ESSAYS ON EMERGING MARKETS

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Abstract

This thesis presents three essays on emerging Markets, with a special emphasis in Ecuador. The thesis uses both individual level (Chapter 1) and firm level data (Chapter 2) from Ecuador. Using dynamic pseudo panels, the first chapter finds an effect of entrepreneurship on the social mobility of Ecuadorians, with women experiencing a larger effect. The second chapter finds that FDI acts as external economies of scale, increasing the size of Ecuadorian firms. Finally, the third chapter presents a theoretical approach to the term maturity mismatch in Emerging Markets' sovereign debt.

Resumen

Esta tesis presenta tres ensayos sobre temas importantes para los países emergentes, con especial énfasis en Ecuador. La tesis utiliza tanto datos individuales (Capítulo 1) como de empresas (Capítulo 2), en ambos casos de Ecuador. Usando cuasi-paneles dinámicos, el primer capítulo encuentra un efecto del emprendimiento en la movilidad social de los ecuatorianos, con las mujeres experimentando un efecto mayor. En el segundo capítulo, se busca determinar los efectos de escala externa de la inversión extranjera sobre el tamaño de las empresas ecuatorianas encontrando un efecto positivo. Finalmente, el tercer capítulo presenta una aproximación teórica a la deuda de corto plazo que es utilizada por países emergentes como parte de su deuda soberana.

Prologue

This thesis presents three essays on emerging markets issues. It relates important topics such as entrepreneurship, foreign direct investment and debt. It is particularly focused in Ecuador, a middle-income country with significant opportunities and challenges in its way as a developing country.

As many other developing countries, Ecuador is facing an "entrepreneurship boom", with several public policies oriented towards entrepreneurial promotional. However, the actual impact ot these policies are not clear. The first chapter of the thesis aims to find an effect of entrepreneurship on income mobility, using constructed pseudo-panels of Ecuadorian individual data. Following other regional works, we observe a higher unconditional mobility than the regional average. Moreover, we find that indeed entrepreneurship acts as a catalyst for income mobility, with an even higher effect when considering only women entrepreneurs.

The role of Foreign Direct Investment in emerging markets is also of great importance. In Chapter 2, we study the determinants of firm size using Ecuadorian firm data for the period 2007-2011. We particularly focus on the role of industry-level foreign direct investment on Ecuadorian firms' size. We argue that FDI acts as an external economy of scale and thus generates spillover effect on

other firms. We find a significant positive effect of industry-level FDI on firm size, when using assets as a measure for size.

The final chapter switches to another recurrent emerging market issue: external debt. Financial crises throughout the years have showed the dangers of having high levels of short-term debt. We show that international investors prefer to finance long-term projects with short-term debt – that bears risk of self-fulfilling crises. Short-term debt enlarges their menu of assets allowing them to extract surplus from domestic entrepreneurs. The risk of a self-fulfilling crisis acts as an entry barrier preventing other funds from flowing into the country. Lenders can assure this equilibrium through some coordination device e.g. a hedge fund.

The three chapters of this thesis present different critical aspects of emerging markets, with a special empirical look to Ecuador. However, the challenges are shared by many other Latin American countries (or other developing nations from other regions).

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1. MOBILITY AND ENTREPRENEURSHIP IN ECUADOR: A DYNAMIC PSEUDO-PANEL APPROACH[1]

1.1. Introduction

There seems to be a consensus among policy makers in Latin America that promoting entrepreneurship is a way to achieve economic development. Different programs around the region, such as *Emprende Ecuador* and Start-Up Chile, exemplify this idea. However, the economic effect of policies that promote entrepreneurship at the country level is still unclear.

In countries like Ecuador, where this study is focused, about one in five people is engaged in entrepreneurial activities, according to the Global Entrepreneurship Monitor Ecuador Report 2010. However, most of the entrepreneurial activity is highly ineffective at creating jobs. Ninety-eight percent of the entrepreneurs created fewer than five jobs. Shane (2009) suggests that these activities are not contributing to economic growth and thus should not be promoted by the government. However, Amorós and Cristi (2010) find a

[1] This chapter is part of the research project "Strengthening Mobility and Entrepreneurship: A Case for The Middle Classes" financed by the Inter-American Development Bank (IDB) Research Department. It was published in Latin American Journal of Economics (November 2014): http://www.laje-ce.org/docs/107764_laje_512307.pdf

positive effect on poverty reduction, which remains an important issue in Latin America, particularly in Ecuador.

Across the world, entrepreneurship is becoming an attractive career option (see for example OECD (2012)). In the particular case of Ecuador, the percentage of people that label themselves as entrepreneurs has been consistently increasing in the last years (see Lasio et al, 2014). However, how successful is entrepreneurship in promoting social mobility? This chapter focuses on this important economic question: what is the effect of entrepreneurship on social mobility? Is there evidence that entrepreneurship increases a person's relative income? In order to determine whether such a correlation exists, we studied the evolution of household income over time, using panel data. Unfortunately, in Ecuador, attempts to build rotating panels have only recently begun to be undertaken, and we encountered several problems when attempting to construct a database using this information. We found many statistical inconsistencies, and only short time spans are available for the construction of the data series. Techniques have been developed to remedy these limitations, and several authors have established that panel data are not necessary for many commonly estimated dynamic models (Heckman and Rob, 1985; Deaton, 1985; and Moffitt, 1990).

To overcome the shortcomings created by the lack of panel data, a pseudo-panel approach was taken in order to estimate the dynamics of the model. This method was first introduced by Deaton (1985)

and consists of categorizing "similar" individuals in a number of cohorts, which can be constructed over time, and then treating the average values of the variables in the cohort as synthetic observations in a pseudo-panel.

The dynamic nature of the model presented results in a series of complications when estimating the autoregressive parameters, as it introduces a missing variable problem that would render standard estimation methods biased. But the fact that the model is estimated at a cohort level provides an alternative to conventional dynamic panel estimation methods, as it can be assumed that the intrinsic cohort average effect will be asymptotically equal to 0 and, with large cohort dimensions, the missing variable problem is solved.

Nevertheless this assumption raises serious questions about the validity of the constructed cohorts as units of study. If one is willing to assume that the intrinsic cohort effect is evened out, then how many idiosyncratic characteristics of the group in question could suffer the same attrition? Cohorts should be constructed on the basis of homogeneity of the individuals within the group, so as to avoid the loss of essential information and to make the mean estimators more significant. If it is assumed that this is not so, then even if the estimations are consistent, the conclusions derived from the study will not be very relevant. On account of this, we propose that the existence of idiosyncratic cohort effects should be taken as an indicator of accurately constructed cohorts. Thus, estimating by

OLS the proposed model without accounting for the unobserved cohort effect will result in positively biased estimators.

An unbiased estimator of the relevant model parameters is obtained through the use of traditional dynamic panel estimation methods (like the two-step least squares estimation or a more efficient estimator obtained by GMM methods). The fact that OLS is expected to provide a positive bias in the estimator if the idiosyncratic component exists is used as a useful check on the validity of the cohorts studied.

We first calculate an unconditional convergence model and then we condition on entrepreneurship[2]. We find an unconditional convergence of 0.86 – slightly below the 0.90 of the region (Cuesta *et al* 2011). When entrepreneurship is included, the convergence decreases to 0.77, suggesting a relevant effect of entrepreneurship on income mobility. Moreover, as shown in the Results section, we find a higher mobility effect on the female cohorts suggesting a stronger relevance of entrepreneurship on women regarding social mobility.

The rest of the chapter is organized as follows: Section 2 reviews related literature. Section 3 presents the data treatment and the construction of the pseudo-panel. Section 4 presents the models of mobility: unconditional and conditional. The econometric

[2] We refer to entrepreneurs as those who declare to "own a business", following Ecuadorian data. More information on Section 3

techniques used for the estimation of the modeled and the assumptions taken are also discussed in this section. Section 5 presents the results and the analysis, and Section 6 concludes.

1.2. Literature Review

The study of income distribution on the basis of equality is one of the most important topics in the field of welfare economics. Traditionally a static approach was taken to provide a measurement of income inequality and welfare in any given society, but this method has a number of shortcomings as in most cases the study of social welfare requires the analysis of income dynamics as well. With the increased availability of panel and time series data, the primary focus of recent research in this area of science has centered more on income mobility. A more comprehensive overview of the basic highlights of the theory of income mobility are presented in Fields and Ok (1996) and Fields (2008).

Due to the lack of extensive panel data in the region, only recently has the study of income mobility and its determinants been undertaken. This was primarily motivated by the development and increasing popularity of econometric techniques to remedy the lack of panel data. Cuesta et al (2011) use a pseudo-panel approach to study the differences in mobility across the Latin American region. They find a high level of unconditional mobility in the region and significant differences across countries. They also find that the measure of unconditional income mobility tends to underestimate

the true mobility experienced by households in an economy. Canelas (2010) also uses this technique to measure poverty, inequality, and mobility in Ecuador and finds a decrease in poverty but persistent inequality between 2000 and 2009.

With the recent development of initiatives to compare entrepreneurship across countries, like the Global Entrepreneurship Monitor or the World Bank Enterprise Data/Survey, research in this area has begun to study the effect that entrepreneurship has on income mobility and to what extent this translates on overall economic growth. Carree and Thurik (2005) provide a survey on the literature linking entrepreneurship with economic growth. Regarding the effect that entrepreneurship has on income mobility, Quadrini (2005), with the use of the Panel Study of Income Dynamics (which is a national survey conducted annually on a sample of U.S. families since 1968), finds that entrepreneurs experience greater upward mobility as they have a greater probability of moving to higher wealth classes and that this is not only a consequence of their higher incomes. But this does not hold for all types of entrepreneurship. For example Shane (2009), using data from several developed countries, shows that promoting a large number of start-ups is not a good public policy, since they do not create many jobs or significantly contribute to economic growth. The most common view found in literature is that there is a particular entrepreneurship relevant in improving economic performance, and it is generally identified as high-growth startup business.

As Lederman et al (2014) comment, policy makers should care about entrepreneurship because is a fundamental driver of growth and development. The relative size of necessity based entrepreneurship in Latin-American countries makes it very important to evaluate and determine the overall effect that public policy oriented in encouraging entrepreneurship will have on the equality and welfare of a society.

However, the amount of literature discussing its effect on income mobility is very limited. Some authors, such as Kantis et al (2002) show the relevance of entrepreneurship in Asian social mobility (compared to Latin America) using descriptive statistics. This chapter fits in the literature by aiming to determine the magnitude of entrepreneurial effect on income mobility.

1.3. Database Treatment and Documentation

The main objective of this chapter is to describe the linkages between entrepreneurship and mobility. In this section, we first analyze the intragenerational mobility experienced by Ecuadorians (unconditional mobility) and approach the potential role of entrepreneurship in improving mobility (conditional mobility). Given that individual data panels are nonexistent in Ecuador, the use of pseudo-panels was required. We start by explaining how we constructed the instrument.

a) Database Treatment

The data used for the construction and estimation of the pseudo-panel were obtained from the National Employment and Unemployment Survey (ENEMDU for its Spanish acronym) collected by the National Institute of Statistics and Census (INEC). The survey is taken at the national level each November, and the results are processed and made public the following month. This data collection methodology has been applied since 2003, as before this year only the urban population was sampled. In some years, national census data are presented in May or June. To avoid any seasonal bias due to variations in the levels of economic activity at different times of the year, only those surveys made public in December were used.

The database used to estimate the pseudo-panel is constructed as a series of independent cross-sections, one for each period analyzed. To determine the period in which the pseudo panel ought to be constructed, it is first necessary to examine the changes made by INEC in the methodology for both the determination of the sample and the estimation of the relevant variables. There are two important changes made in the last decade in the ENEMDU's methodology which are so significant that, without taking them in account, any estimation made for the whole period would suffer from serious bias. The first occurred in December of 2003, before which time only the urban population was analyzed. The definition of what constitutes an urban settlement was also changed in 2003 to include centers with more than 2,000 inhabitants rather than the

5,000 used earlier. The definitions of several labor variables were also modified while others were included. The second set of changes introduced by INEC in September 2007 consisted of several modifications in labor market definitions and classifications, but there were no significant changes in the variables used for this study (even though income estimation suffered some alterations, which will be discussed below).

Because of the loss of information that would result from the construction of a larger panel (in the time dimension), only the 2003-2010 period was studied. To maintain the consistency of the data for the period analyzed, special attention was paid to the changes in the methodology, variable classification, and labels used. The method used for the estimation of individual income was also changed, and new income criteria were introduced after 2007. In addition, even if a survey question was not modified, some of the responses were changed, which in some cases made it impossible to use the variable for the whole period. To account for all of these issues, the income series was constructed using the previous methodology, and all of the other variables included were previously processed to ensure their statistical comparability. Using this methodology, income is calculated as any payment, either monetary or in-kind, received by the individual on a regular basis (daily, weekly, or monthly). Only one type of income source was considered: income generated by work (either from a primary or secondary occupation). A monthly income series was then

constructed by adding all income originating from this source of personal revenue.

The ENEMDUs were processed in order to obtain the pertinent variables at household level, as the information relevant for this study on an individual level is collected by INEC. Data mining techniques were used and, with the use of Structured Query Language (SQL), income and other covariates were aggregated at the desired level.

The first key concept in determining the effect of entrepreneurship on income mobility is the definition of which households are to be considered entrepreneurs. The focus of the study is those households that are entrepreneurs by choice rather than entrepreneurs due to lack of options (a group that is difficult to correctly identify considering the scant information available). In order to reduce the probability of error at the moment of classification, only those households in which at least one member currently employs other workers are considered entrepreneurs.

b) Construction of the Pseudo-panel

In order to analyze the dynamic nature of income mobility, household income needs to be observed over time. Given the absence of panel data, a pseudo-panel must be constructed. The pseudo-panel approach consists of categorizing "similar" individuals into a number of cohorts, which can be constructed over time, and then treating the average values of the variables in the

cohort as synthetic observations in a pseudo-panel. Even though this approach has many limitations compared to real panel data, it reduces several problems characteristic of real panel data. First, it greatly diminishes the problem of sample attrition, hence allowing the possibility for the construction of larger panels in the time dimension. A second contribution is that, as the observations are obtained by averaging different observations in a cohort, the possibility of measurement error is greatly reduced (provided the cohorts are adequately constructed).

