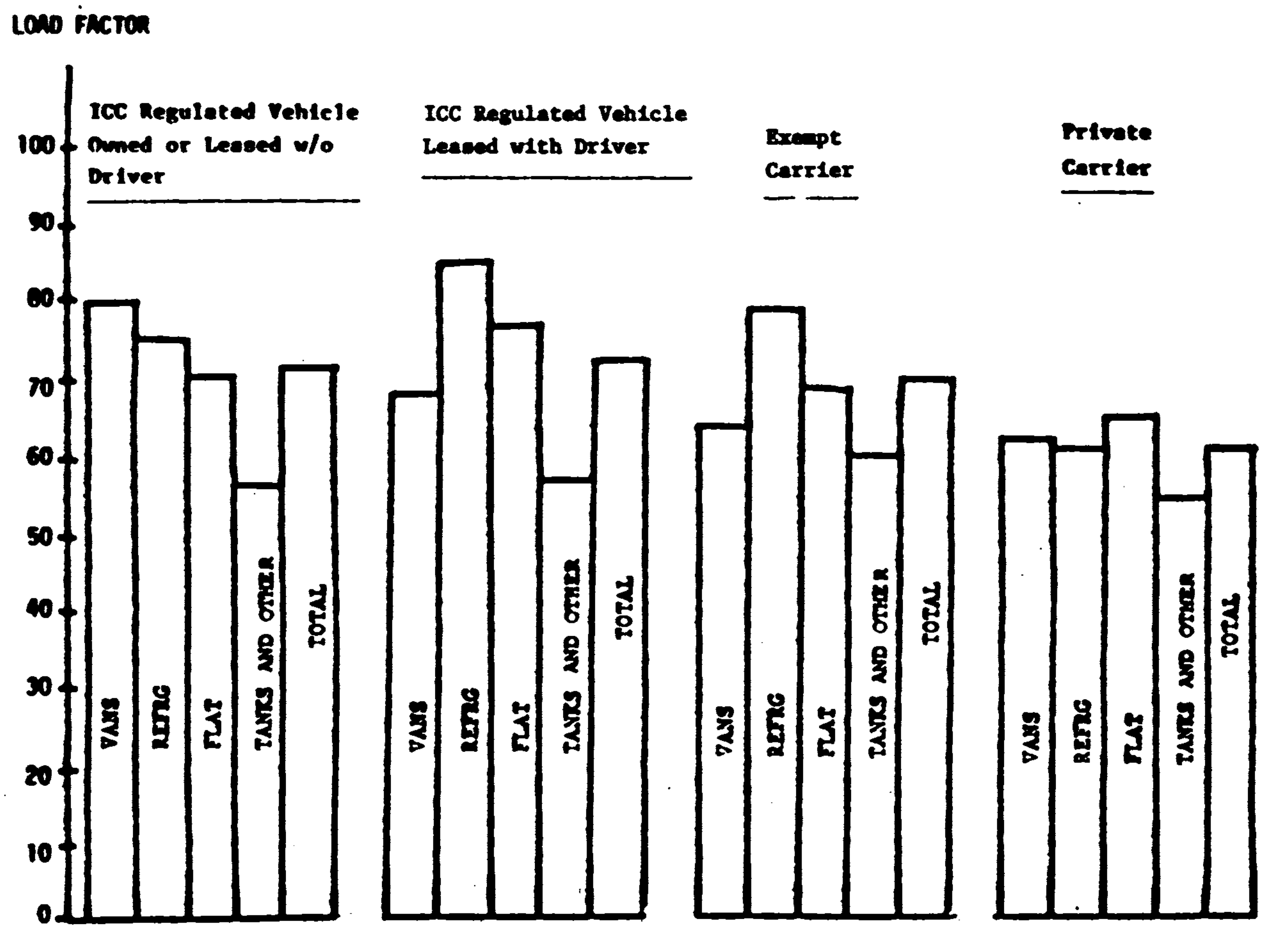
A summary profile of the industry is shown on Table 7. Private carriers represent a smaller percentage of ton-miles than vehicle-miles, reflecting their lower load factors. The figures for fuel use were developed from vehicle-miles using an estimated 4.5 miles per gallon for average fuel usage. Although the figures found in the profile were expanded from a 1974 base, they provide an internally consistent data base for evaluating regulatory changes.

Finally, Table 8 gives an indication of the amount of travel by specialized and unspecialized equipment. Unspecialized equipment has in this table been defined as vans, refrigerated vans and flat bed trailers. All other types of equipment, such as tank trucks, auto carriers, and logging trailers, are included in the category of specialized equipment. The table illustrates that private carriage is more concentrated than regulated carriage in specialized equipment, an important element in estimating the potential of regulatory proposals to decrease the percent of private carriage mileage that is empty.[7]

COMPARISON OF RESULTS WITH OTHER DATA SOURCES

It is useful to compare the information developed here with that available in the literature. The principal alternative source of information on the percentages of truck miles that are empty is the 1973 National Truck Characteristics Report prepared by the Federal Highway Administration (FHWA) in Table 9. Table 10 presents the two data sources together for easy reference. The ICC data show lower percent empty for private vans and for unspecialized vehicles operating under ICC regulation.[8] For the other classes, especially specialized vehicles, both ICC

FIGURE 2
LOAD FACTORS BY EQUIPMENT TYPE
AND TYPE OF AUTHORITY



Source: Table 3.

TABLE 5
DISTRIBUTION OF VEHICLE MILES (X 10^6)
FOR EACH CLASS OF CARRIER AND SPACE UTILIZATION

	Percent of Space Used						
	0	25	50	75	100	Total	Percent of Total Vehicle-Miles
ICC OO	1285	272	258	444	4363	6622	18.54
Exempt OO	113	11	17	34	421	597	1.67
ICC NOO	2431	433	662	904	8297	12727	35.63
Exempt NOO	884	63	106	119	2139	3311	9.27
Private	3751	636	710	773	6592	12462	34.89
Total						35719	100.00

Source: Computed from Table 4 and by assuming the total number of vehicle miles to be the number required to transport 495,000 million ton-miles with load factor of 0.6929 in trucks with capacity of 20 tons: 35,719 = 495,000 ÷ (20 X 0.6929). See U.S. Department of Transportation 1974.

TABLE 6
DISTRIBUTION OF TON MILES[1] (X 10^6) BY CLASS OF CARRIER AND SPACE USED

Percent of Space Used

	0	25	50	75	100	Total	Percent
ICC OO	0	1360	2580	6660	87302	97902	19.77
Exempt OO	0	55	170	510	8419	9154	1.85
ICC NOO	0	2165	6670	13560	165840	188185	38.02
Exempt NOO	0	315	1060	1785	42765	45925	9.28
Private	0	3180	7100	11596	131958	153834	31.08
Total						495000[2]	100.00

Source: Computed from Tables 4 and 5.

[1]Using 20 tons/fully loaded vehicle.
[2]U.S. Department of Transportation 1974.

TABLE 7
PROFILE OF INTERCITY TRUCKING DERIVED FROM ICC EMPTY/LOADED SURVEY
(First Six Months of 1976)

	ICC Regulated, Vehicle Owned or Leased without Driver	ICC Regulated, Vehicle Leased With Driver	Exempt Carrier	Private Fleet	Totals
Number of Vehicles Observed in ICC Survey[1]	2245	1168	689	2198	6300
Percent of Vehicles Observed in Each Category = Percent of Total Vehicle Miles	35.63	18.54	10.97	34.89	100
Percent of Miles which are Empty	19.1	19.3	25.5	30.1	23.7
Average Load Factors	.7393	.7392	.7046	.6172	.7051
Average Length of Haul	304.3	303.1	630.7	182.2	295.9
Total Vehicle Miles X 10^6	12727	6622	3908	12462	35719[3]
Unspecialized Vehicle Miles (X 10^6)[4]	10674	6026	3125	10223	30050
Ton Miles x 10^6	188185	97902	55079	153834	495000[2]
Percent of Ton Miles	38.02	19.77	11.13	31.08	100
Fuel in Gallons x 10^6	2828	1472	868	2769	7938
Percent of Fuel Use	35.6	18.5	11.0	34.9	100

[1] These observations are taken only on Interstate Highways. The distribution of traffic among carrier types is assumed to be the same as for all intercity freight. Comparison of these data with distributions by carrier type for all roads shows considerable differences. See the discussion of this point in text.

[2] Numbers observed in the ICC Motor Carrier Empty/Loaded Survey were scaled to the universe using this figure for U.S. intercity truck ton-miles taken from the 1974 U.S. D.O.T. *National Transportation Statistics*. There appear to be basic inconsistencies between the resulting total vehicle miles and those reported in the *National Transportation Statistics*.

[3] Based on figure for total intercity ton-miles, an average load factor of 0.7051 and a total payload of 20 tons for a fully loaded vehicle. Allocations to type of carrier are based on Table 6.

[4] See Table 8.

TABLE 8
MILLIONS OF VEHICLE MILES AND PERCENT OF VEHICLE MILES
BY TYPE OF EQUIPMENT AND TYPE OF CARRIER

	Unspecialized Equipment[1]	Specialized Equipment	Totals
ICC OO			
Number Observed	1063	105	1168
Percent	16.87	1.67	18.54
Vehicle Miles	6026	596	6622
ICC NOO			
Number Observed	1883	362	2245
Percent	29.89	5.75	35.63
Vehicle Miles	10674	2053	12727
Exempt			
Number Observed	551	138	689
Percent	8.75	2.19	10.94
Vehicle Miles	3125	781	3906
Private			
Number Observed	1803	395	2198
Percent	28.62	6.27	34.89
Vehicle Miles	10223	2239	12462
Totals			
Number Observed	5300	1000	6300
Percent	84.13	15.87	100.0
Vehicle Miles	30050	5669	35719

[1]Vans, refrigerated vans, flatbed trailers.

Source: Calculated from Tables 3 and 5.

TABLE 9
PERCENTAGE OF TRUCKS TRAVELING EMPTY[1]
BY CLASS OF FIRM AND TYPE OF EQUIPMENT[2]

Equipment Type	Carrier Type [3] Private	ICC Regulated	Non-ICC Regulated	Overall Weighted Average
Unspecialized				
Van	32.2	19.1	28.6	
Refrigerated Van	26.2	16.6	22.1	
Flat Bed	41.1	30.8	38.2	
Weighted Average, Unspecialized	34.7	21.6	30.0	29.1
Specialized				
Livestock	43.0	43.9	36.0	
Hopper	41.0	36.1	40.6	
Dump Truck	47.9	41.0	49.6	
Non-petroleum Tanker	43.9	45.1	42.4	
Petroleum Tanker	40.2	46.3	42.9	
Auto Carrier	40.1	36.8	40.2	
Weighted Average, Specialized	43.4	41.5	42.9	42.7
Total				32.0

[1]If one assumes that for a given vehicle mile traveled, the probability that a vehicle will be in the FHWA sample is independent of whether it is loaded or empty, then the data in the table may be interpreted as the percentages of empty vehicle miles.

[2]Table includes data only for semi-combination and full-combination, since these are the principle vehicle types used in medium and longhaul movements of freight when empty mileage is an issue.

[3]Values shown are calculated from FHWA report, Table 7, as follows:

$$\% = 1 - \left[\frac{(\#\ \text{semi-comb} \times \%\ \text{semi-comb}) + (\#\ \text{full-comb} \times \%\ \text{full-comb})}{\#\ \text{semi-comb} + \#\ \text{full-comb}}\right]$$

SOURCE: U.S. Department of Transportation 1975.
Table 7, p. 43.

TABLE 10
FHWA AND ICC MEASURES OF EMPTY MILEAGE

	PRIVATE CARRIERS		ICC REGULATED				OTHER		
	FHWA	ICC	FHWA	ICC 00	ICC NOO	ICC TOTAL	FHWA NON-ICC Regulated	ICC NOO Exempt	ICC 00 Exempt
Van	32.2	26.9	19.1	20.6	12.8	14.6	28.6	30.3	28.1
Refrigerated	26.2	25.5	18.6	10.5	17.6	14.9	22.1	18.1	14.3
Flat Bed	41.1	31.1	30.8	18.0	28.4	21.8	30.0	34.2	11.1*
Other (Specialized)	41.0	43.4	41.5	39.0	39.2	39.1	42.9	38.2	14.3*

*Denotes small sample.

Source: Table 9 and 3.

regulated and private vehicles show reasonably consistent amounts of empty mileage. Despite some differences in the two data sources both are consistent in that they indicate similar load factors for regulated and unregulated carriage for specialized equipment and substantially better empty mileage performance by regulated carriers than unregulated carriers for unspecialized equipment. It is important to note that the percent of empty mileage reported in the ICC data and the FHWA data are well above the 4.4 percent figure reported by the ICC for general commodity carriers in a recent defense of regulatory policy (U.S. Interstate Commerce Commission 1975). General commodity carriers, as noted below, have broader commodity authority and have sufficient geographical and commodity coverage to utilize consolidation terminals. The broader authority of these carriers partially explains their lower percentage of empty miles relative to regulated carriers utilizing unspecialized equipment as a whole.

It is also useful to compare the ICC length-of-haul data with those shown for average length of haul in the Summary of National Transportation Statistics (U.S. Department of Transportation 1975). The latter shows Class I common carriers to have an average length of haul of 276 miles and Class I contract carriers to have a length of haul of 198 miles. The 276 mile figure is consistent with a weighted average for ICC regulated carriers in the ICC data (see Figure 1).

The distribution of intercity ton-miles in Table 7 diverges significantly from commonly recognized industry statistics in Table 11. Data from other sources imply 42.1 percent of the vehicle-miles traveled by interstate regulated carriers, 41.9 percent by private carriers, and only 15 percent by uncertified carriers. Data in Table 11 differ sharply from that in the ICC data regarding private carriage, probably reflecting the greater concentration of private carriage on all classes of roads rather than on the Interstate system only as sampled by the ICC. The representation of ICC regulated carriers in the ICC data is much higher than in Table 11. As suggested by Figure 1, private carriage is more concentrated than regulated carriage in the short-haul market that is probably underrepresented on Interstate highways.

The total of 35,719 million estimated vehicle-miles in Table 7 is substantially lower than the 129,545 million vehicle-miles reported in the National Transportation Statistics for intercity truck vehicle-miles on main rural roads. One possible explanation for this difference is that the National Transportation Statistics reports all truck vehicle-miles rather than only three axle vehicles found in the ICC summary.

The total of all Class I and II regulated vehicle-miles was reported by Trinc's Blue Book of the Trucking Industry (Trinc Transportation Consultants 1975) to be 15,042 million miles. This differs with the 19,349 million vehicle-miles for ICC regulated carriers inferred from the ICC data. In light of these figures for regulated carriers, the 35,719 million figure for intercity truck vehicle-miles seems to be a plausible rough estimate. The figure of 201,456 million ton-miles given in Trinc's Blue Book is not consistent with the 286,086 (i.e., 188,185 + 97,902) million ton-miles for ICC regulated carriers in Table

TABLE 11
INTERCITY TRUCK TON MILES
BY TYPE OF CARRIER (1972)

	All Carriers	For-Hire Regulated Carriers Interstate	For-Hire Regulated Carriers Intrastate	Uncertificated Carriers (exempt traffic only)	Private Carriage
Ton Miles	470[1]	197.9[2]	4.7[2]	70.5[2]	196.93[2]
Percentage of Ton Miles	100.0	42.1[3]	1.0[4]	15.0[5]	41.9[6]

[1] Transportation Association of America 1975, p. 8.

[2] Derived from data on percentage distribution.

[3] Transportation Association of America, p. 9.

[4] Morton 1973, p. 141, based on ICC data.

[5] See Charles River Associates and Cambridge Systematics, *op. cit.*, Appendix A.

[6] 41.9 = 100 - [percentage estimates for the other carriers].

7. The differences in the vehicle-mile and ton-mile figures for regulated carriers may in part be attributable to vehicle-miles and ton-miles by Class III carriers, that are excluded from the Trinc's data. Diesel fuel consumption by combination trucks of 10,083 million gallons in 1974 given in the National Transportation Statistics also differs from the total fuel figure of 7,983 as presented in Table 7.

The relative importance of traffic requiring specialized equipment in the ICC sample can be compared with the 1972 Census of Truck Inventory and Use Survey. Table 12 presents data on the percentage of short-range miles and long-range miles,[9] for a variety of unspecialized and specialized equipment types. Unspecialized equipment accounts for 75.1 percent of total vehicle-miles and long-range unspecialized vehicle-miles are 43.8 percent of the total. The somewhat greater percentage of unspecialized vehicles in the ICC data (84.13 percent in Table 8) is undoubtedly due to the fact that specialized equipment is more concentrated in the short-haul market that appears to be underrepresented in the ICC sample and the fact that the ICC sample considered only trucks with three-or-more axles.

The data presented in Table 7 are an internally consistent set of data for evaluating consequences of regulatory change. The private truck movements by pickup trucks, recreation vehicles, farm vehicles, those with less than three axles and local travel are not of interest to economic regulation and are not included. It seems likely that private trucks are underrepresented in the ICC Empty/Loaded Survey, but it also stands to reason that in the intercity freight market, much short-haul private trucking would not be affected by changes in regulatory policy.

TENTATIVE HYPOTHESES ON THE CONSEQUENCES OF REGULATORY CHANGE INFERRED FROM THE DATA

In a recent paper, the authors pose the following issue (Tye et al. 1977):

> Data presented in the paper indicate that two segments of the industry that are highly circumscribed in operating authority--the owner/operator carrier and the irregular route specific commodity carrier (who frequently employs owner/operators)--are growing very rapidly when compared with other segments of the industry, especially the regular route common carriers. This is in part because under the existing regulatory regime it is much easier to obtain irregular route specific commodity authority than general commodity authority despite the efficiency advantages of the latter.[10] This rapid growth poses the potential danger that operating authority restrictions could become increasingly onerous to the industry.

The ICC data provide an improved capability of analyzing the effects of regulation on the vehicle utilization of irregular route carriers, owner/operators, and private carriers.

TABLE 12
TOTAL VEHICLE MILES FOR SELECTED[1] SPECIALIZED AND UNSPECIALIZED EQUIPMENT BY RANGE OF HAUL[2], ALL CARRIER TYPES IN CENSUS OF TRANSPORTATION

(Millions of Miles)

Equipment Type	Short Range (less than 200 miles) Vehicle Miles	Short Range (less than 200 miles) Percent of Total Miles	Long Range (greater than 200 miles) Miles	Long Range (greater than 200 miles) Percent of Total Miles	Percent of Total Miles (Short and Long Range)
Selected Unspecialized Equipment					
Open top vans	536.6	1.2	563.2	1.2	
Platform	4912.3	10.9	4089.8	9.1	
All other vans	4953.6	11.0	8351.0	18.5	
Furniture van	743.0	1.6	1934.7	4.3	
Insulated nonrefrigerated van	1114.5	2.5	1542.8	3.4	
Insulated refrigerated van	1857.6	4.1	3306.1	7.3	75.1
Total unspecialized	14117.6	31.3	19787.6	43.8	
Cattlerack	949.4	2.1	636.7	1.4	
Tank truck for dry bulk	743.0	1.6	146.9	.3	
Platform with added device	743.0	1.6	73.4	.2	
Beverage truck	330.2	.7	73.4	.2	
Utility truck	866.8	1.9	97.9	.2	
Auto transport	371.5	.8	587.7	1.3	
Pole and logging	495.3	1.1	73.4	.2	
Tank truck for liquids	3013.4	6.7	734.7	1.6	
Dump truck	1279.6	2.8	48.9	.1	
Total Specialized	8792.2	19.5	2473.0	5.5	25.0
Total Specialized and Unspecialized	22909.8	50.7	22260.6	49.3	100.0

Notes on following page.

