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ANTITRUST, UNCERTAINTY, AND TECHNOLOGICAL INNOVATION

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in cooperation with

Committee on
Technology and International Economic and Trade Issues
of the
Assembly of Engineering, National Research Council
and
Office of the Foreign Secretary, National Academy of Engineering

NATIONAL ACADEMY OF SCIENCES
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This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

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PREFACE

In August 1976, the National Research Council Committee on Technology and International Economic and Trade Issues examined a number of technological issues and their relationship to the potential entrepreneurial vitality of the U.S. economy. The committee concerned itself with:

- Technology and its effect on trade between the United States and other western industrialized members of the Organization for Economic Cooperation and Development (OECD);
- The relationships between technological innovation and U.S. productivity and competitiveness in world trade; the effects of technology and trade upon U.S. levels of employment;
- The effects of technology transfer upon the development of the less-developed countries (LDCs) and the impact of this transfer upon U.S. trade with these nations; and
- Trade and technology exports in relation to national security.

In its 1978 report, *Technology, Trade, and the U.S. Economy,** the committee concluded that the state of the nation's international competitive position in world trade is a reflection of the health of the domestic economy. The committee stated that, as a consequence, the improvement of our position in international trade depends primarily upon improvement of the domestic economy. The committee further concluded that one of the major factors affecting the health of our domestic economy is the status of the industrial innovation process. Considerable evidence was presented during the study to indicate that the innovation process in the United States is not as vigorous as it once was. The committee recommended that further work be undertaken to provide a more detailed examination of the U.S. government policies and practices that affect technological innovation.

Three areas have been examined in the present phase of the project. The reports of these studies are

* National Research Council, 1978. *Technology, Trade,and the U.S. Economy.* Report of a Workshop held at Woods Hole, Massachusetts, August 22-31, 1976. National Academy of Sciences, Washington, D.C.

- The Impact of Regulation on Industrial Innovation,
- The Impact of Tax and Financial Regulatory Policies on Industrial Innovation, and
- Antitrust, Uncertainty, and Technological Innovation.

This monograph is the third of this series.

A word is in order about the methodology used in preparing this report. The committee conducted a workshop to (i) involve additional experts in the field, (ii) obtain views of representatives of various government agencies, and (iii) provide a forum for discussion among the committee members, academic and private industry specialists, government personnel, and the authors. The workshop was held on December 20, 1978, in Washington, D.C. In order to give some structure to the workshop, the panel addressed the following questions:

1. Economic Regulation

   Because antitrust actions are a form of economic regulation, the committee asked: In what ways do current antitrust policies and practices promote or inhibit innovation and productivity, capital formation, and the international and competitive position of the United States?

   Implicit in this question are the following concerns: Can we identify antitrust policies and practices that promote the above? If not, can such policies be formulated and made effective? Can we identify antitrust policies and practices that inhibit the above? Is it possible to modify such policies and practices to obtain benefits without inhibiting the above?

2. International Competitiveness

   Until recently the U.S. government's concern with monopoly and relative competitiveness has centered on production and increasingly on marketing within the United States. What kind of measurements and antitrust policies should the U.S. adopt so that U.S. industry will be able to compete against international firms operating outside U.S. policies?

3. Other Issues

   If cooperative R&D between private firms appears to be a productive mode to enhance innovation, what are the conditions under which such cooperative arrangements might be acceptable under current antitrust policies?

   If cooperative R&D were to be arranged in a manner acceptable to the Department of Justice and other enforcement authorities under current antitrust policies, would that arrangement be helpful to the innovative process?

   Should product innovation and technological leadership, which create markets and then lead to dominance of those markets, be regarded as being in restraint of trade?

In addition, two background presentations were made to the workshop participants by authorities in the field. They are

1. "A Review of Antitrust Policies and Issues and the Relationships to Innovation," Phillip Areeda, Harvard Law School, and
2. "Market Structure, Firm Size, and Technological Innovation," Frederic M. Scherer, Department of Economics, Northwestern University.

Following the presentations, each participant from a government department or agency was invited to present his or her perceptions of the major issues as viewed from his or her agency's perspective.

While this monograph is the product of the workshop, it does not constitute the workshop proceedings. Instead, the committee commissioned Douglas H. Ginsburg of Harvard University to write this paper based on the discussions at the workshop, as augmented by his research. Professor Ginsburg's draft was circulated to the committee, which then met with him to discuss criticisms and comments. As a result, this monograph expresses not only the author's views, but also generally reflects those of the committee.

SUMMARY AND RECOMMENDATIONS

Technological innovation has been a significant force driving the economic growth of the United States for much of the nation's history. As the rate of domestic economic growth has slowed over the last decade, signs have appeared suggesting that the reason may be in large part a diminished propensity for innovation among United States industries. Reading such signs, federal policymakers today are appropriately concerned with the maintenance of a high level of technological innovation to secure the country's economic strength.

The apparent decline in technological innovativeness has given rise to a number of explanations. Among these has been the suggestion advanced by some in the business community that antitrust policies and practices, because they are sometimes unclear, may prevent certain business activities that could contribute substantially to technological progress even if they pose insubstantial threats to the preservation of competitive markets.

This report examines the major points of tangency between the antitrust laws and the innovative process in order to determine whether the laws are likely to impinge unduly on technological innovation. Since industrial organization is a primary concern of antitrust policy, the report begins with a review of the literature on the relationship between industrial market structure and technological innovation. Although much work has been done in studying this relationship, surprisingly little of consequence is known. This reflects in part the intractable problems of measuring the innovation phenomenon. Without an adequate gauge of innovation, it is impossible to tell whether one or another market structure is more conducive to technological progress. This much can be said, however: perfectly competitive and tightly oligopolistic markets, as they exist in the models used in microeconomic analysis, are probably less conducive to technological

innovation than markets in which there is some structural concentration but relatively low barriers to entry. Traditional antitrust policy with respect to market concentration does not, therefore, seem likely to impair industry's capacity for technological innovation. At the same time, the Department of Justice has indicated its willingness to condone mergers that would otherwise be challenged if it can be shown that the mergers are likely to contribute to the innovative capacity of the firms.

Certain new developments relating to industrial market structure have more ominous implications for the rate of technological innovation. For example, proposals for whole-sale industrial deconcentration -- i.e., the dismemberment of large firms in concentrated industries -- could create significant disincentives for moderate-sized firms that would otherwise seek to gain a share of the market by aggressive innovation in product and process technologies. If administered without particular regard for the international competitive position of large domestic firms, moreover, such a policy could impair both domestic innovation and the ability of U.S. firms to compete abroad.

The Federal Trade Commission has created a new uncertainty about the impact of antitrust law on technological innovation in its case involving du Pont's titanium dioxide production. That case appears to charge du Pont with "unfair competition" because it developed and exploited a technically superior manufacturing process. Although the complaint was dismissed by the Administrative Law Judge in October 1979, the agency's staff is now prosecuting an appeal before the full commission.

Chapter 3 of this report reviews the position of the Department of Justice regarding the circumstances under which joint R&D ventures may be undertaken without fear of antitrust challenge. The uncertainty of the department's position and the limitations of its procedures for giving more concrete guidance to interested firms are analyzed.

Chapter 4 concerns the relationship between antitrust and patent law as it may affect technological innovation. Particular attention is given to recent developments at the Federal Trade Commission and in private antitrust litigation against Xerox Corporation that have created doubts about the relationship between patent exploitation and antitrust law, with significant implications for incentives for firms to engage in innovative activity.

The committee offers the following recommendations based on the substance of this report.

1. A better understanding of the relationship between industrial market structures and the propensity for technological innovation is needed to inform antitrust policymakers, so that the policy may be conducted in a manner likely to encourage, or at least not to discourage, technological innovation. To this end, research into the relationship should be encouraged, with particular attention to the need for more adequate indices of innovation than economists have yet developed. (pp. 10-13)

2. The uncertain relationship between the level of innovation and the efficiency of R&D spending on the one hand and the degree of corporate diversification across product lines on the other should be investigated further on the basis of the FTC's Line of Business Reporting program, as soon as adequate data are available from the FTC. Until such an inquiry can be made and the relationship can be better understood, the Congress should, in any consideration of antitrust legislation that is likely to inhibit conglomerate mergers, take into account the possibility that such legislation might have an unpredictable effect on technological innovation. (FN. 34)

3. In considering proposed legislation to deconcentrate industry, Congress should take account of the possibility that such legislation might penalize or deter internally generated growth in sales or market share in the absence of proof that such growth was made possible by significant unlawful (i.e., unfair or exclusionary) trade practices. To require the breakup of a firm simply because it achieves a certain size or market share could inhibit technological innovation in cost-cutting production processes and new product development in many of the major companies now responsible for a large share of industrial research, development, and innovation. Such a policy could also work to shift market share to foreign firms, to the detriment of U.S. trade and employment positions. (pp. 20-21)

4. The FTC should abandon its appeal from the dismissal of its complaint against E.I. du Pont de Nemours & Co. involving titanium dioxide (TiO_2). This recommendation is based not on the immediate significance of the particular case for the particular parties, but on its broader implications. If, as it seems, the FTC in this complaint is questioning the legality of rational, noncollusive efforts by business enterprise to exploit process innovations enabling such enterprises to produce useful goods at a lower cost than its competitors (and thereby

undersell them), then the potential outcome of the case might have a chilling effect on other firms engaged in risky and progressive technological innovation. At the very least, the FTC's theory of the case is, in our opinion, so expansive and so little supported either by economic theory or legal precedent that it would make it impossible for a firm that wishes to expand its capacity in order to exploit a cost-saving production process to know how to conform its behavior to the requirements of the law as the FTC interprets it. If such a theory should be upheld on appeal, it could cause such firms to abandon efforts to make socially desirable innovations to the benefit of less innovative competitors and the detriment of consumers. (pp. 21-23)

5. The Department of Justice has asserted that in determining whether to oppose a market-concentrating merger, it will take into favorable account the merged firm's enhanced prospects for technological innovation. The department should further clarify this policy and indicate the type of showing it deems necessary in order to justify on technological grounds a merger that would ordinarily be challenged under its merger guidelines. (pp. 23-25)

6. The Department of Justice has articulated a large number of criteria by which it will decide whether to invoke the antitrust laws to prevent multiple firms (which may or may not be actual competitors) from entering into a joint R&D venture. The department's formal statements provide little guidance for any particular joint venture, however, and the substance of its informal responses to inquiries from the bar are not published. This situation may needlessly inhibit firms from undertaking joint R&D ventures. The department should attempt to clarify its published policy with respect to joint R&D ventures and to devise improved procedures for applying that policy to particular proposals about which it receives formal and informal inquiries. (pp. 26-39)

7. The antitrust laws should not be administered or construed to conflict with the purpose of patent policy in fostering technological innovation. Whereas patent abuse has traditionally exposed a patentee to the strictures of the antitrust laws, no such liability should be incurred by a firm that acquires a monopoly over a market that it has created by its commercial exploitation of valid patents. The courts have always recognized this principle when private plaintiffs have sought treble damages from lawful patent-based monopolists. The principle

should not now be compromised by an attempt to distinguish between damages and injunctive relief in order to compel the licensure of such a firm's patents to its would-be competitors. (pp. 30-33)

1 INTRODUCTION

The primary purpose of antitrust regulation is to ensure that economic markets are competitive.[1] This purpose does not represent an end in itself. Rather it depends upon classical and neoclassical microeconomic theory, which holds that in a state of perfect competition where there are a number of competitors no one of which has the ability to influence the market price of its goods, resources will be allocated most efficiently -- i.e., to those who value them most highly. Consumer welfare (surplus) will thus be maximized, while producers will earn no "profits" as defined in economics, but gain a "normal" return on their invested capital just sufficient to keep it dedicated to its most productive purposes; if it could earn a higher return in another use, it would be put to that use. Under related assumptions in the microeconomic model, consumers and producers have, if not "perfect" information about all prices and market opportunities, at least all relevant information worth acquiring, given that information is itself a costly good. Accordingly, all potential opportunities for increasing consumer satisfaction would be fully exploited, at any given time.