The efficiency and consistency of the estimators depends, among other things, on the criterion used for the construction of the different cohorts and the asymptotic nature of the data assumed. Several of the requirements for the consistency of pseudo-panel estimation are discussed by Verbeek and Nijman (1992), who recommend that the choice of the variables for the discrimination of the cohorts in the sample should follow three criteria:

- The cohorts are chosen such that the unconditional probability of being in a particular cohort is the same for all cohorts.
- The variables chosen should be constant over time for each individual, because individuals cannot move from one cohort to another. This maintains the independence of the different cohort observations.
- These variables should be observed for all individuals in the sample. This could be remedied by the use of unbalanced

panel methods, but due to the short time span of the constructed pseudo-panel, this alternative is not considered.

Following these assumptions, cohorts were constructed using gender and date of birth of the household head. To determine the number of cohorts to be constructed, first the distribution of the date of birth variable was tested with conventional goodness of fit methods, but no traditional distribution seemed to adjust the data correctly. To ensure relatively similar probabilities of belonging to a birth cohort, the aggregated data for year of birth for the eight periods were divided into deciles. This avoids the possibility that a cohort in a given period becomes too small to provide an accurate estimation of its true characteristics. After considering the weights of the observations due to sample stratification, the following deciles were obtained:

Table 1. Date of Birth (z_i^1) cohorts criterion

$$z_i^1 < 1934$$
$$1934 \leq z_i^1 < 1942$$
$$1942 \leq z_i^1 < 1949$$
$$1949 \leq z_i^1 < 1954$$
$$1954 \leq z_i^1 < 1958$$
$$1958 \leq z_i^1 < 1962$$
$$1962 \leq z_i^1 < 1966$$
$$1966 \leq z_i^1 < 1971$$
$$1971 \leq z_i^1 < 1977$$

$$1977 \leq z_i^1$$

Source: Authors' calculations.

Another criterion used to determine the number of cohorts is the gender of the household head (z_i^2). The conjunction of the two variables (considering the criterion proposed for the date of birth) results in 20 cohorts per year and 160 synthetic observations in the pseudo panel. The distribution of the observations and their corresponding expanded population values (by the use of sampling weights) in each of the categories explained are presented in the appendix. The inclusion of the gender of the household head as a determinant for the conformation of the cohorts makes the probability of belonging to a cohort uneven for most cohorts (as male household heads are more frequently found). As the synthetic observations are calculated with different sample sizes, a systematic heteroskedasticity component is introduced to the error. The methods to correct this problem are discussed in Gurgand, Gardes, and Bolduc et al. (1997). This problem becomes less relevant in cohorts constructed with a large number of observations, since the variance of the mean approaches zero as this number tends to infinity.

c) Treatment of Outliers

The household income series each year is irregular, as its standard deviation is between 2 and 4 times the mean. The asymmetries presented by the data may complicate the estimation of any inference model applied. This is also maintained at a cohort level,

and important differences in variances between each cohort average are observed. These differences make the heteroskedasticity component, described in the previous section, more important. To account for this problem, data mining techniques are applied to determine and exclude outliers. A median of absolute deviations (MAD) approach is used to determine outliers in each cohort as, due to the nature of the series, the median is a better central tendency measure than the mean. Under this scheme, the following univariant filter was applied to each observation, and observations that satisfy this restriction are considered outliers:

$$\frac{\left|x_{ct}^{i} - median_{ct}^{j} x_{ct}^{j}\right|}{MAD_{ct}} > 10^{3}$$

As shown in the formula, the method is applied at a cohort level for each period. Approximately 1.2 percent of the sample was determined to be an outlier. In Figures 1 and 2, the average income estimated for male and female cohorts is presented before and after the MAD treatment is applied. The red dotted bands denote the 95 percent confidence interval for the estimated means (solid blue line) for the period analyzed. The graph to the left of each vertical black line corresponds to the estimated cohort mean of household incomes before the univariant filter is applied, and to the right the results excluding outliers are presented.

In observing the two figures, it is noteworthy that the error bands on male cohorts are smaller than those observed for female cohorts,

[3] Traditionally the tolerance criterion is set at 4.5, but this resulted in the loss of 12 percent of the sample, including an important percentage of entrepreneurs.

possibly due to the lower number of observations in the female cohorts. But even after considering those wider confidence intervals, for most of the years studied and most of the birth cohorts, male-headed households experience a significantly higher income than female-headed households (at a 95 percent confidence level). Without the application of the MAD univariant filter, some birth cohorts exhibit very irregular behavior, and in the case of female cohorts some of the error bands explode (raising serious concerns about the validity of those estimations in a pseudo-panel context). However, once outliers are excluded, the error bands decrease considerably and the behavior of the income mean becomes smoother.

Figure 1. Average Income Before and After MAD Treatment for Male Cohorts

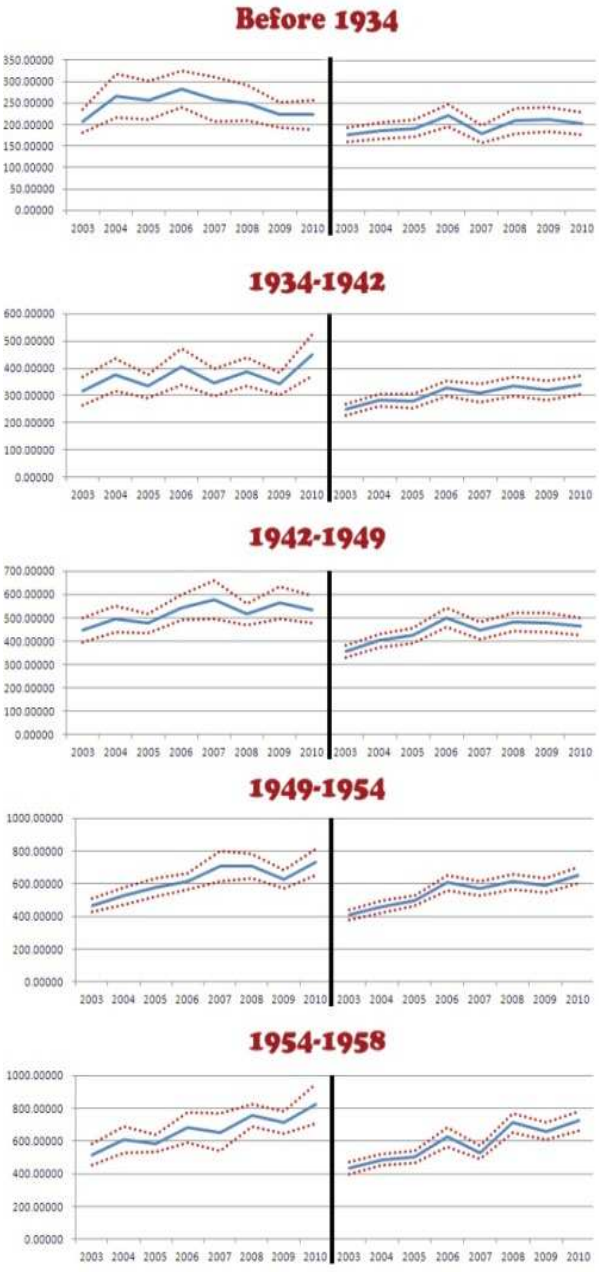
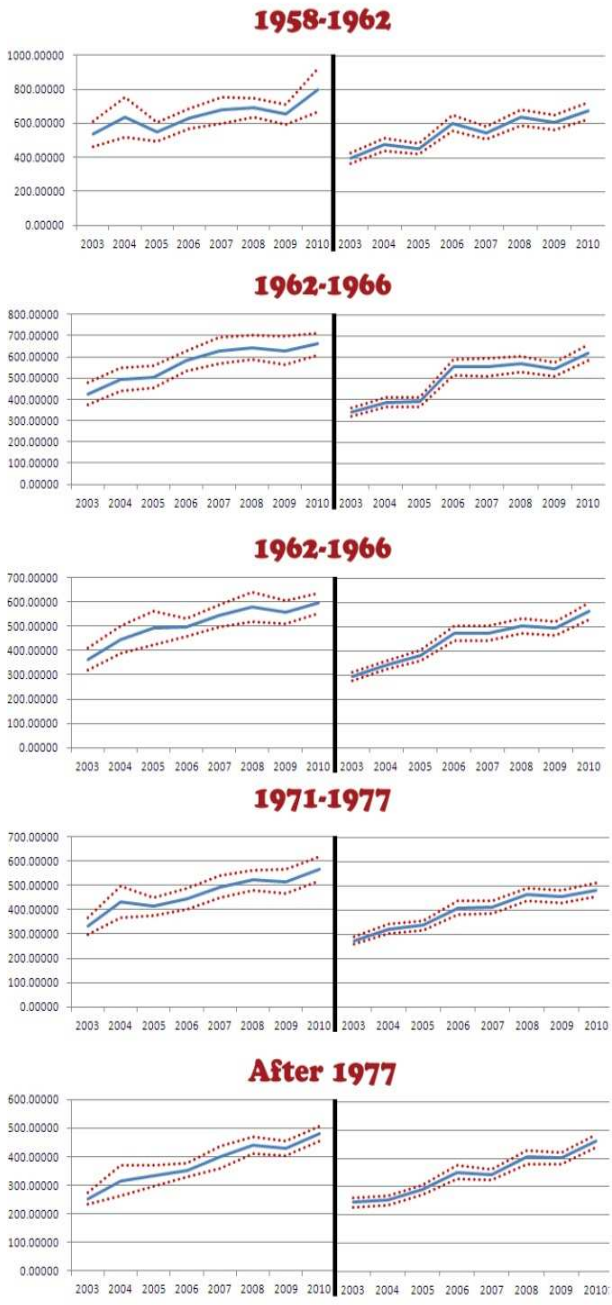


Figure 1 (cont). Average Income Before and After MAD Treatment for Male Cohorts



Source: Authors' calculations.

Figure 2. Average Income Before and After MAD treatment for Female Cohorts

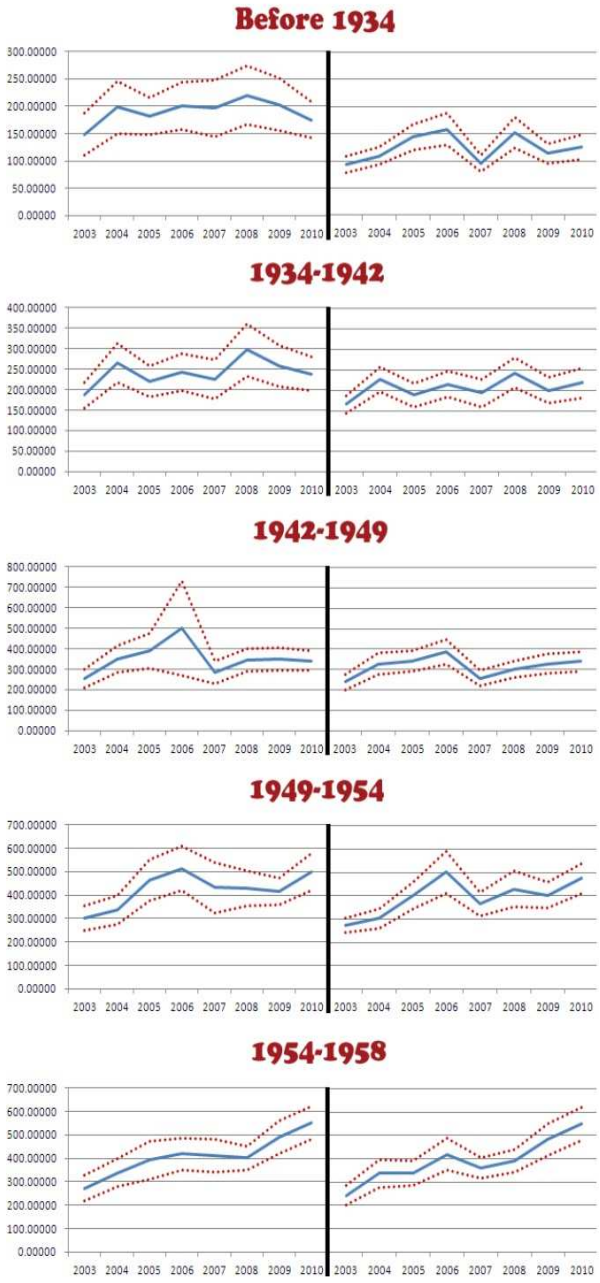
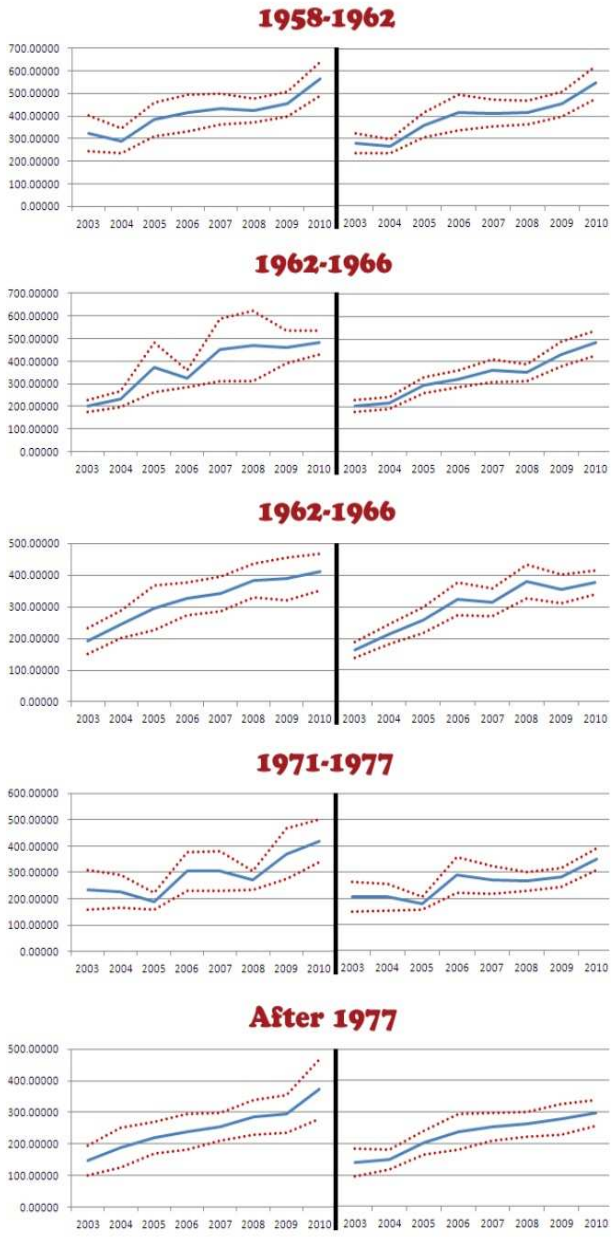


Figure 2 (cont). Average Income Before and After MAD treatment for Female Cohorts



Source: Authors' calculations.