TABLE 12 (Continued)
TOTAL VEHICLE MILES FOR SELECTED[1] SPECIALIZED AND UNSPECIALIZED EQUIPMENT BY RANGE OF HAUL[2], ALL CARRIER TYPES IN CENSUS OF TRANSPORTATION
(Millions of Miles)

SOURCE: Bureau of the Census, 1972 *Census of Transportation, Truck Inventory and Use Survey, op. cit.*, p. 2 and p. 19.

Figures shown were calculated from Census data as follows: Mileage percentages (for long and short range) given in Table 14, p. 19 of the Census, were multiplied by the total miles for all vehicles (for long and short range) in Table 2, p. 2 of the Census. This yields the "miles" data for columns 1 and 3 of this table. These "miles" figures were then summed to give the "total miles, all vehicles." Finally, the percentages in columns 2 and 4 were calculated by dividing this "total" figure into the miles for each vehicle type (for both long and short range.)

Example: Furniture Vans, short haul. 1.8 percent x 41,280 = 743.0, for column 1. Then (743.0 ÷ 45170.4) x 100 = 1.6 percent for column 2.

[1]Several vehicle types were excluded from this table because they are used to a large extent for personal transportation (pickup and panel trucks) or because they are not used for hauling frieght intercity (multistop, Walkin, Garbage and refuse collector, concrete mixer, winch and crane).

[2]Short range is defined as "mostly over-the-road (beyond the local area) but usually not more than 200 miles one way..." Long range is "...more than 200 miles one way..."

SOURCE: Bureau of the Census 1972, pp. 2, 19.

Effects of Restrictions in Authorities of Regulated Carriers

The data on empty miles of owner/operators and non-owner/operators provide insights into the relationship of operating authority restrictions to empty mileage. Owner/operators are more commonly leased by carriers with irregular route authority, while regular route carriers more commonly use union drivers. As noted above, the match is not perfect, and a more thorough study should be conducted to identify the operating authority for each of the ICC-authorized carriers appearing in the sample.

Typically, regular route carriers have very broad authority for general commodities with certain exceptions (dangerous explosives, commodities of unusual value, household goods, commodities in bulk, and those requiring special equipment). Irregular route carriers have authorization to transport specific commodities listed in individual grants of authority. Frequently, the commodities listed are a small subset of those covered under general commodity authority and do not require special equipment. In addition to commodity restrictions, irregular route authority is ordinarily more geographically restricted than regular route authority, frequently specifying service from a single point (city, county or plant site) to points in a limited region (state or group of states) for only the narrow range of commodities listed in the individual grants of authority. Service may be restricted to a single shipper. Such grants of authority are also more likely to contain restrictions on backhaul and to specify equipment.[11]

Recent in-depth interviews of motor carriers investigated the effects of operating authority restrictions on irregular route carriers. Because irregular route specific commodity carriers have substantially more restricted operating authority, they "make much more use of their options to avoid the efficiency consequences of inadequate operating authority, especially the use of complementary provisions in other operating authority, leasing of independent drivers, and hauling exempt commodities. Despite the resourcefulness of the carriers, in some cases these options do not entirely mitigate the consequences of inadequate operating authority. Owner/operators are amazingly effective in using tripleasing to certificated carriers or hauling exempt commodities to remain competitive despite their total lack of operating authority." (Tye et al.)

Given the highly restricted authority of owner/operators and the authorized carriers under which they operate by tripleasing, it might be hypothesized that owner/operators operate with lower load factors and higher empty mileage than non-owner/operators. The data, however, do not bear out this conclusion. Owner/operators are quite efficient overall, as compared with the performance of the rest of the industry, despite their total lack of operating authority. They do appear to suffer lower load factors and a higher percentage of empty hauls for vans (equipment that is most conducive to backhaul traffic) as compared with non-owner/operators operating under ICC authority. However, owner/operators operating under ICC authority perform better than non-owner/operators for refrigerated trucks and flat bed trucks. The conclusion of these data is that the mobility of owner/operators in moving from one firm to another under leasing arrangements and the ability of irregular route carriers to efficiently combine many pieces of complementary, but highly restricted, authority have substantially helped to mitigate the effects of operating authority restrictions.[12]

Indeed, owner/operators demonstrate a better record of load factor for ICC-authorized movements for refrigerated vans and flats, circumstances where both owner/operators and non-owner/operators are likely to be operating under irregular route authority. For specialized equipment both types of operation have equally low load factors. Owner/operators perform worse than non-owner/operators principally in the general van class, where they are more likely to suffer the handicap of restricted irregular route operating authority relative to general commodity authority. The data therefore confirm the interview results, suggesting that irregular route carriers using owner/operators have been resourceful in achieving competitive load factors despite their restricted operating authority. Nevertheless a measurable impact of inadequate operating authority has been observed.

Effect of Regulation on Vehicle Utilization of Private Carriers

Subject to confirmation from the full year's data, the ICC sample clearly shows that private carriage is experiencing more empty miles and lower load factors than trucks operating under ICC authority. However, the data also demonstrate that private carriage is more concentrated in specialized equipment and short-haul movements. In this type of traffic, the potential for backhaul is less and therefore the competitive cost disadvantage suffered by private carriers because they cannot solicit backhaul cargo is less. Therefore the difference between the 19 percent empty mileage for regulated carriers and the 30 percent for private carriers for all equipment types (Table 4) cannot be attributed to regulatory factors alone.

The data suggest that regulatory changes to increase the backhaul opportunities of private carriers should be considered. In a forthcoming study, Charles River Associates and Cambridge Systematics have evaluated three changes in ICC policy towards private carriers.[13] The changes are estimated to result in improvement in empty mileage of private carriers. However, major changes in the efficiency of private carriage would require much more significant changes than were proposed in that study.

The proposals that were made were:

(1) Allow tripleasing of private carriers to common carriers. Current prohibitions on tripleasing by private carriers cause empty backhauls for both private and common carriers. This proposal will extend to private carriers the rights now enjoyed by exempt carriers. Both private and regulated carriers will benefit in reduced vehicle mileage.

(2) Modify the restrictions on intercorporate carriage by private carriers within a corporate family. The ICC has prohibited corporations from performing transportation for subsidiaries, parents, or other commonly owned or controlled corporations on a compensatory basis. Modification of this policy will permit corporations to better capture the economies of coordination of distribution among subsidiaries.

(3) Facilitate the award of contract or common carrier irregular route specific commodity authority to private carriers. The ICC has traditionally not permitted private carriers to mix their operations with contract or common carrier authority, with limited exceptions. Requests by private carriers for operating authority to complement their private operations have been denied on the grounds that they were detrimental to for-hire transportation. This proposal will encourage private carriers to apply for limited authority to supplement their private carrier operation. As an alternative, private carriers could be encouraged to convert their operations to contract carriage by applying for authority for an integrated operation.[14] Such a conversion will permit them to lease owner/operators, which is frequently important in minimizing mileage of irregular route carriers who have inadequate operating authority.

The data indicate that restrictions on private carriage are unnecessarily harsh and should be changed. Many of the techniques available to regulated carriers to mitigate the consequences of operating authority restrictions -- tripleasing to regulated carriers, tripleasing of owner/operators, use of complementary authority, mergers, purchase of authority -- are not available to private carriers. Of the carrier classes, they are the most disadvantaged by operating authority restrictions. Private carriers choose to enter the market for service or rate considerations, despite their relatively poor record on empty mileage and lack of operating authority. Since they will constitute a large share of traffic despite regulatory-imposed handicaps, these handicaps should be relaxed.

This paper is based on research conducted by Charles River Associates Incorporated and Cambridge Systematics, Inc., under the sponsorship of the Federal Energy Administration, to determine "Potential Fuel Conservation Measures by Motor Carriers in the Intercity Freight Market" (April 1977). The authors are indebted to Georgia Johnson of the FEA, Daryl Wyckoff, Charles Taff, and Edward Margolin who made numerous contributions and criticisms on draft material of the larger study. The authors also benefited from detailed comments on the overall research effort from the Bureau of Economics of the Interstate Commerce Commission and the American Trucking Associations. The Bureau of Economics, and James Lungren in particular, also provided invaluable assistance to the study team in providing access to the preliminary ICC Empty/ Loaded Survey data and granting permission for the release of the preliminary data for the first two quarters.

The views and conclusions contained in this document are those of the authors of this paper and should not be interpreted as necessarily representing the official policies of the Federal Energy Administration of the United States Government or the views of the reviewers.

NOTES

1. Edward Miller (1973) analyzed data from the 1963 and 1967 Truck inventory and use survey, conducted by the Bureau of the Census. These data show that for-hire carriers had a substantially higher percentage of return loads, but failed to identify the type of vehicle. The degree to which empty miles reflected the greater use of specialized equipment in private carriage could therefore not be ascertained. (This problem was corrected in the 1972 Census). Miller also analyzed data from the Federal Highway Administration (FHWA) loadometer studies. These data showed that specialized equipment, such as dump trucks and oil trucks, were empty more often than unspecialized vehicles -- reflecting the virtual impossibility of securing backhauls for many types of specialized equipment. For this reason, the percentage of specialized trucks that were empty tended to be similar for regulated and unregulated carriers. But for most equipment types, private carriers were more frequently empty than regulated carriers and the difference was greatest for unspecialized equipment.

Based on these data, Miller concluded that both private and regulated carriers suffer from excessive empty mileage. He inferred that since private and regulated carriers using general purpose vans incurred empty mileage 31.2 and 19 percent of the time respectively, they failed to secure backhaul cargo 62.4 and 38 percent of the time respectively.

2. The ICC (1975) estimated that common carriers of general commodities experience only 4.4 percent empty mileage. This figure is discussed below.

3. To correct for differences in the density of traffic and segment lengths and the use of substituted data under certain circumstances, the data should be weighted to eliminate bias. The unweighted special tabulations reported here result in an overestimation of the percentage of miles that are empty by approximately 10 percent. For example, where the percent empty is reported to be 20 percent, correction by weighting would reduce the percentage to approximately 18 percent.

4. The percentage of total vehicle-miles that were leased with driver is a useful proxy for use of owner-operators by carriers. These figures were 9 percent and 36 percent for general freight carriers and specific commodity carriers, respectively, in 1974. See Charles River Associates and Cambridge Systematics, Appendix A.

5. This difference in trip lengths would be even more apparent if all roads, rather than only the interstate system, had been sampled.

6. Adjustments to this assumption to reflect actual capacity for each of the classes of carriers did not affect the distributions materially.

7. This concentration of private carriage in specialized equipment would no doubt be even more apparent for a sample of all roads rather than only interstate highways. The figures for percent of vehicle-miles in specialized equipment are 18, 16, and 9 for private, ICC NOO and ICC OO respectively.

8. Weighting for segment lengths, traffic density, and substituted data as noted above would reduce the percent of empty mileage in the ICC data.

9. More than 200 miles.

10. For evidence on this, see Tye et al.

11. For detailed evidence on these points, see Tye et al., and Charles River Associates and Cambridge Systematics op. cit, Appendix A and B.

12. See Tye et al., for further discussion of the techniques available to carriers to mitigate operating authority restrictions.

13. Estimates of the savings in vehicle-miles and discussion of the proposals are provided in the study.

14. Private carriers are frequently reluctant to convert to regulated carriage, however.

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DISCUSSANT'S COMMENTS

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Professor Hillman's paper provides a needed and timely update on the still-evolving chain of conditions affecting the regulation of intermodal rate competition. Professor Hillman demonstrates convincingly that the prohibition of so-called umbrella ratemaking has not, contrary to widespread belief, been assured by various provisions of the Railroad Revitalization and Regulatory Reform Act of 1976. The ultimate interpretation and application of these provisions to rail-initiated rate reductions that are directed toward the capture of road and water-borne traffic might well produce consequences quite different from those envisaged by persons who have exulted over the 4-R Act's regulatory changes.

In the view of this discussant, however, several other aspects of the 4-R Act are of greater immediate importance insofar as the Act's prospective impacts upon the efficacy of railway pricing and intermodal competition are concerned. One such aspect is the concept of market dominance, which plays a key role in governing the extent to which railway pricing managers can utilize the opportunities for greater ratemaking flexibility that ostensibly have been provided by the 4-R Act. The act required the Interstate Commerce Commission to develop and promulgate standards for determining whether or not a railway possesses market dominance in the movement of particular commodities between specific pairs of points and the commission recently did so, but in ways that appear inappropriate to numerous partisan and independent observers.

Also, of crucial importance is the act's directive for development, by the ICC, of a new cost and revenue accounting system. The information produced by the new system will operationalize cost concepts specified in the act that delimit the range within which railway ratemaking presumably can function without subjection to certain previously applicable grounds for regulatory intervention. Of basic concern is the question of whether the commission will produce a costing system capable of providing economically relevant information. That is, will the commission fully pursue the <u>attainable</u> state-of-the-art in railway costing, and will such an effort bring forth cost data superior to those that are obtainable from existing formulae for both pricing and other analytical and decision-making purposes?

Notice should also be given to provisions of the 4-R Act that are intended to stimulate rail pricing actions reflective of seasonal, regional, and other peak-off-peak variations in the demands for, and supply costs of, railway services. Rail rates sensitized to such variations would appear to be of greatest potential use in competition for traffics moved by exempt agricultural haulers, by various forms of regulated motor carriers that concentrate upon truckload lot-sized movements, and by domestic water carriers.

Professor Boyer's paper persuasively emphasizes the need for properly identifying and weighing the significance of competing carriers' service quality characteristics vis-a-vis their rate and supply cost levels in making judgments about (1) the past results, and (2) future directions and consequences of freight modal split patterns. The general significance of the impact of such qualitative characteristics upon the pecuniary and opportunity costs of choosing between the services of alternative forms of carriage has been a basic point of focus for over 20 years in the field of business logistics or physical distribution management. Familiarity with this field and, in particular, with "real world" freight market conditions causes the present discussant to concur fully with Professor Boyer's judgment that ignorance or inadequate recognition of service quality characteristics has seriously affected the accuracy of various economists' widely-publicized estimates of the extent of regulation-induced intermodal traffic misallocation and economic costs thereof.

Professor Paul Roberts, like Professor Boyer, has performed the important service of focusing on some crucial but not fully recognized conditions that bear upon the deregulation debate and upon the selection of proper frames of reference for performing economic analyses of motor freight transport. Of particular value is Professor Roberts' recognition that trucking is highly heterogeneous in terms of types of service produced, shippers' needs or demands for service, and requisite plant and equipment. Hence, the oft-voiced contention that trucking closely approximates the purely competitive model is not applicable to some prominent categories of motor freight operation (e.g., LTL-oriented common carriers of general freight). This poses questions about the relative workability of rate competition between trucking firms, and the consequences that might ensue in the absence of regulation. Professor Roberts offers a plausible scenario about what could conceivably occur in the wake of total deregulation.

Professor Nelson's paper centers upon a seductively structured but questionable syllogism that assumes <u>all</u> economic regulation of <u>all</u> aspects of <u>all</u> types of motor freight transport to be incapable of functioning as intended within acceptable limits of performance. It is true, as Professor Nelson contends, that the negative or restraining orientation of much of economic regulation, together with other conditions, prevents a commission from compelling firms and industries under its jurisdiction to take various types of positive actions. However, this does not deny the possibility that a commission can establish and administer selected conditions which guide or draw regulated firms' commercial behavior toward socioeconomic desiderata.

At variance with Professor Nelson's principal theme is his fleeting suggestion in a closing paragraph that characteristics of nationwide LTL-oriented general freight carriers might sustain a need for some type of economic regulation. Professor Nelson also indicates a preference for continued regulation of commercial motor passenger carriers. This provokes the question of whether disequilibria-related costs that ensue from the dynamics of complete unregulated market forces might outweigh the private and social benefits occasioned by continuous availability of regularly scheduled common carrier movements of randomly offered freight shipments.

The paper by William B. Tye, et al., is primarily a data source on motor truck capacity utilization. An evaluation of the policy changes recommended in its concluding section would require an examination of the larger study to which it reportedly relates.

DISCUSSANT'S COMMENTS

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A useful way to begin a critique of a paper is to state succinctly the central point that the author is making. This review will proceed by so capsulizing each paper, commenting on the extent to which the author succeeds in convincingly establishing that point, and raising other questions suggested by each paper. I will conclude with general remarks about the area of research of which these papers are but a part.

1. Tye, et al., "Load Factors of Motor Carriers..."

The purpose of this paper is to show that new, disaggregated survey data confirm our suspicions that regulation causes excessively low load factors in trucking. These data permit simultaneous disaggregation of carriage data by the type of truck trailer used and the ownership and regulatory status of the trucker.

Undoubtedly, these new data may well put to rest the criticism of past studies that the data on which they were based were too crude to support the conclusions derived from them. Moreover, the numerous tables showing loadings by type of truck and carrier are of interest and consistent with the authors' conclusions that regulation causes inefficiently low load factors.

Nevertheless, this paper must be regarded as a tentative early utterance, rather than the last word, on the meaning of these new data. Two additional pieces of work are needed to make the authors' conclusions completely convincing. First, nowhere are any statistics reported to measure the sample variance of the various averages reported in the tables. In the absence of these statistics, the statistical significance of the differences in the numerous reported sample means remains in doubt. Second, the paper does not provide a conceptual model to motivate the particular format in which the data are presented and to provide a coherent explanation for the results of the data analysis. In particular, no behavioral, technical or economic explanation is provided that would indicate that the particular categories in the table all make good analytical sense and that the statistical results confirm the power of these explanations. Instead, the authors readily accept industry and regulatory classifications. Unless a conceptual rationale for expecting the results in the paper is provided, the differences across categories in mean load factors do not have much meaning.

2. Roberts, "Some Aspects of Regulatory Reform..."

The central theme of Roberts' paper, at least implicitly, is that the structure of the trucking industry is, to an important extent, a consequence of regulatory policies. The paper does not discuss why anyone should care about the effect of regulation on the structure of the industry, but presumably this is an important issue because, in principle at least, the structure of the industry affects its efficiency.

The paper attempts to show that deregulation would cause a reduction in the number of categories into which firms might fall, thereby implicitly making the point that regulation creates categories, subcomponents and specialties of trucking firms that would not continue to have a rationale if only technical and economic features of the industry determined its structure. But perhaps the paper could go even further in questioning the extent to which current ways of categorizing subactivities of the industry have a rationale outside of the regulatory process. Two questions spring to mind: (1) Why should firms be specialized at all in terms of the types of routes served, the kinds of goods carried, the size of shipments transported, or even the mode of transportation used? (2) What commodity classifications make sense in that different types of route structures, pricing formulas, and even organizational structures are necessary to provide transportation of them?

Existing classification schemes reflect regulatory and legal pigeonholes, which may or may not make economic sense. One purpose of classifications for regulatory convenience is to erect barriers to competition by segmenting the market. Another purpose is to facilitate price discrimination. Still another purpose is to facilitate interfirm transfers of information, that aid in maintaining collusive behavior. None of these rationales would survive deregulation if the trucking industry would emerge as competitive.