Even this brief description of the microeconomic model reveals that it is a static model. It purports to describe the process of adjustment between different moments, without allowing that any adjustment might ever be necessary. If at Time 1 all goods have been allocated to their highest and best use, it would seem that a Time 2, at which this condition no longer held, could come about only through either an unexplained change in consumer preferences or an exogenously imposed alteration in the pool of available resources, such as occurs when a natural disaster occurs or a natural resource is discovered.

More important for present purposes, the model gives rise to a "growth paradox,"[2] since the observed growth in the U.S. gross national product during the twentieth century cannot be fully explained by the

growth in capital stock; some disputed, but nontrivial part of that growth appears to be accounted for by pure productivity increases.[3] This, in turn, implies that growth has been a function of the producers' ability to combine resources in new ways that are more productive than the old ways -- to devise previously unimagined managerial techniques, production methods, and products. It implies, in short, that what may generally be called "technological innovation" has been a driving force in economic growth during the most readily observable period of our economic history. Further, it implies that if our economic growth is to continue, the nation must appropriately be concerned with both the ability of producers to engage in technological innovation and the effects of national policies that might inhibit the innovation process.

As the rate of economic growth in the U.S. economy has declined over the last decade, it has been noticed that the rate of technological innovation seems to have declined. The observation is impressionistic, however. It is based upon such facts as the declining productivity growth rate and number of patent filings, the adversely changing balance of trade, and the decreasing share of technology-intensive products in world trade. Each of these could be explained, of course, on a number of grounds. Nonetheless, there is now a widespread belief that the U.S. economy's propensity for technological innovation is at a low ebb and that our future economic growth may be much lessened as a result.[4] Industry and government policymakers are appropriately concerned with the maintenance of a high level of technological innovation in the future, regardless of whether technological innovation is actually on the decline relative to the past.

There are a number of explanations for the apparent decline in technological innovation. Many have been advanced by the business community, which, despite its possible interest in championing one theory or another, must be acknowledged to occupy a highly relevant position for viewing and describing the phenomenon. It is, after all, the business sector -- present firms and would-be entrepreneurs -- to which we have primarily looked for technological innovation in the past.[5] Prominent among the explanations are the demands imposed by "regulation," principally those in the environmental, health, and safety areas, as well as the effects of federal economic and tax policies.

Less often mentioned, perhaps, but nonetheless a major concern in the business community, is the effect of the antitrust laws and their enforcement policies on technological innovation. The general

theory of antitrust is not implicated in this concern, of course. There is no serious doubt about "the legislative judgment that ultimately competition will not only produce lower prices, but also better goods and services"[6] -- i.e., that competition is a spur to innovation. The concern arises rather at the margin of antitrust enforcement policy. Because of a preoccupation with the model of perfect competition, however, the antitrust laws may be, it is suggested, preventing firms from taking steps that would contribute to technological innovation and thus to economic growth. By the ambiguity surrounding the precise requirements that these laws impose, moreover, they may deter business activity that would be useful in advancing technological progress and that, if the law were more clearly known, would prove to be inoffensive in any event. Finally, it may be argued that the changing pattern of world trade, in which the United States now faces vigorous competition from overseas firms in both domestic and overseas markets, requires a somewhat different attitude toward antitrust enforcement if American firms are to remain competitive with their technologically innovative foreign rivals.

These concerns require us to examine each of the major points of tangency between the antitrust laws and the innovative process in order to determine as best we can whether those laws are impinging upon, or rather unduly impinging upon, technological innovation. That there may be some cost to technological progress would not be enough, surely, to discard or revise the national commitment to antitrust as one means of policing market behavior in the interest of consumers. The question ultimately is whether the cost of antitrust as we now know it is too high and, if so, whether it could be lowered by a more refined approach to antitrust concerns.

Although phrased as an empirical question, the trade-off between antitrust and technological innovation is unlikely to be empirically knowable. At best we can hope to survey the areas of potential conflict between the goals of antitrust and of innovation, assess the probable balance, and perhaps suggest methods by which we could reach more confident judgments with further study. If in the process there appear to be areas in which even modest actions could be taken with the clear expectation of improving our lot, let us take them without awaiting the further study that may be necessary before other accommodations can be recommended.

2 INDUSTRIAL MARKET STRUCTURE AND TECHNOLOGICAL INNOVATION

The original and still principal concern of antitrust regulation has been with price fixing and market allocation among competitors. It is also, therefore, concerned with industrial market structures, such as monopoly and oligopoly, that facilitate such practices or have similar consequences. Indeed, most of the "unfair" or "coercive" or "exclusionary" trade practices with which antitrust enforcement is concerned could not arise to any appreciable extent in a market that conformed to the ideal competitive market of the microeconomic model. Nor does their existence in the real world of imperfect markets seem likely to be significant to our concern with technological innovation. We shall begin our survey, therefore, with the relationship of market structure to technological innovation. This will be relevant to the antitrust laws governing mergers and monopolization as well as to recurring proposals for the deconcentration of industry.

Some decades ago, Joseph A. Schumpeter seriously questioned the relevance of the perfect market model to economic and technological progress. In that model, no single firm would be a large enough factor in its market to generate the supernormal profits necessary for investment in technological progress -- i.e., in research into and development of new products and processes. Perfectly free entry, moreover, would deter the introduction of new methods of production and new goods inasmuch as no more than a competitive rate of return could be earned in the new field.[7]

That the real world does not conform to the model comes as no surprise. Firms engage vigorously in research and development looking toward technological innovation. They have, and must have, at least some "market power." From this Schumpeter concluded:

> What we have got to accept is that [large enterprise] has come to be the most powerful engine of [economic] progress. . . . In this respect, perfect competition is not only impossible but inferior, and has no title to being set up as a model of ideal efficiency.[8]

Schumpeter thus hypothesized that large size and some monopoly (i.e., market) power are prerequisites for economic growth through technological progress. He thought the promise of monopoly power would drive firms to innovate, while the fear of losing that power would promote continued innovation. The competition for technology, it was argued, would benefit society more than the loss in price competition.[9]

The question, after Schumpeter, then became to what degree the structure of an industry must depart from that envisioned in the classical model in order to assure a desirable rate of technological progress. More precisely, since all real world markets are "imperfect," the task for investigation has been the relationship between technological innovation and particular, imperfect market structures. How much monopoly power is necessary? Desirable? Excessive, in that the loss of consumer surplus from diminished competition exceeds the value of the resulting degree of technological innovation? Though economists differ in many of their findings and much work is yet to be done, they have found only modest support for Schumpeter's theory -- theoretically or empirically -- and we know little about the optimum industry market structure. In the section below we will review current economic thought on the effect of market structure on innovation.

REVIEW OF THE LITERATURE[10]

In order to understand better how market structure affects innovation, innovation itself must be understood and, more problematically, measured. Economists define a technological innovation as the first commercial application of a new or improved process or product.[11] The process of innovation, therefore, may embrace a range of activities from the generation of an idea by an inventor to its subsequent commercialization by an entrepreneur.[12] This broad, sequential understanding of innovation is essential if effective policies for its encouragement are to be devised. Innovation would not be spurred, for example, by a policy that facilitates invention but deters making the capital investment necessary to its introduction in the marketplace.

At the same time, however, innovation so defined is difficult if not impossible to measure. Consequently, it has become customary for students of innovation to focus on the invention component of innovation, and often further to narrow their sights by using research and development (R&D) efforts as a proxy for inventive activity, because at least rough quantitative data on R&D inputs and outputs are available to them. Moreover, even the R&D used as a measurement proxy for invention, which is in turn a proxy for innovation, is not easily defined. The relevant concept of R&D would not include cosmetic changes in a product (say automobile body style), but would include even incremental process or product advances developed by a firm that does not formally classify these efforts as R&D.[13] Unfortunately, it is almost impossible to measure R&D in so refined a manner. So most studies ignore the refinements at the risk of understating or occasionally overstating the resources committed by a firm to technological innovation. This should be kept in mind while examining R&D input measures of innovative activity.

Even with this highly imperfect approach, it remains impossible to measure technological innovation directly -- to compare two firms or industries, or one firm or industry at two different times, and to say with any rigor which is the more innovative. In a further bow to practical limitations, therefore, technological innovation is necessarily gauged by examining the inputs and outputs of R&D efforts. Examples of the former might be spending or employment of R&D personnel; examples of the latter include patents granted and new product sales. Each such measure is an imperfect proxy for R&D, as will be discussed below; but input factors do have the attraction that they can be more reliably and easily measured. In addition, studies have generally found a significant and positive (though not always linear)[14] correlation between input and output measures. Furthermore, though output factors may be affected by antitrust action -- e.g., there is a decrease in the number of patents applied for by a firm operating subject to a consent decree that requires compulsory patent licensing -- Scherer has reported, and it seems intuitively plausible, that the effect on decisions made to commit resources to R&D is slight.[15]

The usual measures of R&D input have been R&D expenditures, R&D employees, and R&D professional employees; the number of scientists and engineers employed is sometimes used to capture the contributions of technical improvements developed in a firm's operating divisions. If raw numbers were used, an overwhelming amount of private manufacturing R&D would be found in the very largest firms.[16]

A firm with $1 billion of sales committing 1 percent of sales ($10 million) to R&D has the same absolute commitment as a $50 million firm committing 20 percent of its revenues to research. Since it would therefore be misleading to conclude that size alone contributes to the larger firm's relative research effort, economists have introduced the concept of "research intensity." This measure is determined by dividing a firm's R&D expenditures (or R&D employees, etc.) by its total sales (or total employees). Using research intensity thus permits at least rough inter-firm and inter-industry comparisons to be made.

Even adjusted input figures may be deceiving, however. Studies have indicated, for example, that small firms are more efficient than larger ones in conducting research, once a low threshold is met.[17] Cooper found that R&D is more efficiently done in small companies, a fact that he attributed to differences in the experience of technical people, their attitudes toward cost in small companies, and the greater degree of communication and coordination than is possible in large companies.[18] Mansfield rejected the hypothesis that this phenomenon is caused by large firms conducting more "basic research" that is technically more progressive but entails a longer completion time; firms half the size of the largest have a similar degree of commitment to basic, longer-term, technically progressive projects.[19] Scherer and others have suggested that large companies may simply conduct research on a grander scale, which would create the statistical appearance of greater research intensity but not necessarily reflect any greater innovativeness.[20] Indeed, it is also possible that industry leaders deliberately choose complex, costly development strategies in order to block smaller competitors, and one study found evidence that large firms in some industries suppress inventions.[21] Each of these possible phenomena would tend to overstate the output value of research inputs among larger firms.