Additional descriptive statistics regarding the cohorts constructed after the outlier treatment are presented next. For most of the male cohorts, the percentage of households located in urban areas is significantly lower than the one presented by female cohorts. This might be due to a more traditional family life in rural areas, which makes single-parent families, or female-headed households, a less common occurrence. It is also important to note that the number of entrepreneur households headed by women is significantly lower than those headed by men. This is accentuated by the fact that almost half of all female entrepreneur households include a member, different from the household head, who owns a business.

Table 2. Urban Ratio

	Male Households								Female Households							
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
$z_i^1 < 1934$	56%	58%	56%	54%	53%	53%	53%	54%	59%	63%	64%	66%	62%	63%	62%	63%
$1934 \leq z_i^1 < 1942$	59%	61%	55%	56%	61%	60%	60%	59%	68%	67%	62%	63%	65%	67%	66%	71%
$1942 \leq z_i^1 < 1949$	64%	64%	62%	61%	61%	61%	59%	58%	71%	74%	72%	73%	71%	72%	72%	72%
$1949 \leq z_i^1 < 1954$	66%	67%	65%	66%	66%	68%	63%	63%	75%	75%	79%	79%	77%	77%	74%	76%
$1954 \leq z_i^1 < 1958$	70%	70%	67%	68%	67%	68%	67%	66%	81%	81%	80%	77%	80%	75%	74%	73%
$1958 \leq z_i^1 < 1962$	69%	68%	70%	71%	67%	69%	63%	66%	78%	80%	78%	76%	83%	84%	78%	79%
$1962 \leq z_i^1 < 1966$	68%	69%	68%	73%	68%	67%	67%	66%	72%	76%	78%	79%	78%	76%	77%	77%
$1966 \leq z_i^1 < 1971$	66%	67%	68%	66%	67%	66%	66%	66%	77%	76%	78%	82%	79%	78%	81%	80%
$1971 \leq z_i^1 < 1977$	67%	69%	70%	69%	68%	67%	70%	68%	76%	73%	80%	74%	77%	71%	82%	82%
$1977 \leq z_i^1$	71%	69%	71%	75%	70%	70%	73%	73%	84%	84%	86%	77%	84%	82%	86%	83%

Source: Authors' calculations.

Table 3. Entrepreneurship Ratio

	Male Households								Female Households							
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
$z_i^1 < 1934$	6%	11%	9%	9%	5%	6%	4%	3%	3%	3%	2%	4%	2%	3%	2%	2%
$1934 \leq z_i^1 < 1942$	9%	13%	11%	11%	8%	9%	7%	5%	5%	8%	5%	7%	5%	5%	3%	2%
$1942 \leq z_i^1 < 1949$	9%	13%	13%	13%	11%	13%	7%	7%	4%	10%	5%	6%	5%	5%	3%	4%
$1949 \leq z_i^1 < 1954$	9%	12%	12%	14%	12%	11%	9%	7%	7%	7%	7%	10%	6%	6%	4%	3%
$1954 \leq z_i^1 < 1958$	9%	15%	12%	16%	8%	11%	10%	8%	7%	7%	5%	7%	6%	5%	6%	3%
$1958 \leq z_i^1 < 1962$	8%	13%	12%	12%	12%	10%	10%	7%	5%	4%	5%	5%	3%	5%	5%	4%
$1962 \leq z_i^1 < 1966$	8%	12%	10%	13%	10%	11%	7%	8%	3%	7%	6%	6%	5%	6%	3%	1%
$1966 \leq z_i^1 < 1971$	5%	10%	10%	10%	10%	10%	8%	9%	5%	6%	4%	6%	6%	3%	2%	3%
$1971 \leq z_i^1 < 1977$	6%	9%	8%	9%	9%	8%	6%	5%	3%	5%	4%	7%	3%	4%	1%	3%
$1977 \leq z_i^1$	5%	6%	5%	6%	3%	4%	4%	2%	3%	3%	2%	3%	2%	5%	1%	1%

Source: Authors' calculations.

Table 4. Percentage of Entrepreneurs who are Household Heads

	Male-headed Households								Female-headed Households							
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
$z_i^1 < 1934$	78%	69%	76%	71%	72%	76%	62%	68%	37%	52%	30%	49%	58%	40%	21%	42%
$1934 \leq z_i^1 < 1942$	76%	88%	88%	87%	72%	77%	70%	77%	26%	35%	34%	52%	58%	45%	49%	39%
$1942 \leq z_i^1 < 1949$	73%	82%	85%	79%	80%	80%	82%	69%	53%	66%	70%	50%	63%	80%	56%	59%
$1949 \leq z_i^1 < 1954$	78%	81%	78%	82%	86%	79%	87%	80%	84%	74%	75%	66%	79%	44%	39%	40%
$1954 \leq z_i^1 < 1958$	77%	80%	80%	78%	82%	89%	82%	90%	61%	81%	57%	58%	84%	80%	81%	66%
$1958 \leq z_i^1 < 1962$	85%	82%	90%	81%	88%	84%	78%	81%	61%	84%	72%	85%	74%	84%	88%	77%
$1962 \leq z_i^1 < 1966$	90%	84%	83%	82%	80%	92%	94%	92%	55%	79%	82%	96%	71%	90%	95%	87%
$1966 \leq z_i^1 < 1971$	85%	79%	89%	85%	88%	93%	89%	86%	66%	67%	60%	86%	70%	96%	83%	97%
$1971 \leq z_i^1 < 1977$	84%	86%	83%	87%	86%	86%	86%	82%	95%	93%	75%	87%	100 %	82%	87%	90%
$1977 \leq z_i^1$	79%	91%	79%	98%	90%	77%	82%	90%	86%	60%	100 %	70%	79%	62%	74%	87%

Source: Authors' calculations.

1.4. Income Mobility and Entrepreneurship

a) The Unconditional Model

Income mobility presents a measure of the relationship between past and present income. This relationship can be represented by the following equation:

$$y_{i,t} = \beta y_{i,t-1} + \psi_{i,t}$$

Where $y_{i,t}$ represents the household i income on period t, $\psi_{i,t}$ a composite error term and β is a measure of the unconditional income convergence (β=0 represents a perfect income mobility and β=1 represents an absence of income mobility or perfect convergence).

Since the information for the same individual is not available in the different years sampled, a pseudo panel approach was taken in order to estimate the β parameter. As previously mentioned the synthetic observations are constructed with the average values of the household observations in each cohort. The dependent variable used for the estimation of the model is the log of the average household's income for the cohort and the period studied, which makes the β parameter a measure of the elasticity of past and present income. The respective cohort model can be expressed as follows:

$$\ln(\bar{y}_{c,t}) = \beta_1 \ln(\bar{y}_{c,t-1}) + \bar{\psi}_{c,t}$$

For ease of exposition, the logarithm of the income variable for each cohort will still be represented as $\bar{y}_{c,t}$.

Fields and Ok (1999) demonstrate that this measure of income mobility is the only one to have a set of desired properties (scale invariance, symmetry, multiplicability, and additive separability).

b) The Conditional-Entrepreneurship Model

As shown in Cuesta and Ñopo (2011), the measure of unconditional income mobility tends to underestimate the true mobility experienced by households in an economy. The effect of household covariates on income mobility can be estimated by an extension of the previous model.

$$\bar{y}_{c,t} = \beta_1 \bar{y}_{c,t-1} + \beta_2 \bar{\varepsilon}_{c,t-1} \bar{y}_{c,t-1} + \beta_3 \bar{\varepsilon}_{c,t} + \beta_4 f_c \bar{y}_{c,t-1} + \beta_5 \overline{X^1}_{c(t),t} + \beta_6 \overline{X^2}_{c(t)} + \bar{\psi}_{c,t}$$

Where:

$\bar{y}_{c,t}$= Represents the Neperian logarithm of the average household income of cohort c in period t. The income variable is previously deflated considering the purchasing power parity (PPP) index reported by the World Bank, thus allowing inter-country comparison.

$\bar{\varepsilon}_{c,t}$= Is the proportion of households which are considered to be entrepreneurs in cohort c and period t. This regressor is believed to be predetermined, a concept that will be clarified below.

f_c= Is a dichotomic variable which takes the value of 1 if c is a female cohort and 0 otherwise.

$\overline{X^1}_{c(t),t}$= A set of time-variant household covariate averages for cohort c and period t. These regressors are believed to be exogenous.

$\overline{X^2}_{c(t)}$= A set of time-invariant household covariate averages for cohort c. The term $c(t)$ is included to denote that the average is taken on period t and, as the sample mean is an error-driven measurement, differences may be observed in time. These variables need not be truly time-invariant, but the rate at which they vary may be too subtle to be observed in one period (variables that present a staircase behavior and which require more than one period to register a change fall in this category). An obvious example is the gender of the household head, due to the construction of the cohorts. No assumptions about the relationship of these covariates with the error term are made.

β_5 and β_6= Are vectors of the pseudo-elasticity of said covariates on present incomes.

$\bar{\psi}_{c,t}$= A composite error term determined by the next equation.

$$\bar{\psi}_{c,t} = \bar{\lambda}_c + \bar{u}_{c,t}$$

Where $\bar{\lambda}_c$ is a time-invariant intrinsic cohort "c" component which cannot be observed, and $\bar{u}_{c,t}$ is an error term. The different possible assumptions for these terms are considered below.

The total measure of income mobility can be expressed as:

$$\frac{\delta \bar{y}_{c,t}}{\delta \bar{y}_{c,t-1}} = \beta_1 + \beta_2 \bar{\varepsilon}_{c,t-1} + \beta_4 f_c$$

Where

β_1= Represents the part of income convergence that is only explained by past income.

β_2= is the effect that a marginal increase in the entrepreneurship percentage in the cohort has on its income convergence.

β_4= represents the variation in income convergence experienced by female cohorts.

If the number of observations in each cohort is sufficiently large, $\bar{y}_{c,t}$, $\bar{\varepsilon}_{c,t}$, $\overline{X^1}_{c(t),t}$ and $\overline{X^2}_{c(t)}$ will provide accurate estimators of the true cohort means. An unbiased estimator of the relevant model parameters can be obtained through traditional dynamic panel estimation methods (like the two-step least squares estimation or a more efficient estimator obtained by GMM methods).

c) Estimation by Dynamic Panel Methods

The dynamic nature of the model presented results in a series of complications when estimating the autoregressive parameters. Because the estimation centers on following the same cohorts over time, as previously indicated, an unobserved fixed component is introduced into the equation. The following expression is obtained by replacing the composite error term with its determinants:

$$\bar{y}_{c,t} = \beta_1 \bar{y}_{c,t-1} + \beta_2 \bar{\varepsilon}_{c,t-1} \bar{y}_{c,t-1} + \beta_3 \bar{\varepsilon}_{c,t} + \beta_4 f_c \bar{y}_{c,t-1} + \beta_5 \overline{X^1}_{c(t),t} + \beta_6 \overline{X^2}_{c(t)} + \bar{\lambda}_c + \bar{u}_{c,t} \quad (1)$$

By expressing this equation on the $t-1$ period, one can show that the unobserved component is correlated with the previous income (this is also likely to hold for the other contemporaneous covariates), which introduces a missing variable problem that would render standard estimation methods biased. However, several assumptions can be made about the nature of the error components (depending on the licenses the researcher is willing to take), and from which different consistent estimation methods can be derived.

The following assumptions are made about the cohort covariates and the error components:

- The error term is believed to be serially uncorrelated,[4]

$$E\left(\bar{\mu}_{c,t} \bar{\mu}_{c,t-1}\right) = 0 \quad (2)$$

- Entrepreneurship is believed to be predetermined,

$$E(\bar{\varepsilon}_{c,t-s} \bar{u}_{c,t}) = 0 \quad \forall \quad s > 0 \quad (3)$$

This means that the error term may be correlated with contemporaneous or future entrepreneurship levels. This assumption is made because entrepreneurship is believed to be

[4] This hypothesis can be tested and if the error's autocorrelation cannot be rejected at a given confidence level, then other considerations, which are later specified, must be taken into account.

endogenous, as it is difficult to establish a causal relationship between this variable and the contemporaneous average household income for each cohort. This assumption also serves as a source of instruments to account for the endogeneity problem derived from the described nature of entrepreneurship.

- The time-variant cohort covariates are assumed to be exogenous, but not strictly so.

$$E\left(\overline{X^1}_{c(t),t-s}\bar{u}_{c,t}\right) = 0 \quad \forall \ s \geq 0 \qquad (4)$$

- No assumptions are made about the nature of the time-invariant covariates.
- Building on the belief that the errors are serially uncorrelated, a natural supposition is made:

$$\mathrm{E}(\bar{\mu}_{c,t}\bar{y}_{c,t-1}) = 0 \qquad (5)$$

The fact that the model is estimated at a cohort level provides an alternative to conventional dynamic panel estimation methods. Moreover, if it is assumed that:

$$\lambda_i \sim N(0, \sigma^2) \quad \forall \ i \in c \ \wedge \ \forall \ c \in C \qquad (6)$$

then the intrinsic cohort average effect will be asymptotically equal to zero and, with large cohort dimensions, the missing variable problem is solved. Next, instrumental variables are needed to account for the endogeneity of entrepreneurship, after which a two-stage OLS estimation method will provide consistent estimators (even though a robust estimation is recommended because of the existence of an important heteroskedastic factor caused by the use

of sample averages as observations). But assumption (6) implies that no intrinsic cohort effect exists, which raises serious questions about the validity of the constructed cohorts as units of study. If one is willing to assume that the intrinsic cohort effect is evened out, then how many important effects suffer the same attrition? Cohorts should be constructed on the basis of homogeneity of the individuals within the group, so as to avoid the loss of essential information and to make mean estimators more significant. If it is assumed that this is not so, then even if the estimations are consistent, the conclusions derived from the study will not be very relevant. Hence, the existence of idiosyncratic cohort effects should be taken as an indicator of accurately constructed cohorts. On account of these issues, and the belief that the cohorts defined for this study are correctly specified, assumption (6) is relaxed.

Thus, estimating the proposed model without accounting for the unobserved cohort effect will result in biased estimators and ordinary least squares (OLS) methods will result in a positively biased estimation (Nickell, 1981). The fact that OLS is expected to provide a positive bias in the estimator if the idiosyncratic component exists is a useful check on the validity of the proposed cohorts studied.