Roberts obviously treats seriously the contention that trucking exhibits important scale economies, which, of course, has deep implications for his conclusions about the future structure of the industry. Roberts' discussion of scale economies is particularly grating to an economist, and I hope for reasons more profound than a disciplinary territorial imperative. At the microcosmic level, his criticism of Friedlaender's work on hedonic cost functions is, quite simply, wrong. Introducing measures of shipment size is not a specification error unless an increase in firm size causes shippers to increase the size of their shipments. Friedlaender's technique is appropriate for getting at a crucial question: How much of the efficiency advantage of larger firms is due to their having better route structures and markets, and how much is due to technical scale economics internal to the firm?

Still, the work of Friedlaender and others remains imperfect. The two most important problems with the literature on scale economies are, first, that nearly all authors exclude factor prices from their cost functions, and second, that existing ICC cost data are too crude to allow detection of any aspect of the production process that does not have extremely robust, consistent effects of great magnitude. Failing to find scale economies through econometric analysis, then could be a commentary on data and methods more than on underlying technological realities.

Nevertheless, the econometrics literature is far more sophisticated, its analysis far more rigorous, and its conclusions far more measured than Roberts' commentary on the issue. Roberts offers as a defense for the presence of scale economies and entry barriers in a priori discussion of the difficulties of coordinating a trucking operation to maximize load factors. Like most a priori arguments, this one has a strong dose of reality: a one-truck national trucking firm is, no doubt, in deep trouble. But the trucking industry is a big business, and the a priori argument sheds no light on how big (relative to a truck route) a firm has to be to capture these scale economies. Moreover, when do the opposite a priori arguments about inefficiencies of control and coordination in large organizations begin to offset the potential scale economies in load coordination?

In general, the literature on scale economies misses the critical issue concerning the structure of a deregulated industry. Any analysis taking the entire existing industry as a data base essentially ends up determining whether the largest few score of firms are more efficient than the smallest few score. But the key policy question is whether a typical shipper will, in a deregulated state, have a choice among several (e.g. five or ten) firms, or instead have to be satisfied with one or two. The latter breeds monopolistic abuses, but a number of firms that is infinitesimal compared with the present trucking industry can still provide ample competition to protect shippers from abuse of market power. Neither a priori nor econometric analyses have yet dealt with whether two or twenty firms will survive deregulation; instead, it implicitly deals with whether hundreds or scores will survive. Of course, if the answer from econometrics is that no scale economies are evident now, the more important question, by obvious extrapolation, is answered. But a priori arguments can never answer this question. At best, they can convince a reasonable person that an industry would undergo a particular qualitative change if its environment were altered. But only model-building and rigorous data analysis hold any hope of answering the quantitative question of whether the change will be great enough to undermine the possibilities for a competitive structure.

3. Hillman, "Intermodal Rate Competition..."

According to Hillman, the "Quad-R" Act does not seriously circumscribe the ability of the ICC to continue to promulgate largely anti-competitive policies in setting minimum railroad rates. His paper is totally convincing in presenting the logic some federal judge of the future will propound in upholding a rate decision that is based on the harm that a lower rate might inflict on competitors. The problem is two-fold: the 1976 act, in the long-standing tradition of regulatory legislation, is vague and self-contradictory, and the courts, in keeping with legal precedent established in Nebbia v. New York, are unlikely to overturn any ruling by a regulatory agency as long as some subsection of the law contains a mandate consistent with it and the administrative procedures surrounding the ruling were consistent with established practices of law.

The principal questions that Hillman leaves unexplored are: (1) how vague legislative directives are translated into specific legislative policies, (2) whether statutory or nonstatutory controls are more important in determining regulatory outcomes, and (3) why Congress behaves as it does in legislating and overseeing regulatory law. Of course, Hillman cannot be faulted for leaving these questions unexamined; after all, it took many pages of erudition to make his primary point. His paper simply serves to raise a number of ancillary issues that naturally follow from the observation that Congress, after 90 years of experience, still does not see fit to change its basic set of instructions to the ICC.

My suspicion is that scholars have overestimated the role of laws in regulatory policy. Suppose that lawmaking, because it is so public, must always be an act of consummate compromise, for only then can a congressman be assured of avoiding a well-financed campaign by the opposition in the next election, supported by whomever might have been done in by crisp, clear legislation. In such a world, the key to understanding regulatory policy might not be the law, but the oversight hearings concerning budget and appointments. In a total Machiavellian vein, Congress may be responding to the weakness of judicial oversight in regulatory policy by purposely making laws vague and contradictory in order to preserve for the oversight process the meaningful legislative control of regulatory actions.

4. Nelson, "Can the Motor Carrier Industry be Regulated?"

Nelson's paper is devoted almost exclusively to one point: in a competitive industry, regulation cannot, on average, reduce prices without undermining the industry. This point is not novel; indeed, the author was an early voice in the growing chorus of economists whose dissatisfaction with the regulation of transportation is based upon this simple, yet profound premise. Moreover, this paper lacks the empirical verification of the point that abounds in other writings by the same author. On the other hand, the literary and historical references in the paper should demonstrate beyond possibility of disproof that economists need not, of necessity, be Philistines.

Nelson makes a second point that, while not a first, is sufficiently unusual for research scholars that it deserves plaudits. Nelson observes that the ICC must be doing something right, for it seems to have the general approval of Congress. This is a profound, important observation. It deserves considerable further examination, for it suggests a line of scholarly inquiry that is largely underdeveloped, saving a few dilettantish comments like, "the Teamsters did it."

The longevity of the ICC and its policies, documented by Hillman, stands as convincing testimony to the general popularity of surface freight regulatory policies on the Hill. Two explanations for this amazing social artifact immediately come to mind.

Hypothesis I: Voters generally like regulation, even if it is inefficient, because people find market processes distasteful.

Competitive markets are risky to individuals. As Roberts correctly observes in his paper, in unregulated markets prices are subject to unpredictable swings. Although this actually contributes to market efficiency the prospects of large inframarginal gains and losses in wealth during adjustments to equilibrium may be more frightening to some citizens than is the loss of efficiency from dampening the swings.

Moreover, part of the risk of a competitive market is the punishment of the less efficient through bankruptcy. Certainly a regulated industry, and perhaps a society in general, may regard regulation as a worthwhile insurance policy against bankruptcy, purchased at a reasonable price in terms of efficiency losses.

Hypothesis II: The structure of the political system and of Congress gives elected officials perverse incentives with respect to regulatory policies.

Suppose that the object of a politician is to be reelected. To a voter, a senator or congressman is two things: 1/535th of the process by which laws are passed, and an undiluted provider of ombudsman services. Consequently, a key part of reelection is likely to be the provision of services to constituents back home through interventions into bureaucratic processes.

A second key feature of Congress is specialization and reciprocity. To function effectively in an era of pervasive, complex government, Congress must divide responsibilities among its members. But most congressmen do not represent districts that care about only one or two arenas of public policy. Consequently, to provide an incentive for specialization, Congress operates on reciprocity rules: congressman A helps Congressman B on issue X if B returns the favor on issue Y.

The ombudsman role plus reciprocity produces a legislative branch largely concerned with providing favors. In this context, the ICC is no more than another opportunity for pork barrel. Congressman A trades opposition to a route abandonment request as a favor to a small town chamber of commerce in Congressman B's district in return for B's support of a dam in the district represented by A. Generally speaking, this logrolling system favors well-organized, homogeneous interest groups, such as trade associations and unions, at the expense of more amorphous (but larger) groups.

All of this rings somewhat true, the essence of the regulatory problem is not wrong-headed itself. Congress places congressmen and voters in a prisoner's dilemma -- pursuit of rational self-interest in such a milieu makes everyone worse off.

5. Boyer, "Intermodal Competition and ...Service Differentials."

The point of Boyer's paper is that inventory management aspects of the methods used by economists in the past to estimate "service differentials" among modes are crude, and probably understate true differentials, thereby causing systematic overestimates of the extent of modal misallocation of freight in surface transportation.

As a theoretical matter, Boyer's point is correct. The inventory and late delivery costs of shipments are crude approximations of the theoretically appropriate methods. Whether these approximations are so crude that they are misleading is less clear, and certainly not demonstrated by Boyer.

The evidence presented in Boyer's paper consists of a simulation model that generates intermodal differences in holding costs. This model and the analysis that underpins it are based upon three crucial assumptions. First, the only relevant option open to a firm is a full truckload or a full rail carload shipment. Second, entry of intermediaries, such as jobbers and wholesalers, is foreclosed. This precludes the development of intermediaries to smooth the relationship between shipments and sales by acting as a mechanism to pool the demand for transported goods. Third, the service quality of transport modes is technically predetermined, rather than being under the control of firms and, indirectly, regulators by virtue of their control of prices, route structure and entry. If the transportation sector is regarded as more dynamic than Boyer presumes and these assumptions are relaxed, his analysis is not very relevant.

Boyer's argument is serious if few firms fall into cases in which the intermodal service differential must always be small, regardless of the dynamics of the industry. What is needed to establish the importance of his analysis is an empirical study of the actual distribution of shippers by the intermodal differences in inventory costs. Given the nature of the ICC data, this demonstration may well be impossible.

Boyer makes a key point that deserves emphasis through restatement. The key to coming to grips with the true magnitude of intermodal misallocation of freight is likely to be better estimates of cross-elasticities of demand, rather than more accurate estimates of the service differential. The effect of the service differential is important only insofar as it affects the substitutability of one transport mode for another. The best evidence that the differential is small enough to make intermodal competition important is to demonstrate that a significant proportion of the freight switches modes in response to relative price changes. If the existing estimates of intermodal misallocation of freight are disastrously wrong, the evidence is most likely to be found in very low cross-elasticities of demand, rather than in better estimates of the value of the service differential.

6. Concluding Observations

Transportation economics is a well-ploughed field of research. Moreover, for 40 years the pace of the development of the industry has been governed by regulation, with the result that the economics of the industry today -- particularly the motor carrier segment -- are much the same as the economics of two or three decades ago. As a result, researchers have probably already observed most of the key insights about the operations of the industry, and have pretty thoroughly mined ICC data for as much as they are likely to yield. If so, the role of more scholarly research in this field is very limited. Moreover, research is not likely to have much additional impact in the debate about deregulation.

Unless some great new insight that has eluded us until now is about to spring forth, the role of academic research in this area has been reduced to refining the technical details of a largely correct, complete picture of the industry. This does not make the field very exciting intellectually. Moreover, additional research may be politically uninteresting as well. Academics lack the resources and the data ever to bear a real burden of proof on any significant issue in the regulatory debate. In addition, research is largely irrelevant to the issues of income distribution that suffuse the questions of regulatory policy in transportation. The wealth effects of changes in institutional rules are probably the dominant political issue in the regulatory reform movement, and research can do little to resolve this issue.

Faced with a declining net intellectual contribution and policy impact to further research, scholars seem to have responded by becoming more polemical. This undermines the credibility of past research, as well as wastes good scholarly talent on an activity for which politicians, industry representatives and union leaders clearly have superior skills. At the risk of breaking precedent by calling for less research, surely a violation of the tenets of my membership in the community of scholars, perhaps it's time we gave up estimating the effects of the regulation of surface freight transport.

The flaw in the preceding argument is that it ignores the problem of who will teach transportation courses. Indeed, it ignores the severe macroeconomic shock that would accompany the sudden unemployment of the staff of Northwestern's Transportation Center.

If study and publish we must, perhaps a more fruitful topic is the economic effect of politics on transportation regulation. This commentary contains numerous observations on the way that the political system creates regulatory problems, but only the barest beginnings have been made to advance these observations to the status of testable hypotheses.

In any case, thought should be given to revising an old saw from the testbooks of elementary economics. It was once observed that the days of philosophers are over, the days of statisticians, economists and charlatans are here. Now, perhaps in transportation the days of statisticians and economists are also drawing to an end, and we should let the charlatans have the field to themselves.

CHAIRMAN'S COMMENTS

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I sat here for two days and listened and noted a lot of things. It seems to me the conclusion that I am walking away with is that we still have a long way to go. We need a lot of data. Some of it that we have actually comes from the regulated sector itself. If there were not a regulated operation, we probably would not have had any data. I happen to do a lot of work in some other countries that are not regulated and, believe me, it is a pleasure to come back and use some of this -- even this poor regulated data. We need even more.

Early in the program, what seemed to be vital analysis is not as central to the problem as we thought it might be. I think we are changing our minds regarding what the really relevant issues are in determining what the policy might be.

I am not sure, based on some remarks made in this session, how sure we are of how regulation is practiced and enforced in the United States today. We have a conceptual model of what we think the regulation is, and yet, from the field work that David Maister, I, and other people have done, we find that the "regulation" is in the minds of the regulators because we cannot find too much of it at times in the field. In fact, we would even be curious to find out how a "truly regulated" trucking industry might perform.

I will have to say, and this is not meant to be demeaning of the sessions, that I am not finding myself stimulated to pick up the banner of any great cause as a result of them. It may be that the victory has gone to the status quo, as David Maister remarked yesterday, in the two provinces with diametrically different regulatory processes that went through detailed analysis and hearings, and came to the conclusion that what they had was, in fact, the best possible world. This annoys me.

It annoys me that the status quo can gain a victory because, in a sense, if that can continue to occur, then the victory goes to the people who would fear innovation and stimulation.

I would have to say that I am not as certain as some of the speakers are that we have the best transportation system. I think we have plenty of room for innovation and stimulation. I think there is a great opportunity to improve our transportation system.

But, on the other hand, the one thing I find as I am closing the formal part of this session, is that I have not come out with a conceptual framework or mandate that cries for an immediate and direct change in policy that I am willing to pick up and run with. It seems to me that we have a very long way to go.

PLENARY SESSION

Chairman: Leon N. Moses

DISCUSSION--SESSION I

MR. BRAEUTIGAM: Dr. Friedlaender, I found your paper generally very good and I think the inclusion of factor prices and quality of service is important.

One thing implied by each of the papers that did estimate economies of scale, is the fact that a total cost function exists. By that I mean that it is assumed that in producing a given level of output, a trucking firm combines its factors of production. Like capital and labor; in a way that minimizes the cost of producing that level of output. Do you believe that this is a good assumption to make, particularly in view of information in other research papers written recently, such as Russel Cherry's that will be talked about tomorrow. He points out that in some cases one might use something like the operating ratio to introduce a particular kind of bias, or restraint, so that firms would not combine the factors of production efficiently in producing a given level of output. If that is the case, then is it appropriate to estimate a total cost function as these papers have done?

DR. FRIEDLAENDER: While the question of cost-minimization is clearly a problem, it is not a problem because of the operating-ratio constraint. The potential problem caused by the operating-ratio constraint is really an analogue of the Averch-Johnson effect. Therefore, let me very briefly discuss the Averch-Johnson effect and then discuss why I do not think that that kind of analysis is relevant to the operating-ratio effect.

Basically, the Averch-Johnson effect indicates that if a firm is operating under a rate-of-return restraint that limits its allowable return to capital, then it will operate along a distorted cost curve. It will employ more capital than is efficient, more capital than it would in a nonregulated situation.

The Averch-Johnson effect only holds, however, if, in fact, the firm faces a binding rate-of-return restraint. In situations in which the constraint is not binding, there will be no distortions. I think this is the problem with trying to extend that analysis to the operating-ratio effect in the trucking industry.

Recent papers by Russell Cherry and Thomas Moore argue that the operation-ratio effect should distort factor choices and lead to a non-efficient cost curve. Consequently their analysis indicates that if we assume that firms are minimizing costs subject to existing factor prices, we are committing a specification error since the actual cost curve that firms follow is not the one that we are postulating.

The problem with that argument is that no one firm actually operates under a binding operating-ratio constraint. As far as I know, if the ICC sees Roadway Express with a low operating ratio, it is not going to tell Roadway to change its ways. The way the operating ratio seems to work is essentially as an average and an aggregate. When the industry average is not at a level that the ICC finds acceptable, it may take steps with respect to overall rate changes, but it does not tell a specific firm to change its rates. Since the operating ratio affects averages and not the specific firm, it should not cause the firm to operate along an inefficient cost curve.

However, I have to admit to being somewhat uneasy with the neo-classical model that does assume that firms maximize profits and minimize costs. Thus while virtually all econometric analysis is based on that assumption, I think that the work by Oliver Williams and others, that assumes that firms maximize utility functions, may well be a better representation of reality.

As far as I know, no one has really done any work relating the cost functions of firms to their objective functions, except in the Averch-Johnson and related contexts. Thus in answer to Professor Braeutigam's question, I would like to state that it may well be that we are making a bad assumption in assuming that firms are neo-classical cost minimizers, but I do not think that the operating-ratio constraint that is imposed on the industry is going to create biases in our cost functions if, in fact, the firms are minimizing costs.

MR. MORITZ: I would like to comment to all the participants on the inputs that went into the methodology, rather than the methodology of analysis. All were post-1973 data. I am a bit concerned with that because we in the industry have been making efforts to improve the data. Also, it has been mentioned here that using data that was not collected for the explicit purpose of econometric analysis may cause a problem.

Post-1974 there were some changes in the system of accounts that were created by the ICC. One that I am concerned about is the ton factor. Prior to 1974 tonnage could be put in either on a build or an actual basis. The industry has seen, on an average, about a 4 percent difference between the tonnage factors that came out prior to 1974, and those that came out after 1974. The problem of variance here gets to be a little difficult because we are looking, in an econometric analysis, at individual firms. Some firms were already using an actual basis prior to this period.

My second concern is that some research we have been doing in the industry itself has been presented to the ICC and has been found to be of interest in other quarters. The research concerns off-balance sheet investment in the industry which takes place because the system of accounts calls for "carrier only data" versus a "consolidated basis data." The position change there may be somewhat radical. For instance, the Eastern-Central case shows that if you use "consolidated basis data" versus "carrier only basis data," the carrier operating property net is increased on an average by 50 percent. Changes in the case of a particular firm may be radical. I wonder if you would comment on the input data and how it might affect your results?

DR. FRIEDLAENDER: It is difficult to answer that question. I think that Dr. Klem gave a very eloquent discussion of the kinds of errors in the data that we face. Also, Mike Lawrence gave a good summary of the problem with respect to constructing factor prices. Clearly the data are not as clean as we would like them to be. Without knowing, however, whether there are biases that are inherent in the nature of the data, one could probably say reasonably safely that the errors in the data will increase the variance and the noise, but that they will not necessarily bias the results. But clearly the data are a problem and if we could get cleaner data from the trucking industry, we would certainly be delighted.

DR. KLEM: I would just like to echo what Professor Friedlaender said. I have heard about many of these problems, too, and observed many of them. However, those errors I have observed have really been of the random type where people put down unreasonable numbers. That is exactly the kind of data problem that I tried to address in my paper. I think potentially, it can be addressed, though it would certainly be nice if we could reduce the magnitude of that kind of data problem.

PROFESSOR CHOW: May I also comment on Mr. Moritz question? Many of the problems relating to the use of ICC data are based on allocation. That is, some of the natural classifications of data were allocated to functional cost classifications. I believe all of the data used in my research are straight numbers that have no allocation to them. As I had indicated, any ratio that represents firm productivity could bias the results as would be the case for load factor and cost per employee. The data used in the tapes are from the annual reports and are relatively well cleaned up at this point, inasmuch as they are used in the compilation of the ICC Transport Statistics. Dr. Klem has indicated that these are as clean as possible.