The problems raised in the above discussion lead one to consider using output measures to test for relative innovativeness. The leading measures of output are patents awarded, "important" inventions, and sales of new products.[22] It should be noted, however, that smaller firms employ a larger percentage of their patents in their products or processes than do large firms.[23] A more disturbing factor to one attempting this measurement is that many inventions, including important ones, are not patented. Indeed in some important industries such as electronics, patenting is becoming increasingly less common precisely because the rapid pace of development makes it ever less important to have a patent monopoly on "last year's" technology.[24] Furthermore, as

Scherer has explained, firms may have incentives to pursue research, regardless of whether it yields patents, in order to gain know-how, create product differentiations, and maintain cost competitiveness.[25] Nevertheless, Comanor and Scherer thought patents granted a reasonable proxy for inventive output, though they also considered it a better measure of the general rate of technical advance in an industry than the rate of innovation by a particular firm.[26] The problem with new product sales volume as an alternative output measure is that it is affected by such factors as the size of the market and general economic conditions that do not themselves reflect the productivity of the inventive process.

With these measurement difficulties in mind, economists have restated Schumpeter's hypothesis to test whether research intensity increases with firm size and concentration (market power) in an industry. Rosenberg found research intensity (over a defined range) to be inversely related to firm size, though positively related to market concentration, as measured by the four-firm concentration ratio -- i.e., the percentage of sales held by the four largest firms. As he explained, Schumpeter's hypothesis would gain some support if the concentration effect proves to be greater than the market share effect.[27]

Comanor reached similar findings on the effect of concentration in industries in which the prospects for achieving product differentiation were small. Where these prospects were high, and there was thus an additional incentive for research, the concentration effect was unimportant. In addition, if barriers to entry are high in a concentrated industry, that is a disincentive for smaller firms to engage in R&D, since they might not be able to use the output.[28]

Under what conditions will the largest firms in an industry account for a larger share of the innovations in that industry? According to Mansfield, the investment in R&D must be large relative to the size of potential users; the minimum size of the firm that can use it profitably must be large, and the average size of the four largest firms must be significantly larger than the average size of all potential users. In the industries that Mansfield examined, the sixth largest firm was large enough in two (coal and petroleum), while a smaller size was adequate in one (steel).[29]

Other studies showed that maximum research intensity occurs when the four-firm concentration ratio is between 50 and 60 percent. The concentration ratio loses much of its explanatory power, however, when a dummy variable for "technological opportunity" is included.[30]

Much research has been done on the effect of firm size on R&D intensity. Once some sales threshold (which Scherer has estimated to be $250 to $400 million in 1978 dollars) has been passed, greater size does not increase research intensity -- although larger firms may have an advantage in carrying on very major projects.[31] This holds whether an input measure (R&D employees or expenditures) or an output measure (patents) is used. For perspective, it should be noted that virtually all of the companies on the Fortune 500 list are above the size at which Scherer estimates that a firm's further growth adds to its research intensity.

A word of caution is appropriate here, for Scherer's results vary greatly among different industries. For example, in the chemical industry, the larger firms do more than their share of new product innovation.[32] A commonly given explanation for such inter-industry disparities in the relationship between firm size and R&D intensity lies in the varying degree of opportunities for product differentiation in different industries. The more likely it is that a firm can differentiate its product from another and thereby gain some (classical economic) market power, the greater its incentive for innovation.[33] Some empirical evidence has been found to support this hypothesis, but the evidence is ambiguous.[34]

Scherer has suggested that much of the inter-industry difference in the relationship between firm size and R&D intensity may be explained by differences in "technological opportunity." There is inevitably a serious problem in establishing whether technological opportunity causes concentration or vice versa, but he at least has found it more plausible that technological opportunity leads to greater concentration than the reverse. If the technological opportunities in an industry remain high, moreover, concentration should have little effect on the level of innovation in that industry.[35]

Another hypothesis used to explain inter-firm differences in research intensity is that success breeds success. Branch, investigating the correlation between profits and research and using patents as a proxy for the latter, found causal effects in both directions, but the effect of R&D effort on future profits was stronger than the effect of past profits on increased R&D efforts; indeed, only 6.5¢ of each marginal dollar of earnings went to R&D.[36] Grabowski, too, found a long-run relationship between cash flow (retained earnings) and R&D levels.[37] Grabowski and Meuller also investigated the effect that capitalizing and depreciating R&D expenditures would have on profit rates for firms. They found that firms in research-intensive industries earn

significantly above average returns on their R&D capital. This was expected because an above average premium should result from above average risk-taking and limited risk-pooling. Further, R&D does not provide much collateral, which both increases the riskiness of R&D and may provide a barrier to entry, since a firm without a successful "track record" cannot obtain funds as readily in the capital market.[38] This is more of a threshold barrier, however, than an intensity determinant.

The "success-breeds-success" results are not too surprising, especially when one recalls that R&D, as an organized private economic activity, will presumably be performed to the extent, and only to the extent, that it is privately profitable.[39] While it must be financially profitable in the long run,[40] the yield that leads to further research in the short run may be success in past research, as reflected in discoveries and patents.

Another factor that could account for some of the observed differences in both inter-firm and inter-industry R&D intensity is the willingness of entrepreneurs to exploit science for industrial purposes. As one firm or industry or nation achieves success by applying to commerce what it learns in science, others may follow. Scherer has suggested that this "research conception" merely adds a random variable that cannot explain all the inter-industry or inter-firm variation.[41] It would be difficult, too, to distinguish empirically between such a factor and technological opportunity.

Several studies have inquired into whether a firm's degree of diversification affects its R&D efforts.[42] Their hypothesis was that a diversified firm would be able to utilize more of its research outputs within its various lines of business. It may even be more likely to recognize the commercial potential of its research findings because of its involvement in multiple markets. This may be an impetus to additional R&D, because it reduces the risk that research expenditure will not realize a return. The higher rate of success that is likely to result should in turn stimulate more research. The results on this point vary greatly, however, with some investigators finding a positive relationship,[43] others negative,[44] and still others getting mixed results.[45] When a firm diversifies from a less research-intensive to a more research-intensive industry, it does appear to expand its R&D;[46] but that may simply be necessary in order to compete. Kelly has suggested that product diversification has greater research advantages if the diversification is into related products.[47] Thus far, however, the evidence on diversification must be considered inconclusive.

Market structure appears to have an effect on both the rate at which research is conducted and the rate at which innovations are introduced. Since Schumpeter, innovation has been understood as a sequential process beginning with the generation of an idea, followed by a problem-solving or development stage, and leading to initial implementation and then diffusion.[48] Even widespread diffusion, moreover, may be followed by further improvements, often made or suggested by users.[49] Accelerating the pace of development prior to implementation will normally increase costs due to the resulting overlap of steps, the need to follow parallel experimental approaches in case of failure, and the addition of personnel with diminishing returns to scale. The perceived benefits, however, also increase with a more rapid pace. The successful firm will be able to profit from its innovation for a longer period of time and to begin doing so at an earlier (less time-discounted) point. Even if it has no patent protection, the firm will have gained a head start on its rivals, and its lead may not easily be dissipated after the others enter.[50]

Thus, while the costs of accelerating the innovative process depend upon the state of technology, the benefits will turn to a greater extent upon market structure. In a merely imperfectly competitive market, the innovator captures part of its rival's market share. This provides an incentive for each of the firms in that market to conduct research. If there is a dominant firm, however, it will have less market share left to gain from its rivals, so it may have less incentive than they have to innovate. On the other hand, when a dominant firm is threatened by a smaller innovator, it has more to lose; the dominant firm could then perhaps be expected to become a potent imitator that will accelerate its R&D effort when challenged. In fact, Scherer cites case studies that support both of these propositions.[51] If both are true -- and there is certainly no logical inconsistency between them -- then firms with market power may or may not be research intensive, depending upon their perception and fear of being challenged in their market. Scherer has observed from this type of evidence that market structure may have "less influence on the pace at which innovation occurs than certain other variables" -- particularly the richness of technological opportunity.[52]

At the same time, harkening back to Schumpeter, too much competition with a potential for rapid imitation could slow down innovation by reducing the potential to profit from an innovation. Scherer has identified five factors that could cause this effect to dominate the competitive spur to technological innovation: "the size of the overall market

profit potential; the number of actual or potential rivals vying to share that potential; the speed at which rivals are expected to react and imitate; the degree to which being first confers a permanent product differentiation advantage; and the magnitude of anticipated R&D costs."[53] He concluded that rivalry stimulates rapid development of new products, provided the prospect for profits is not eliminated by overcrowding. This is consistent with the recent work of Mansfield et al., who compared the social and private rates of return for a variety of inventions. The social rate of return exceeded the private rate of return by the greatest margin for those innovations that could be imitated relatively cheaply by competitors, regardless of their patentability, thereby depressing the private rate of return.[54] Indeed, in 30 percent of the small sample examined by Mansfield and his colleagues, the private return was so small that, in hindsight, the associated R&D investment was not justified, although the social benefit was high.

Scherer has also observed that because the costs and benefits of innovation are constantly changing as the state of knowledge expands and the demand for products shifts, a technological innovation will at some point, in principle, become profitable for a firm regardless of market structure -- indeed even if it is a monopoly. In fact, this point may occur earlier for a monopoly than an oligopoly, because the monopoly has no imitating rival to share the market. Thus, it can recover its R&D costs more readily. The monopoly firm may wish to delay the introduction of an innovation, however, if it expects further favorable changes in the costs or benefits by doing so.[55]

In a similar analysis, Kamien and Schwartz have determined that new entrants or firms earning no monopoly profits will be hardest to discourage from innovating and will be the fastest developers. They showed that the expected capitalized value of the rewards of innovation, rather than the composition of those rewards (short-term monopoly returns versus long-term moderate returns) govern the decision to invest in innovation. Further, the rewards of innovation consist solely of the marginal profit owing to innovation -- i.e., projected profit less profit lost by shifting to the innovation. They concluded that the greater the current profits, the smaller the incentive to undertake any new product and the longer the development period.[56] This suggests rather strongly the superiority, in terms of technological innovation, of more over less competitive markets, although this superiority may not extend to the case of perfectly competitive markets.

They also found that the entry of a rival through innovation may have a very different effect on the incumbent firm's R&D schedule,

depending on its motive for engaging in research. If the first firm conducted research for the profit it anticipated from developing its innovation, it would slow its efforts; but if it was engaged in research because it feared a loss of its present market share, then, with the materialization of that possibility, it will hasten its rate of development.[57]

The effect of a first firm's uncertainty as to the success of a research project and as to the progress of a competitor's R&D is problematic in all these studies; it cannot be evaluated empirically, although the mathematical models do attempt to take it into account. With that qualification in mind, Kamien and Schwartz's major finding here is that "uncertainty regarding rival behavior may retard [a firm's] spending in the early phases of an R&D project and accelerate spending in later stages," due to the risk of losing profits to the rival innovator.[58]

Lastly, it seems that "new entrants contribute a disproportionately high share of all really revolutionary new industrial products and processes."[59] Where the entry of significant competitors is possible, therefore, innovation will be much faster. Thus, barriers to entry are an important factor. If they are too high, innovation is thwarted, or at least delayed. If they are too low, so that any innovation could easily be imitated by a large number of rivals, there is little or no financial incentive to research. Moderate entry barriers would, therefore, seem to be most conducive to a market with a high level of innovation.