To draw out the fixed effect of the error term, a possible solution would be to apply a mean deviation transformation to equation (1). Under this transformation, the equation variables are expressed as a deviation from their period mean, thus eliminating the time-

invariant cohort fixed effect and any other fixed variable (within estimation). But in panels with a short time span, the transformed autoregressive term $(\bar{y}_{c,t-1}{}^{*} = \bar{y}_{c,t-1} - \frac{1}{T-1}(\bar{y}_{c,2} + \cdots + \bar{y}_{c,T}))$ is now negatively correlated with the transformed error term $(\bar{\mu}_{c,t}{}^{*} = \bar{\mu}_{c,t} - \frac{1}{T-1}(\bar{\mu}_{c,2} + \cdots + \bar{\mu}_{c,T}))$ as the $\bar{y}_{c,t-1}$ term correlates negatively with the $-\frac{1}{T-1}\bar{\mu}_{c,t-1}$ term in the transformed error. This bias decreases as the time frame T becomes larger; hence, the within estimators are asymptotically consistent on the time dimension. Bond (2002) points out that these different directions in the bias of both OLS and within estimators provide useful bounds on the accuracy of any other theoretical superior estimator proposed.

Another approach that eliminates the unobserved fixed effects is to apply first differences to equation (1) as shown next:

$$\Delta\bar{y}_{c,t} = \beta_1\Delta\bar{y}_{c,t-1} + \beta_2\Delta(\bar{\varepsilon}_{c,t-1}\bar{y}_{c,t-1}) + \beta_3\Delta\bar{\varepsilon}_{c,t} + \beta_4\Delta(f_c\bar{y}_{c,t-1}) + \beta_5\Delta\overline{X^1}_{c(t),t} + \Delta\bar{\mu}_{c,t} \quad (7)$$

Where

$$\Delta\bar{y}_{c,t-1} = \bar{y}_{c,t-1} - \bar{y}_{c,t-2}$$

As first differences are applied, any time-invariant regressor is also eliminated and can no longer be estimated. It can easily be shown that the $\bar{y}_{c,t-1}$ component in the transformed autoregressive term is correlated with the $\bar{\mu}_{c,t-1}$ component in the transformed error term

by the dynamic nature of the model. Following the method proposed Holtz-Eakin, Newey, and Rosen (1988) and continued in Arellano and Bond (1991), a generalized method of moments (Hansen 1982) approach is taken to account for the endogeneity presented in (7). Building on the first moment conditions given by (3), (4) and (5), a set of instruments are available to account for this problem. As the number of available instruments is quadratic in the time dimension of the panel, many problems can be encountered in finite samples. Roodman (2006) presents various methods available to account for the over identification problem derived from large instrument matrixes.

Another possible estimation method would be the use of system GMM, presented in Blundell and Bond (1998).[5] The advantage of system GMM is that it permits the estimation of time-invariant variable parameters by the inclusion of both level and difference instrument sets, but it also requires the use of large instrument matrices. Due to the instrument proliferation relative to the small sample size that would occur if the previous estimation method were used, the traditional difference GMM approach was preferred. But, as previously noted, this eliminates from the estimation any time-invariant regressor.

1.5. Results

[5] This method requires an additional assumption that the deviation of the first observation from the steady state is uncorrelated with the fixed effect.

The results of the estimation of the conditional and unconditional income mobility models are presented. As previously explained, the models are also estimated by the use of OLS and within estimation to obtain reasonable bounds for the autoregressive parameter and to evaluate the results obtained by GMM.

a) The Unconditional Model

The unconditional model was estimated using difference GMM procedures. As previously indicated, it is expected that a heteroskedastic component exists in the error term; hence, a robust correction in the variance and covariance matrix of the errors is applied. A total of 140 observations were used in the estimation of the model (since one period is lost due to the application of first differences), and a collapsed instrument matrix[6] containing a total of two instruments was used.

Table 5. Unconditional Model Results

	Coefficients		
	Within Estimation	**OLS Estimation**	**GMM Estimation**
$\overline{y}_{c,t-1}$	0.476379*** (0.05998)	0.922871*** (0.02993)	0.864752*** (0.08274)
Constant	3.438388*** (0.38695)	0.559065*** (0.19341)	-

Source: Authors' calculations.
Note: *** Significant at 1%

[6] See Roodman (2006).

It can be observed that the GMM estimator for the autoregressive term is inside the bounds given by the OLS and within estimators. The total unconditional convergence is estimated at 0.86, slightly below the 0.9 obtained for the rest of Latin America (Cuesta et al., 2011). As expected, the OLS estimator is larger than the one provided by GMM methods. This supports the belief that the cohorts are adequately constructed, as the unobserved cohort fixed effect is present, (hence the OLS estimation is positively biased). But due to the robust estimation method applied to the GMM estimation, its 95 percent confidence interval is wide and includes the value estimated by OLS; thus, the difference observed is not significant. Additional relevant statistics for GMM estimation are presented in Table 6.

Table 6. Unconditional Model Relevant Statistics

	Statistic	**P-Value**
Arellano-Bond Test	2.95	0.003
Sargan Test*	0.03	0.870
Hansen Test *	0.05	0.824

Source: Authors' calculations
Note: *The statistic has a chi-squared distribution with 1 degree of freedom.

The Arellano-Bond test for autocorrelation is used to determine if the errors are serially uncorrelated (assumption (2)). The null hypothesis is that no second-order autocorrelation is present in the transformed error component (which translates to first order autocorrelation in level equation (1)); and as the hypothesis is not rejected, the assumption that there is no autocorrelation present in the error holds.

The Sargan and Hansen tests are used to determine the quality of the instrument matrix used. The null hypothesis is that the instruments are not exogenous (which means that instrument matrix is not valid). Thus, for the consistency of the GMM estimators, this test must be rejected. The Sargan test is not robust, and the Hansen statistic is a robust measure but its validity is reduced as the number of instruments used increases (a frailty not shared by the Sargan statistic). Therefore, high p-values obtained for this test are generally construed as a warning of misspecification. However, taking into account the small number of instruments used and the fact that the Sargan test also presents high p-values, the hypothesis of exogeneity of the instruments is confidently rejected.

b) The Conditional-Entrepreneurship Model

Only one cohort covariant was considered for the $\overline{X^1}_{c(t),t}$ vector: the average number of residents whose income represents more than 25 percent of their household income for cohort c in period t. This

measure is considered to be much more volatile in time than any other household covariate (including age of the household head, number of residents per household, education level for older cohorts, etc.), and thus would be able to survive the first differences taken. The following results were obtained:

Table 7. The Conditional Model: Results

	Coefficients		
	OLS Estimation	**Within Estimation**	**GMM Estimation**
$\bar{y}_{c,t-1}$	0.944132*** (0.0385)	0.651593*** (0.10039)	0.7739*** (0.12009)
$\bar{\varepsilon}_{c,t-1}\bar{y}_{c,t-1}$	-0.369551*** (0.10023)	-0.16449* (0.08786)	-0.24995* (0.12764)
$f_c\bar{y}_{c,t-1}$	0.002318 (0.00608)	-0.27818** (0.10851)	-0.297292* (0.15998)
$\overline{X^1}_{c(t),t}$	0.054548 (0.09872)	1.423304*** (0.20309)	2.237625*** (0.44658)
$\bar{\varepsilon}_{c,t}$	3.087679*** (0.56992)	0.891305 (0.57498)	1.793539** (0.84013)
Constant	0.292977 (0.25073)	1.030288** (0.46863)	-

Source: Authors' calculations.
Note: * Significant at 10%;** Significant at 5%;*** Significant at 1%.

As occurred in the unconditional model, the first autoregressive term is inside the bounds given by the other estimation methods. The difference between the OLS and GMM estimators is more notorious in the conditional model, but it is still not significant at a 95 percent level. This will be very difficult to accomplish considering the small size of the pseudo-panel and the robust estimations made.

The total income mobility can be expressed as follows:

$$\frac{\delta \bar{y}_{c,t}}{\delta \bar{y}_{c,t-1}} = 0.7739 - 0.25\bar{\varepsilon}_{c,t-1} - 0.2973 f_c$$

This means that an increase of 1 percent in the level of entrepreneurship in a cohort in period $t-1$, translates into an increase of 0.0025 in the income mobility of said cohort in period t. An interesting result is that female cohorts experience significantly higher income mobility, as their base convergence level can be expressed as (since $f_c = 1$ for female cohorts):

$$\frac{\delta \bar{y}_{c,t}}{\delta \bar{y}_{c,t-1}} = 0.4766 - 0.25\bar{\varepsilon}_{c,t-1}$$

To complement the reduction of income convergence that occurs with an increase in the percentage of entrepreneurs in a given cohort, this increase also positively affects future income.

Additional relevant statistics for GMM estimation are presented below:

Table 8. Conditional Model: Relevant Statistics

	Statistic	P-Value
Arellano-Bond Test	1.59	0.111
Sargan Test*	33.4	0.001
Hansen Test *	17.15	0.192

Source: Authors' calculations.
Note: *The statistic has a chi-squared distribution with 13 degrees of freedom.

The Arellano-Bond test is rejected at a 10 percent level, so first-order correlation in the error term is to be expected. On account of this issue, assumptions (2), (3), (4) and (5) need to be corrected as follows:

$$E(\bar{\mu}_{c,t}\bar{X}_{c(t),t-s}) = 0 \;\; \forall\, s \geq 1 \quad E(\bar{\mu}_{c,t}\bar{y}_{c,t-2}) = 0 \;\forall\, t \geq 3$$
$$E(\bar{\mu}_{c,t}\bar{\mu}_{c,t-s}) = 0 \quad \forall \quad s > 0$$
$$E(\bar{\varepsilon}_{c,t-s}\bar{u}_{c,t}) = 0 \quad \forall \quad s > 1$$
$$(\overline{X^1}_{c(t),t-s}\bar{u}_{c,t}) = 0 \quad \forall \quad s \geq 1$$
$$\mathrm{E}(\bar{\mu}_{c,t}\bar{y}_{c,t-2}) = 0 \quad \forall \quad t \geq 3$$

The following instrument matrix was constructed:

For every $t \geq 4$

- $\bar{y}_{c,t-\mathrm{s}}\ \forall\, s \geq 3$,
- $\bar{\varepsilon}_{c,t-\mathrm{s}}\bar{y}_{c,t-\mathrm{s}}\ \forall\, 3 \leq s \geq 4$,
- $f_c\bar{y}_{c,t-1}\ \forall\, 3 \leq s \geq 5$
- $\bar{\varepsilon}_{c,t-2}$
- $\overline{X^1}_{c(t),t-1}$

As was done with the unconditional model, the instrument matrix constructed was collapsed to reduce the number of instruments without loss of information. This resulted in an instrument matrix with a total of 18 instruments and 120 observations available for the estimation of the model.

The Sargan statistic is not robust and, due to the heteroskedasticity of the error term (guaranteed by the pseudo-panel approach taken), the fact that the null is not rejected should not be alarming. The Hansen test is rejected at a 10 percent significance level, but the value is not high enough as to generate doubt (an empirical rule of thumb is to consider p-values approaching 0.3 or higher as suspicious) so no miss specification signs are present.

1.6. Conclusion

There have been few attempts to measure the determinants of income mobility in Latin America, due mainly to the limited information collected in those countries and the lack of panel data. This is especially true for Ecuador, where few such studies have been undertaken. But building on recently developed methods of estimation without the use of panel data and other efforts to reduce the dependence of consistent autoregressive estimators on a large time frame in a dynamic panel scheme, estimations of income mobility and its determinants were achieved for the Ecuadorian case.

Through the construction of a pseudo-panel and the application of difference GMM estimation methods, unconditional and conditional income mobility models were estimated. As expected, and in accordance with other empirical studies, the unconditional model tends to underestimate true income mobility, as there are other factors not included in the equation that explain future income and are correlated to previous income (there is a missing variable problem and estimations are biased). The inclusion of other cohort covariates in the proposed model reduces the bias and permits the analysis of other determinants of income mobility and future income (these might be affected by public economic policy). One of those factors, and the one of particular interest for this chapter, is the percentage of entrepreneurs in the different cohorts.

The results of the GMM estimations revealed that entrepreneurship not only reduces income convergence by 0.0025 but also increases future average cohort income by 1.79 percent per percentage-point increase in the cohort's entrepreneurship rate. This means that entrepreneurship not only positively affects income generation on average, but also makes it easier to generate such an increase. Another interesting result is that households headed by women tend to experience more income mobility. This, paired with the fact that their income is significantly lower than those of male-headed households, is a clear indication of the vulnerability of female-headed households.

It is also important to notice that the difference between the OLS and GMM estimators is more notorious in the conditional model. This supports the belief that the cohorts are adequately constructed; as the unobserved cohort fixed effect is present, (hence the OLS estimation is positively biased). Nevertheless, this difference is not significant at the 95% level, and this will be very difficult to accomplish considering the small size of the pseudo-panel and the robust estimations made.

The classification of entrepreneurship used in this study suffers from data censorship, as only families currently in charge of a business are considered entrepreneurs. Households that owned a business but went bankrupt would fall in the non-entrepreneur category. This leads not only to an overestimation of the positive effect mentioned in future income but also to a possible further increase in the positive effect on income mobility. However, considering that under normal conditions most businesses that go bankrupt follow a process that takes time, the censorship should not be problematic. This is because in any given period, some entrepreneurs are thriving while others are failing. This effectively reduces the average income they perceive over time and considerably diminishes any possible bias.

The results of this study indicate that public policy should put special emphasis on promoting incentives for the development of entrepreneurship as a strategy for economic development.

Appendix Table 1. Distribution of the Households Sampled by Gender and Date of Birth Cohorts

	Cohorts	Years Analyzed								Total
		2003	2004	2005	2006	2007	2008	2009	2010	
Men	1	1521	1487	1401	1328	1156	1176	1145	1121	10335
	2	1399	1601	1325	1392	1205	1259	1315	1405	10901
	3	1535	1523	1438	1420	1524	1682	1645	1755	12522
	4	1549	1510	1518	1501	1357	1308	1388	1426	11557
	5	1150	1353	1251	1242	1198	1183	1247	1322	9946
	6	1491	1412	1337	1445	1200	1385	1382	1406	11058
	7	1506	1577	1548	1339	1367	1402	1328	1516	11583
	8	1655	1731	1595	1803	1728	1723	1725	1774	13734
	9	1671	1639	1497	1515	1794	1789	1552	1581	13038
	10	961	1038	1220	1347	1862	1758	1787	1933	11906
Women	11	680	657	642	620	526	612	564	589	4890
	12	505	580	530	570	500	536	506	602	4329
	13	486	495	429	482	522	582	625	727	4348
	14	434	435	381	415	417	408	459	531	3480
	15	305	360	310	353	342	342	401	453	2866
	16	356	346	314	317	349	427	417	442	2968
	17	337	356	307	319	361	386	350	435	2851
	18	312	329	309	391	366	456	439	467	3069
	19	211	252	258	267	303	350	370	432	2443
	20	195	209	225	279	332	368	406	473	2487
Total		18259	18890	17835	18345	18409	19132	19051	20390	150311

Source: Calculated by Authors based on ENEMDU surveys.