MR. SWEENEY: Professor Chow, assuming that there are distinct economies of scale, would you see this as promoting, eventually, three or more major motor carriers, a consolidation something like that of the automobile industry where there are only four major manufacturers: General Motors, Ford, Chrysler, and American Motors? Would you see that as a deregulation, assuming this efficiency of cost would lead to that, and if it did lead to that result, would you consider that to be desirable?

PROFESSOR CHOW: It is desirable to have the carriers' price reflect their costs with or without regulation. If the carriers definitely have economies of scale and it develops that there are three or four carriers, they will be in a monopoly position or in an oligopoly position in most of their markets. In either case, the demands of the carriers will be where the marginal revenue curves are below the demand curve. From straight micro-economy theory, they will not charge a competitive price, and this is a price that does not reflect marginal costs.

MR. SWEENEY: We seem to be focusing very heavily in this meeting on cost, and the question of whether the regulatory agencies are doing a good, adequate, or bad job. That relates to how they are performing their function, of course, and their function is not to allocate costs. It is to allocate rewards. I am just going to suggest that there is much to be done in studying whether rewards are being allocated properly, whether certain carriers are being overcompensated, and determining who is making the money in the industry, and why. Is it because of regulation? Is it because of the tariff rate structure? Things of that nature should really give us the answer to whether regulation is doing its job or not.

DR. MOSES: I would like to have Dr. Friedlaender respond to Dr. Lawrence's earlier criticism about service in the true sense, about how that is represented on cost curves, and on Dr. Lawrence's claim that very large firms are absent from her sample.

DR. FRIEDLAENDER: Dr. Lawrence, your question is well taken and, in fact, whenever I have presented this information, a major criticism has been raised about those issues. At those times I have agreed with the critics and told them that we are working to extend the sample. We are, in fact, doing that, and only last Monday my research assistant told me that we had finally run a large sample of all of the Class I carriers whose data were appropriate and valid.

The sample that I reported on was about 168 carriers in the Northeast, Middle Atlantic, New England, and Central regions. We have now extended the sample to include the other regional carriers, plus the large inter-regionals and transcontinentals that Roadway, and similar carriers would be a member. Preliminary results, and I have to stress that they are preliminary, indicate that the conclusions seem to strongly indicate a need to change the size of the sample. In other words, when we introduce constant dummy variables for the large inter-regionals and the other carriers outside of the region, the dummy variables are in general, insignificant and the coefficients of the expanded sample are remarkably similar to the coefficients of the smaller sample. This indicates -- and quite frankly this surprises me -- that the large carriers do not have a fundamentally different technology from the smaller carriers. These findings are, of course, very preliminary, but our preliminary estimates would indicate that what is true for Boss-Linco, is also true for Roadway.

The second point that you raise about whether differences in haul and load are due to regulation is certainly a valid point. Quite frankly, I think that one has to say that one cannot be sure of the sources of the differences. If you look at the kinds of restrictions placed on routes and commodities, though, there certainly are reasons to believe that firms that have a lot of operating rights should have longer hauls and larger loads than firms with more restricted operating rights. That does imply that large firms should have longer hauls and larger loads, that, in fact, our econometric evidence indicates.

I think the real problem, though, is whether small rural communities will receive better or worse service at higher or lower rates in a deregulated environment than they presently receive. If it is true that small shipments, small loads, and short hauls have higher cost than large shipments, long hauls, and large loads, will small firms in small rural communities be able to get the same economies of utilization as larger firms in large urban areas? Unfortunately, we simply do not know the answer to that question.

My guess is that the diseconomies of small size that we observe are a lot less than a simple correlation between cost and scale would indicate, but there are still probably going to be some diseconomies in that small firms serving small shippers on light density lines will probably not be able to get as full economies as large firms on high density lines. Thus there may well be some cost differences between large and small firms in a deregulated environment. In sum, while I would guess that a lot of the differences in haul and load are induced by regulation, it is unlikely that all of them are. But that is really a conjecture.

DR. LAWRENCE: Let me respond to your response. I am delighted that you are expanding your study to the full industry, and I will be very anxious to read the paper. It is difficult to respond to that extension before I have had a chance to look at it.

In terms of regulatory versus technological economies of scale, many people would agree that some part of load average and some part of average length of haul is attributable to the regulatory process, and on that point we can agree. Where we come to a parting of the ways is on the question of how important the management actions are on those two variables. I happen to know that load average is an active management strategic decision in most large trucking companies. It is not a passive residual of operating authority, even though operating authority and extensiveness of operating authority is definitely going to influence it.

People in the industry would argue that most of the influence on load average comes from corporate strategy rather than from operating rights, and that is a subject that has to be researched thoroughly before we can talk about the rest of your paper.

DR. FRIEDLAENDER: One last point. How about length of haul since that variable appears to be the major source of apparent economies of scale? I agree with your point to the extent that average load is an endogenous variable. One has to be very cautious in interpreting it.

DR. LAWRENCE: The question of haul is one that is more difficult to answer than the question of load. For many years executives in the trucking industry believed that the longer the haul the more profitable it would be, and therefore, trucking companies managed their operations in such a way as to emphasize long hauls, and to de-emphasize the shorter hauls.

In recent years, as the result of econometric research done by people such as Garland Chow, and also because the industry has become more enlightened, we have come to realize that it is simply not true that the longer the haul the more profitable the traffic. As a matter of fact, the relationship between average cost and length of haul is something of a U-shaped curve, and many of the carriers are beginning to redesign their systems and change the management so that the average length of haul is not as long as it used to be. Length of haul is now an active management variable, and is not only a passive residual of operating rights. I think that I am more right on load and you may be more right on haul -- but we have got to do research to find out. We just cannot make arbitrary assumptions on these critical questions in our research design.

DR. KLEM: I just want to put in a point of view that the significance of the length of haul on the cost is interesting but does not have much significance on the structure of the industry.

What you are really talking about is the taper in the cost curve. In fact it is definitely true that it costs more than half as much to take a shipment half the distance. Nevertheless, because a shipper does not usually have the alternative of taking a shipment half the distance, there really are two different markets. Except for long-term locational decisions, it is just not an important issue.

MR. MORITZ: May I briefly respond to something Dick Klem said earlier about a non-empiric econometric analysis for economies of scale? It is a factor that I think needs to be included in any policy discussion about whether we should have regulation of the trucking industry. That has to do with the barrier of entry posed by difficulty in getting capital if a company is going to extend its length of haul, and that implicitly says they are going to extend their operations into another geographical territory. All the papers have been concerned with general freight carriers of LTL commodities, and they are a great deal more capital intensive than any other sector of the trucking industry. For example, to buy land now for terminals generally takes more than a million dollars.

MR. EASTMAN: Several papers dealt essentially with economies of scale and one aspect concerns me. It is that when looking at output and plotting unit costs against some measure of output, a wider band results from segmenting the industry than occurs in a change in the curve for a particular segment that is supposed to show whether or not there are economies of scale. I think this is quite dramatically shown in Mr. Koenker's charts. (see Koenker's paper Figure 1) Although the three curves showing different H's and W's did not identify what the quantities were, I note the spread between the curves is greater than the unit cost change with output of any individual curve. The change in the individual curve is what we are trying to show as economies or diseconomies of scale. The separation of the curves themselves, that is, which is of a greater magnitude, is arbitrary, whether it is done by weight or whether by length of haul. My question is: Have you thought about this and what do you think it means?

MR. KOENKER: It has been mentioned by a number of participants already that it is necessary to segment the market. We are really interested in what happens when the scale of a firm is increased leaving the traffic characteristics unchanged. We are trying to identify, so to speak, a pure scale effect. I think that we are all quite aware of the fact that costs are dramatically different for loads of different characteristics. The object of the analysis is to try to identify a scale effect which is divorced from the load characteristics. If one does not try to control for load characteristics, then one gets spurious results.

MR. TERRY: My question is also about Mr. Koenker's chart. If I understand it, the green bar shown is the optimal size of firm, and if so, I get the optimal size of firm to be between $400,000 and $1 million. (see Koenker's paper Figures 1 and 2)

MR. KOENKER: I have converted ton-miles to dollars and I know what it costs to run a ton-mile, so that calculation does not follow.

MR. TERRY: My difficulty then is that I do not know how I would operate the postulated million dollar truck line. If this were to be a Los Angeles to New York truck line, using 1972 figures, the cost to run was about $1.00 a mile. That comes out to about three loads a week in each direction, so there would be a load on Monday, Wednesday, and Friday. The drivers would then have to be spaced resulting in lay-over days for them each time. If the line were Chicago to New York, a load a day might be carried, but the load for Chicago would have to be collected by going around New York, which is a big city. What troubles me is that the economic analysis comes out with an optimal size firm that you could not possibly operate in a "less than truckload" business. It would seem to me to be impossible to run even that Chicago/New York truck line. Suppose we wanted to operate from Fort Pierce, Florida to Madison, Wisconsin where there is only about a shipment a month. I am concerned about the analysis because the implications of what you are doing are very important to the trucking industry and to the transportation system in the United States. When the answer comes out that the optimal size of the firm is something that could not be operated, I think it is worth going back and looking at what was done. Did you consider this aspect when you reached that conclusion?

MR. KOENKER: Let me mention two points. One is that the data that was used to fit these particular cost functions were all data from firms that were operating in the central states. There were no national carriers in the set, but the real response is that these cost functions fit with data that are from firms that are operating in your industry. I did not just make up these cost functions. One observes costs, output and load characteristics for the sample of firms in the central states over a 25 year period, and one fits that cost function to them; this is the story that the data tells.

MR. TERRY: Was it a reasonable result?

MR. KOENKER: Well, until someone is able to produce convincing results that indicate significant scale economies at levels of scale greater than this, I think the burden of proof is on the other side.

DR. LAWRENCE: That is so, of course, only if we assume that this analysis was done correctly, and there has already been a lot of evidence brought out that it was not done correctly.

DR. FRIEDLAENDER: It seems to me that suddenly the discussion has changed and that we are really not talking about whether there are scale economies but whether there are scale diseconomies, and this graph indicates rather mild scale diseconomies. (see Koenker's paper Figures 1 and 2) Although our analysis also indicates rather mild scale diseconomies, my own sense is that one probably has to be somewhat cautious in asserting that there actually are scale diseconomies, because it is important to realize that any graph relating average costs to output has to assume that everything else remains constant. We evaluated our costs at mean qualities and mean factor prices. Since, however, our cost functions indicate that production is non-homothetic, it is not possible to make a "blow up" of any given graph or to shift its scale. Thus while there may be mild diseconomies of scale at mean factor prices and mean qualities, we cannot infer that mild diseconomies of scale will hold at all factor prices or all qualities. Thus I am not sure that we understand the structure of the industry sufficiently to state that there are diseconomies of scale.

However, I am fairly confident in saying that any economies of scale that may exist disappear at very low levels. Thus while one may not be able to say that the optimum level of a trucking firm is on the order of $1 million revenue, one can probably say that a million dollar firm should be able to get the same economies as a billion dollar firm. Those two statements are, of course, somewhat different.

DR. LAWRENCE: Let me have Professor Chow respond.

PROFESSOR CHOW: Let me go back to the concept of regulatory induced economies of scale. As far as length of haul is concerned, if one tries to single out the effect of length of haul on cost, then whether it is a result of regulation or whether it is a result of management decision becomes irrelevant because it isolates the cost scale effect and that is the relevant objective. The same goes for other so-called regulatory factors. I think it is another question, indeed a yet unanswered one that a particular factor is caused by regulation. May it not be caused by management choice?

The next point has to do with the criticisms over the fact that I do not have explicit input costs in my model. The source of this criticism may be the proper definition of economies of scale and whether pecuniary economies of scale or economies of size, as some authors define them, are relevant. If I am interpreting Professor Duncan's remarks correctly, he is saying that one should discount the advantages of a large carrier which, because of its size, is able to get inputs more cheaply, for instance hire labor at a lower cost. To me that is what one calls pecuniary economies of scale, and one would be eliminating that by putting in a factor cost variable. I know for a fact that many of the large carriers are able to finance themselves more cheaply because they are large. Is this a benefit of size or are you going to hold it constant by putting the input prices in? Being realistic, if a business out in the industry is lowering its cost and driving out another business, these advantages are relevant. Therefore, if we hold such advantages constant, we are simply saying that a large business which can buy in large quantities and which can get quantity discounts, has an irrelevant advantage. In this respect, I think I agree with Dr. Klem because he has indicated that he is looking at a total aggregate economies of scale. It is not only the production function producing more than double the output for double the input, but also reductions in cost due to the quantity buying, cheaper financing, and lower labor costs.

DR. KLEM: If I may return to that discussion of the optimal scale, remarks made seem to point to a need for some further research. In moving truckload shipments, probably the minimum efficient scale is a truck. If shipping less than truckloads, the minimum efficient scale is somewhat larger. In my analysis the minimum efficient scale was at about 5 or 6 million dollars a year. That contrasts slightly with Mr. Koenker's results, simply because the trucking firms I considered were in somewhat different markets than those he looked at. He considered the shorter haul carriers and I looked at all of them. It would appear profitable to look at the effect of shipment characteristics on the low point in the cost curve.

DR. WYCKOFF: This will be an observation, not a question. This session was to be on cost and demand, and all four papers dealt with costs in substance. However, many of the questions and criticisms raised by presenters, discussants, and the audience, seem to have to do largely with the issue of demand.

I am sure that there were no demand papers because demand information is one of those confidential items that people in the business do not openly discuss. That is the kind of information they use to make their living.

Meaningful discussions and the ability to make definitive decisions about concentration require an understanding of demand. When we start to do that, we will clear up issues such as [illegible] I do not consider length of haul or shipment size as issues of quality, but instead believe those to be shipment features. I consider load to be partially a demand issue, but it is partially a management issue, too. One can decide to move for schedule or for load, depending on how the company is managed. Another item I wanted to mention concerns ton-miles.

Absent from most of the papers is the point that these are revenue ton-miles, not available ton-miles. Professor Friedlaender's approach did deal to some extent with load, and it is interesting to note that in the trucking industry, we measure the cost of the product consumed rather than the cost of the product produced. That is unusual compared to other industrial analysis.

An additional question is whether there is economy of scale in length of haul. In studies I have done I have not usually considered the application of spreading of a fixed cost as an economy of scale. What we here are calling economy of scale of a length of haul, is really the spreading of a fixed cost of a shipment over the number of miles of the trip. There are fixed and variable cost elements, both to the shipment size and to the length of haul.

I would be very interested in what Professor Friedlaender's final results are, but I suspect that I already know what they will be. The model is a relatively simple mathematical formulation that implies smooth curves. I think that there are discontinuities on middle-sized carriers. My own observations and studies have indicated that. The fact that there are relatively fewer large carriers than there are middle and smaller size carriers would, in fact, also produce the same shape of curve just because of the small amount of data available on the very large-size carriers. The density of occurrences in the smaller carrier and middle-sized carrier would produce this shape of curve even if we add in a few Roadways.

One last note is that the largest carriers in the United States do not necessarily operate the largest terminals. The largest carrier in the United States is Roadway. They use a high intensity terminal strategy and operate some of the smallest terminals of all of the LTL carriers, because they are able to make so many direct shipments without the use of breakhaul because of their service. With regard to the quality issue, if regulation were to be criticized at this stage, based on remarks made from these papers, it might be from the fact that there may not be enough choice between service and price that may be offered to a shipper. That does produce a strange sort of situation because all the prices do tend to be the same and shippers then can opt for different levels of service. It would be a strange individual who would not opt for the maximum amount of service, given a particular price.

PROFESSOR P. ROBERTS: I would note that if we had price competition, we would not be having this discussion this morning. The essence of our problem here is that we have got service competition.

Another point that Mr. Koenker made in his paper was that there has to be segmentation of the freight market and he breaks it down into three or four levels of service. Dr. Friedlaender is conducting segmentation in another way. The segmentation that is appropriate, I would argue, are those level-of-service variables which Dr. Wyckoff mentioned. In fact, those level-of-service variables are crucial on the demand side too. For example, frequency of service, travel time, reliability, damage to goods, and loss, in conjunction with the minimum size in shipment, must be taken into account. It is exactly those features that have to be used to make the market segmentation, and we have not covered those in any of the papers.

MR. NIEMAN: I think it is necessary to make one general point and then I would like to make a second observation.

My first general point is that it is important for all of the audience to realize that we are talking about only the general freight industry. There is another segment of trucking serving this country that has not even been discussed today. It is very important that it be understood by the public, the officials, and those in the audience who represent public agencies.

My second point is that it was very difficult for me to cope with Dr. Friedlaender's Q factors, because they were not quality factors. In running the trucking business day in and day out, management is trying to cope with these items of quality of service and is successfully distinguishing itself both as to the rate at which it attracts market share, and as to the profitability for its shareholders.

Now, it may, or may not be those two things are somewhat contradictory with public policy. Quality of service is the single biggest differentiating factor in the trucking industry today. While the people today have addressed themselves to the cost structure of the industry, and that is appropriate, it is only half of the equation.

MR. BOYD: There is another methodology for assessing scale economies that is complementary to econometric estimations of cost functions. It was suggested by George Stigler, and it is the survivor principle. If one observes in a market that larger firms are increasing in size and smaller firms are diminishing in size, as has happened in automobile manufacturing so far this century, then one concludes from this methodology that there are economies of scale in automobile manufacturers.

We have observed that concentration in this segment of the motor freight industry is increasing. Unfortunately, that observation does not allow us to distinguish between two alternative hypotheses. One where concentration is increasing because of regulation, and there are various arguments one could make in support of that hypothesis. The contrary hypothesis is that it is increasing in spite of regulation and that, therefore, anything that would relax regulation would tend to speed up this concentration. That is the central issue for public policy.

It seems to me that we do have experiments or observations that we can make that would allow us to determine which of those two hypotheses is more nearly the truth. What do we observe about increasing or decreasing concentration in those states that have more, or less, regulation and in those that have experienced differences in regulation? There may be people here that have looked into this issue. If so, I would be interested in what this complementary kind of methodology might tell us about the effect changes in regulation have on concentration in the industry.

DR. MOSES: As we look at the alternatives and the question of survival, I believe that we ought to ask where concentration is and where some of the greatest growth is taking place. I think the answer is in private carriage, in the private ownership, and the immense expansion of the private fleets. If we are looking for survivorship, that is the place for the survival. We may then ask if there is anything in the regulatory framework causing that. In fact, the study referred to, Stan Warner's earlier study, grew out of an analysis done 17 years ago on the growth of private carriage.

We were even then worried about the regulatory impact on the allocation of freight to the common carrier and that, in fact, it encouraged the growth of private carriage.

DR. KLEM: To return to points raised earlier by Professor Duncan on the effect of factor prices, I want to clarify two points. First, if prices are non-parametric, then they do not belong explicitly in the regression. I believe Professor Duncan concurs on that. Second, if prices are non-parametric, these are the factor prices, and the effect of those non-parametric prices does not belong in the relationship. I am aware that information about the technology of the industry, which is of value in some other context may be lost, but this process may allow making statements with a bit more precision about the aggregate effect of the technological economies of scale and the market or external economies of scale.

As one final point on that aspect, there are other factor price effects which, from my point of view, do belong in the relationship, such as geographic effects. The usual trans-log methodology deals with geographic effects but alternately they can be picked up and, in fact, were picked up in my analysis, by the dummy variables for geographic area.