INFERENCES AND IMPLICATIONS

Considering the extent of academic study that has been devoted to testing Schumpeter's hypothesis, it is disappointing to acknowledge the limited degree to which empirical research has advanced our understanding of particular markets. Few scholars would claim to be able to say whether a particular industry is presently more or less concentrated than a "desirable" degree of technological dynamism would require. Of industry structure in general perhaps somewhat more can be said, but an increase in level of generality is felt as a cost when one seeks to draw inferences concerning the appropriate role of antitrust policy and enforcement for particular industries, or indeed, particular firms within industries. Thus, Professor Scherer, who is probably our closest student of the relationship between industrial organization and technological innovation, has concluded his study by stating:

> We emerge again with a threshold concept of the most favorable industrial climate for rapid technological change. A bit of monopoly power in the form of structural concentration is conducive to invention and innovation, particularly when advances in the relevant knowledge base occur slowly. But very high concentration has a favorable effect only in rare cases, and more often it is apt to retard progress by restricting the number of independent sources of initiative and by dampening firms' incentive to gain market position through accelerated research and development. Likewise, it seems important that barriers to new entry be kept at modest levels, and that established industry members be exposed continually to the threat of entry by technically audacious newcomers . . . What is needed for rapid technical progress is a subtle blend of competition and monopoly, with more emphasis in general on the former than the latter, and with the role of monopolistic elements diminishing when rich technological opportunities exist.[60]

Professor Markham, who has suggested that Schumpeter's hypothesis has met the test of factual analysis to emerge as a plausible alternative to the traditional competitive rubric, is only somewhat more positive in his conclusion:

> If technological change and innovational activity are, as we generally assume, in some important way a product of organized R&D activities financed and executed by business companies, it is clear that the welfare payoffs that flow from them can to some measurable extent be traced to the doorsteps of large firms operating in oligopolistic markets.

> Even if all could agree with this general conclusion, however, it is not clear that this would argue for a significant reorientation of antitrust policy goals or modification of the present standards for attaining them. . . . Although this may indeed call for an antitrust policy falling considerably short of wholesale dissolution of market concentration and of the largest one hundred or so corporations, the past and present thrust of antitrust renders this argument virtually superfluous.[61]

Put another way, the "present thrust of antitrust," as Markham has referred to it, does not purport to threaten large firms in oligopolistic markets simply because of what and where they are. Under the present antitrust laws "size alone is no offense."[62] Indeed, monopoly alone is no offense.[63] But the antitrust laws, too, are dynamic.

For the last 20 years, highly respected commentators have been proposing one or another "Industrial Reorganization Act" that have as their common theme the dissolution of the larger firms in oligopolistic markets. Such proposals vary in the precise formulae by which they would identify the targets for dissolution, but they are consistently predicated upon the assumption that the presently obtaining, internally generated market position of many major firms enables them to charge super-competitive prices while engaging in a less than desirable degree of technological innovation.

The first such proposal to come to prominence defined "market power" as "the persistent ability . . . to restrict output or determine prices without losing a substantial share of the market, or [substantial profits due to] the increased output or lower prices of rivals"; provided for the dissolution or division of firms with "unreasonable" market power; and provided that market power shall be deemed to be unreasonable market power unless certain exculpatory circumstances be shown. These included, among those most relevant to our purposes here, the demonstration that "low prices or superior products [are] attributable to the introduction of new processes [or] product improvements."[64] Under such a scheme, that is, large firms in oligopolistic markets would be obliged to show, if they are to avoid dismemberment, that they have been sufficiently technologically innovative to explain their success and to justify their continued existence. Yet, in

light of the measurement and other problems surveyed above in connection with the effort to determine the socially efficient relationship between market concentration and technological innovation, it would certainly be difficult for any firm to establish convincingly its innovativeness -- e.g., by relating market success to R&D expenditures. Perhaps more significantly, however, the prospect of such a burden would seem to be precisely what is needed to deter the moderate-sized firm in a concentrated industry from attempting to gain market share by aggressively innovating in technology to produce a more attractive product or a more cost-efficient production process to enable it to lower its prices.

Legislating industrial deconcentration may now pose yet another problem for technological innovation in the United States that did not exist 20 years ago -- and is still often overlooked. Some industrial firms with large or even dominant shares of the domestic market face intense competition in overseas markets, often from competitors that are subsidized by their governments or, more frequently, are at least unaffected by U.S. antitrust policies. The U.S. firm may be able to realize scale economies, particularly in R&D, and thus be able to meet competition abroad, only because of its large size. If such a firm is divided into multiple firms under an antitrust policy that looks only to the domestic market in determining whether a firm enjoys "unreasonable market power," no one of its successor firms may have a large enough domestic market base to sustain the predecessor's level of innovation. The result of deconcentration would then be to reduce the technological innovativeness of the firms serving the domestic market and to lose foreign (and eventually domestic) market share to overseas firms.[65] Any policy of industrial deconcentration that is not sensitive to its own international market implications, therefore, has risks for both the innovative capacity of the domestic economy and the resulting trade position of the country.

Even without the benefit of industrial reorganization legislation, the Federal Trade Commission (FTC) staff is pursuing a complaint against E.I. du Pont de Nemours & Co. in connection with that firm's "dominant" share of the domestic annual production of titanium dioxide (TiO_2) pigment.[66] According to the company, it has spent "many millions of dollars" over a ten-year period to develop a new, cheaper method of continuous production.[67] In the view of many outside technologists, the new process is a major technological innovation, and the FTC itself acknowledges that du Pont enjoyed a cost advantage derived

from basic technological superiority as well as the economies of scale and greater experience it had realized as a result of its advanced technology.[68]

The FTC's theory of the case is by no means clear, but it appears to be arguing that du Pont has unlawfully attempted to monopolize the TiO_2 market by expanding its domestic production capacity enough to enable it to capture all growth in domestic demand through the 1980s; this is coupled with the novel charge that du Pont implemented a pricing policy designed to frustrate the growth of "competitors with their higher cost processes."[69] As a result, according to FTC, the market for TiO_2 is now concentrated, in that the top four firms account for more than 80 percent of it, and du Pont alone has a 43 percent share. Furthermore, barriers to entry into this market are said by the FTC to be high. For relief the FTC therefore seeks the divestiture of two of du Pont's TiO_2 plants and royalty-free licensing of all its technology and know-how used in connection with this production. This would assure (for a time) that at least six firms share the 80 percent of the market now held by the four largest firms.

While it is difficult to discern from the FTC staff's trial brief the precise burden of the commission's theory, it is at least equally difficult to determine whether the commission, in seeking to deconcentrate the market for TiO_2, is not also penalizing a form of technological innovation that made it possible for du Pont to obtain its present market share. It is the essence of competitive markets for a firm to seek to gain a price advantage through legal means, such as greater efficiency and superior technology, and thereby gain market share. Such a strategy has been ascribed to Texas Instruments in the following passage from a news article:

> The company would commit itself to a 25% to 30% growth rate by building new plants while its first plant for a product was not yet going full tilt. TI assumed ... that it could then capture a big share of a growth market by taking advantage of declining unit costs to price its products below the competition's. The Japanese government, with an export-or-die outlook, sees such a strategy as logical [according to a business consultant], but the U.S. government frequently takes an opposite point of view with its antitrust policies.[70]

It bears recalling that the FTC case against du Pont implicates the company's pricing policies in some less than clear fashion.[71] In the absence of predatory pricing by du Pont, however, it would appear that du Pont's actions involve nothing inappropriate to competitive markets. If the FTC staff's view -- that du Pont violated the law, at least in part, by reason of its rapid expansion of capacity to exploit a new and cheaper way of making TiO_2 -- prevails, then the line between successful technological innovation and unlawful means of commercializing and exploiting that innovation will have been substantially blurred.[72]

It is at least implicit in this transaction that the FTC has, or certainly should have, some theory of the distinction between very successful technological innovation and unlawful monopolization, and of the general relationship between the desirable level of technological innovation and the accompanying trade-off in industry concentration. Why, after all, has the commission singled out du Pont alone for reorganization? Why has it sought to create two, rather than one or three or four new firms in the TiO_2 market? Just what are the "appropriate" four-firm and eight-firm concentration ratios, in the commission's view, for a technologically dynamic industry, such as the pigment or overall chemical industries appear to be? At the very least, it would seem incumbent upon the commission to make its theory explicit for the guidance of the business community. In the absence of such a public revelation, the deterrent effect of its activities on important forms of technological innovation -- those capable of sweeping a market, at least temporarily, because of their price or quality superiority -- will be similar in kind if not in degree to the deterrent effect implicit in the various proposed industrial reorganization acts mentioned above.

The appropriate or even tolerable relationship between industrial concentration and technological innovation is implicated also in the merger context. Mergers among horizontal competitors are severely constrained under Section 7 of the Clayton Act[73] and the Merger Guidelines promulgated by the Department of Justice under that act.[74] These guidelines specify the conditions, as measured mathematically by market share, under which mergers between direct competitors will be presumed unlawful and will ordinarily be challenged. They do not purport to immunize mergers that are not covered by the guidelines, nor do they foreclose the possibility that a merger that would otherwise be prohibited under the guidelines might be exempted under certain narrowly defined circumstances.[75] In short, whatever one's view of the

substantive merits of the guidelines, they represent a laudable revelation of prosecutorial policy in an area where some degree of precision has been deemed practical.

The question arises, however, whether the Merger Guidelines would be waived, or whether a merger that is not expressly prohibited by the guidelines would go unchallenged, on the ground that it will result in a firm that is better able to compete technologically with the others in its industry than could either of the merging firms alone. In a recent address, a deputy assistant attorney general for the antitrust division has indicated that just such a consideration would be taken into account:

> In particular situations where significant R&D gains would be achieved by permitting a market concentrating acquisition to take place, we would weigh that factor against any possible competitive losses which might also result from the transaction.[76]

This attitude was reiterated, albeit somewhat less clearly, in the Department of Justice's response to the initial questionnaire of the interagency Task Force on Domestic Policy Review of Industrial Innovation.[77] In neither instance, however, did the department or its spokesman indicate the type of showing that would have to be made in order to justify a merger on the ground that it would foster technological innovation. The relevant facts, it would seem, would relate not only to the firms themselves and to their technological capacities, opportunities, and resources, but also to the market structure in which they would be operating after the merger was consummated. Nor did the department provide illustrations drawn from its own experience in approving mergers, if any, on this ground. Indeed, the department has indicated that it would be cautious in condoning mergers in order to accomplish a "limited end" -- enhanced capacity for technological innovation. It will be particularly cautious where there may be alternatives to that end that have less potential for restricting competition, such as limited-purpose joint ventures.

Notwithstanding the patently difficult problems involved, it would seem helpful for the department at least to attempt to give some greater indication of the types of circumstances in which it assertedly had been or would be inclined to approve mergers upon the ground

that they have a significant potential for contributing to technological advancement within an industry. This might be accomplished through the use of illustrative cases, in the manner of the department's Antitrust Guide for International Operations.[78] At the very least, the department should give some indication of the factors it will consider relevant to such a claim and the burden facing the proponents. Failing such action, there remains, as the department has said in issuing its Antitrust Guide for International Operations, "uncertainty [that] may sometimes cause businesses to abandon or limit unobjectionable transactions, or to embark upon unnecessarily restrictive transactions which would not be undertaken if the antitrust risk were more clearly perceived."[79] In this context, the consequence of uncertainty may be to inhibit the commercialization of technological innovations that could prove to be of great benefit to consumers and to the U.S. trade position.

3 JOINT R&D VENTURES

In discussing the Department of Justice's approach to potentially innovation-enhancing mergers, as we have just done, the possibility of a joint venture was raised as an alternative that might produce less of a threat to restrict competition between the firms wishing to merge. Indeed, a joint venture can be seen as a partial rather than complete integration of two firms, which preserved *pro tanto* their capacity to compete with respect to the portion of their operations that is not integrated in the joint venture. Where the joint venture would participate in a market in which the parent firms do not each compete, the joint venture can be viewed as a new entrant bringing an additional competitor to a particular market.