Appendix Table 2. Distribution of the Households Weighted by Gender and Date of Birth Cohorts

	Cohorts	Years Analyzed								Total
		2003	2004	2005	2006	2007	2008	2009	2010	
Men	1	222185	213682	217222	204647	172527	181443	181781	171545	1565031
	2	195668	238828	205626	219123	198276	201554	226031	226984	1712091
	3	244078	241450	237137	227344	250774	276392	277756	284957	2039888
	4	239114	242831	258934	260577	235487	234598	243217	246474	1961232
	5	179716	220244	219791	225065	216272	212070	217332	218750	1709240
	6	236965	224501	234392	253949	219800	247841	238696	241102	1897246
	7	240246	255779	268285	247245	248280	257454	238871	260530	2016690
	8	264702	276059	270947	303896	317966	304104	307826	310869	2356368
	9	267446	277079	279140	263016	328642	327426	284393	277867	2305008
	10	154527	166747	216726	240924	347137	328959	341834	352987	2149840
Women	11	99501	96330	99457	102256	88582	100515	97725	98631	782996
	12	76802	86569	87160	92989	84152	89649	88349	105824	711495
	13	80186	81541	74399	84685	95134	105482	114474	129457	765357
	14	72619	74104	72840	81452	82510	78154	81774	92864	636317
	15	55332	63672	59513	68102	63566	61199	71520	82187	525090
	16	58501	59247	54766	57536	70491	89688	78716	84324	553269
	17	53132	59559	59351	61261	67628	74120	69591	88904	533544
	18	52854	50106	60060	80833	68931	85654	85545	92480	576463
	19	35325	37220	48858	45945	58482	62280	74424	82875	445407
	20	30134	33381	42505	47290	63648	70016	82707	93536	463217
	Total	2859031	2998930	3067109	3168135	3278284	3388597	3402560	3543144	25705790

Source: Calculated by Authors based on ENEMDU surveys.

2. EXTERNAL ECONOMIES OF SCALE: FOREIGN DIRECT INVESTMENT AND FIRM SIZE IN ECUADOR

2.1 Introduction and Literature Review

There is a broad literature on the determinants of firm size (For a survey, see Bernard and Muller, 2000). Economies of scale, economies of scope or transaction costs are some of the most common explanations. Other papers such as Evans (1987) suggest the importance of growth and age in determining the size of firms. With the somewhat recent boost of entrepreneurship, the relevance of determining what makes a firm larger has gained importance.

On the other hand, although the role of FDI in economic growth is generally perceived as positive, the channels though which this effect is generated is not all clear. Foreign Direct Investment is perceived in many countries as a way for development. Some authors, such as Al-Sadig (2013) have found that FDI incentives domestic investment. The crowding in effect of FDI is noted in Göcer et al (2014) and other authors.

Agglomeration externalities allow new catalysts for gowth and economic development.

In this chapter, we analyze the role of industry level foreign direct investment (sectorial investment) on the firm size of Ecuadorian firms. We pose it to be an external economy of scale. Following Broadberry and Marrison (2002), we focus on external economies of scale as a source of cost-benefit and thus enabling firm size increase. In particular, Broadberry and Marrison differ internal from external economies of scale:

"Internal economies of scale are a fall in unit costs arising from the expansion of an individual firm, and hence are not necessarily associated with an increase in the scale of the industry. External economies take the form of a fall in unit costs arising from an expansion of the industry without an increase in the size of individual firms"

Other authors that explore the role of external economies of scale include Chipman (1970) that formally defined the concept. However, in other contexts it was used long before (see for example

Hoover 1937 that used the concept to explain urbanization externalities).

Among the drivers of external economies of scale, authors like Ciccone (2002) or Wheeler (2001) have shown that they lead to better access to human capital decreasing also the search costs of labor force.

It is of particular interest to analyze the effect of Foreign Direct Investment in Ecuadorian firms, given the low levels of FDI received by Ecuador in the recent years: it is among the lowest of the region (World Bank, 2015) and in particular significantly lower than its neighbors Colombia and Peru. Also, being a country that has benefit from the oil boom (from 2007 to 2014),

The rest of the chapter is organized as follows: Next section presents the theoretical model, and the data implications. Then, we analyze the results of the dynamic estimation under three econometric scenarios. Finally we present some concluding remarks and future work.

2.2 The Model: Determinants of Firm size

As discussed in the previous sections, the analysis of the dynamics in firm size has been approached in literature in several different ways.

The present study seeks to evaluate the determinants of firm size and its development through time, distinguishing between industry level effects, referred to in literature as *external economies of scale*, and firm level determinants of scale and cost structure. Formally, the size of a firm i from an industry j in a given period t can be represented as follows:

$$s_{it} = \beta_0 + \alpha s_{it-1} + \beta_1 n_{it} + \beta_2 {n_{it}}^2 + \beta_3 n_{it-1} + \beta_4 v_{it} + \beta_5 v_{it-1} + \beta_6 age_{it} + \beta_7 FDI_{jt} + \beta_8 FDI_{jt-1} + \varphi_{it} \quad (1)$$

Where,

s_{it}: Is a proxy variable for the size of the business measured as the total assets owned the firm i on period t.

n_{it}: Represents the number of employees working for firm i on period t. Moreover, the existence of diminishing returns in labor, given the size of the firm in question in the last period (s_{it-1}) and the other determinants considered, could be contrasted by evaluating if β_2 is significantly below 0. The n_{it-1} term is included considering the difficulties a firm faces when deciding to reduce its number of employees from one year to the next, mainly due to existing job contracts and regulations.

v_{it}: Represents the total sales of firm i on period t. The lag of this regressor is included recognizing that, in some industries, consumers tend to form long term relationships with the business offering them goods and services.

age_{it}: Is the age of firm i on period t. Hence, the relevance of the firm's life cycle in its growth (for the analyzed time period) could be evaluated by β_6 coefficient.

FDI_{jt}: Represents the Net Foreign Direct Investment (FDI) received by industry j on period t.

This covariate serves as a proxy for the external economies of scale created by foreign investment as it percolates through a given industry by increasing its capital and the access to modern technologies. These in turn can be utilized by firms other than the primary beneficiaries of the investment. Due to the lack of information of FDI in a resolution lower than an industry level, the existence of the external economies of scale can only be evaluated on average for the different industries that constitute the Ecuadorian economy. A lagged term of this covariate is included considering that this type of investment could take more than one year to manifest as external economies of scale to businesses other than those directly receiving the transfers.

α: Represents the autoregressive coefficient, which in this context could be interpreted as the growth inertia of a given firm (or the proportion of a firm's size that is explained only by its size the period before).

φ_{it}= A composite error term determined by the next equation.

$$\varphi_{it} = \lambda_i + \mu_{it}$$

Where λ_i is a time-invariant intrinsic firm characteristic which cannot be observed, and μ_{it} is an error term which is assumed to be serially uncorrelated. The importance of this assumption is discussed below.

The specified functional form allows for the contrast of several different theories of the dynamics of firm growth by assessing which of its determinants were significant in the Ecuadorian business environment for the years studied. Furthermore, unbiased estimators of the relevant model parameters, required to test the different hypothesis, can be obtained through dynamic panel estimation methods like the two-step least squares estimation (Anderson-Hsiao 1981) or a more efficient estimator obtained within the Generalized Method of Moments (GMM) framework.

a) Estimation by Dynamic Panel Methods

The dynamic nature of the model presented renders static panel estimation methods biased because the estimation centers on following the same firm over time. This introduces an unobserved

fixed effect that is correlated with the autoregressive term (Nickell 1981). The following expression is obtained by replacing the composite error term with its determinants in (1):

$$s_{it} = \beta_0 + \alpha s_{it-1} + \beta_1 n_{it} + \beta_2 {n_{it}}^2 + \beta_3 n_{it-1} + \beta_4 v_{it} + \beta_5 v_{it-1} + \beta_6 age_{it} + \beta_7 FDI_{jt} + \beta_8 FDI_{jt-1} + \lambda_i + \mu_{it} \quad (2)$$

By expressing this equation on the $t-1$ period, one can show that the unobserved component is correlated with the previous firm size, which in turn introduces a missing variable problem that would render standard estimation methods biased. However, given the assumed relationship between the error term and past realizations of the dependent variables, different consistent estimation methods can be derived.

For the model in question, the following assumptions are made:

- The error term is believed to be serially uncorrelated,

$$E(\mu_{it}\mu_{it-1}) = 0 \qquad (3)$$

- The number of employees and the firm's sales are believed to be endogenous,

$$E(n_{it-s}\mu_{it}) = \mathrm{E}(n_{it-s}^2\mu_{it}) = E(v_{it-s}\mu_{it}) = 0 \quad \forall \quad s \geq 2 \qquad (4)$$

This means that the error term is correlated with contemporaneous or future employment levels or sales. This assumption is made because of the plethora of other firm level factors, which are not

accounted for in the model, and which affect simultaneously its size, number of employees or sales.

- The Net Foreign Direct Investment is assumed to be exogenous, but not strictly so.

$$\left(FDI_{jt-s}\mu_{it}\right) = 0 \quad \forall \ s \geq 0 \qquad (5)$$

This assumption is made considering that the FDI measure used is at an industry level and that, in the context of a given firm i, its contribution to this aggregate would be marginal. Hence, this covariate would be independent to any omitted firm characteristic.

- Building on the belief that the errors are serially uncorrelated, a natural supposition is made:

$$\mathrm{E}(s_{it-1}\mu_{it}) = 0 \qquad (6)$$

Thus, as previously mentioned, the estimation of the proposed model without accounting for the unobserved cohort effect will result in biased estimators. Moreover, it can be shown that ordinary least squares (OLS) will result in a positively biased estimation.

To draw out the fixed effect of the error term, a possible solution would be to apply a mean deviation transformation to equation (1). Under this transformation, the equation variables are expressed as a deviation from their period mean, thus eliminating the time-invariant cohort fixed effect and any other fixed variable (within estimation).

But in panels with a short time span, the transformed autoregressive term $({s_{it-1}}^* = s_{it-1} - \frac{1}{T-1}(s_{it-2} + \cdots + s_{iT}))$ is now negatively correlated with the transformed error term $({\mu_{it}}^* = \mu_{it} - \frac{1}{T-1}(\mu_{i2} + \cdots + \mu_{iT}))$ as the s_{it-1} term correlates negatively with the $-\frac{1}{T-1}\mu_{it-1}$ term in the transformed error. This bias decreases as the time frame T becomes larger; hence, the within estimators are asymptotically consistent on the time dimension. Bond (2002) points out that these different directions in the bias of both OLS and within estimators provide useful bounds to check the specification of the proposed model.

Another approach that eliminates the unobserved fixed effects is to apply first differences to equation (2). It can easily be shown that the s_{it-1} term in the transformed autoregressive covariate is correlated with the μ_{it-1} component in the transformed error term. Following the method proposed in Holtz-Eakin, Newey, and Rosen (1988) and continued in Arellano and Bond (1991), a generalized method of moments (Hansen 1982) approach is taken to account for the endogeneity created in the differenced model. Building on the first moment conditions given by (4), (5) and (6), a set of instruments are available to account for this problem. As the number of available instruments is quadratic in the time dimension of the panel, an over-identification problem can be encountered in finite samples. Roodman (2006) presents various methods available to account for issues for this issue.

One drawback of the aforementioned methodology is that, as first differences are applied, any time-invariant regressor is also eliminated and can no longer be estimated. This is also true for any covariate which varies slowly in time (or in a stepwise manner). Hence, the application of this technique would eliminate the proposed model's capability to contrast several hypothesis of the determinants of a firm's growth like: the importance of its life cycle (captured by its age) or the relevance of business scale measured by a slowly changing covariate (number of employees).

To account for this issue and in order to increase efficiency, Blundell and Bond (1998) proposed that instead of estimating the differenced model with the instruments, derived from the moment conditions outlined before, the level equation should be estimated with the use of differenced instruments. For this to be valid, as Roodman (2009) outlines, it is required that any change in an instrumenting variable w be uncorrelated with the unobserved fixed effect: $E(\Delta w_{it}\lambda_i)$=0. This implies that $E(w_{it}\lambda_i)$ is time-invariant. Moreover, Blundell and Bond show that for this to hold, an assumption must be made about the initial conditions of the data generating process which is that, controlling for the covariates, faster-growing individuals are not systematically farther or closer to their steady states than slower-growing ones. This is a reasonable assumption in the context of the proposed model, as the introduced covariates account for differences in both the life cycle and scale of the different firms.

In order to make use of the additional moment conditions given by the method outlined, without losing those obtained by the original Arellano-Bond estimator, Blundell and Bond estimated a stacked data set consisting of both the differenced and level information for each individual (System GMM). In the following section the results of implementing this estimation method to (2) are presented.

2.4 Results

The results for the estimation of the proposed model are presented next. It is important to note that the applied methodology requires several modeling choices regarding the shape of the instrument matrix and the estimation of efficient and robust variances. Moreover, the risk of over-fitting endogenous variables is high within this framework on account of instrument proliferation, an issue that, as previously discussed, would render biased coefficients. To account for this, a detailed explanation of the number of instruments used and the type of matrix constructed is presented. This information is complemented with the exposition of several tests of autocorrelation in the error term and over-identifying restrictions which serve as flags for specification errors. In addition, as previously explained, the models are also estimated by the use of OLS and within panel estimation to obtain reasonable bounds for the autoregressive parameter and to evaluate the results obtained from System GMM.

a) The Instrument Matrix

Building on the moment conditions defined in (4), (5) and (6) a collapsed[7] instrument matrix containing 17 instruments was constructed. The following instruments were considered:

- As the dependent variable is predetermined, lags 1 through 4 were considered as valid instruments
- For the not strictly exogenous variable FDI, the contemporaneous realization and its 3 first lags were used.
- The age of the firm was used as a standard instrument (it instruments itself), which means that it was added as one column of the instrument matrix. Due to the fact that the age increases by one each year, only the untransformed version of this instrument was considered.
- For the endogenous variables, namely number of employees and sails, only lags 2 and 3 are used as instruments. It is important to note that, to avoid instrument proliferation, only one of the employee measures ($n_{it}{}^2$) was used as instrument.
- The System GMM methodology also includes the differenced values of the instruments to correct for endogeneity in the level equation. Due to its nature, as previously mentioned, the age of the firm was not differenced and added to this set.