PROFESSOR DUNCAN: Putting in the dummy variables, I agree, handles the problem of leaving out the factor prices, but only if the factor prices are non-varying within the region and if you assume a homothetic -- actually a Cobb-Douglas technology. I think then that it is a very restrictive assumption.

Secondly, I do not see why one would necessarily want to mix up pecuniary with non-pecuniary returns to scale. It seems to me that what one would like to know is what the technological returns to scale are on the one hand and what, if any, are the pecuniary returns on the other hand. Then, if you want to aggregate, you can. As it stands now, one cannot say which is which and, depending on whether the returns to scale are technological or pecuniary, it seems to me one would suggest different ways of looking at the problem of deregulation. Therefore, I think it is really important to distinguish between the technological returns to scale and the pecuniary returns to scale. Here, by pecuniary returns I mean returns to scale that may be observed because a large firm can make a better deal with a supplier than, say, a small firm.

DR. KLEM: I concur with most of that. I would rather have had them separate and that is an area for further research. However, such a separation is not relevent to determining broad questions of regulatory policy, e.g., the appropriate roles for entry controls and pricing restrictions.

MR. KOENKER: I would like to concur with others that it is very crucial in doing this sort of work to make some attempt to allow the optimal scale to depend on load and haul characteristics and, if possible, on the other kinds of quality of service variables that have been mentioned. Unfortunately, these variables are difficult to measure, given the current sources of data. The cost curves that I discussed earlier are not meant to be definitive representations of what is going on in the industry. But I think that the work that Klem and Friedlaender have done seems to indicate that the point estimates of optimal scale in the industry are really rather surprisingly low compared to the existing size distributions of firms in the industry.

PROFESSOR LaLONDE: Professor Duncan made the comment that the small shipments problem, and perhaps I am paraphrasing him incorrectly here, was not controversial. In essence, the implication was that our paper was not controversial and, judging from the discussion, perhaps it is not. I would like to reinforce, however, the notion that many of the things that we have been talking about in terms of profitability, attracting capital, viability, the incidence of private carriage, the demand notion, and so on, if we trace them back far enough, take us to the small shipment problem. I do think, perhaps, it is not controversial; perhaps we know how to solve the problem; but it seems to me if we do, then we ought to get on with the job.

DR. LAWRENCE: I should say here that first of all it was impossible for LaLonde to present all aspects of the complex and comprehensively-done paper in the short time allowed. Secondly, some of his results are controversial. If his results are correct, then I think there is significant research support for the contention that the rate structure of the motor carrier industry needs to be restructured. The complete text of the paper will show these points.

PROFESSOR DUNCAN: My remark was meant only to imply that the need to do that kind of methodology or to take that kind of approach was non-controversial. Quite frankly, I do not know which of the results would be controversial.

PROFESSOR CHOW: I agree that we should separate the sources of economies of scale among the technical, the pecuniary and the regulatory. I strongly feel that pecuniary sources of scale, economies to the degree that they do exist, are real economies of scale and infer a real cost advantage on carriers. To the degree that they exist, a carrier can have a market advantage.

There have been several comments about the simplicity of one model versus a more sophisticated model. I think I would certainly like to try to impute factor costs and see how that would affect my particular model's results if the inclusion would not bias the results. I should add, particularly for those of you who are familiar with mass transit, that for a while many transportation planners have looked to new technology for solutions and found instead that old technology with intelligent application proves out to be better.

DR. FRIEDLAENDER: I would like to address the policy issue that Mr. Sweeney raised earlier. That is, why do we care about economies of scale? I am willing to take my evidence and Dick Klem's evidence that there are probably not very many economies of scale in the trucking industry. The implication of that, of course, is that if we deregulated, there would not be any concentration in the industry. Having said that, however, I will throw out a counter-hypothesis which really supports the position of Paul Roberts and Daryl Wyckoff, which indicates that we need to do more work on demand. Even if there are constant returns to scale in the industry, if, in fact, demand depends very much on service, it may well be true that large firms can offer more frequent service than small firms and will therefore have an advantage, not necessarily in terms of cost, but in terms of profits. Thus it is possible that even if there are no economies of scale on the simple cost side, there may be differential advantages that large firms can have on the demand side. Dr. Wyckoff's point is well taken. It is too bad that there were not more demand papers presented at this workshop.

The data to do that kind of analysis is very hard to come by, but before one wants to jump to the conclusion that there are no advantages to large size trucking firms, and that we do not have to worry about concentration, one should spend more attention on the demand side than we have. This is clearly a very important research area.

MR. FLOTT: I am very much encouraged by the presentations that were made here today. The recognition by the authors that these data must be disaggregated and that we can no longer look at the industry as just one overall trucking industry is an encouraging sign. I hope that the authors will pursue this.

I think Chow's paper, for example, showing the importance of separating a carrier, long haul, short haul, heavy intensity service in an area, and light intensity service in an area, is one step in the right direction.

PROFESSOR LEVINE: With respect to Professor Friedlaender's last point, I think it should be emphasized that even if certain differential advantages should be found for large firms across certain service variables, that that would not necessarily have any particular implication for the regulatory regime.

It is perfectly possible that certain large firms could compete with each other in a healthy way across service variables while smaller firms with cost advantages competed with both by offering service to customers who did not need what the larger firms had to offer. I would show the rental car business, for example, as an example of that phenomenon at work.

DR. LAWRENCE: I would sum what you have heard today in this way. Regardless of the econometric technique that is used to examine the existence or non-existence of economies of scale in the trucking industry, the model must be specified correctly. The question of specification includes these parts: Are there any variables? Are there any factors that are connected with the relationship between size and cost that are not included in the specification of the model and what would be the effects? The task is to decide which of these research papers is correct and what future economic research on this subject is correct. It includes evaluating the various model specifications.

I thank the panel for their contributions and I thank the audience for their attention.

DISCUSSION--SESSION II

MR. WEISS: Professor Allen, when two commercial zones intersect, and quite a number of them will under the new ICC rules, does that free traffic between the two cities from regulation? As I understand it, Washington and Baltimore are going to intersect.

PROFESSOR ALLEN: Baltimore/Washington zones would do that, I believe, but Fritz Kahn of the ICC should respond.

MR. KAHN: Yes, the zones would intersect, so operators would be free to establish a truck line between Baltimore and Washington, since continuous commercial zones are exempt from regulation.

PROFESSOR ALLEN: An interesting extension of that concept might be to expand the zones throughout the whole country.

MR. ROBISON: Assuming the redefinition and expansion of the ICC commercial zone is, as you contend, a microcosm reflection of the benefits of economic deregulation, it does raise an interesting question about relating your problems now existing in the Section 203B6 area of the regulatory structure. It would be interesting to try to relate the two.

MR. EASTMAN: Mr. Kolins, you favor regulatory reform and advanced a proposal for modifying existing certificates to allow generic commodity classification. You also proposed to give the private carriers the opportunity for inter-corporate hauling. I admit that is one way to go. Let me ask if you are familiar with another proceeding before the ICC, MC103, in which the shipper who wants to go into for-hire carriage can do so? This process can be facilitated by changing the rules of entry so that the common carrier can get the necessary operating rights. In the MC103 situation, competition can be stimulated between private and for-hire carriage. What are your thoughts about that?

MR. KOLINS: I am familiar with it, but please forgive me if my response is not very specific as it relates to that particular case. Given a limited familiarity with the MC103, it seems to me that the concept involved in that case and the notions that I put forth today essentially head in the same direction. While I do go a little farther and propose more comprehensive regulatory reform than does MC103, that case, if I understand it correctly involves an easing of entry, albeit under the certain circumscribed conditions involved in that proceeding. I am one who favors an easing of entry controls, as I indicated earlier, but do not favor absolutely free entry. I would say that, in my view, the proceeding MC103, probably points generally in the correct direction. However, I would tackle the situation a little bit differently and more comprehensively.

MR. MORITZ: Professor Allen, you showed in your graphs that there was quite a bit of movement of industry, shopping centers, and the entire collection of individuals who will be shippers, out of the commercial zone region prior to any change in the commercial zone region. It seems to indicate to me that transportation was their consideration when they made that move. They must have considered the fact that they were going to need transportation either intra- or inter-commercial zone. What problems did they face in their relocation decision?

PROFESSOR ALLEN: Presumably, transportation was involved. However, there were other factors involved in the location decision and the net result is that it appeared to these shippers to be more profitable to move out, given high crime rates in the city-commercial zone area, higher insurance rates, congestion, the inability to go to one floor, that is, single story, technology, the desire to be near interstate highway interchanges, and so on. Apparently, it seemed beneficial to them to go out and take advantage of low insurance rates, low crime rates, low property tax rates, single-story construction, and things of this nature, as opposed to any advantages of being inside the zone. That is why I predicated my statements on ceteris paribus types of assumptions.

MR. MORITZ: But they did receive service?

PROFESSOR ALLEN: They certainly did, and by their own statements they enjoyed it more when they received more service.

MR. ROBISON: Professor Allen, if I may return to add to my comment on the problems in the 203B6 exempt area, they relate principally to three things: poor service, lack of equipment, and bankruptcies. I might add that 203B6 refers to unprocessed agricultural commodities.

PROFESSOR LEVINE: I have heard of some problems with respect to the agricultural exemption, but I have also heard some good things about it too. There has been some evidence in the past that when a commodity goes back and forth between being regulated and being deregulated, there is an average of about a 20 percent decrease in rates when the commodity moves to an unregulated status. It is true though that the studies on this subject are quite old.

MR. VOORHEES: I would just like to comment that the point on the 203B6 area was made from a carrier's viewpoint. We have quite a bit of data at Iowa State indicating that, from a customers viewpoint, there are absolutely no problems at all in this agricultural exemption area.

MR. PAPADOPOULOS: Dr. Miller, you mentioned an estimate of value of regulation to society as varying from minus a billion dollars on up.

Does that estimate include any value that relates to the private carriers, and the inter-corporate hauling that Mr. Kolins referred to, and how they are affected by the regulations?

DR. MILLER: My estimates were not sufficiently sophisticated to try to bring in that specific element. They are just very crude, rough, aggregated figures. I think a good count of the costs would need to be very specific. Unfortunately, we do not have good data that allows us to make these kinds of measurements. In the airlines industry, there are roughly ten major carriers. In the trucking industry, there are many thousands of carriers. Another factor is that the ICC, whether it finds it very burdensome or simply because it does not choose to do so, does not collect much good data that would enable one to make those kinds of estimates. Mr. Kiley may wish to comment about those costs or values of regulation.

MR. KILEY: If you say that you have done some rough statistical work and evaluation and then say that regulation costs the consumer anywhere from 2 to 6 billion dollars, I can just as easily say on the same basis, the same type of analysis, that it is saving them 10 billion dollars. You would have just as much trouble proving I am wrong as I have proving you are wrong. As a matter of fact, I believe I have a better basis for it, although the figures do not come to my mind immediately.

Take the price trend during the time of the greatest inflationary pressures, '72 through '75, and look at what happened to the general price, and compare that with the price of motor carrier service. Motor carrier prices lagged behind the general price index. So I would just as easily say that regulation saved the consumer hundreds of millions of dollars.

DR. MILLER: In response, let me say that comparing the wage-price index with the motor carrier rate increase shows there is, as you suggest, a very large saving. But in looking at the consumer price index, or the GNP deflater, it is found that the savings are not in the very large numbers of millions that you mentioned. They are actually an extremely small dollar amount. There are very interesting questions as to what those price deflaters are supposed to be measuring. Also, presumably, one should look at what happened to truck costs vis-a-vis what happened to truck rates, and not what has happened to some overall price index compared to truck rates.

If I may return to the 203B6 question, with respect to the bankruptcy aspect, there has been a recent study for the U.S. Department of Transportation by Messrs. Miklius and Casavant of Washington State University. That study shows that the bankruptcy rate is extremely low for agricultural motor carriers. The statement was made that the bankruptcy rate is either at the industry average or less than the industry average. According to this result developed by an agricultural school, there is no excessive bankruptcy rate in this industry. It is stable.

MR. ROTH: Dr. Miller stated that consumers were paying the cost of operating authorities through rate increases. That is just not right, because operating costs have never been in the rate base for motor carriers.

Professor Allen, you stated in your presentation on the Philadelphia case that service had increased for those shippers because of the commercial zone extensions and that more carriers were knocking on shippers doors. I would like to ask what happened to load factor of the various carriers, and what potentially was the implication, for example, for fuel use on those carriers?

PROFESSOR ALLEN: I cannot comment on what happened to load factors and I have a problem on the fuel question. With respect to decreased interlinings on the truckload movements I visualized fuel consumption as decreasing. One of the major questions posed when the ICC opened this up for hearings was what happened in the LTL type movements with respect to fuel efficiency? I do not know the answer, but I can envision various types of pick-up and delivery schemes that would be better from a fuel point of view. I did suggest that maybe we ought to study the fuel use question to find the answers.

On the truckload side, however, since you cannot now make a direct movement and eliminate the interline, I would suspect that there would be fuel savings. But for less than truckload, I do not know.

DR. MILLER: I am well aware that certificate values do not enter the rate base, but that does not matter. The point is that the certificates are revealing and that there are sufficient monopoly rents being earned. It does not have to be in the rate base. The fact that the operating authority has value is simply a reflection that monopoly rents are being earned.

PROFESSOR LEVINE: An economist would say that under something resembling perfect competition or even fairly good competition, people are earning just about enough money to keep them in the business and not enough money so that they feel strongly about staying in it. When people spend a lot of money for pure entry rights to get into a business, one must assume that the business is an exceptionally profitable one. Otherwise, people would pursue other opportunities. Where entry is restricted and people are willing to pay for entry rights, most of us hypothesize that the restrictions on entry are what create the profit opportunities.

MR. CLAPP: Dr. Miller, in view of your characterization of the industry as one that is not behaving competitively with respect to price, I believe that there are several thousand tariff filings per year. I think if you looked into it more closely you would find that, in these filings, there were several thousand rate reductions per year, either applying to all carriers party to the tariff or in the form of individual exemptions. This suggests that there is some price competition going on.

DR. MILLER: I think you are correct. There can be changes in cost of market conditions which would make for price reduction as well as price increase. This may well happen, but it is what I would characterize as price competition in competitive industries.

DR. WYCKOFF: Dr. Miller, in your study of these high prices paid for authorities, could you characterize which type by size of carrier has been paying these prices? Has it been the small, medium, large, or all carriers?

DR. MILLER: I do not have that information. The data I have is from the 43 cases in '71, '72, and '73, given to Congresswoman Fenwick by the Interstate Commerce Commission. The type of information you seek would be very useful information and I wish the ICC would collect and publish it.

DR. WYCKOFF: Would you respond to a possible conclusion? It might be that, in fact, large carriers can afford to buy these authorities at very high prices because of some possible advantages in large size. Secondly, they may see greater advantage to getting bigger, and would be willing to pay these prices, an opportunity that may not be equally open to smaller concerns. Another possibility might be a large company buying a 10-mile piece of authority to finish a network. That might be worth a tremendous amount of money, but it is not necessarily just a monopoly profit on 10 miles of authority. I am just pointing out that you cannot necessarily relate profits to a few miles of authority or the business that is related to that authority when you bought it.

DR. MILLER: The firm presumably will be significantly better off financially if it is willing to pay for that additional authority. You raised an interesting point, and I agree that in a system of transportation, specific authorities are worth more to certain firms than to others. Someone commented that if a company can add to the scope of its coverage by buying authority, then they may pay high prices and it has nothing to do with monopoly profits, but is economy of scale. I don't consider that is the same thing as an economy of scale. It is not the kind of thing that would give rise to lower unit costs in the absence of regulation.

PROFESSOR LEVINE: I would like to comment a little further on that. Under circumstances where there was no entry regulation, several firms might find it profitable to expand to a certain size in the sense that there were advantages to large scale that would ultimately be reflected in rate competition among them to consumers and lower prices to consumers. When one pays for the authority, it must be on the assumption that competitors will not be able to expand to similar large scale without paying the same sorts of rents or entry costs that you will. One pays for it because he does not expect to reflect the economies of scale in his rates. If you expected to reflect them all in your rates, there would be no money left over to pay for the authority.

MR. COONEY: Mr. Kolins, I have dealt with entry into regulated carriage for a number of years and I have seen many of the decisions made by the ICC. With reference to the five items one might like considered in ICC proceedings, I suppose you would agree that they could be considered now under the existing law. Perhaps, then, a statutory change would not be needed. Instead, there could be a change within the commission itself. Your first three items, I agree, are very important considerations, and I think I could at least match you case for case to show decisions where grants of authority were made because of operational feasibility showings.

However, I am somewhat concerned about the other two items mentioned, user preference and lower rates. I am concerned about injecting them into operating rights proceedings and granting on the basis of user preference, that is, if you mean a preference merely for a particular carrier. I think the more important consideration is the public need and not whether a particular shipper has a brother-in-law in a carrier and could get a grant of authority on that basis alone.

The rates, also, pose a serious problem. If lower rates are injected as a basis for granting operator authority, there will be no guarantee that the carrier would continue those lower rates. After a period of time he could drop those rates, and he would merely have gotten the authority without actually operating on the basis that he showed to obtain the authority in the first place.

MR. KOLINS: In terms of the shipper preference argument, I did not intend to promote a frivolous sort of preference treatment. Obviously, shipper preference relates to the notion of a better service or a service that is more responsible to the needs of the particular shipper.

As to the rate question, it seems to me that while you express your concern, it is only of superficial validity. The notion of a carrier holding out lower rates and then, after getting authority, not providing service at those rates, would not, and need not occur as a practical matter. I do not think shippers are so naive as to get whipsawed by a carrier offering lower rates, obtaining wholehearted shipper support, and then turning around and increasing his rates. I do not think commercial relationships, or the commercial realities, would allow for that sort of thing. But more than that, certainly any change along the lines I have suggested could be structured quite clearly in a way that would protect against a precipitous change of that rate. There could be, as has been suggested by others including Chairman O'Neal of the Interstate Commerce Commission, certain requirements attending applications envisioning lower rates where those rates would have to be retained for a certain period of time unless certain circumstances could be shown that would support changes. Your fear, while on the surface is a genuine kind of concern, could be coped with rather easily.

DISCUSSION--EVENING SESSION

MR. KAHN: Mr. Pearce, it has now been a little over a year since the enactment of the regulatory reform legislation of 1976 in that the revisions of the Interstate Commerce Act followed pretty much the lines that you espoused, as General Counsel of the predecessor organization to the Committee Urging Regulatory Reform for Efficient National Trucking (CURRENT) that you now serve. Would you comment on accomplishments that you see have been achieved this past year.

MR. PEARCE: As far as I have been able to see without spending a great deal of time on detailed examination of the railroad markets, I have not observed any major change in the price offerings or the service offerings of the railroads. I think there are at least three reasons for that.

First, my anticipation was that we would not begin to see substantial changes until about four or five years had passed. Second, we have not really begun the changed pricing mechanism envisaged in the act because the rate bureau changes have not been made and substantially put into effect yet. And third, I have the impression that the ICC and the carriers are still very gingerly feeling their way toward the possibilities of increased degrees of pricing freedom insofar as any ICC controls on maximum or seasonal rates are concerned.

MR. O'NEAL: I would like to make a comment on that. As far as the Interstate Commerce Commission is concerned, we have pretty much finished most of the rulemaking that relates to increased pricing flexibility by the carriers. Some of those rulemakings have been of recent vintage, but the principal one that results from the act established the standards for determining market dominance and has been in effect for about six or seven months. We have not noticed many adjustments by the carriers thus far.