Nonetheless, joint ventures cannot be and are not always viewed by the Department of Justice as net additions to the competitive picture. The fact is that joint ventures, including those operating in a market in which neither parent operates, are susceptible to abuse -- i.e., to anticompetitive purposes. First, they may serve as the conduits through which the parent firms exchange price or other information in restraint of trade in their market. Second, they may represent a single new entrant in a market that each (or all) of the parent firms would otherwise have entered independently; this lessens the potential if not the actual competition in the joint venture's market.[80]

In recognition of such dangers, the department has sought to confine joint ventures to those situations in which they represent a contribution to rather than a diminution of competition and to confine their activities to the business purposes that justify their creation. The U.S. Supreme Court has agreed and has held that the general strictures of Section 7 of the Clayton Act should be applied to joint ventures much as they would be to mergers.[81]

Of course, joint ventures may be desired by firms for a variety of

legitimate business reasons, including their ability to share risks, to aggregate resources for large undertakings, and to combine complementary resources held by the respective parents but not readily obtainable by either in the open market.[82] Each of these reasons may come into play when firms seek to form the type of joint venture that is of the greatest relevance to the subject of technological innovation, *viz.*, joint R&D ventures.

Although there has been little if any enforcement activity against pure R&D joint ventures,[83] Department of Justice officials have spoken several times to the criteria they would use in evaluating such an undertaking.[84] Aggregating what they have said, the following general principles emerge:

Joint R&D ventures, like other joint ventures, are to be examined under a "rule of reason" -- the procompetitive and general consumer benefit potential that the venture represents in its market is to be balanced against the anticompetitive potential that it poses in that market and in the market in which the parents operate. Thus, the department will look to the claimed justification for collaboration; whether the R&D proposed as a joint undertaking would be done in any event by one or both of the firms independently if the joint venture is not undertaken; the number and market power of those firms that would not be participating in the joint venture but would instead be pursuing independent research with the same or similar goals; the degree or vigor of competition within the affected industries; and the structure of the proposed joint venture, i.e., whether it has been designed to minimize the risk of anticompetitive interchanges between the parents (separate personnel, etc.).

Even more generally, the department is concerned with the effect that formation and operation of the joint venture would have on the incentives facing the joint venture, its parents, and its competitors to engage in vigorous innovational competition. The department has recognized that "basic" research may be the least attractive research activity for any one firm to undertake, since it may not be able to appropriate all the fruits of its labor. Accordingly, the department may be more tolerant in weighing the factors set out above for a situation in which a joint venture is proposed to do "basic" or fundamental work in contrast to "applied" or developmental work. Indeed, where basic research is concerned, it may seem that the closer to industry-wide the parent group, the greater its incentive for basic research. Nonetheless, the department seems to take a dimmer view of joint ventures the closer they come to being industry-wide on the ground that they may have less incentive to pursue innovation vigorously, and it does not seem to differentiate on this score between industry-wide basic and

applied research.[85] Department spokesmen have also expressed concern that innovations developed by a joint R&D effort be made available to nonparticipating competitors on a "reasonable basis" -- i.e., at a royalty that will be neither prohibitively high for the competitors nor so low as to create a "free rider" disincentive to the coventurers. This is an extremely murky area, however, because the department has not publicly given any more specific guidance, and the reported cases in which courts have set royalties under compulsory licensing decrees are not illuminating.[86]

From the foregoing summary, it should at least be clear that the published sources of guidance to business people and their lawyers planning joint R&D ventures provide little basis on which to plan with confidence that no adverse antitrust consequence will ensue. The Department of Justice has reported, however, that in the period 1968 to 1978 it responded to 29 specific requests for guidance concerning proposed R&D joint ventures under its Business Review Procedure; it found no reason to take issue with 90 percent of the proposals it reviewed.[87] Although the department obviously means to imply with these facts that the combination of general and specific guidance it has given does not leave an undue measure of uncertainty to those who seek, its figures tell both more and less than the whole story.

In an economy the size of the United States, it would seem that over the course of a decade 29 inquiries concerning planned R&D joint ventures is hardly a large number. There are at least three hypotheses that could explain the curious fact that so few inquiries were made, though. (1) The people engaged in planning R&D joint ventures find that they do not need further information about the antitrust law respecting them; they are entering into joint ventures or not on the basis of optimally informed legal advice. (2) People planning joint R&D ventures prefer to seek informal responses from the department, because they find the Business Review Procedure awkward. Or, (3), the ambiguities of the law and enforcement practice are deterring people from formulating joint R&D plans in the first instance.[88]

The first hypothesis seems implausible on its face. From what is known, published, and summarized above, it would seem that any particular proposal for a joint R&D venture would almost inevitably face great uncertainty under the criteria. The relevant considerations are too multitudinous and potentially conflicting in any given factual setting to give satisfactory guidance standing alone.

The second hypothesis -- that people more often seek informal than formal advice from the department -- is more plausible. It has long been common practice for members of the antitrust bar to consult with enforcement attorneys about particular plans, and the relatively recent institution of the Business Review Procedure has not, unsurprisingly, altered this fact. Under the Business Review Procedure, the department states formally no more than a present intention not to sue. In return, however, it exacts a detailed, written statement of the proposed business arrangement, including all relevant background information, documents, and oral understandings among the parties. These submissions are placed in a public file for one year, and any exceptions to such disclosure must be specifically requested and justified. Thus, the party using the procedure undertakes what may be a substantial burden of formal documentation and the business and legal risks associated with prior disclosure of its plans.[89] The formal clearance letter it receives is expressly predicated upon the accuracy and completeness of the representations it has submitted and does not, in any event, bind the department, although it does invite greater reliance than considerations of good faith alone would do if the department had given merely informal, oral advice.[90]

If the second hypothesis is correct, or correct to any substantial degree, then it would be more informative to know something about the outcomes in the department's informal responses to inquiries concerning joint R&D ventures than about its formal responses. What does it "require" of the proposals that come informally before it? Publicizing the contents of these dealings without compromising the advantages that they hold for those who make inquiries would admittedly be a formidable task. It might be beneficial to the public if the department devised a means of doing so, however. Perhaps it could adapt the procedures used by the Internal Revenue Service, under which private letter rulings are issued to inquiring taxpayers, while a significant body of recurring or important factual settings and the rulings thereon are published as Revenue Rulings that do not identify any individual or firm but are cast in the form of hypothetical situations.[91]

Finally, it remains possible that the third hypothesis holds -- that is, that the ambiguity surrounding what constitutes a lawfully structured joint R&D venture is deterring business people from entering into them.[92] Whether this is so, by the nature of the case, not even the Department of Justice can say. It is not at all improbable, however, and this problem too would be avoided if the department used one procedure or another to clarify the law relating to joint R&D ventures.

4 PATENT LICENSING AND ANTITRUST RELIEF

No discussion of the relationship between antitrust and technological innovation, whether it is undertaken individually or by joint venture, can fail to consider also, at least briefly, the relationship between antitrust and patent law. Unfortunately, however, it remains true that "[p]atents usually bring confusion to antitrust discussions."[93]

In order to limit the confusion, it is well to establish from the beginning that the frequently posed conflict between the procompetitive policy underlying antitrust and the monopolization inherent in the award of a patent overstates by implication the degree of necessary conflict between the two legal regimes. In fact, the patent monopoly stands as a solid exception to the antimonopoly presumption of the antitrust laws. True, the exception and the patent may fall if the patent is "misused" in an attempt to acquire in fact a greater monopoly than the patent confers in law. Often, too, the misuse may implicate an antitrust violation, as, for example, when the patent is licensed to another for use under an agreement that also contains restraints of trade that are neither inherent in nor ancillary to the exclusive rights conferred by the patent upon the patentee-licensor.[94]

That said, it must be conceded that there is at least some lingering doubt about the antitrust status of some restrictive clauses in patent licenses. Thus, the Supreme Court has never squarely held that a licensing agreement could not fix the price at which the licensee's product, incorporating the patent technology, may be sold,[95] nor that a licensor may not restrict the fields in which its licensee may use the patent,[96] and may not require that the licensee grant back to the licensor on an exclusive basis such improvement patents as the licensee obtains in the course of using the licensed patent.[9] More important than a square holding, however, the Justice Department has indicated its opposition to such practices,[98] as have leading commentators on the

subject.[99] As a result of the department's known attitude and readiness to litigate an appropriate case regarding any of these restrictions, their use appears effectively to have come to a halt.[100] It is very doubtful, however, whether the inability of a patentee to engage in such restrictive licensing practices has any effect on the incentive to invest in technological innovation of the sort that leads to the issuance of a patent. As Professor Turner has pointed out, the decision to invest in research is fraught with uncertainty about the precise rewards that will ensue:

> It seems highly probable, to say the least, that such additional opportunities as the right to impose price-fixing or other restrictions in the patent licenses are of far too marginal and indeterminate value to have any significant effect on the decision to invest in research and development.[101]

Although the issues relating to restrictive patent licensing may have been laid to rest by reason of the Justice Department's announced enforcement policies, if not by judicial confirmation, the Federal Trade Commission has now injected a new and potentially much more significant element of uncertainty into the patent-antitrust relationship. In 1969, the FTC filed a complaint against Xerox Corporation, charging it with monopolistic practices and seeking broad equitable relief.[102] The FTC generally charged Xerox with having accumulated a complex web of interrelated patents with the purpose and effect of acquiring a complete monopoly over the plain paper copier market. The proceeding was terminated in 1975 when the court entered a consent decree under which Xerox offered nonexclusive licenses under any three of its plain paper copier patents at no royalty and under all of its patents at nominal royalties of one-half of 1 percent per patent up to a maximum of 1.5 percent for any one product, plus the right to a grant-back of nonexclusive licenses on all xerographic patents of the licensee. Since Xerox acquired its patents before there was any market for plain paper copiers, the FTC appears to have been operating upon a novel theory in bringing its case.[103] Because the matter was settled by consent, however, the commission's theory remains unventilated.

Meanwhile, in 1973, SCM Corporation sued Xerox, alleging violations of §§ 1 and 2 of the Sherman Act and § 7 of the Clayton Act. SCM alleged that Xerox, acting unilaterally and in concert with its affiliated companies, excluded SCM from the field of plain paper copying by refusing to license its patents to SCM. The jury in that case found that as of 1969 when SCM sought a license from Xerox, the latter company had monopolized the market for plain paper or convenience office copiers in violation of all three of the cited statutory sections. The District Court, however, set aside the jury's award of damages, reserving SCM's claims to equitable relief (compulsory licensing) until such time as the Court of Appeals had reviewed its holding that the antitrust violations before it could not create treble damage liability in the circumstances of this case.[104]

In distinguishing between monetary and equitable relief, the court reasoned as follows:

> A § 2 violation based on the dominance of a patent owner after the expiration of basic patents may well warrant prospective equitable relief, even if the patent owner, once having acquired monopoly power, simply continues to invest in research, to patent resulting inventions, and to exercise the lawful power to exclude, provided by each new patent, by refusing to license the patent. Prospective equitable relief may be required to achieve the competitive purposes of the antitrust laws, and it can be fashioned without undue impairment of the objectives of the patent laws. . . .
>
> However, the prospect of paying potential competitors three times the profits they would have earned if they had been granted patent licenses would pose a grave threat to achieving the objectives of the patent laws. The company facing such a prospect might well decide either to forego basic research and invest in other profit opportunities or pursue research and forego patent protection, relying instead, especially in a high technology field, on the lead-time it could achieve before reverse engineering enabled competitors to make competitive products. There would be either fewer inventions, or, at least, less public disclosure of inventions, or both.[105]

The court went on to note that the prospect that a company might have to license its technology after the expiration of its basic patents, but during the continued life of various blocking improvement patents, would introduce less uncertainty and have less economic impact than damage liability for its refusal to license to others.[106] The court's distinction between monetary and equitable relief is not wholly persuasive, however. The difference between the remedies is one of degree. The prospect of being required to license improvement patents is likely to inhibit investment in innovation and subsequent improvements less than would the possibility of damage liability.[107] The court is thus balancing "the objectives of the patent laws" with "the competitive purposes of the antitrust laws" by limiting the remedy to avoid "undue impairment" of the patent regime. In this way, the court has avoided grappling with the apparent anomaly that acquisition and commercialization of a patent could ever constitute a violation of the antitrust laws. That anomaly exists at the level of the substantive regimes, at least as interpreted by the court;[108] it can be avoided but not resolved by precluding damage liability.