[7] Roodman (2009) shows the superiority of collapsed instruments with simulations in some common scenarios.

b) Estimation Results

The estimation results are presented in table 2.1. In order to obtain a robust estimation to heteroskedasticity or serial correlation in the errors, a two-step estimation is applied. However, Arellano and Bond (1991) show that this produces standard errors which are downward biased when the instrument count is high, making inference unreliable. To account for this issue a Windmeijer (2005) correction is applied to the variance of the two-step estimates.

Table 2.1. Determinants of Firm Size: Estimation Results

	Coefficients		
	OLS Estimation	**Within Estimation**	**GMM Estimation**
$s_{i,t-1}$	0.8987991***	0.131757***	0.686546***
	(0.00114)	(0.00371)	(0.21209)
$FDI_{j,t}$	0.4085***	0.504826***	0.400271***
	(0.13396)	(0.13409)	(0.11039)
$FDI_{j,t-1}$	-0.47582***	0.016748	0.23323
	(0.13283)	(0.12853)	(0.18066)
$n_{i,t}$	3717.707***	4744.462***	8762.21*
	(97.24029)	(148.5559)	(5306.433)

$n_{i,t-1}$	-207.4778***	127.2898***	-8.868695
	(44.91764)	(43.9088)	(144.5494)
$n_{i,t}^2$	-0.05499***	-0.069379***	-0.376117
	(0.00163)	(0.00235)	(0.85608)
$v_{i,t}$	0.294173***	0.301207***	0.630999***
	(0.00301)	(0.00336)	(0.12419)
$v_{i,t-1}$	-0.221073***	-0.036297***	-0.46092***
	(0.0032)	(0.00363)	(0.11614)
$age_{i,t}$	5357.093***	53573.48***	3188.696
	(1066.178)	(9453.663)	(12316.7)
Constant	-79934.96***	83626.51***	-193346.2***
	(20083.98)	(126242)	(74034.93)

Source: Authors' calculations.

Note: * Significant at 10%;** Significant at 5%;*** Significant at 1%.

The first thing that should be noted is that the autoregressive term is significant at a 5% level and within the bounds given by the OLS and within panel estimation. It is important to notice that the lower bound, given by the within panel estimation, is severely downward biased due to the short time panel length so the true parameter value

should be closer to the upper bound. This means that any shock from the steady state size of a firm would take several periods to dissipate, all else hold equal. This type of behavior has been mentioned throughout the literature since, increasing a business' size requires commitments that cannot be broken in short periods of time.

The number of employees hired is found to be significant at a 10% confidence level, which means that, conditional on the other covariates like the type of industry, increasing the number of employees tends to, on average, increase a firm's size. This result is to be expected in countries like Ecuador whose growth is not technologically driven. This is due to the fact that most of its industries are labor intensive, with limited technification in its production process. The total sales done by the business is also found to be significant and positive at a 5% confidence level. This result again is to be expected. The recreation of these patterns serves in part to validate the use of the total assets as a measure of a business size.

The age of the business was not found significant in the proposed model, which means that the firm's life cycle was not a relevant force determining the size of a firm for the studied time period. It can also be observed that, even though the coefficient multiplying the n_{it}^2 term is negative, it is not significant at a 10% level. This means that, on average, the diminishing returns of labor are not a relevant force determining firm size in the studied time period.

On the other hand, the Net Foreign Direct Investment has a significant positive effect on the average firm size of the Ecuadorian Economy. This result suggest the importance of external economies of scale in the growth of a business in the Ecuadorian economy. Moreover, an increase of US$1.0000 in the sectorial FDI increases US$0.40 on the total assets of the average firm.

Concerning the lagged covariates, only the sales variable resulted significant at any traditional confidence level. Furthermore, the effect the lagged sales has on a firms total assets is negative, suggesting that higher sales on the last period, *ceteris paribus*, should reduce a firm's size next period. At first his result is counterintuitive, but it can be explained in the context of the period comprising the sample studied. In the first year of the sample, the Ecuadorian economy (and most of the world) was suffering a recession. What these results suggest is that, controlling for other firm's covariates and the level of foreign investment in its industry, business with higher sales were more vulnerable and in average reduced their size the following years. The fact that current sales have an important and significant positive effect suggest that the negative effect past sales have on current business sizes is a transient phenomenon due to the unstable conditions experienced in the first years of the sample. We expect for this relationship to reverse if longer time frame for the panel is constructed.

c) Specification Tests

As previously mentioned, the validity of the estimation results presented rests on the exogeneity of the instrument matrix. On account of this issue, additional relevant statistics for the System GMM estimation are presented below.

Table 2.2. Conditional Model: Relevant Statistics

	Statistic	**P-Value**
Arellano-Bond Test for first order autocorrelation	-2.32	0.020
Sargan Test*	231.09	0.000
Hansen Test*	9.02	0.251

Note: *The statistic has a chi-squared distribution with 7 degrees of freedom.

The Arellano-Bond test for first order autocorrelation in the transformed error term (first difference) is rejected at a 5% confidence level. Hence, assumption (6) which treats the lagged dependent variable as predetermined holds.

The Sargan Test for over-identifying restrictions rejects the null hypothesis of joint validity of the instrument matrix at a 5% confidence level. Nonetheless, this test is not robust so this test alone should not be taken as a sign of misspecification. A robust Hansen Test, on the contrary, doesn't reject the null at any traditional confidence level. Moreover, the p-value is not high

enough as to generate doubt (an empirical rule of thumb is to consider p-values approaching 0.3 or higher as suspicious).

It should be noted that, even though the Hansen test is robust, it is still weak to large instrument count. On account of this, a set of difference-in–Hansen tests are used to test the validity of subsets of the instrument matrix. The results are presented on Table 2.3.

Table 2.3. Difference-in-Hansen Tests

Instrument subset	Test	Statistic (Chi-Squared)	Degrees of Freedom	P-Value
GMM instruments for levels	Hansen Statistic (excluding instrument matrix)	1.99	3	0.574
	Difference*	7.03	4	0.134
Collapsed instrument matrix for lagged dependent variable	Hansen Statistic (excluding instrument matrix)	1.09	3	0.78
	Difference*	7.94	4	0.094
Collapsed instrument matrix for FDI	Hansen Statistic (excluding	2.61	2	0.271

	instrument matrix)			
	Difference*	6.41	5	0.268
Collapsed instrument matrix for employees squared	**Hansen Statistic (excluding instrument matrix)**	3.28	4	0.512
	Difference*	5.75	3	0.125
Collapsed instrument matrix for sales	**Hansen Statistic (excluding instrument matrix)**	2.41	4	0.662
	Difference*	6.62	3	0.085
Age instrument matrix	**Hansen Statistic (excluding instrument matrix)**	8.66	6	0.194
	Difference*	0.37	1	0.544

*Note: * The Difference-in-Hansen Statistic test the null hypothesis that the excluded instrument matrix is exogenous.*

It can be observed that the exogeneity of all instrument sets are not rejected at a 5% significance level and that only the validity of the sails and lagged firm size instrument set is rejected at 10% significance level. However, recall that the Arellano-Bond Test (which has been shown to be more powerful) rejected the presence of first order correlation in the first order difference of the error term, validating the use of the second order lags of the dependent variable as instruments.

It is also important to notice that the validity of the GMM instruments for the level equation is not rejected at any traditional confidence level. This matrix subset is comprised of the first order difference of the instruments, and is added by the System GMM methodology.

This reinforces the assumption made that, given the firm covariates included in the model; faster-growing businesses are not systematically farther or closer to their steady states than slower-growing ones.

2.5 Concluding Remarks

In this chapter, we present a dynamic model to find the effect of FDI from a sectorial level on average firm size. We find a significant effect of foreign direct investment (0.40) on the firm size, measured by its assets.

There are some interesting policy implications from this result. This result seems to reinforce the idea that foreign direct investment presents spillovers to national investors (through technology or labor mobility).

We also find that there is an important "stickiness" in firm size: that is, size is highly dependent on the size of the previous period (see the coefficient on the autoregressive term). The results regarding number of employees are as expected.

Regarding policy implications, results suggest the importance of government incentives to Foreign Direct Investment. In particular, incentives should be prioritized to those sectors that have greater impact on the firm size, which also will have impact in number of firms (thus increasing the size of the sector). The size "stickiness" suggests a role for long-term interventions.

Future developments of this chapter will like to approach on determining the effect on unit costs to evaluate "actual" economies of scale. Due to the limitations of data, we believe that firm size is a good implication of improvements on unit costs. It should also be interesting to expand the database to more time periods as well as an international comparison with other countries of the region.

3. SHORT TERM BORROWING: EMERGING MARKETS' ONLY CHOICE?

3.1. Introduction

A particular feature of emerging market crises is the excessive amount of short-term borrowing[8] . On the other hand, Aizenman and Hutchison show how countries with less balance sheet exposure - i.e. lower levels of short-term debt resist better to the recent global financial crisis. Similar results were found by the International Monetary Fund in a recent project.

During the last fifteen years, there has been some research in this area trying to explain why this kind of borrowing is dangerous. More recently, there has been some work seeking to explain the rationale behind the existence of short-term debt. That is, if short-term debt is bad, why do we observe it? In this chapter, we will present a possible explanation to answer this question. When countries borrow short term, they are exposed to the risk of a self-fulfilling crisis[9]. When creditors believe countries will not be able to honor their debt, they do not roll over the loans, and then

[8] See, for example Krugman (1999).
[9] See for instance Cole and Kehoe (1998), and Chang and Velasco (1998). Also, Rodrik and Velasco (1999)

countries effectively cannot pay. Hence, bad expectations may produce a crisis. The literature has concentrated in explaining why short-term debt is ”bad”, but not on why does short-term debt exist in the first place[10].

Other authors have focused on the implementation of policies that rule out the possibility of these crises, going from regulation of capital flows to the proposal of a new set of contracts. In a survey by Rogoff, he analyzes the potential role of international institutions, such as an international lender of last resort or an international bankruptcy court. He also shows the effect of controls on capital flows (both inflows and outflows). However, he mainly concentrates on how to avoid the crises given the debt structure and does not question the debt structure itself.

It should be clear that countries are not interested in taking self-fulfilling crisis risk, mainly because of the losses observed when there is such a crisis, but also because the high interest rates that are needed to attract funds. Thus, it is surprising that we observe short term borrowing given the monopoly power any debtor has on her debt structure and therefore on her risk.

[10] There are few exceptions. See, for example, Broner et al. (2004)

This chapter is aimed on explaining this particular feature of the financial structure. In particular, given that debtors are negatively affected by short-term debt, the question we want to address is "*Is it in the interest of creditors that countries finance long term projects with short term debt? If so, how do they accomplish it?"*

In order to answer these questions, we model a small country with long-term investment projects to be financed by specialized risk-averse foreign investors. The economy produces many non-tradable intermediate goods that are in turn used to produce a tradable final good. The technology of the final good is crucial. We assume that there is a critical mass of inputs required to have positive production of the final good. This assumption creates a linkage between intermediate firms that will in turn affect the optimal debt structure that firms take.

If this project is financed with long-term debt (i.e. if the project and the debt have the same maturity), there is no risk[11]. This together with the abundance of foreign resources competing on the project, imply zero premium for investors, i.e. they will get the world risk

[11] In other words, we are assuming there is no production risk. This assumption can be easily removed.

free rate. Thus, in this scenario all the surplus of the project goes to the entrepreneurs.

But, the project can also be financed with short-term debt (that is debt maturity shorter than the project: there is *maturity mismatch*). The existence of production linkages eliminates the monopoly power of the borrowers on their risk. If a large fraction of firms borrow short term, the possibility of a crisis on those firms will produce a collapse of the final good sector reducing the demand for all intermediates. Thus, even when borrowing fully in long term, a firm can be risky. The liquidity risk acts like an entry barrier limiting the amount of resources competing for the project. This allows international investors to extract part of the surplus (otherwise taken by entrepreneurs). Then, the investor's portfolio is composed by both risk free investment in the world's safe technology (the country is small and does not exhaust resources) and risky in- vestment in the country.

This chapter will argue that this last portfolio (composed partly by short-term debt) is preferred by the lenders to the one composed by long-term debt. Notice however that this does not imply that creditors like crises; they just like the possibility of it. On the other hand, entrepreneurs prefer to avoid maturity mismatches. However,

high enough term premium[12] can induce entrepreneurs to finance their project with short-term debt. In other words, equilibrium with a project fully financed by short-term debt can exist.

Which equilibrium would be observed? We will argue that if, when deciding the investment creditors can coordinate, they will choose to finance these projects with short-term debt. This coordination can be done through some international financial intermediary, e.g. a hedge fund. However, coordination is not perfect. The existence of a hedge fund is not enough to avoid the possibility of a crisis: investors can run on the hedge fund, forcing the hedge fund to run on the country.

The chapter is organized as follows: Section 2 presents a model of debt maturity choice in a competitive bond market. Section 3 does welfare comparisons between equilibria for both agents and for the economy as a whole. Section 4 introduces a financial intermediary (a hedge fund) to obtain a unique equilibrium. Section 5 concludes.

[12] We refer to term premium as the difference between long term and short term interest rate

3.2. A Model of Optimal Debt Structure in a Competitive Bond Market

Let the economy be composed by a continuum of firms that produce intermediate goods to be sold to a final sector. The intermediate goods are differentiated and non-traded whilst the final good is traded. In addition, there is a continuum of international lenders that behave perfectly competitive. All lenders and entrepreneurs live for three periods: 1, 2, 3.

Each entrepreneur maximizes her utility function $E\{U(\cdot)\}$. She has an illiquid investment project that lasts two periods. She invests an amount Ki in period 1 and the project yields $f(K_i)$ in period 3. The production function f is a continuous, concave, twice-differentiable function that satisfies Inada conditions. We assume that in period 3, once debts are paid, she consumes. If, for any reason at period 2, she has to disinvest part of the capital, she will only get a fraction φ of it. The remaining fraction is destroyed due to costly disinvestment.