I would note that there is a lot more pricing competition among the motor carriers that do not have this same kind of flexibility in the statue.

MR. SWEENEY: Mr. Fitzsimmons, during the past couple of years, segments and groups of regulated motor carriers have taken a position that there have been no labor productivity gains attained by the trucking industry for the past few years, or that there is actually a negative productivity gain. They are getting less work out of the drivers and the laborers than they got a few years ago. Do you have a position on that?

MR. FITZSIMMONS: My position is that I do not know why the carriers increased the length of their cargo-carrying units from 18 to

45 feet. I do not know why they continually fight for advanced weights if there is not more productivity. They have done such things as taking off three-man dock crews, using one-man dock crews, pushing more freight over the docks, and unloading more freight than they have at any time in the last 50 years. If that is not productivity, I don't know what is.

MR. SWEENEY: Mr. Fitzsimmons, you were talking before about the problems with owner-operators, the fact that these operators are working long hours and are not being able to pay off their trucks. You noted the safety problems and everything that goes along with the poverty of the owner-operator. Do you think that the ICC should be given statutory jurisdiction over the compensation paid to owner-operators by regulated carriers?

MR. FITZSIMMONS: Well, I do not think the ICC would accept that responsibility. I do not think the Congress has a right to give that jurisdiction to the Interstate Commerce Commission. That is a matter for the Congress to determine, because the responsibilities of the carrier as well as the responsibilities of the shippers are there. I do not think the shipping public should be allowed to go out and entertain brokerage operations without controls.

Any certificated carrier must be responsible to the Interstate Commerce Commission, to DOT, and for its own welfare. I am saying this because the Chairman of the ICC is here. Re-regulation is really what is coming about as far as those gypsy operators are concerned. I am talking about the individual who goes out on the highway and offers himself and his truck for service for any price he can get. There are many owner-operators who operate as an employee of a carrier, and that carrier has the responsibility for his hours of service, as well as his equipment. But unfortunately, the shipping public finds a way to get brokers to go ahead and sell loads to these individuals and the broker has no control over the safety of their equipment, the compensation that they receive, or the maintenance of their equipment.

MR. MENDELOWITZ: Those who benefit from regulation make a strong case for retaining it. Those who do not think they benefit very substantially, but would benefit from reform, are interested in reform. The representative of the shippers is interested in reform. The representative of the Teamsters and the representatives of the truckers are interested in maintaining the status quo, so it seems to me that your statements have made the case for regulatory reform, namely, those who benefit are the truckers and the Teamsters and those who lose from the existing system are the shippers.

MR. SOLLENBARGER: May I partially answer the question? I think Mr. Morton, who was here, probably represents more shippers than any other, and he said he was wholeheartedly in favor of regulation. I said that I was in favor of modification in some cases. I am not sure that I agree with Mr. Mendelowitz's characterization or the generalization at all. I do not think it is applicable.

MR. PEARCE: I would not speak for Mr. Morton, but as I read the National Industrial Traffic League's statements which he did not completely spell out, they are in favor of easing entry into regulated trucking and in favor of cutting back on the scope of rate bureaus.

MR. FROST: Without statutory deregulation, how would you foresee the ICC using competition as a regulatory tool in the entry area, the rate area, and the merger area with regard to motor carriers, and how would you implement such a policy?

MR. FITZSIMMONS: I have maintained for years that the ICC has been undermanned and, therefore, limited in policing the industry. I think the ICC is outstanding. The problem is not going to be solved by deregulation. I think the ICC, as well as the Public Service Commission in Intrastate Direction, could do the job in all aspects as far as the industry is concerned, if they had the policing power, the wherewithal, and the financing to maintain a policing agency. They have maintained it, created, and lived with the increase as far as traffic is concerned for the shipping industry, as well as for this great nation of ours, for years and years, but you cannot have an army to fight if you do not have the soldiers.

MR. O'NEAL: Let me answer the question from the ICC standpoint. The Interstate Commerce Act, as Mr. Frost well knows, since he once worked for the commission, does have a considerable amount of flexibility built into it. The commission has begun in recent years to use that flexibility in many ways, and one of the things it has done in recent months is to expand the commercial zones, which is a form of deregulation, at least for the metropolitan areas of the country.

We have in effect in the rate area a practice where the commission, unless there is some discriminatory practice involved, will not normally suspend a rate decrease where the rate is above or at variable cost. I believe this has added considerably to the recent rate activity that I think has grown in the last few years. Also, the commission has, without statutory directive, made important changes in the rate bureaus where it has guaranteed the right of independent action by individual carriers. We have seen a fairly significant growth in independent actions by individual carriers, because now it is a little bit easier. They are not as likely to have protests of rates by rate bureaus.

As far as entry is concerned, other than the commercial zone expansion, there are things the commission could do, such as utilizing more than it has in the past the concept of prospective grants of authority. That is, granting authority to carriers to carry out certain functions that are similar in nature. The one that I have in mind, in effect, relates to the transportation of waste materials. The commission is in the process of taking some action with respect to brokers of freight where it is likely that the agency will reduce the public convenience and necessity (PC and N) requirement of brokers to the point where all they will need to show, in order to become regulated brokers, is fitness to provide the service. Those are some of the things I think the agency can do and has recently shown an inclination to do.

MR. PEARCE: May I comment? I would agree with Mr. O'Neal that each of those steps he mentioned has been constructive. I have for a long time felt that there is a drastic and serious misallocation of manpower in the commission. For years, according to the budget reports to Congress and common observation, a large portion of the agency's resource has been devoted to defining with particularity limitations on service and making sure that nobody stepped over them instead of facilitating provision of service, assuring a truthful market, and assuring an informed market. If that emphasis could be changed, the agency might be able to do a great deal more.

MR. FLOTT: At the conclusion of Jack Pearce's prepared remarks, he made some allusions to regulations in European countries that I know he gleaned from Tom Moore's book. I am just very sorry that Tom Moore did not come here today, because there is a substantial amount of misunderstanding about the connection, the regulation conditions in most European countries.

We talk about deregulation in Great Britain, but most of the European countries impose regulation on trucking to control capacity and to restrict the competition of trucking with the state-owned railroads. This is, of course, one reason that the American Trucking Associations is opposed to nationalization. They know what kind of a pattern took place in Europe. But in England today, there are still entry controls and all the carrier has to prove is fitness. There are no rate regulations.

Just last month they decided to start reissuing restricted licenses to private motor carriers. A restricted license means that the holder of a private carrier license will not be able to haul for hire at all. Sweden, for example, deregulated, but after two years they reimposed entry controls and rate regulation because of the chaotic conditions that took place.

Germany, as one example of one type of rate regulation, has a very different type of regulation on short haul as compared to long haul, if you can conceive of that in a country the size of Germany relative to the United States. In any event, on the long haul, where a carrier has to have a separate license for each vehicle he wants to operate, he has to have a separate license with every vehicle that is on the road. Thus, his capacity is closely limited and the state limits the total number of for-hire licenses that can exist, and in addition to that, the state also sets the rate for the various commodities. However, if a shipper tenders a certain amount of freight, then the carrier is allowed to give the shipper a discount from the published rate of the regulatory bureau, a discount from that rate depending on the size of the shipper. In effect, in Germany, the large shippers pay substantially less than the smaller shippers.

There is a considerable amount of misunderstanding about the condition of regulation in the rest of the world as compared to the

United States, but I would say that in almost every developed country in the world, there is some form of regulation of entry and rates in the motor carrier industry.

MR. CALLAGHAN: Mr. Sollenbarger, you mentioned in your presentation that we should quit devising ways to take profitable traffic away from the common carrier. With regard to that statement, I am curious as to the position of the Regular Common Carrier Conference on the Herman Brothers petition, which is designed on its face at least, to facilitate the movement of traffic from private carriage to common carriage. Secondly, I am curious to know if you feel that increased opportunities for contract carriers would be a device that would take profitable traffic from common carriers.

MR. SOLLENBARGER: First, I am not aware of the petition you are talking about at all, so I cannot comment on that issue. Second, I am talking about a situation which causes us to subsidize certain traffic, and if we subsidize it, we must get that money someplace. Therefore, we are charging a higher rate for some other traffic in order to pay that subsidization. If we did not have to subsidize that traffic, common carriers could compete on a more favorable basis with private carriage. In this case I am not talking about any kind of regulated carriage. I am talking about non-regulated carriage, even exempt transportation, for that matter.

After all, we have some empty trucks moving from the West Coast east. Maybe we could compete for that traffic if we did not have to maintain our rates at such a high level to subsidize other traffic.

MR. SWEENEY: I would like to make one comment. I think there is some kind of a void here with Mr. Morton gone, as to what shippers have to say. As I mentioned before, I do represent shipper groups, and unfortunately, since the topic of this meeting is not deregulation, we did not come here with a position on deregulation. I do want to state that most of the shippers that I come into contact with, talk to, are in favor of continuing regulation rather than deregulation. The only real strong pocket of deregulation that I have seen is extremely large shippers such as Mr. Pearce has represented in the past. I think if you took a head count, you would probably find most shippers would like to keep the commission in pretty much the same form it is in today and favor maintaining the regulation of trucking. That may come as a surprise to some people.

MR. PEARCE: I would like to respond to that. Dan O'Neal and I have had different views on this issue for some time. I have read the National Industrial Traffic League's positions, and I have read the industry surveys that have been published in trade magazines from time to time. When I talk with the people that I work with, large companies and some small ones, I think it is fair to say that most people in the industrial traffic community cannot really feature doing away with the ICC or with all regulation.

However, when you get down to cutting back on the rate bureaus and loosening up the entry restrictions, persistently you come up with about three-fourths or more of the shippers saying they want those things to happen. When you get down to experience, different people run into different subsets of the industrial traffic community. Those subsets I run into feel, from strongly to not so strongly, that these things should be done, and should have been done some time ago.

DISCUSSION--SESSION III

MR. HASEK: I would like to point out one thing about the platform study, that is a research study affecting small shippers by the ICC Cost Section. This study will start later this year. We have a few other research projects that we are actively considering. One is a rate-of-return study; another is a method of developing up-to-date changes in non-labor cost in order to eliminate using the wholesale price index as a surrogate.

It is clear that we need more money and appropriations, and more support from shippers and industry to do research into the areas of motor carrier and railroad costing. We solicit your support for such work.

MR. SWEENEY: I would like to respond to that. In my paper, I point out the fact that a considerable amount of the Cost Section's money is being wasted on territorial cost publications, and those seem to be the only publications they put out in the last year. Here is a good place to give up something that is useless and use the money to do something that is constructive. In other words, I agree with you. I am not critical of what you say. The money is there. You just have to do a little zero-base budgeting.

With regard to an earlier statement about testimony before the ICC, the trucking industry has been presenting to the ICC economic testimony by an economist right along. Dr. Silberman and Professor Nelson have both made presentations. So there is not a complete void of economic testimony before the ICC. We are having a little difficulty in deciding exactly what we should do with the economic testimony.

DR. LAWRENCE: My question is to John Roberts. I think it was misleading when you said that if there are economies of scale in the trucking industry that under regulation truckers should be allowed to earn zero profits. Any comment?

PROFESSOR J. ROBERTS: That, again, is an instance of economists using perfectly sensible words to mean strange things. What an economist means by zero profit is not at all what a businessman would think. By zero profit, an economist means zero rent or zero monopoly profits. Economists consider a competitive return on capital, including any risk premium, to be a necessary cost of business to be covered before any profit is earned. In other words, you have to receive enough return to keep the capital in the industry. It is only once that is covered that economists start talking about profit. So, zero profit, in this context, means earning a rate of return that attracts and holds capital in the industry, if it is there.

DR. LAWRENCE: My second question, then, is stimulated by your comments about the inability of truckers and theorists to agree concerning research on the long-run cost curve of the industry. Your comments were two-fold.

The first was that under competitive equilibrium the industry operates on the long-run cost curve, that means that price is equal to marginal cost, is equal to average cost. That means there is no excess capacity in the industry. Let me comment on that for just a second. The LTL general freight segment of the regulated industry is by far the largest segment, and is one that has a natural tendency to excess capacity. It is not excess capacity in the sense that empty trucks run up and down the highways. Rather it is excess capacity in the Chamberlain sense. That is, that resources often are being employed less efficiently than they could have been employed under a competitive circumstance.

The second comment that you made is that there are conditions under which economists support regulation of business. One of those conditions is the condition of imperfect competition. It is absolutely true, as Professor Harbeson said earlier, that the industry is not homogeneous. It is heterogeneous. It is characterized by firms that are competing for the same business, but that face different demand curves. That, by definition, is imperfect competition.

Combine the fact that there is Chamberlain-type excess capacity in the industry with the fact that the industry is imperfectly competitive, and I would argue that, if allowed to, firms will engage in ruinous price competition. This will come about because of the existence of excess capacity in an imperfectly competitive industry. Would you respond to that please?

PROFESSOR J. ROBERTS: Certainly. The pure competitive model does, as you say, indicate that price comes out equal to marginal cost, equal to average cost. That is a condition of equilibrium. What I was trying to say about these second-best solutions was that they are probably better than we can do, rather than worse than we can do. This is not because they involve price different from marginal cost and price discrimination, both of which could be thought of as yielding "distortions." We should, in fact, ideally have these "distortions," since they are the results of an optimizing solution which indicates that marginal cost pricing is not optimal. Rather, I think that these equations point to something much, much better than we can achieve.

It seems to me that after we look at those formulas and think about what would be involved in optimal regulation, it would become apparent that we simply cannot do it. What is more, we are not now trying to do it. The picture that I gave of price discrimination, entry controls, profits, etc., involves the same phenomena we currently observe. But the current patterns of these variables are likely to depart from the competitive norms in entirely the wrong directions, given the way that ICC and industry decisions are made now. Really, what we have to choose between is not the optimal regulation I was talking about and a competitive outcome, but rather between something like regulation today, reformed in perhaps some ways, but still imperfect, and a deregulated industry.

The point is that the deregulated industry is not going to be perfectly competitive except perhaps in a few areas. Full truckload hauling and a few high-volume LTL routes might approximate the competitive ideal pretty closely, but many markets would not, either because there are economies of scale, even if there are limited ones, or because demand is not strong enough to support more than one or two firms. The question then is: Do we prefer a very costly and perhaps inefficient system of regulation, or a system of a mixture of imperfect competition, a little oligopoly, and a little competition?

I think that if we deregulate, what is likely to come out is that there are going to be significant increases in concentration in some parts of the trucking industry. This may be accompanied by price-cutting while there is an adjustment of the excess capacity. What will happen is that the big firms, that have the ability to balance loads and to get rid of these Chamberlainian excess capacity problems, are going to come out way ahead. I do not think we are going to get something like a perfect competitive solution. It is just not there in the structure of the industry.

Even with this concentration, I do not think we will get a freight movement industry that looks much different or performs much worse than other sectors of American industry do today.

DR. LAWRENCE: I want to add one further comment about something that you said. It is true that there are segments of the industry that would be oligopolistic under competitive conditions, under a deregulated environment. A somewhat isolated point is the fact that certain of what seem to be large firms would be driven out of the industry, because they are subject to significant Chamberlain-type excess capacity. This makes research on the cost structure of the industry nearly impossible, because it is exactly those firms that are operating off of the long-run cost curve that, by definition, means that their average costs per unit are higher than they would otherwise be in a perfect environment. It is the average cost per unit of the large firms that are operating off of the long-run cost curve that causes one to find some large firms that give testimony to the absence of economies of scale in the industry.

DISCUSSION--SESSION IV

DR. WYCKOFF: I would like to give an opportunity to each of the members of the panel to respond to the discussants if they desire.

PROFESSOR HILLMAN: You will not be surprised if I agree with Professor Noll that the impact of appointments to regulatory agencies may be at least as significant as the substantive and procedural provisions governing the operation itself.

I suppose one reason that subject was not addressed is because the Quad-R Act, notwithstanding everything it did deal with, did not purport to address the appointment process. It did not say, in effect, that in order to fulfill the objectives that were so clearly set forth, that appointments in the future will be made consistent with the fulfillment of these policy objectives.

Said another way, the process of appointments tracks very closely the process by which these ambiguous standards are determined; namely, a highly political process in that each of the various constituencies has to be given its due. Just as you find a careful balance, a little bit for everyone, in the Quad-R Act in this area of intermodal competition, so, we find much the same thing in the nature of the appointments.

I would conclude by saying, without being critical of either one, that with respect to the legislative history of the Quad-R Act, however they may be otherwise perceived as having different views, that former Chairman George Stafford of the commission and present Chairman O'Neal took remarkably similar positions before Congress on the essentiality of preserving intact the commission's powers in this area.

DR. BOYER: I have been a teacher now for two years, but listening to the comments reminded me suddenly of being a student again, and of my frustration when I was sure that the professor had not read my paper. I tried to say that business logistics was not interesting to an economist, and properly so. Economists are interested in macro results, in the sense that they are interested in knowing what the results on aggregations of shippers in markets would be. I tried to say that business logistics, a micro analysis, was not going to give us any interesting information about such aggregations of shippers. I don't really claim to have discovered business logistics. I did claim that business logistics has been used by economists, but has been used wrongly. Further I said that business logistics actually should not be used by economists.

DR. NELSON: I would like to address myself to both discussants, to Noll, first of all. I feel like Le Bourgeois Gentilhomme, who was delighted to discover that he had been speaking prose. I discovered

I had two points in the paper, for that I thank the discussant.

As for Spychalski, he raised the question of passenger transportation. I must say, my career has never been distinguished for relevance in any sense of the word, but I would plead innocent on jurisdictional grounds, to start with. I did not know passenger transportation was being discussed at this conference. However, it does say motor carrier, so let us look at passenger transportation for a moment. I think this is a very interesting and important issue.

I believe that there are differences in just about every respect between passenger and freight transportation. I will start on the truly political and work over into the economics, by identifying, for example, Senator Harrison Williams of New Jersey, specifically, with achieving the largest transportation subsidy allocable, or attributable, on a per capita basis to any group in the country, to that relatively small number of people who use rail commutation to enter and leave our older northeastern cities.

This movement has spread until we have, I think, the biggest policy issue now facing the field of transportation in this country. That is, what is UMTA? I believe that very gradually we are beginning to develop a preliminary approach to some kind of economic criteria for urban passenger transportation. In my view, this effort has not gone very far, and it has a tremendous distance to go. However, it is my belief that one of the biggest problems in this area is that political thinking is some 30 years ahead of economic thinking. The politicians jumped on this bandwagon right after World War II. The economists are just beginning to analyze why urban mass transportation should be given any federal subsidy at all in a given community.

In the meantime, we have some sensational anomalies. I notice that the Boston and Maine Corporation is about to retire its entire bond issue and it is selling now for something like 87. On any kind of capitalization of anticipated future earnings that I can conceive, that bond issue is worth about minus five. How could it be selling for 87? Simply, they managed to unload a number of rail branch lines, the Saugus branch, et cetera, on the Massachusetts Bay Transportation Authority for a very high price. This money, as I understand it, is being used to buy up part or all of that bond issue.

If you tried, either on the commuter lines that are being bought by public authorities or, for that matter, on the corridor line from Boston to Washington, to apply normal economic rules of capitalization of future earning power to the price being paid, you would, in every case, arrive at a huge negative price. ConRail, for example, would have paid somewhere between $2 and $5 billion for the privilege of disposing of the corridor route, as opposed to buying it up.