As a practical matter, moreover, the investment inhibiting effect of the future possibility of having to license patents to competitors may prove to be quite substantial if the investment under consideration is large, risky, and likely to require many years to be fully recouped. The inhibition, although undoubtedly less than that imposed by damage liability, may be sufficient to prove fatal to some development efforts. The court, however, had no basis for presuming that the social cost of such lost opportunities for innovation is less (or more) than the social cost of the patent-based monopolies that would be left undisturbed if equitable relief were not available to compel licensing.

Clearly, the outcome on appeal of this phase of the Xerox litigation will have the potential to significantly affect the incentives facing firms engaged or contemplating engaging in technological innovation. If the District Court is upheld in suggesting that compulsory licensing may be available against Xerox, then the ominous ambiguity arising out of the FTC's complaint against Xerox may be largely but unhappily dispelled. If the District Court is reversed, however, and damages are available to the plaintiff, then a substantial conflict between the antitrust and patent regimes will have been created. If we continue to hold, as we have since the writing of the Constitution, that the patent regime, more probably than not, does "promote the Progress of Science and the useful Arts,"[109] then it will be time to consider again a statutory intervention to preserve the integrity of the patent system from the logic of the antitrust laws, remorselessly applied.[110]

5 CONCLUSION

This survey of the relationship between antitrust policy and technological innovation is neither as broad nor as deep as the subject can stand. Incomplete though it may be, it should serve to illustrate that the probable effects of antitrust on innovation, whatever their magnitude, flow at least as much from the uncertainties surrounding as from the requirements of the antitrust laws. To a large extent, uncertainty is inevitable in antitrust because of the generality of the statutory charters given to the enforcement agencies and private plaintiffs. This element is compounded by the breadth and variety of transactions and arrangements to which these laws apply. But it does seem that the Department of Justice and the Federal Trade Commission could do more than they have done to clarify their interpretations of the law and their policies toward enforcement.

To the extent that the enforcing agencies do use the familiar techniques of administration -- policy statements, interpretive regulations, routinized and public advisory mechanisms, etc. -- they would, of course, risk confining their own discretion to respond to unanticipated and needful situations. The Department of Justice's favorable experience since the promulgation of the Merger Guidelines and its hopeful attitude in issuing its Antitrust Guide for International Operations suggest that at least in some areas the risk may be small and tolerable to the department. If the department and the FTC are as concerned about the effects of antitrust law and its uncertainty upon technological innovation as the present administration seems to be,[111] they should seek out and take the opportunities they have to clarify the antitrust obligations of business.

FOOTNOTES

1. P. Areeda & D. Turner, *Antitrust Law* paragraphs 103-05 (1978) [hereinafter cited as Areeda & Turner]. As they observe, however:

> At the same time, competitive policy also promotes 'populist' goals that are commonly thought important. It disperses wealth; limits business size; broadens entrepreneurial opportunities; and substitutes the impersonal forces of the market place for the economic power of individuals or groups to exploit or coerce those with whom they deal. *Id.*, paragraph 103.

When economic and populist objectives have diverged, "the courts have given efficiency and progressiveness priority over 'populist' goals." *Id.*, paragraph 104.

The antitrust laws of principal relevance to the topic of this paper are the Sherman Act, §§ 1, 2, 15 U.S.C. §§ 1, 2 (contracts, combinations, and conspiracies in restraint of trade; and monopolization and attempted monopolization); Clayton Act § 7, 15 U.S.C. § 18 (acquisitions that may substantially lessen competition or tend to create a monopoly); and Federal Trade Commission Act § 5, 15 U.S.C. § 45 (unfair methods of competition).

2. See B. Klein, *Dynamic Economics* 1 (1977), and sources there cited.

3. Compare Denison, "Some Major Issues in Productivity Analysis: An Examination of Estimates by Jorgenson and Griliches," *1972*

Survey of Current Business 37, with Jorgenson & Griliches, "Issues in Growth Accounting: A Reply to Edward F. Denison," *id.*, pg 65.

4. See, e.g., "Vanishing Innovation," *Business Week* July 3, 1978, pg 46; cf. F. Scherer, "Technological Maturity and Waning Economic Growth," in *Arts and Sciences* (Fall, 1978, Northwestern University).

5. It is also true that in the past government policy has looked primarily to universities and other research institutions to conduct basic research. The recent diminution in federal funding of basic research at universities has given rise in that sector to the perception of an analogous crisis in basic research, the applied commercial and military effects of which will not be felt for some time to come.

6. National Society of Professional Engineers v. United States, 435 U.S. 679, 695, 98 Supreme Court 1355, 1367 (1978).

7. J. Schumpeter, *Capitalism, Socialism, and Democracy* 105 (3d ed., 1950); see T. Morgan *Economic Regulation of Business* 9 (1976):

> A perfectly horizontal deman curve is ... an important concept on economics because it comes close to describing the state of the world as it appears to a form in perfect competition. A farmer on a given day, for example, can almost certainly sell his goods only at the market price. Furthermore ... no farmer is big enough to have his production really affect the price ...

It is probably significant that so much research in the agricultural sector has been carried on by suppliers and by states through their land grant agricultural colleges and county extension services. This probably reflects the fact that there is no room for research and development in an industry as close to perfectly competitive as agriculture has historically been.

8. See Schumpeter, *supra* note 6, pg 106.

9. *Id.*, Chs. VII & VIII.

10. This section of the present paper draws liberally upon Kamien and Schwartz, "Market Structure and Innovation: A Survey," 13 *Journal of Economic Literature* 1 (1975), and F. Scherer, *Industrial Market*

Structure and Economic Performance (2nd ed. 1979), Chapter XV of which Professor Scherer graciously made available for this project. See also Markham, "Concentration: A Stimulus or Retardant to Innovation?" in Goldschmid, *et al.*, eds., *Industrial Concentration: The New Learning* (1974). Additionally, I wish to acknowledge the invaluable research done for this section by Howard B. Jacobson, J.D. '79, Harvard Law School.

11. E. Mansfield *et al.*, *The Production and Application of New Industrial Technology* 12 (1977). In this sense, technological innovation may be distinguished from other types of innovation, such as managerial or marketing techniques.

12. See Landau, "Innovation," *Chemtech* (Jan. 1979).

13. E.g., S. Hollander, *The Sources of Increased Efficiency* (1965), reports that more than half of the reduction in the cost of producing rayon in the plants of E.I. du Pont de Nemours and Co. has been the result of gradual process improvements that could not be identified as formal projects or changes. See generally Abernathy & Utterback, "Patterns of Industrial Innovation," 80 *Technology Review* 3 (1978).

14. Scherer, *supra* note 9, chapt. 15, pg 30 (linear homogeneous relationship between patenting and R&D employment for larger firms); cf. Staff Report, Federal Trade Commission, *The Semi-Conductor Industry* 108-12 (1977), reported in Scherer, *id.* at n. 43.

15. F. Scherer, S. Herzstein, A. Dreyfoos *et al.*, *Patents and the Corporation* (2d ed. 1959), recounted in Scherer, "Antitrust and Patent Policies," in K. Strootmann, ed., *Innovation, Economic Change, and Technology Policies* (1977).

16. See, e.g., National Science Foundation, *Science Indicators 1978* (1979).

17. See, e.g., J. Schmookler, "The Size of Firm and the Growth of Knowledge," in Z. Griliches, Y. L. Hurwicz, eds., *Patents, Invention, and Economic Change* (1972).

18. Cooper, "R&D is More Efficient in Small Companies," 42 *Harvard Business Review* 75 (1964).

19. E. Mansfield, *Industrial Research and Technological Innovation--An Economic Analysis* (1968), discussed in Kamien and Schwartz, *supra* note 9, pg 10.

20. See Scherer, "Antitrust and Patent Policies," *supra* note 14, at n. 18.

21. J. Blair, *Economic Concentration: Structure, Behavior and Public Policy* (1972), discussed in Kamien and Schwartz, *supra* note 9, pg 10.

22. A further distinction is sometimes drawn between all patents and "important" patents, but they were found to be similarly distributed in J. Schmookler, *Invention and Economic Growth* (1966).

23. Schmookler, *supra* note 16.

24. See, e.g., Shapley, "Electronics Industry Takes to 'Potting' its Products for Market," in *Science,* Nov. 24, 1978, pg 848, which reports that "the so-called patent decline may be merely a patent bypass" brought about because "an invention can be obsolete in the 2 or so years it takes to be patented." The "potting" referred to in the title of this article and also known as "black boxing" includes several techniques that are used to make it impossible for a would-be imitator to learn the configuration of an electronic device.

25. Scherer, "Antitrust and Patent Policies," *supra* note 14. This observation may have its greatest force as applied to innovations in the ongoing production process, as implied in the general theory of the learning curve in production. As explained by J. Fred Bucy, President of Texas Instruments, Inc., complete exploitation of the learning curve phenomenon involves not only spreading fixed costs over a larger unit volume: "It also involves constantly forcing manufacturing costs down through design improvement of the product and the production process." "Texas Instruments Shows U.S. Business How to Survive in the 1980s," in *Business Week,* September 18, 1979, pp 66, 68.

26. Comanor & Scherer, "Patent Statistics as a Measure of Technical Change," *Journal of Political Economics* 392 (1969).

27. Rosenberg, "Research and Market Share: A Reappraisal of the Schumpeter Hypothesis," 25 *Journal of Industrial Economics* 101 (1976).

28. Comanor, "Market Structure, Product Differentiation, and Industrial Research," 81 *Quarterly Journal of Economics* 639 (1967).

29. Mansfield, "Firm, Market Structure, and Innovation," 71 *Journal of Political Economics* 556 (1963).

30. See Kamien and Schwartz, *supra* note 9, pg 21, and sources there cited. The concept of "technological opportunity" may be described roughly as the rate of growth in the scientific and technological bodies of knowledge upon which the firm draws.

31. Scherer, *supra* note 9, chapt. 15, pg 32. In the first edition of this work, Scherer estimated the relevant range at $75 million to $200 million for most industries. *Id.*, pg 361 (1970).

32. See sources cited at Scherer, *supra* note 9, at n. 52; Kamien and Schwartz *supra* note 9, pg 17.

33. See Comanor, "Market Structure, Product Differentiation, and Industrial Research," 81 *Quarterly Journal of Economics* 639 (1967).