On the other hand, the representative lender is a risk averse investor with wealth W. She can invest in a risk-free storage technology that we assume pays 1, or lend in two maturities: short term loans

(D) which last one period and long term loans ($K-D$) which last two periods (charging respectively net rates r_S and r_L). If she decides to lend short term, at period 1 she will have another decision to take: She will decide whether to roll over the debt or to use these resources to invest in the risk-free technology. Finally, in period 2 she consumes. Thus, the lender's problem is to maximize her expected utility $E\{V(\cdot)\}$, where V satisfies all desirable properties.

The final sector uses different inputs denoted by Z_i. Moreover, the final sector can only produce if there is a *sufficiently large amount of inputs available*.

Formally, let $N = \{i : Z_i > 0\}$, then the final good production is

$$Y = \begin{cases} \left[\int_0^1 Z_i^{\infty} di\right]^{\frac{1}{\infty}} & , \quad m(N) \geq \mu \\ 0 & , \quad m(N) < \mu \end{cases} \qquad (1)$$

Where μ is the minimum amount of inputs required to have positive production. This creates a linkage between firms to insure that in case of financial distress, all firms are affected.

Definition 1 *Let* $\bar{K}$ be the level of capital for which $f'(K) = 1$.

The amount of capital invested in the country will never exceed $\bar{K}$. This would be the capital invested if there were no issues of liquidity. For any level of capital higher than this threshold, the return would be lower than the risk-free technology.

Assumption 1 *Available resources for entrepreneurs are not scarce, i.e.* $\bar{K} < W$

This assumption will imply that competition among entrepreneurs will not exhaust surplus.

Assumption 2 *International investors are specialized: they invest a non-negligible fraction of their portfolio in the country.*

Notice that lenders are risk averse. If lenders invest a negligible fraction of their wealth in a country, they would behave as risk neutral. The specialized investors assumption prevents this from happening.

The timing of the problem is as follows

• At $T = 1$, lenders and entrepreneurs decide the amount to be invested and the debt structure.

• At $T = 2$, lenders holding short-term debt decide to rollover or not their debt.

• At $T = 3$, entrepreneurs sell their intermediate good to the final output sector and debt is repaid.

Definition 2 (Competitive Bond Market Equilibrium) The equilibrium will be characterized by a set of prices $\{P_i, r_{Si}, r_{Li}\}$ $\forall i$, and quantities $\{D_i, K_i\}$ $\forall i$, such that:

(*i*) Given $\{P_i\}$, final sector firms maximize profits.

(*ii*) Given $\{r_{Si}, r_{Li}\}$, lenders maximize utility.

(*iii*) Given $\{r_{Si}, r_{Li}\}$ and final sector demand, entrepreneurs maximize utility.

(iv) Markets clear.

a) Final Good Sector

At $T = 3$, the final good sector firms buy inputs to produce the only tradable good in the economy (Y). We will use the price of the final good as the numeraire, i.e. $P_Y = 1$. The problem of the final good sector is

$$\max_{\{Z_i\}} \left\{ Y - \int_0^1 P_i Z_i \, di \right\}$$

where P_i is the price of intermediate i, and Y is the production as defined in Equation 1.

The first order conditions are:

$$Z_i = \frac{1}{\infty}\left[\int_0^1 Z_j^{\propto}\, dj\right]^{\frac{1-\propto}{\propto}} \qquad Z_i^{\propto-1} - P_i = 0;\ \forall i$$

Let G_i be the revenue function of intermediate i, i.e. $G_i = P_i Z_i$. The first order condition implies[13]:

$$G_i = \frac{1}{\propto}\left[\int_0^1 Z_j^{\propto}\, dj\right]^{\frac{1-\propto}{\propto}} Z_i^{\propto}$$

b) Roll Over Decision

At $T = 2$, lenders have to decide if they roll over the debt or not. Let us begin the analysis by analyzing the possibility of a run on a single firm. Denote β_i as the fraction of lenders that at period 1 decide to run on firm i. Again, we refer to "run" as deciding not to renew their short-term contracts from period 1 to period 2.

If the revenue of firm i after paying the long term bond holders, is still capable of paying the short term bond holders that did

[13] This expression is valid whenever production of intermediate is completed. In some cases, this will not be the case. If production is not completed, *Gi* would be equal to the residual value of the firm. We leave this explanation for later.

not run $(1-\beta_i)$, then a run was definitely not optimal: The β_i investors that ran should not have run, i.e. $\beta_i = 0$[14].

On the other hand, suppose that firm i is not capable of repaying the $1-\beta_i$ bond holders that did not run. In this case, a run was optimal, and all investors should have done it, $(\beta_i = 1)$. Lemma 1 states this formally[15] .

Lemma 1 *For each firm i, there cannot be partial runs: either all investors run or none of them do. In particular*

$$G(K_i - \beta_i(1+r_{Si})D_i/\varphi) - (1+r_{Li})(K_i - D_i) \geq (1-\beta_i)(1+r_{Si})D_i \Rightarrow \beta_i = 0$$

$$G(K_i - \beta_i(1+r_{Si})D_i/\varphi) - (1+r_{Li})(K_i - D_i) < (1-\beta_i)(1+r_{Si})D_i \Rightarrow \beta_i = 1$$

Let us now consider the possibility of runs on different firms. Lemma 1 implies that each firm is either fully attacked or is not attacked at all. It is easy to see that for some levels of short-term debt,

[14] Actually, they are indifferent since from period 1 to period 2, the project yields as the safe technology. However, we assume that there is some small cost of running

[15] Notice that the short term interest rate from period 1 to period 2 is always zero since uncertainty is fully resolved in period 1

$$G(K_i - (1 + r_{Si})D_i/\varphi) - (1 + r_{Li})(K_i - D_i) \geq 0 \qquad (2)$$

i.e. firm i is able to pay its long-term bondholders even in the case of a full run on its short-term obligations. Clearly, for levels of debt that satisfy 2, firm i will not be attacked[16].

On the other hand, whenever

$$G(K_i) < (1 + r_{Si})D_i + (1 + r_{Li})(K_i - D_i), \qquad (3)$$

firm i will be fully attacked. Lemma 2 states these two results formally.

Lemma 2 *For each firm i,*

- $G_i(K_i - (1 + r_{Si})D_i/\varphi) - (1 + r_{Li})(K_i - D_i) \geq 0 \Rightarrow Prob(\beta_i = 1) = 0$
- $G_i(K_i) < (1 + r_{Si})D_i + (1 + r_{Li})(K_i - D_i) \Rightarrow Prob(\beta_i = 1) = 1$

For further notation, we will refer to D_i^* as the level of short term debt that satisfies 2 with equality, i.e. as the maximum level of short term debt for which firm i will be attacked with probability zero[17].

---

[16] Notice that G() depends on prices. Prices can be low enough so that Equation 2 is never satisfied

[17] Clearly D^* depends on the demand of the final good sector.

Note that Lemma 2 does not cover all possible levels of short-term debt. What can we say about these other levels of short-term debt? Entrepreneurs with these levels of short-term debt will have positive probability of runs. We will assume for these firms that the attack decision follows a sunspot.

Let $B \subseteq [0, 1]$ be the set of firms that are attacked, i.e. $i \in B$ only if $\beta_i = 1$. Furthermore, denote S to be the set of firms that for any possible "attack" set B, satisfy 2. In other words, $S = \{i : \forall B, \ D_i \leq D^*\}$. Finally, denote

$R = [0, 1] - S$ as the set of firms that are not in S.

Notice that a possible attack can be anything going from the empty set to the set R[18]. Moreover, if a firm i is not part of an attack B, but for this event firm i satisfies 3, then B should have probability zero. In order to satisfy these conditions we will take a simple and often-used distribution focusing on attack to all firms or no attack at all.

---

[18] It should be clear to see that $B \cap S = \emptyset$ implies Prob(B)=0

Assumption 3 *Lenders will decide to run or not following a sunspot: With probability π lenders will attack all firms, and with probability $1-\pi$ they will not attack at all.*

$$Prob\,(B = \emptyset) = 1 - \pi$$

$$Prob\,(B = R) = \pi$$

This is not the only distribution consistent with lemma 2.

c) Optimal Debt Choice

We are now capable of analyzing the problem of lenders and entrepreneurs. Let us begin by defining r_i as the weighted average return rate of investment in firm *i*, i.e.

Definition 3 Let's define the average interest rate for entrepreneur i as the weighted average of the short term and long term interest respectively.

$$r_i = \frac{D_i}{K_i}\, rS_i + \frac{K_i - D_i}{K_i}\, rL_i$$

Moreover let R_1 and R_2 be a partition of the set R ($R_1 \cup R_2 = R$ and $R_1 \cap R_2 = \emptyset$). R_1 will be composed of firms

such that $i \in R1$ if and only if $D_i < D_i \leq \varphi K$. Naturally, $i \in R2$ if and only if $D_i \geq \varphi K$.

Finally denote X_{Si} (X_{Li}) as the amount of debt invested short (long) term in firm i.

Lenders' Problem

Lenders will solve the following problem:

$$\max_{\{X_S, X_L\}} \Bigg\{ (1-\pi) V \left(W + \int_0^1 [x_{Si} r_{Si} + x_{Si} r_{Li}] di \right)$$

$$+ \pi V \left(W + \int_s [x_{Si} r_{Si} + x_{Si} r_{Li}] di \right.$$

$$+ \int_{R_1} \left[x_{Si} r_{Si} + x_{Li} \left(\frac{G_i (K_i - (1 + r_{Si}) D_i / \varphi}{K_i - D_i} - 1 \right) \right] di$$

$$\left. + \int_{R_2} \left[x_{Si} \left(\frac{\varphi K_i}{D_i} - 1 \right) + x_{Li} (-1) \right] di \right) \Bigg\}$$

It is easy to show that the first order conditions of this problem imply that lenders will charge the following interest rates:

$$\forall_i \in S, \quad r_i = 0 \tag{4}$$

$$\forall_i \in R_1, \quad r_i = \frac{\pi}{1-\pi} \frac{V'(C_R)}{V'(C_\theta)} \left[\frac{K_i - D_i - G\left(K_i - \frac{D_i}{\varphi}\right)}{K_i} \right] \tag{5}$$

$$\forall_i \in R_2, \quad r_i = \frac{\pi}{1-\pi} \frac{V'(C_R)}{V'(C_\theta)} (1-\varphi) \tag{6}$$

Where CB is the payoff for the lenders when the event $B \in \{\emptyset, R\}$ occurs.

Entrepreneurs' Problem

What is the optimal response of entrepreneurs? Notice entrepreneurs act as monopolistic competitive in their own intermediate good. They maximize the following problem

$$\max_{K_i, D_i} \{(1-\pi)U(G(K_i) - (1+r_i)K_i) + \pi U(I_{\{S\}}(G(K_i) - (1+r_i)K_i))\}$$

s.t. Equations (4) to (6).

$I\{S\}$ is an index function that takes the value of one whenever $i \in S$

Whenever feasible, entrepreneurs will choose to be in *S*. Symmetry of the problem implies that either all entrepreneurs are in *S* or none of them are.

Suppose first that $\forall i \in S$, i.e. every entrepreneur satisfies Equation 2 (with $r_S = T_L = 0$). If this is the case, all entrepreneurs will produce a positive amount of intermediates, ($Z_i > 0$), and thus, there is positive production (see Equation 1).

Moreover, the entrepreneur's problem maximization and symmetry imply

$$G'(K) = f'(K) = 1$$

i.e. $K = \bar{K}$.

Furthermore, notice that $G_i = \frac{1}{\alpha} f(\bar{K})$, $\forall i$. It should be easy to see that there is a positive level of short-term debt D^* such that Equation 2 is satisfied. So, *S* was indeed feasible, therefore they choose to be in S and we have an equilibrium.

On the other hand, suppose that S is not feasible. Moreover assume $m(R2) > 1 - \mu$, where $m(R2)$ denotes the measure of the set $R2$. In this case, whenever $B=R$, then $Y = 0$. Thus, the revenue function is $G_i = \varphi K_i - D_i$ (in other words, the residual value). So, S is indeed not feasible and every entrepreneur *i*

is indifferent about her debt structure[19]. The first order condition of the problem now imply

$$K_i: \left[\int_0^1 Z_j^{\alpha} dj\right]^{\frac{1-\alpha}{\alpha}} Z_i^{\alpha-1} f'(K_i) - (1 + r_i) = 0$$

By symmetry among entrepreneurs, we have: $Z_i = Z_j$. This condition and the lenders supply of funds give the solution for the debt market:

$$r = \frac{\pi}{1-\pi} \frac{V'(W - (1-\varphi)K)}{V'(W + rK)} (1 - \varphi) \qquad (7)$$

$$f'(K) = 1 + r \qquad (8)$$

Equations 7 and 8 define the second equilibrium in the economy. Notice there is an investment level lower than $\bar{K}$.

Proposition 1 There *are two equilibria in the model*:

$$\bullet\ m(S) = 1,\ D \leq D^*$$

$$\bullet\ m(R2) > 1 - \mu,\ D \geq \varphi K$$

Proposition 1 shows the two equilibria in the model. In the chart below we characterized the respective interest rates, utility levels, debt amounts and investment amounts in each of the two

[19] To see that substitute $G_i = \varphi K_i - D_i$ in Equation 5 and notice it becomes identical to 6

equilibria. In the Appendix, we show that there are no other equilibrium.

Characterization of Equilibria

Equilibrium E0

$$r = rS = rL = 0$$

$$f'(K) = 1$$

$$D \leq D^*$$

$$U(G(K) - K)$$

$$V(W)$$

Equilibrium E1

$$r = \frac{\pi}{1-\pi} \frac{V'(W-(1-\varphi)K)}{V'(W+rK)} (1-\varphi)$$

$$r_S = \frac{\pi}{1-\varphi}\left(1-\varphi\frac{K}{D}\right)$$

$$r_L = \frac{\pi}{1-\varphi}$$

$$f'(K) = 1 + r$$

$$D \geq \varphi K$$

$$(1-\pi)U(G(K)-(1+r)K)$$

$$(1-\pi)V(W+rK) + \pi V(W-(1-\varphi)K)$$

3.3. Equilibria and Welfare Comparisons

We have seen that when deciding the maturity structure, there exists multiple equilibria: the project can be financed with

long-term debt (E0) or with short-term debt (E1)[20]. We now turn to answer the question: what equilibrium does each agent prefer? It should be obvious to see that entrepreneurs prefer the equilibrium with long-term debt (E0). The project will be completed with probability one, it will generate resources, interest rates are zero and there is no default.