Actually, what is happening is that huge positive prices are being paid for properties with negative earning power. An economist stands baffled before this kind of manifestation of tremendous political interest in passengers, as opposed to freight in general, especially in the older cities where there is much travel by rail or by subway, and much travel between certain favorite points. We are just beginning to face the problem of whether to subsidize freight transportation at all; and if so, who should subsidize it, how much, and so on.

Secondly, as to the economics of passenger transportation, I think there is a real fundamental difference in the basic character of the industry in that scheduling is much more important for passengers than it is for freight. That has two manifestations. One is that being on time, in principle at least, is much more important. Secondly, having a complete schedule is more important. From a standpoint of externalities in this kind of thing, you do have a problem in passenger transportation that is going to show up very clearly in airlines in the near future. For that mode, I am not so much worried about the question of what will happen to the smaller towns if competition becomes much freer. But I am worried about what will happen with some of the less popular schedules. The reason is that there are externalities here, external costs and benefits, in a largely competitive airline situation. Operators would try to grab for the best schedules with the highest load factors and let somebody else take the losers, even though the losers are necessary in terms of enhancing the total value of the product.

This same situation exists, but to a much lesser degree, in freight transportation. I would say that there are two fundamental differences here that are important. One is that passenger transportation, largely due to the fact it affects commuters and others directly, while freight does not, are in some cases receiving tremendous subsidies, on a per passenger basis, right now. Nobody even questions it. Freight transportation is not in that kind of situation yet. The first question is, should freight have subsidies, and what are the criteria if it is to have them?

The second fundamental difference is simply that in passenger transportation, time is important in different ways, and it is more important than it is in freight transportation.

MR. BOYD: Underlying the debates that have been going on at this workshop between the deregulators and the regulators, that roughly correspond to the academies and researchers on the one hand, and the industry people on the other, are two different views of the world.

The industry would have us view regulation as a protector of the consumer against monopoly abuses. The academic view is that regulation is a device for the creation of monopoly profits that are distributed through various means, to either other groups of customers or to the providers of the service.

The former view, I think, is characteristic of the academic view of a generation or more ago. The latter view, despite what Roger Noll implied, is a revolutionary reorientation of the academic opinion of economic regulation of rates and entry. This latter view does suggest, however, that the key to improving the efficiency of transportation is not in more detailed studies of how regulation works and how it allocates resources. We know enough, I think, already to make a strong case that regulation does misallocate resources. However, there are always arguments that could be made against this; our knowledge is never perfect.

Rather, what I have characterized as the academic view suggests that the key to reform is in recognizing that any kind of change represents gains and losses to certain groups. In this particular case, it appears that the losses would be highly concentrated; that is, the people that gain from the present situation would stand to lose a lot whereas the rest of us who would gain would stand to gain, in the aggregate, perhaps a lot, but individually probably a minor amount. Those who have a stake in the current system also tend to be the source of information to the public about its effects.

The real benefit of a conference such as this, is that it stimulates and exposes independent information about the effects of regulation, and therefore, exposes the true effects of regulation. If the public, as Roger Noll seems to believe, really wants what regulation is giving us, then I think that that is a choice for the public to make under a democratic system. The advantage of, or the social benefit of this kind of conference, is to generate and publish disinterested information about the impacts of regulation.

DR. WYCKOFF: Questions are now invited from the audience, since we are close to the time limit we have set.

MR. MORITZ: I want to ask Mr. Noll if he is familiar with the Associated Transport, Eastern Freightways, Nelson Truck Line, M&M Transport, Braswell, Western Gillette, and I could add quite a few more?

MR. SWEENEY: I might comment that they have all declared bankruptcy in the last six months.

MR. NOLL: I understand the question about recent bankruptcies in trucking. I was not being facetious when I offered the hypothesis that one of the things that society might well want to do is to protect people from bankruptcy. From the perspective of economic efficiency in a competitive, free enterprise society, this is silly, because that particular conceptual model on an economy does not recognize the failure of firms as a cost.

I personally think that it is disingenuous for the trucking industry to argue that the reason for ICC regulation is to protect shippers from monopolization. If, in fact, the real reason for regulation is to protect truckers from bankruptcy, I suggest that economists, industry spokesmen and union leaders go hand-in-hand to Congress to state that fact.

With regard to the frequency of bankruptcy in the trucking industry, one consequence of business cycles is that some competitive firms go out of business when times are bad. The question remains, as a long-term empirical one, whether there is more or less bankruptcy in regulated industries than in unregulated industries. The conclusion that I derive from the literature is that rate averaging, combined with a policy that considers damage to competitors in setting price floors, blunts the advantages to be gained by a low-cost firm and to some degree protects the high-cost firm.

MR. MORITZ: I am concerned about some of the broad generalizations that are made about the industry that create paradox situations.

For instance, there seems to be a belief that there are no bankruptcies. I would make the point that bankruptcies are taking place, and that less efficient carriers are going out of business. Now, to talk of rate making, it appears that the cost data used are those of the more efficient carriers that survive. Does this create a stabilizing effect, and is the process working? If so, I would suggest that shippers should use the efficient truckers who are justifying their rates on much more efficient operating circumstances and the lowest cost possible. My experience in the past several years is that rates have been filed, and we hear the big headlines about general increases, but that the price that is being paid to move freight is nowhere near what we generally hear about. I hope we will try to learn more about generalizations such as these after this conference.

PROFESSOR MUSKIN: During the course of describing his scenario on deregulation, I think Paul Roberts said that small carriers could not compete either on a rate or service basis against large carriers. I am glad he said that, because it gives me an opportunity to add to my previous comment about virtuoso carriers. At one time I was a terminal manager in Philadelphia for Consolidated Freightways, which was then the largest carrier in the country.

At the time, some years ago, there was a virtuoso carrier operating between Philadelphia and Buffalo, and I understand such situations can still exist today. The name of that carrier was and is Mushroom Transportation Company. I obtained sanction for the idea that we would go after Buffalo business because there was some good freight moving at high rates. I did realize that we would have to compete with them on a reasonable basis, meaning that we would have to send out a truck every night, full or empty.

For six weeks I sent that truck out nearly empty and it came back nearly empty. Mushroom Transportation Company went continually along its way. Any price competition that was possible was involved with putting in special rates for shippers in order to attract them to our side. The probability was assessed as being low that even the special rates would pull a significant amount of freight over a reasonable amount of time away from this virtuoso.

So, the result was that we abandoned the effort. But in the event of rate deregulation, I suppose your assumption is that, indeed, the large carrier could lower the rate and continue a low rate, perhaps even below so-called compensatory or relevant costs, for a sufficient amount of time to bring the competitor to his knees. That would, thereby, confirm your claim that small carriers cannot compete on both bases.

To extend Roberts' scenario, then, wouldn't it be reasonable to assume that an interposition, another intervention, regulation in other guise, would come about through the Department of Justice taking a very keen look and perhaps having a very good basis for supplanting what the ICC now does.

DR. PAUL ROBERTS: It seems to me that the Sherman Antitrust Act would pick up where the ICC left off, and the real question would be how long it would take the Justice Department before they could prepare the action to stop the growth of these carriers.

As things stand right now, Congress' permission and the appropriate legislation has allowed the carriers to work together to decide how the rates will be decided. That is, to use the rate bureaus.

MR. NIEMAN: Twice during the last two days, a ripple has gone through the audience when the concept of an owner/operator came up. Unfortunately, there were a number of people in attendance yesterday who are not here now. In my discussions with them they seemed to think that concept might be the great panacea. As a result of these conversations, I have a question for Dr. Paul Roberts. However, I would like to preface my question with two observations. The first is that I represent several operating companies that are classified as regulated regular route carriers of general freight. One of the things that distorts the whole description of this industry, part of the heterogeneity, is that the companies I represent employ in excess of 900 owner/operators. At least 700 of them are employed in the transportation of commodities that are otherwise described as A-17 commodities.

One fact is that we consider ourselves the carrier, or the company, and we employ those owner/operators. Another fact is that one of our operating entities does not carry the certificate that entitles them to conduct the operation. Rather, it employs owner/drivers who themselves have that operating certificate. Yet, we are conducting a multi-million dollar business in 13 foreign countries.

My question is this: If an owner/operator is, to some folks, a panacea, is an owner/operator a trucking company? And if entry were significantly eased by some form of deregulation, would an owner/operator, in that sense, be a trucking company?

DR. PAUL ROBERTS: My good friend Jim Schloss has watched me pursue this line of simplification for some time, and he has cautioned me, although I think I am probably as aware of the degree of simplification as Jim is, that it is not nearly as clearcut as I make it out to be. I agree that when we say that owner/operators just work for irregular route carriers, and so on, that is not the whole story.

I think that it has been difficult for us to get a conceptual model of what is gòing on out in the industry. I suppose I am guilty of performing the ultimate simplification, which is perhaps a bit too simplified for all aspects that must be considered.

I recognize that there are owner/operators all the way across the front; they are doing all sorts of things; and I am not sure whether I can completely answer your question.

DR. MOSES: I might, at this point, return to Nolls' comment. He was paying a great deal of attention to the importance of the political process, and urging that many of our solutions and understandings are to be found not in the measurement of economies of scale or other econometrics techniques, but in an understanding of the political process. I found myself in agreement with that and I wanted to add that there is a way in which the competitive mechanism finally triumps in this atmosphere. We get government agencies who have a recognized relationship with a set of clients. For example, the Federal Railroad Administration has become a recognized supporter of the railway industry, providing research funds and supporting it in its competition with the trucking industry.

There is also the Saint Lawrence Seaway Development Corporation, and it has its clients. There is UMTA, and it has its clients. This client relationship is expanded further by the involvement of legislators in this process as well. Therefore, what you have is competition, a new form and a very, very expensive form of competition, in that federal tax funds are channeled through these agencies that then become very, very powerful.

MR. KILEY: Would you expand your comment to include your view of the connection between the trucking industry and the Federal Highway Administration?

DR. MOSES: My knowledge of the trucking industry is not as great as yours, but as to the connection, I would say that the trucking industry has not been as strategically or technically aware as it should have been. The industry was not in the past involved as much as it should have been with the Federal Highway Administration. The trucking industry just has not been as successful in their relations with the FHA as have, for example, the railroads in their relations with FRA.

MR. GRABNER: I would like to raise a question that I think we have probably overlooked here, and have probably also overlooked throughout the entire academic discussion of this subject. How can the distribution of resources in an imperfect economy be improved by focusing on the attempt to develop a perfectly competitive structure on the selling side of an economy that is characterized by considerable market power on the buying side?

It seems to me that this gets us into a condition of oligopsony and monopsony, that we don't like to talk about; but that we are talking about the transportation industry getting the benefits of the producer surplus. Yet the demand for transportation is a derived demand. We are looking at a concentrated industry, by and large, on the purchasing side; and it is quite likely that any savings that are realized by "the public" as a result of deregulation, simply get added to the gross margin of the manufacturing companies on the other side. And to think that this will have any relationship to lowered prices, I believe, is utter naiveté. We have simply overlooked the fact that one cannot deal with this subject without dealing with the demand side, preferably to the supply side.

DR. MOSES: With respect to your comments, the question is raised about second best or third best, that is, coming as close as possible but not reaching long-run competitive equilibrium. If you create additional competition in the transportation sector, how do you even know you have done any good? For that, I ask response from some of our economists present, possibly a theorist who is still here. Perhaps John Roberts will answer.

PROFESSOR JOHN ROBERTS: I thought being a theorist was going to exempt me from this session. Obviously, the extent to which any cost savings are passed on as savings to consumers depends on how competitive you think the manufacturing industry--let us use that as a shorthand for people who are buying transportation services--is. I had hoped to beg off, as a theorist, to questions like this.

I rather suspect that, though certainly tomorrow the benefits of lower transportation charges won't be passed on to consumers, in many sectors of the economy there is sufficient competition. We have a model of competition that, to make all the theoretical niceties work, requires in fact an infinite number of firms.

Well, very few industries have an infinite number of firms in them! But if we talk something that is a little more realistic, some sort of notion of workable competition, then I think there are many U.S. industries that meet something like that standard. This is largely an article of faith, and largely a matter of how you define workable competition.

I suspect that cost savings are passed on at least in slower rising prices. But, again, this is something that comes down to a kind of empirical question that has been addressed by the industrial organization people for many years.

MR. GRABNER: In my view, that has gone on without producing many satisfactory answers.

PROFESSOR JOHN ROBERTS: Well, that is your evaluation of 30 years of research. I am not sure if there is a satisfactory answer. It seems to me that markets do function to some degree, and pretty well in a lot of places. Most of our economy does function pretty well.

DR. PAUL ROBERTS: Related to this point about where the cost saving may come from or where it goes, suppose you save this money by taking it away from the trucking industry in essence and throwing it back into the economy. I have implemented some of the kinds of models that Ken Boyer talked about a little earlier; and although I am not 100 percent confident of the figures that come out of those models, they nevertheless tell me that the amount of changes in the transport sector, through rates and so on, are very small in comparison to the changes in logistics costs. Let us call them total logistics cost. Now, total logistics costs get right back into the "gut level" operations of the firm. They come in and out of the monetary economy through the inventory process. In particular, as you get adjustments during a depression, companies will want to get more of their money in cash. They may liquidate some of their inventory, or hold off in buying to preserve cash, as the case may be.

My point is that this is a very difficult thing to capture in terms of the amount of cash, and it may only be found in the dynamics of the economy in the total logistics cost. It may, therefore, be difficult to identify precisely, but it should make the economy more productive overall.

Several years ago, we were working on the Harvard model of transport and economic development in developing countries, in particular on the Colombian transport model. John Meyer and Dave Kresge and I have had some very interesting discussions about whether to use, in our economic model, the actual transport prices reported by the model, or whether these figures--that is travel time and schedule frequency and the other level of service kinds of things, when costs were determined--were found elsewhere in the economy. We said that in the first round we wanted to use just transport prices. We found later on that that would not work; the models would not even work with only that in there. We had to put the whole non-market costs of transport, including loss of production through spoilage and so on, into our model in order to make the thing work.

We said it must be in the economy somewhere then. If you look at an input/output model of the economy you find these other costs in the form of increased productivity to the economy due to avoiding spoilage in the field, due to increased productivity of the factory because he had inventory there on time, due to all sorts of other reasons. They are there in the input/output table, but they are scattered all over the place.

My point is that this productivity we see, this tiny little tip of the iceberg, namely the transport cost savings, may be found multiplied many times over--I would suggest 10 times over--in the rest of the economy's functionings and the productivity of it.

DR. MOSES: Further questions or comments?

DR. BAESEMANN: As a one-time theorist, I would like to add to Professor John Roberts' comments, that there is a recent large and very elegant body of theory relating to topics, such as the role of potential entry and imperfect information, leading firms to behave much like the competitive model. Regardless of the fact that markets are not perfect, firms may approximate competitive behavior. To the extent that economics and economic theory will be of any use, we have to believe in something like workable competition. I have some faith in the notion that firms that are faced with potential entry have an incentive to generate competitive outcomes. I also have respect for the work of F.M. Sheerer, 1974, and his book, "Industrial Pricing". He argues that market power on the buyer's side is also a goal towards competitive outcomes and not necessarily something we should fear.

DR. MOSES. Thank you. Further questions or comments? Thank you very much, the session is adjourned.

PARTICIPANTS' COMMENTS

PARTICIPANT COMMENTS

Terence A. Brown
Capitol Campus
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Dr. Friedlaender concludes that without economic regulation there would be no encouragement -- based solely on costs as opposed to demand -- for concentration in the motor carrier industry. I would like to at least raise the possibility that in one rather specialized market there might be a cost basis for some concentration. Long distance shipments of consolidated LTL traffic moving between major city pairs might offer cost savings to larger firms using TOFC (trailer-on-flatcar) service. This is predicated on the assumptions that large shippers of such freight would be offered, and could profitably take advantage of, significant price discounts for large (train load) lots of loaded trailers.

A recent study done for the Department of Transportation ("Utilization and Freight Rate Policy," DOT-TST-76T-27, Office of University Research) described a Plan I negotiation in that the railroads agreed to haul TOFC trains from San Francisco to Chicago for approximately one cent per ton-mile. Under this arrangement the motor carrier would have had to invest in flatcars and loading equipment and perform all services other than the line haul movement. The railroads would have been liable only for damage due to accidents to the train. Obviously, the additional services in investment required would increase the cost to the motor carrier, but as long as costs did not double, the rate would be attractive in comparison to the two cents per ton-mile cost recently estimated for independent truckers operating under ideal conditions. If such rates were offered they might encourage motor carriers (and other consolidators) to become large enough to take advantage of them.

Admittedly, the above rate information is of marginal value; if better data is available that will conclusively answer the question, I would appreciate receiving it. Such information would be of help in determining the role of TOFC service in a deregulated environment.

PARTICIPANT COMMENTS

Paul Stephen Dempsey[1]
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I would like to specifically respond to the remarks of Mr. Ronald K. Kolins delivered on April 7, 1977. Although I agree with several of his premises and a number of his suggestions for the improvement of motor carrier entry control, I am somewhat disturbed by the lack of familiarity displayed by Mr. Kolins with the contemporary efforts of the Interstate Commerce Commission (ICC) to rectify many of the regulatory problems with which he expressed concern. I will confine my discussion solely to a survey of some of the primary efforts recently undertaken by the ICC to become more responsive to this nation's changing transportation requirements. I will not confront the other issues raised in his paper (such as, for example, the questionable assertion that stability in the industry will actually be retained with the implementation of proposals such as those proffered therein).

Mr. Kolin's first suggestion is that entry be eased so that a grant of authority will be issued upon a demonstration that the proposed operations will improve carrier efficiency (e.g., by enabling better equipment utilization and balanced two-way operations). In fact, the ICC has already taken significant steps in this direction.