34. Professor Scherer has pointed out that investigation into the relation between research spending and diversification will be facilitated under the FTC's new Line of Business reporting program. See Federal Trade Commission, *Statement of Purpose; Annual Line of Business Report Program* (1973); but see Bentson "The FTC's Line of Business Program: A Benefit-Cost Analysis," in H. Goldschmid, ed., *Business Disclosure: Government's Need to Know* (1979), which questions the utility and consistency of the data to be expected under the program.

35. See Scherer, *supra* note 9, chapt. 15, pp 60,64; cf. Kamien and Schwartz, "On the Degree of Rivalry for Maximum Innovative Activity," 90 *Quarterly Journal of Economics* 245 (1976), which demonstrates the analytic possibility that an intermediate intensity of technological rivalry is most stimulating for innovative activity. At present, however, "the intensity of technological rivalry cannot be identified with any conventional measure of market structure." *Id.*, pg 259.

36. Branch's work, in a doctoral dissertation, is reported in Scherer, *supra* note 9, chapt. 15, pg 38; a previous effort appears at Branch, "Research and Development and its Relation to Sales Growth," 25 *Journal of Economics and Business* 107 (1973).

37. See Grabowski, "The Determinants of Industrial Research and Development: A Study of the Chemical, Drug, and Petroleum Industries," 76 *Journal of Political Economics* 292 (1968), discussed in Kamien and Schwartz, *supra* note 9, pg 13.

38. Grabowski & Mueller, "Industrial Research and Development, Intangible Capital Stocks, and Firm Profit Rates," 9 *Bell Journal of Economics* 328 (1978).

39. See, e.g., "Vanishing Innovation," *supra* note 4, pg 49.

40. Needham, "Market Structure and Firms' R&D Behavior," 23 *Journal of Industrial Economics* 241 (1975) states the long-run economic calculus as follows: a firm's R&D intensity will be higher the lower the price elasticity of demand for the firm's product, given the research elasticity (Δ quantity demanded/ Δ research intensity) for the firm's product.

41. Scherer, *supra* note 9, chapt. 15, pg 56.

42. Although they often occur together, diversification is logically distinct from both firm size and market concentration.

43. Grabowski, *supra* note 36.

44. Comanor, "Research and Technical Change in the Pharmaceutical Industry," 47 *Review of Economic Statistics* 182 (1965).

45. See Scherer, *supra* note 9, chapt. 15, pp 34-35.

46. See Kamien and Schwartz, *supra* note 9, pg 27, and sources there cited.

47. *Id.*

48. See, e.g., Utterback, "Innovation in Industry and the Diffusion of Technology," in *Science*, Feb. 5, 1974, pp 620, 621; Mansfield, *supra* note 10; Landau, *supra* note 11.

49. See, e.g., von Hippel, "Users as Innovators," *Technical Review,* Jan. 1978, pg 30; Abernathy & Utterback, "Patterns of Industrial Innovation," *Technical Review* June/July 1978, pp 3,4.

50. See Note, "Innovation Competition: Beyond Telex v. IBM," 28 *Stanford Legal Review* 285, 297-98 (1976).

51. Scherer, *supra* note 9, chapt. 15, pp 52-53.

52. *Id.*, chapt. 15, pg 54.

53. *Id.*, chapt. 15, pg 48.

54. Mansfield *et al.*, "Social and Private Rates of Return From Industrial Innovations," *Quarterly Journal of Economics* 221 (1977); reprinted in E. Mansfield *et al., supra* note 10, pp 144, 158.

55. Scherer, *supra* note 9, chapt. 15, pg 50.

56. Kamien and Schwartz, "Potential Rivalry, Monopoly Profits, and the Pace of Innovative Activity," 45 *Review of Economic Studies* 547 (1978).

57. *Id.*, see Kamien and Schwartz, "Risky R&D With Rivalry," 3 *Annals of Economic and Social Measurement* 267 (1974).

58. Kamien and Schwartz, *supra* note 9, pg 31.

59. Scherer, *supra* note 9, chapt. 15, pg 66; see J. Tilton, *International Diffusion of Technology: The Case of Semi-conductors* (1971); R. Schlaifer & S. Heron, Development of Aircraft Engines and Fuels (1950); B. Klein, *supra* note 2, pp 89-139 (automobiles, commercial aircraft and aircraft engines, and semiconductors).

60. Scherer, *supra* note 9, chapt. 15, pp 67-68.

61. Markham, *supra* note 9, pg 268.

62. 1 Areeda & Turner, *supra* note 1, pg 9.

63. United States v. Grinnell Corp., 384 U.S. 533, 570-571 (1966).

64. Draft Antitrust Law § § 2(a), (c) (3), 3(b), in C. Kaysen & D. Turner, *Antitrust Policy: An Economic and Legal Analysis* 266-69 (1959); see "Concentrated Industries Act, White House Task Force Report on Antitrust Policy" (1968) (Neal Report), reprinted in *BNA Antitrust & Trade Regulation Report* No. 411, Special Supplement Part II (1969) and 2 *Antitrust Law and Economics Review* 11 (1968); Industrial Reorganization Act, S. 2832, 92d Congress, 2d Session (1972), reprinted at 118 Congressional Record 24925 (1972); Note, "The Industrial Reorganization Act: An Antitrust Proposal to Restructure the American Economy," 73 *Columbia Law Review* 635 (1973).

65. See Scott, Review of Bergsten *et al.*, "American Multinationals and American Interests," 20 *Harvard International Law Journal* (1979).

66. 3 *Trade Regulation Report* (CCH) § 21,407 (Dkt. 9108, April 5, 1978), complaint dismissed (Brown, ALJ, Sept. 4, 1979), notice of intention to appeal filed Sept. 26, 1979.

67. "How Antitrust Charges Can Limit R&D Payoffs," *Business Week,* July 3, 1978, pg 48.

68. FTC Trial Brief, pg 67, see *id.*, pg 44.

69. FTC Trial Brief, pg 67. The pricing policy is not alleged to be "predatory," however that term is defined. Rather, the "policy was to price as high as possible so as to . . .generate adequate cash for the capital intensive du Pont expansion program, but price low enough so that competitors with their higher cost processes would be unable to expand profitably or generate the resources to finance their own expansion plans."

    On the debate over what constitutes price predation, see 3 Areeda & Turner, *supra* note 1, paragraph 711, and Greer, "A Critique of Areeda and Turner's for Standard for Predatory Practices," 24 *Antitrust Bulletin* 233 (1979).

70. "Texas Instruments Shows U.S. Business How to Survive the 1980s," *Business Week*, Sept. 18, 1978, pg 68.

71. E.g., "When others attempt to increase prices, du Pont's failure to follow results in recision of the increases. On several occasions . . . du Pont forced competitive price rollbacks in an effort to insure the success of its 'growth strategy.'" *FTC Trial Brief,* pg 33.

72. The FTC Staff's Trial Brief is intentionally disregardful of this distinction when it states, in introducing its case, "It is of no consequence how [du Pont's] cost advantage came into being . . ." *FTC Trial Brief*, pg 1.

73. 15 U.S.C § 18, which prohibits the acquisition by a corporation engaged in commerce of the shares or assets of another such corporation "where in any line of commerce in any section of the country, the effect of such acquisition may be substantially to lessen competition, or to tend to create a monopoly."

74. U.S. Dept. of Justice, "Department of Justice Merger Guidelines" (1968), reprinted in 1 *Trade Regulation Report* (CCH) paragraph 4510. The FTC has also issued policy statements concerning acquisitions and mergers in certain industries, *viz.*, cement, food distribution, grocery manufacturing (rescinded), and textiles (rescinded). See *id.*, at paragraphs 4520-35.

75. The principal exception is for the "failing company." *Id.*, at § 9; see International Shoe Co. v. FTC, 280 U.S. 291 (1930).

76. Address by Ky P. Ewing, Jr., "Antitrust Enforcement: A Positive Force for Innovation," Institute of Electrical and Electronics Engineers. *1978 Conference on U.S. Technological Policy* (Sept. 20, 1978), pg 11.

77. Antitrust Division, U.S. Dept. of Justice, *The Impact of Department of Justice Programs on Industrial Innovation*, Oct. 17, 1978, pg 12.

78. Antitrust Division, U.S. Dept. of Justice, "Antitrust Guide for International Operations" (1977), reprinted in *Antitrust & Trade Regulations Report* (BNA) No. 799, at E-1 (1977), and *Trade Regulations Report (CCH)* No. 266, pt. II (1977).

79. BNA, *supra* note 73, at E-1.

80. But see Pfeffer & Nowak, "Patterns of Joint Venture Activity: Implications for Antitrust Policy," 21 *Antitrust Bulletin* 315 (1976), which suggests, on the basis of an empirical study of joint ventures in manufacturing during the 1960-1971 period that even joint ventures between firms with only slight horizontal or vertical relationships are motivated to develop anticompetitive linkages where market structure renders it legally impractical to forge more direct ties. The authors concluded that:

> While joint venture activity is also predicated by technological considerations, the substantial predictive power of market structure for horizontal joint ventures, and resource interdependence for joint ventures, generally, indicate that technological considerations do not, by themselves, satisfactorily account for observed joint venture activity. It appears that substantial additional enforcement activity is warranted. *Id.*, pg 339.

81. United States v. Penn-Olin Chemical Co., 378 U.S. 158, 168 (1964). In this case the court also laid down the criteria to be used in assessing the probability of a joint venture substantially lessening competition:

> ...the number and power of the competitors in the relevant market; the background of their growth; the power of the joint venturers; the relationship of their lines of commerce; the competition existing between them and the power of each in dealing with the competitors of the other; the setting in which the joint venture was created; the reasons and necessities for its existence; the joint venture's line of commerce and the relationship thereof to that of its parents; the adaptability of its line of commerce to non-competitive practices; the potential power of the joint venture in the relevant market; an appraisal of what the competition in the relevant market would have been if one of the joint ventures had entered it alone instead of through Penn-Olin; the effect, in the event of this occurrence, of the other joint venturer's potential competition; and such other factors as might indicate potential risk to competition in the relevant market. *Id.*, pg 177.

82. See C. Kaysen & D. Turner, *supra* note 63, pg 136; "Antitrust Guide for International Operations," *supra* note 73, at Case C, Case M.

83. In 1974, Assistant Attorney General Kauper reported that the Department of Justice had "not challenged in court agreements purely for joint research, although it has investigated some." Kauper, "Innovation Insurance: Private or Public?" 61, 63, in *Institutional and Legal Constraints to Cooperative Energy R&D* (Commerce Tech. Advisory Bd., U.S. Dept. of Commerce, 1975). Pfeffer & Nowak, *supra* note 75, pg 338, reported that no such suits had been filed as of 1976.

84. See Ewing, *supra* note 71, pp 8-9; "Antitrust Guide for International Operations" *supra* note 73, E-7 (Case D); Baker, "Antitrust as a Spur to Technical Progress," 23 *American University Law Review* 547, 553-55 (1974); Kauper, *supra* note 77; Turner, "Patents, Antitrust and Innovation," 28 *University of Pittsburgh Law Review* 151, 157-59 (1966).

85. In connection with industry-wide ventures, department spokesmen often cite the so-called SMOG and Aircraft Manufacturers cases, neither of which is entirely relevant to the R&D joint venture concerned with basic research. In the first case, United States v. Automobile Mfrs. Assn., 1969 Trade Cases paragraph 72, 907 (C.D. Cal. 1969) (consent decree), a group of automotive firms conducted joint and pooled research into automotive emissions control. It was not in the interest of these firms to succeed in developing emissions control technology, however, and thus it is not at all implausible that their joint efforts represented a means of assuring that no single firm did so under the pressure being applied by the federal government. See Ginsburg, "Making Automobile Regulation Work: Policy Options and a Proposal," in D. Ginsburg & W. Abernathy, eds., *Government, Technology, and the Automobile* (1980).

    In the second case, United States v. Manufacturers Aircraft Assn., 5 *Trade Regulation Report* paragraph 45,072 (S.D.N.Y. 1972) an industry-wide group had agreed to pool and cross-license at a fixed royalty all future innovations that any of them should make in what was clearly an area of specifically applied research.

86. The department may have passed upon particular royalty proposals under its Business Review Procedure, but those transactions, while available to the public, are not published; see *infra*. Regarding the judicial precedents, see F. Scherer, *The Economic Effects of Compulsory Patent Licensing* 47-50 (1977).

87. U.S. Dept. of Justice, *supra* note 72, pg 13. The Business Review Procedure is set out at 28 C.F.R. § 50.6. Cf. Federal Trade Commission, Advisory Opinions, 16 C.F.R. § 1.2-1.4.

88. A fourth possibility is that businesses are proceeding with what they believe is inadequate information to form joint R&D ventures, i.e., are "taking their chances." This seems unlikely to occur on a significant scale, however, and is therefore not treated further.

89. 16L Business Organizations, von Kalinowski, *Antitrust Laws and Trade Regulation* § 91.02 n. 3: "Violations are often uncovered at this point."

90. See 2 Areeda & Turner, *supra* note 1, at § 320.

91. In this and other contexts, the department should also consider the practice of the Federal Communications Commission in publishing "primers" covering in great detail, by a question and answer with commentary format, some of the subjects on which it receives the most inquiries from interested parties. See, e.g., *Primer on Ascertainment of Community Problems by Broadcast Renewal Applicants,* 41 Federal Regulation 1371, 35 P&F R.R. 2d 1555 (1975). These are analogous to, but much more elaborated than, the department's effort in its "Antitrust Guide for International Operations," *supra* note 73; as one commentator has said of the hypothetical joint R&D venture instanced in the guide, "the facts supplied are so sparse that one must conclude that either a modest showing will suffice or, more probably, that the department has made very little commitment as to what constitutes a sufficient justification for an R&D joint venture." Brodley, "Joint Ventures and the Justice Department's Antitrust Guide for International Operations," 24 *Antitrust Bulletin* 337, 351 (1979).

92. See Advisory Subcommittee on Regulation of Industry Structure and Competition of the Advisory Committee on Industrial Innovation, Draft Report, pg 36 (U.S. Dept. of Commerce, Dec. 20, 1978), which reports the existence of "several examples in the pharmaceutical and aircraft industries in which proposals for technically meritorious joint research projects were discouraged by legal counsel because of the uncertain possibility of future antitrust attack. In each such case joint research did not occur, and the research was not undertaken at the individual firm level."

Of course, reports of such examples are suggestive only and not to be taken as dispositive even with respect to the particular instances alleged, since the sources of such information are self-serving and their own counsels' opinions were based upon proposals the details of which are unreported. They do, however, point up both the difficulty of ever determining how much of an activity is deterred and the potential for misunderstanding among those affected by the vaguer aspects of antitrust law and policy, such as those governing joint R&D ventures.

93. Areeda & Turner, *supra* note 1, at paragraph 704a. For fuller discussions of the patent/antitrust issues, see W. Bowman, *Patent and Antitrust Law* (1973), and Priest, "Cartels and Patent License Arrangements," 20 *Journal of Law & Economics* 309 (1977).

94. E.g., a tie-in that could constitute a *per se* violation of the antitrust laws stands on no better footing when the tying product is a patent. See Mercoid Corp. v. Mid-Continent Investment Co., 320 U.S. 661, 666 (1944); Mercoid Corp. v. Minneapolis-Honeywell Regulator Co., 320 U.S. 680, 684 (1944).

95. See United States v. Masonite Corp., 316 U.S. 265 (1942); cf. United States v. Line Material Co., 333 U.S. 287 (1948). United States v. Huck Mfg. Co., 227 F. Supp. 791 (E. D. Mich. 1964), affirmed by an equally divided court, 382 U.S. 197 (1965).

96. See General Talking Pictures Corp. v. Western Electric Co., 304 U.S. 175, affirmed on reh., 305 U.S. 124 (1938). See generally Frost, "Restrictions on Field of Use and Territories," 42 *Antitrust Law Journal* 633 (1973).

97. Transparent-Wrap Mach. Corp. v. Stokes Smith Co., 329 U.S. 637 (1947).

98. See, e.g., "Antitrust Guide for International Operations," *supra* note 73, at E-12.

> The Department has made clear for a number of years that it questions the need for an appropriateness of exclusive grantback provisions; and it may be in an appropriate case wish to assert that an exclusive grantback requirement involving independent parties is per se illegal. An exclusive grantback tends to perpetuate a monopoly of the licensor and may discourage innovation by the licensee. Of course the licensor has a legitimate interest in assuring that it has access to improvements on its patent, but this interest, we believe, can normally be satisfied by a nonexclusive grantback, at least in the case of a non-blocking patent.

Cf. *id.*, at E-10, where the department adopts a rule of reason approach to the analysis of territorial restrictions in know-how licensing and suggests that an even more tolerant view of such clauses would be warranted in patent licenses.

99. See, e.g., C. Kaysen & D. Turner, *supra* note 63, pg 165 (exclusive grantbacks); 173 (resale price-fixing) Areeda & Turner, *supra* note 1, § 705e (grantbacks).

100. But cf. United States v. Wisconsin Alumni Research Foundation, 1970 Trade Cases paragraph 73,015 (W. D. Wis. 1970) (consent decree against grantbacks).

101. Turner, *supra* note 83, pg 153.

102. Dkt. 8908, *Trade Regulation Report* (CCH) FTC Complaints & Orders 1970-73 Transfer Binder, paragraph 20,164 (complaint); *id.*, 1973-76 Transfer Binder, paragraph 20,995 (consent order).

103. For an interesting attempt to develop a theory to explain the FTC's complaint on rational economic grounds, see Goetz & Schwartz, "The FTC and Xerox: Multiple Patent Exploitation as an Unfair Method of Competition," in K. Clarkson & T. Muris, eds., *Economic Regulation and Consumer Welfare: The Federal Trade Commission Since 1970*, (1979).

104. SCM Corp. v. Xerox Corp., 463 F. Supp. 983 (D. Conn. 1978). The court apparently rejected the jury's conclusion that a 1956 agreement between Xerox and the Battelle Memorial Institute restrained trade in violation of Section 1 of the Sherman Act. Under the agreement Xerox acquired basic xerography patents from Battelle; Battelle agreed to assign to Xerox subsequent inventions relating to xerography, as long as Xerox maintained a specified level of research expenditures at Battelle; and Battelle terminated Xerox's prior contractual obligation to use diligent efforts to secure sublicensees to commercialize the patents for which Xerox had obtained exclusive licenses from Battelle.

The court also denied that an award of damages could be based on the Section 7 claims that (1) the 1956 agreement and later patent acquisitions pursuant thereto, and (2) Xerox's continued holding of these patents in 1969 had the probable effect of lessening competition or tending to create a monopoly. Xerox had no market power in 1956 -- indeed the relevant market did not then exist -- and had no obligation thereafter to license its patents to competitors rather than hold them exclusively. In reasoning similar to that concerning Section 2 (quoted in the text), the court went on to say that "even if the 'holding' theory of § 7 could create damage liability for the holding of some assets, a proper reconciliation of the patent and antitrust laws precludes the application of such a doctrine to patents."

The court of appeals has since directed the district court to clarify whether it "intended to hold that Xerox was 'liable' on the post-1969 claim but that money damages weren't available as a remedy, or whether the court decided merely that money damages were not a remedy without deciding the issue of liability." 599 F.2d 32, 33 (2d Cir. 1979). The district court has since reiterated that it has decided only that "SCM is not entitled to money damages and no decision has been made with respect to Xerox's liability." 474 F. Supp. 589 (1979).

105. 463 F. Supp., pp 1013-14.

106. There seems to be no reported case in which a potential competitor has recovered its lost profits as damages because of a patent owner's unilateral refusal to license a valid patent. *Id.*, pg 1012.

107. But cf. F. Scherer, *supra* note 85, pg 75, which finds "no significant indication that 44 companies subjected to compulsory patent licensing decrees sustained less intense R&D efforts [in 1975] than other firms of comparable size and industry origin."

108. In the court's view, Xerox violated Section 2 if it willingly acquired or maintained its monopoly power by acquiring patents in violation of either Section 1 or Section 7, or by methods other than patent acquisition. According to the court, "[s]ince the jury found that the acquisition of patents pursuant to the 1956 Xerox-Battelle agreement violated the standards § 7 and § 1, [the court] presumed that, under the instructions, these findings were a principal basis for the finding ... of a § 2 violation." *Id.* pg 1008. Thus, in upholding the jury's Section 2 finding, the court implicitly held that Xerox acquired or maintained monopoly power through the 1956 agreement by which it acquired patents, notwithstanding its own explicit Section 7 holdings that the relevant market did not exist in 1956 and that, at least for purposes of determining damage liability, Xerox's acquisition and retention of patents under the agreement did not even meet the looser standard of Section 7 -- that it have the probably effect of lessening competition.

109. U.S. Const., Art. 1, Section 8, Cl. 8.

110. See, "White House Task Force Report on Antitrust Policy" (1969), reprinted in *Antitrust & Trade Regulation Report* (BNA) No. 411, pt. II (1969), which recommended that "a patent owner who has granted a license with respect to the his patent must license all qualified applicants on equivalent terms," but that a patentee "may decline to issue any licenses at all"; *To Promote the Progress of ... Useful Arts, Report of the President's Comm'n on the Patent System* 36 (1966), Recommendation 22 of which called for an amendment to the patent stature clarifying and broadening substantially a patent owner's right to restrict or condition licensure of its patent.

111. In April 1978, the President initiated a Domestic Policy Review (DPR) of the subject by establishing an Industrial Innovation Coordinating Committee to develop recommendations for changes in federal policies and programs affecting industrial innovation. The committee, which was chaired by the Secretary of Commerce and involved 28 agencies, submitted an options paper to the President in October 1979. On October 31, the President announced certain executive decisions based on the DPR and sent a message on industrial innovation to Congress stating that specific legislative proposals would follow.

Two of the measures announced by the President concern antitrust policy. First, he directed the Department of Justice to "issue a guide clearly explaining its position on collaboration among firms in research." "Presidential Message to the Congress on Industrial Innovation," H. Doc. No. 96-214, 125 Cong. Rec. H10,046, H10,047 (daily ed. Oct. 31, 1979). Second, the department and the FTC are "to initiate discussions with industry about innovation, antitrust policy formulation, and enforcement. The purpose is to dispel the perception that antitrust policy inhibits innovation and to improve communication" between industry and the enforcement agencies. "White House Fact Sheet, The President's Industrial Innovation Initiatives" 7 (Oct. 31, 1979).

The first of these two steps responds to Recommendation 6 made in this paper. The second addresses the paper's general theme concerning the effect of antitrust uncertainty on innovation; whether it implies substantive changes in enforcement policy, however, is not clear.