Among the elements that are ordinarily examined by the ICC in its determination of whether proposed motor common carrier operations satisfy the statutorily imposed requirement of public convenience and necessity are those involving the operational feasibility of the proposed service and the operating economies and efficiencies to be realized as a result of the institution thereof. The national transportation policy, as expressed by Congress, requires the promotion of safe, adequate, economical and efficient transportation services. The operating economies and efficiencies to be derived from the institution of proposed motor carrier operations is therefore a significant consideration in any application proceeding, and the ICC has striven to foster efficient and economical operations among carriers subject to its regulations. (Stillwell 1975)

This policy is dynamically depicted in its promulgation of regulations providing for the elimination of gateways, (Code, Section 1065, 1976) and those involving superhighway and deviation rules. (Code, Section 1042, 1976) These rulemaking proceedings had, as among their principle objectives, the promotion of fuel conservation and the elimination of excessively circuitous routes. (Motor Service, 1969)

(Gateway, 1974) Similarly, a regular route carrier seeking alternate-route authority may predicate his application exclusively upon proof of the improved operating economies and efficiencies to be derived from the institution of the proposed service. In order to obtain a grant of authority on this basis the carrier, in addition to establishing such operating economy and efficiency, must satisfy the three following criteria: (1) that it is currently operating between the involved termini over a practical and feasible route; (2) that it is an effective competitor for traffic moving between the aforesaid points because it is handling a substantial volume of traffic; and (3) that a grant of the proposed authority would not enable it to improve materially its competitive position to the detriment of existing carriers. (Hayes, 1952) (Consolidated, 1974)

The ICC has expressed an official policy in support of efficient and economical two-way motor carrier operations. (ICC, 1973) (Indianhead, 1975) Thus, for example, the commission has taken a somewhat liberal approach in the authorization of backhaul operations so as to enhance the free flow of commerce and to simultaneously foster balanced, economical and efficient motor carrier operations. (Aubrey, 1966) (Samack, 1967)

The deadheading of equipment sacrifices both the economy and efficiency of operations, increasing substantially the cost of transportation. (Marrone, 1973) Such operations also aggravate the nation's energy shortages, and thus are inconsistent with the public interest. It has therefore been recognized that an existing carrier should not be required to absorb such higher operational costs as result from deadheading where an applicant can supply equipment to a supporting shipper from a nearby terminal facility without deadheading. (Chandler, 1974) (Suwannee, 1977) Similarly, in multiple application proceedings, the ICC has recognized the inherent advantages of carriers which maintain operations and terminal facilities near prospective origins and destinations, so as to insure balanced and efficient services. (Riss, 1966)

Two recent decisions (Transport, 1976) (Kroblin, 1976) indicate that operating economies and efficiency are significant factors in evaluating whether an applicant's proposed single-line operations will be authorized in lieu of existing joint-line services. In the most recent of these two cases it was emphasized that "it is fundamental that public convenience and necessity may be found in operating economies and in those things which contribute to expedition and efficiency because, while they may most obviously benefit the carrier and shipper, they also contribute indirectly to more reliable, expeditious, and less costly transportation -- the advantages of which are realized ultimately by the consuming public." (Kroblin, 1976) (D&L, 1974) (Dealers, 1975)[2]

In November of 1973, the ICC issued a general policy statement (Federal 32856, 1973) which is also pertinent to the value which the ICC ascribes to the issue of the operating economies and energy efficiencies to be derived from the institution of proposed operations. The statement provides that those seeking motor carrier operating authority are required to submit evidence in their initial representations regarding the operational feasibility of the proposed service. In fact, it has frequently been recognized that efficient and economical balanced round-trip operations that eliminate the costs inherent in empty vehicular movements benefit both the motor carriers, and the shippers and consumers they serve. (Rogers, 1969) (Maxwell, 1970) (Mason & Dixon, 1972) Such efficient and economical two-way operations, by eliminating the empty dead-head mileage, will ordinarily reduce the carrier's costs and such savings may ultimately be passed on to the consumer through reduced transport charges. Moreover, an evaluation of the operational feasibility of a carrier's proposed operations has long been an integral element in motor carrier entry control. (Bos, 1948) (Stone, 1952) (Ace, 1976)[3]

Mr. Kolins also suggests that the issue of rates be given consideration in evaluating the public need for the proposed operations. Although the level of rates is not a matter that is ordinarily considered in determining whether a proposed service is in the public interest, the ICC will consider the issue where existing rates are demonstrated to be so unreasonably high as to constitute, in effect, an embargo. (Southland, 1959) Moreover, in an application proceeding involving competing modes of transportation, the issue of a carrier's rates vis-a-vis those provided by a carrier of another mode is ordinarily given consideration by the ICC. (Schaffer, 1957)

Finally, Mr. Kolins expressed consternation with the allegedly restrictive language embraced within grants of motor carrier operating authority issued by the ICC. Actually, however, the ICC in August of 1975 approved a policy of granting authority as broadly as possible in terms of commodities, service points and areas, as free as possible from service -- inhibiting restrictions and other limiting or fragmenting features that can be expected to interfere with carrier growth, efficient operations or rational service to the public. Thus, most of the restrictive amendments that today appear in certificates or permits issued by the ICC are instigated by the applicant in framing or amending his application. (Watkins, 1971)[4] The ICC frequently concludes that the authority granted should not be fragmented in order to protect the opposing circumscribed operations of protestants.

I therefore contend the ICC has made numerous significant efforts to encourage the efficiency and economy of motor carrier operations, while concurrently preserving economic stability in the industry it regulates. During our contemporary era of volatile public needs and national priorities, the flexibility with which the ICC has approached the problems described herein is as encouraging as it is essential if we are to preserve the world's most dynamic transportation system.

NOTES

1. The opinions expressed herein are those of the author only, and should by no means be construed as opinions held by the Interstate Commerce Commission or its staff.

2. The approach in these cases appears inconsistent with that taken in the two prior decisions of D&L Transport, Inc., Ext. - Chemicals, Vol. 120 Motor Carrier Cases of the Interstate Commerce Commission Reports, p. 254 (1974), and Dealers Transit, Inc., Ext. - Wisconsin, Vol. 123 Motor Carrier Cases of the Interstate Commerce Commission Reports, p. 191 (1975), that also evaluated the weight to be accorded the issue of operating economies and efficiencies to be derived from the institution of direct, single-line services to replace existing interline operations.

3. Compare Stone Lines, Inc., Contract Carrier Application, Vol. 54 Motor Carrier Cases of the Interstate Commerce Commission Reports, p. 310 (1952) and Ace Freight Line, Inc., Ext. - Canned Goods, Vol. 124 Motor Carrier Cases of the Interstate Commerce Commission Reports, p. 799 (1976).

4. An exception exists with respect to the issuance of general commodity authority, where the ICC ordinarily imposes five specified exceptions unless a public need for the excepted commodity has been demonstrated.

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PARTICIPANT COMMENTS

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Several participants in the workshop expressed a common misconception about the structure of the trucking industry; a belief that in the absence of regulation specialization would not take place on the part of carriers as to commodities or routes and territories.

The experience of those within the industry runs counter to this misconception. Motor carriers specialized their operations and equipment for a variety of reasons. Tank trucks, dump trucks, auto transporters, and cattle racks are examples of vehicles not readily adaptable to the movement of general cargoes. Carriers also specialize due to the availability of specific types of freight and the inclination of the carriers to keep their operations manageable. Carriers limit their hauls to one commodity such as coal, crushed stone, bulk petroleum, or sulphuric acid even though their equipment could haul other commodities.

Many of the so-called restricted certificates that exist today resulted from formalization -- under the grandfather clause of the Motor Carrier Act of 1935 -- of operations that evolved prior to regulation. Carriers have added new types of operations to their original authority. Special divisions under the parent company have been set up to carry out these new and different operations.

General freight carriers differ markedly in the freight they handle and the routes and territories in which they operate. Those operating in the Carolinas and from that area to the Northeast and Midwest haul a high percentage of textiles and tobacco products. Those operating in the Midwest tend to handle manufactured iron and steel products.

Another misconception is the belief that the motor carrier industry supports continued economic regulation because the operating certificates are valuable. The important question is not whether operating certificates have value, but whether there is a public need for controlled entry. The U.S. Supreme Court has said that the motor carrier industry prior to ICC regulation "was unstable economically, dominated by ease of competitive entry and a fluid rate picture," and that "it became overcrowded with small economic units which proved unable to satisfy the most minimal standards of safety or financial responsibility." U.S. Supreme Court, Vol. 334, p. 298 (1953)

Unimpressed with the lessons of history, some argue that the motor carrier industry has come of age. The type of competition unleashed by deregulation would bring the healthiest of carriers to their knees. Formerly regulated carriers, to compete with the newcomers, would reduce service and defer safety and maintenance programs.

Limitation on the number of carriers increases the value of rights given to those licensed to perform a service. What must be pointed out is that the value of operating rights is never paid for by the shipping public. The cost of operating rights cannot be recovered through the rate structure. Section 216(h) of the Interstate Commerce Act provides that in rate cases, the value of the carrier's operating rights shall not be used in determinating a fair return or profit.

Shippers and the general public benefit from the limitation on operating certificates. A regulated carrier's safety record is far better than an unregulated carrier. The Bureau of Motor Carrier Safety has a weapon to enforce its safety regulations. The possibility of revocation of a carrier's operating certificate, or denial of additional rights, for unsafe operations has resulted in strong and effective safety programs among regulated carriers.

The value of operating certificates has aided in obtaining financing for the capital needed to conduct a good and responsive motor carrier service. Without this source of financing, shippers and carriers would suffer from older equipment, less sophisticated freight handling facilities and vehicle maintenance shops, and the many other capital improvements requiring financing. The banking industry, under deregulation and virtual freedom of entry, would hesitate to finance motor carrier investment in the future.

The implication that motor carriers are lying in wait to sell their certificates and make a profit is simply not true. The vast majority of carriers are interested in providing the best transportation service they can. Proof of the success of their efforts is the satisfaction of shippers.

In conclusion, competition alone at any cost is not a proper goal. To paraphrase Disraeli, the free market is an expedient, not a principal. The motor carrier industry is not a dramatic example of inexpedient regulation.

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U.S. Supreme Court, Vol. 334, p. 298 (1953).

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A great portion of Mr. Kolins' presentation is devoted to the expression of his beliefs that 1) the ICC has been over restrictive in allowing new entry into trucking, and 2) that the restrictions within the certificates granted cause higher than necessary rates and consumption of fuel. A number of the primary and secondary sources he cites have recently become dated. The era of the fuel crisis has caused several in-depth research efforts to be launched. The results of these new investigations are a major leap in knowledge between the "perceived" impact of regulatory controls and the "actual" impact on the motor carriers.

Several of the papers presented at the workshop (those of Paul Roberts, et al and Hayden Boyd) are the result of some of this new in-depth research. Another major contributor in this area, but who was not on the workshop program, is Professor Charles Taff at the University of Maryland. It is most important that the insights these gentlemen have exposed be listened to and considered in policy formulation.

Truck operators have recognized for some time that the "perceived" inefficiency of an operating authority that allows the movement of a specifically named commodity from one geographic location may, in reality, be a blessing in disguise. The restricted authority may fill a backhaul problem of another restricted authority. Only when all the so-called "subs" of a carrier's operating authority are pieced together can there be any evaluation of whether there is efficiency or inefficiency. An example of this is Refrigerated Transport, Inc., who, as of Thursday, April 14, 1977, had filed for 1,061 "subs."

It could easily be argued that the level of operating efficiency is a responsibility and prerogative of carrier management. The ICC policy of granting restricted operating authority in one particular market based on the merits of the need for the proposed service in that market avoids the usurping of that management responsibility. The inefficient carrier will eventually fall by the wayside. This can be demonstrated by a review of the bankruptcy and merger cases that come before the ICC.

The smart carrier will carefully analyze the new market he wishes to enter before applying for authority. This analysis will be aimed at discovering both front haul and back haul traffic. If, in the judgment of the carrier, authority for both on one certificate seems unlikely, two separate applications can be made. The approval rate for these applications has been extremely high over the past years. The work of Taff and Rodriquez, to be found in the Transportation Journal, Winter 1975 and Winter 1976, offers strong proof in this direction.

The final point that deserves comment is that of intercorporate transportation. Mr. Kolins failed to point out that if this is truly a serious problem, an immediate remedy exists for each individual conglomerate corporation. Adjustment of the present corporate structure so as to bring all affiliates and subsidiaries under one corporate roof will dissolve all restrictions presently placed on the corporate truck fleet. Of course, the tax advantages offered under the separation of affiliates and subsidiaries, that are a major reason for such corporate structures, would be lost. This tradeoff of legal options of this nature is a normal fact of corporate life.

In the discussion of fuel conservation, pollution and general efficiency levels, there is recognition of the fact that private transportation (the private automobile, the private jet, etc.) ranks low on levels of efficiency. The government has adopted programs aimed at discouraging the use of such extravagant consumers of fuel. It is puzzling that the same order of priorities has not been espoused by the government and others in the area of freight transportation.

The proposal to allow intercorporate hauling could very well fly in the face of efforts to increase transport efficiency when taken from a "system" viewpoint. The freight that is proposed to be eligible for intercorporate hauling is already moving. It is moving by some form of for-hire transportation. If that freight were taken away from the for-hire motor carrier, problems of empty hauls and lighter loads would cause lower operating efficiencies and thus higher costs to the general users of for-hire carriers. It is very important to remember that no new freight will be created by this proposal. There will only be a shifting of freight.

The U.S. Department of Transportation had the consulting firm, Drake Sheehan/Stewart Dougall, Inc., carry out a series of case studies and these were documented in DOT Reports, Numbered OS-33017 and OS-40113, in 1973 and 1974. The researchers did not believe that the limited number of cases were representative of the entirety of private transportation and, therefore, felt the results should not be used in policy discussions. However, two items of importance that were strongly evident in the cases studied were that 1) private carriers would be very selective in the freight they would carry (a practice referred to as cream-skimming), and 2) that "in most cases, applicable for-hire carrier rates were used" . . . in corporate transfer pricing.

Under these two practices it would seem very likely that the benefits of intercorporate hauling proposals would fall only to the conglomerates. The "public benefit" of transport savings would be retained by the conglomerate and the issue of equal opportunity fair transportation would shift from the arena of the ICC to that of the Federal Trade Commission.

PARTICIPANT COMMENTS

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While many interesting issues were raised in the workshop, these comments focus on the session entitled "The Structure of the Motor Carrier Industry: Empirical Findings about Cost and Demand." Despite the lofty and global connotation of the title, the substance was essentially confined to the extremely parochial issue of trucking scale economies, necessarily slighting many more important structural features associated with demand as well as with other cost ramifications.

My 1956 article entitled "Some Aspects of Motor Carrier Cost: Firm Size, Efficiency, and Financial Health," to be found in Land Economics, Aug. 1956, has occasionally been cited as the forerunner of the long train of subsequent abstract studies. In common with the band of scholars still pursuing this scale economy will-of-the wisp, I neither claim nor admit any ancestral relationship to the current studies of trucking scale economies. I personally have been unable to discern a sufficiently close association with policy questions to warrant much further attention to this matter. The controversy over trucking scale economies seems analagous to the question so zealously debated by medieval ecclesiastics of how many angels can dance on the point of a needle.

With this skeptical view, my early participation may warrant some explanation. The study had a very explicit policy genesis and orientation. The Senate Small Business Committee, spurred on by Walter Adams of Michigan State who served as its temporary economic counsel, had charged the Interstate Commerce Commission with favoring large truckers in certificate and acquistion cases. The ICC's response was most ambiguous, both denying and justifying the favoritism. It asserted that large motor carriers were more efficient than small ones because on the average they had lower operating ratios, a highly questionable test that required investigation. The operating ratio is a patently weak efficiency measure because of its high sensitivity to revenues that are determined by traffic mix and rate structures. My evidence confirmed the very loose tie between operating ratios and cost control and established revenues as much more critical.

The use of averages was also questionable. Size-cost comparisons established that many small firms were as efficient as large ones. The comparative cost performance of small carriers thus warranted more attention than the progression of unit costs with increasing size. The cost differentials among small firms were explained primarily by variations in average haul and in "route utilization" density measured by vehicle miles per route mile. Since many small firms performed as well as the large in these respects, they were not considered indications of scale economies. However, possible economies were recognized from managerial and regulatory policies leading to company expansion that increased these performance factors up to a threshhold cross product. The fallacy of the commission's response to the Senate Small Business Committee was rather clearly exposed, thus serving the study's specialized purpose.

The generation of hypotheses deducing pure scale economies is quite surprising since traditional economic models surely provide no support. Although the track record is good for other industries, model predictions are not necessarily conclusive for trucking. Nevertheless, this violation of their dictates clearly places the burden of proof on studies that purport to find scale economies and not on those confirming the economic theorems. The results are inconclusive only because the proponents are unable to sustain this burden. The flimsiness of the supporting evidence is suggested by this very inconclusiveness itself. Extremely small variations in coefficients give different answers. If all of this groping and grubbing is necessary, expectations for finding much substance in the quest are necessarily remote. With the results "too close to call," it would be plain folly to base any important policy on such research.

But it is most doubtful that any important policy issues hinge on abstract scale economy considerations. Managerial expansion decisions must consider specific operating factors and market opportunities. Related regulatory policies for acquisitions, mergers, and certification, as the floor discussion emphasized, involve questions of overall operating patterns, demand considerations, and service improvements. Any interest in establishing a theoretical basis for discriminatory trucking rates not only runs counter to the major thrust of Ex Parte MC-98 to put rates on a much firmer cost footing, but also is too far-fetched to be seriously considered as a policy issue in this context. The great void of policy discussion in the session is probably eloquent.

Trucking cost structure research is certainly warranted. Casting such inquiries into the narrow mold of scale economies, however, has corrupted the response to this urgent need. The researchers are so engrossed with methodology that they apparently confuse ends and means. This limits the narrow concentration on scale and methodology imposed on relevant inquiries is vividly protrayed in this session. The LaLonde paper, that specifically examined cost structures _per se_, was virtually ignored by the discussants and received little attention from the floor. Professor Nelson's comments in another context that terminal costs are the real meat goes straight to this point. (This orientation even simplifies the output unit problem permitting vehicle miles for line haul services and tons for terminal operation eliminating the hopelessly ambiguous ton-mile measure.) The structural insights that LaLonde and his associates were seeking will not be found serendipitously while exploring scale economies. It is more apt to be the other way around.

Work in truck cost research, even when directed at scale economies, can certainly be a respectable intellectual pursuit. But the heavy concentration of effort on this narrow and not clearly relevant subject in both academic and government circles is both mysterious and highly questionable. It is indeed startling that the program arrangers could turn up so many people working in this area. Most of the talents and resources devoted to this question could be more fruitfully channeled to others with more clear and direct policy significance.

It is equally regrettable that a workshop on regulatory policy should have gotten so bogged down in this narrow and essentially methodological subject. This not only diluted the program, but contributes to the growing distrust of economics and economists. What could be more damning than resource misallocation by the high priests of allocative efficiency.

PARTICIPANT COMMENTS

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It is, of course, not possible to adequately comment on the two days of technical papers and discussant presentations at the Workshop on Motor Carrier Economic Regulation without having copies of the actual written papers. However, it must be emphasized that while the discussants and the audience stressed the heterogenous nature of the trucking industry, it was not clear in many of the papers as to exactly what "industry" the speakers were analyzing.

In some cases, the papers were referring to the regulated general freight motor carrier industry and in other cases, the entire trucking industry, including the unregulated sector, was the point of reference. In still other cases, it was not possible to determine the nature of the "industry."

The trucking industry is not one industry but "trucking" represents many industries of which the regulated general freight sector is one portion. The International Brotherhood of Teamsters negotiates the national master freight agreement and supplemental agreements as collective bargaining representative for some 400,000 workers. In addition, the national master automotive transporters agreement and supplemental agreements covering some 30,000 workers are negotiated by the international union.

Some 200,000 to 250,000 additional workers in "trucking" are members of the teamsters union and collective bargaining agreements are negotiated by teamster affiliates. Examples include collective bargaining agreements with United Parcel Service, master agreements on a geographical basis in bulk-haul transportation, cement, and other commodities, and many private carriage agreements. Wages, hours and working conditions can and do differ among the agreements.

Some speakers were confused in their discussion of owner-operators. They did not realize that thousands of owner-operators employed on a long-term lease basis by regulated trucking companies are members of the teamsters union and are covered by collective bargaining agreements. These owner-operators are different from independent contractors or gypsies in the unregulated, or exempt, area of trucking. Confusion can lead to misleading analysis.

Any economic study of the costs and benefits of deregulation of trucking must first define the nature of the industry and then must study the impact on the work force. It is quite conceivable that workers in different sectors of the broadly defined trucking industry will not be equally affected by deregulation proposals.

We were disappointed that the impact of any deregulation proposal on the work force was not mentioned in any of the prepared papers. Obviously, the economic security of 600,000 workers and their families is a matter of vital concern and cannot be ignored.

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