But, what do lenders prefer? One can think that they should also prefer equilibrium E0. There is no possibility of crisis, and investors always seek to avoid crises. Don't they? Let us compare the perceived utility in both equilibria. In equilibrium E0, when they invest only in long-term debt, lenders have only one investment opportunity: both long-term debt and the risk free technology pay 1. On the other hand, when they finance the project investing in short term debt, lenders are investing in two assets: Short term debt (K) and risk free technology (W−K). But notice, that they can always replicate their investment in E0, by fully investing their wealth in the risk free technology: they optimally choose not to. Therefore, their utility must be higher in E1.

In particular, the perceived utility of the lenders in the case of long term financing (E0) is $V_0 = V(W)$ while in the case of $E1$ is $V_1 = (1-\pi)V(W + rK) + \pi V(W - (1-\varphi)K)$. It should be

[20] Remember we have assumed without loss of generality that $D = 0$ in $E0$ and $D = K$ in $E1$

clear that $V1 > V0$: otherwise they could always set $K = 0$ and thus $V1 = V0$. Proposition 2 states this point.

Proposition 2 *Lenders prefer to finance the investment projects with short-term debt. In other words, they prefer Equilibrium E1 to Equilibrium E0.*

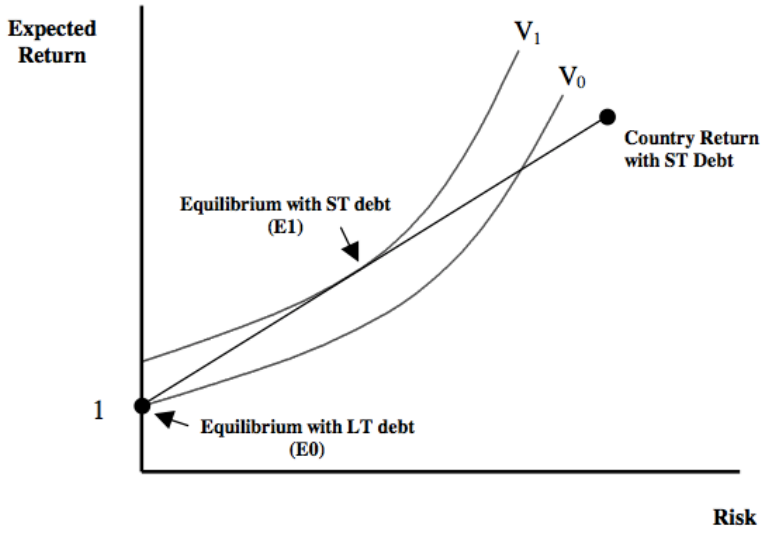
Proof. See Appendix.

Figure 1 gives an intuition for this result. We plot an expected return - risk graph and compare the utility in both equilibria. $V0$ denotes the utility perceived by lenders when investing long term. Clearly, this type of debt bears no risk and thus the equilibrium point lies on the vertical axis. When one includes short-term debt (with a high return and high risk), the average return will be the point marked as return with short-term debt. Then, V1 would be the utility of the lenders when investing K in short term and $W - K$ in the safe technology.

It is easy to see that $V1 > V0$.

Why are lenders better off in an equilibrium where crises are possible? No- tice that in equilibrium E0, given that $W > K$ (i.e. resources are not scarce) lenders cannot extract any surplus from the entrepreneurs. Why? If lenders wish to charge more than 1 on the debt, the extra W − K will immediately flow to the project and thus, the equilibrium rates will again be the risk free ones

Figure 1: Lenders prefer financing projects with Short Term Debt

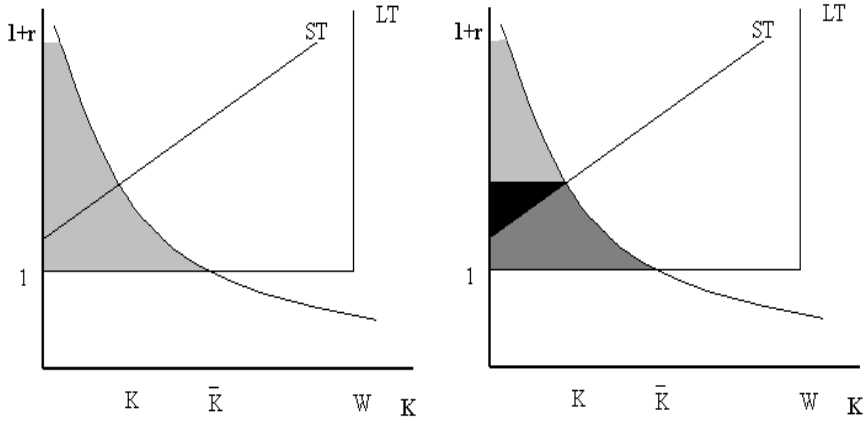


On the other hand, when they finance the project with short term debt, lenders have optimally chosen to place K in the project and $W - K$ in the risk free technology, although the latter pays strictly less than the project. Why don't these resources flow into the project? Clearly, the reason is that the project now bears risk. Thus, the risk of a crisis is acting as an "entry barrier" preventing other lenders from placing their resources in the entrepreneurs' risky project. This allows lenders to extract surplus from the entrepreneur making this equilibrium more attractive.

It is important to notice that lenders prefer the equilibrium debt level where a crisis is possible ex ante, but clearly, they want the crisis not to happen ex post.

Figure 2 shows another interpretation of this result. The line $f'(k)$ is the demand of funds of entrepreneurs and the lines ST and LT are the supply of funds by the lenders. As in a basic supply and demand model, we can calculate and compare surplus from each agent. In the graph on the left, the equilibrium when the project is financed with long-term debt, all the surplus goes to the entrepreneurs (gray area). On the other hand, the graph on the right shows the equilibrium when the project is financed with short-term debt. Here the surplus of entrepreneurs is clearly reduced but there is positive surplus for the lenders. Thus, lenders prefer this equilibrium.

Figure 2: Increase in Lenders Surplus and Dead-Weight Loss



What can we say from a social point of view? It should be straightforward to see that equilibrium E0, i.e. the one with long-term debt is socially optimal. On one hand, in the first scenario, the project takes place and it generates new resources with probability 1, while in the second it only generates resources

with probability π: for the latter case, a planner intervention could improve both agents by reallocation of resources. Moreover, notice that in equilibrium E0 the invested capital equals the optimal level of the entrepreneurs. On the other hand, when the project is financed with short term debt, K is smaller than the optimal level of capital, even though lenders have available resources: in this case, there in *under-investment* in the economy.

Figure 2 also shows this point. The graph on the left shows the total surplus of the project when financed by long-term debt (the gray area). On the other hand, the graph on the right shows the surplus when the project is financed by short-term debt. There is a significant dead-weight loss (dark gray area) due to the possibility of crises and the corresponding reduction in investment. Clearly, from the surplus areas we can see long-term debt is socially preferred.

3.4. Departing from the Competitive Bond Market

The model presented in the previous sections has two equilibria. One is preferred by the lenders (E1) and the other preferred by the entrepreneurs (E0). Unless we depart from the competitive bond market, we cannot say much more. In particular, we cannot say which of the two equilibria actually occur.

Coordinated Entrepreneurs

Let us first assume that entrepreneurs can coordinate to assure their preferred outcome. How do entrepreneurs coordinate? The natural way would be through the government. The government can impose taxes on short-term debt, or can act as a lender of last resort.

Coordinated entrepreneurs would maximize their utility subject to Equation 4 to Equation 6. Clearly, the choice of entrepreneurs is to be in S, i.e. to run safe projects.

Note that despite coordination, the outcome is the same as in the competitive bond market equilibrium. This is due to the perfectly elastic supply of funds under long term financing.

Coordinated Lenders

The first way of coordination that one would think of is perfect coordination. Lenders will aim to extract monopoly profits from entrepreneurs. The outcome in this scenario would be long-term borrowing (no risk) and they would charge an interest rate higher than the world's risk free. Moreover, the capital inflows would be very low. Formally, lenders maximize their problem (See Section c) subject to entrepreneurs' demand $f'(K) = 1 + r$.

It is easy to see that this is the classic cartel problem of coordination. Unless there is some technology to avoid defection, this outcome will not be sustained in equilibrium: lenders have incentives to deviate. Since each lender is negligible and does not

affect the market interest rate, she will decide to invest more than the monopoly quantity.

Without a technology to deter defection, the coordination itself should assure that lenders will not deviate. This implies that the contract has to consider not only entrepreneurs demand but also that lenders cannot do better lending directly to entrepreneurs. Therefore, the contract should yield a Nash Equilibrium.

The only Nash equilibria in this model are the ones obtained in the previous sections: one with short-term debt ($E1$) and the other with long-term debt (E0). Since coordinated lenders that cannot avoid defection should choose a Nash equilibrium, they choose the one in which they are better off: $E1$.

We think that this scenario resembles the late 90's financial markets situation (high levels of short term debt). However, it is difficult to think of a coordination as described above. On the other hand, we did observed that a significant fraction of the Asian flows came through financial intermediaries, such as hedge funds. We will present a model of optimal debt maturity with a hedge fund and show that it replicates the imperfect coordination result.

a) Equilibrium with Hedge Funds

Nowadays, most international investments are made through some type of financial intermediary, e.g. investment banks, hedge funds, etc. In particular, several authors have stressed the importance of such agencies in triggering some recent crises such as the East Asian one.

Through a hedge fund, lenders will be able to guarantee the existence of the equilibrium preferred by them ($E1$).

A hedge fund will be an agency that offers a particular contract to the lenders. A contract is composed of four items: a return rate r, an investment amount K, the probability of repayment q[21], and a fee charged by the agency for managing the funds λ. In other words, define a contract as $\mathrm{Hj} = \{r_j, K_j, q_j, \lambda_j\}$.

The timing is similar to the one in the competitive bond market. However, there is an extra period: $T = 0$ where hedge funds compete. Without loss of generality, we will assume there are two hedge funds competing for funds `a la Bertrand.

• At $T = 0$, hedge funds compete to attract lenders' resources fully specifying all characteristics of contracts.

[21] Choosing q is equivalent to choose between long term debt (q = 1) or short term debt (q = 1 − π)

• At $T = 1$, hedge funds and entrepreneurs negotiate the debt structure[22]

• At $T = 2$, lenders decide to roll over or not the loans.

• At $T = 3$, production takes place and debts are repaid.

In order to attract lenders to invest through the hedge funds, these will necessarily offer contracts in which lenders have no incentives to deviate. In addition, they should meet entrepreneur's demand of capital that will be given by $f'(K) = 1 + r$. Thus, hedge funds will only offer contracts that satisfy either $E0$ or $E1$.

Notice that to run or not is not a decision variable for the hedge fund, i.e. its existence does not avoid the possibility of a self-fulfilling crisis[23]. However, given that it is (fully) leveraged, and that the investors can always ask their money from the fund, whenever investors run on the hedge fund, the latter has to run on the entrepreneurs.

Formally, a particular hedge fund solves the following problem:

$$\max \begin{cases} q\,\lambda 1[rK] & , \; H_1 \succ_L H_2 \\ q\,\lambda 1\left[\frac{rK}{2}\right] & , \; H_1 \succ_L H_2 \\ 0 & , \; H_1 \succ_L H_2 \end{cases}$$

[22] Notice that, since the contract was already fully specified in period 0 by the hedge fund and the lenders, the entrepreneur basically has no decision to take in this period. She can only decide to take or to reject the hedge fund's offer.

[23] In other words, we are assuming an open-end fund.

s.t.

$$V_{H_1} = \begin{cases} f'(K) = 1 + r \\ (1-\pi)V(W + (1-\lambda_1)rK) + \pi V(W - (1-\varphi)K), q = 1-\pi \\ V(W) \qquad\qquad , \quad q = 1 \end{cases}$$

$$r = \begin{cases} \dfrac{\pi}{1-\pi}\dfrac{V'(W-(1-\varphi)K)}{V'(W+(1-\lambda_1)rK)}\,(1-\varphi), q = 1-\pi \\ 0 \qquad\qquad\qquad\qquad , q = 1 \end{cases}$$

where $H_1 \succ_L H_2$ means lenders prefer (get higher utility) contract of hedge fund 1 than contract of hedge fund 2. Hedge funds are constrained by the entrepreneurs' demand and the supply of funds by lenders[24].

Clearly, the competition among hedge funds will drive the fee to zero. Moreover, it will imply the occurrence of Equilibrium $E1$.

Proposition 3 *Assume there is free entry of hedge funds in the economy. Hedge funds do not charge any fee for managing the funds, i.e. λ = 0. Moreover, the unique equilibrium is:*

$$D = K < \overline{K} \; and \; r = \frac{\pi}{1-\pi}\,\frac{V'(W-(1-\varphi)K_i)}{V'(W+rK_i)}(1-\varphi). (E1)$$

[24] Remember that lenders can have one of two supply schedules (See Equations 4 and 6) depending on the probability q, which in turn depends on the debt maturity

Proof. See Appendix.

Obviously, the result of a zero transaction fee is not a realistic result. In reality, hedge funds do charge a fee for their operations. This happens basically because of imperfect information. Given that hedge fund has some information that is not accessible (or accessible at a high cost) to individual lenders, the latter are willing to pay some kind of fee. Another explanation would be that through the hedge fund, lenders can exploit increasing returns, sharing a possible high fee among many agents.

3.5. Concluding Remarks

This chapter presents a model of optimal debt maturity. If long-term projects are financed with short-term debt there are possibilities of (self-fulfilling) liquidity crises. These crises cause very much damage to the global economy, especially to emerging market entrepreneurs, the borrowers. This is precisely the reason that makes so puzzling the existence of short-term debt. If borrowers suffer from it, why don't they avoid it?

The assumption of production complementarities is the novelty feature of the model. This assumption destroys the monopoly power that borrowers have on their risk of liquidity. If enough firms are financed with short-term debt, the possibility of a liquidity crisis will affect the whole economy, including the firms with long-term borrowing.

In this chapter, we have shown a situation in which short-term borrowing can be an equilibrium. Nevertheless, the assumptions of the chapter do not exclude the possibility for long-term borrowing as an equilibrium. Hence, we have multiple equilibria. The natural question to ask is *what are the welfare effects of each equilibrium?*

Long-term borrowing ensures projects are completed and that the optimal amount of capital is invested. This is a Pareto efficient allocation. But, precisely for this reason, lenders will compete to invest their money, reducing the interest rates and, therefore, destroying any possibility to get part of the surplus the projects generate.

On the other hand, short term lending may produce the abandonment of profitable projects because of expectational shocks. This will produce lower investment and higher interest rates. Clearly, this is not efficient and reduces borrowers welfare. But, surprisingly it improves lenders welfare. Short-term borrowing has risk but has a higher return as well. Therefore, investing in short term debt enlarges the menu of assets for international investors.

The final part of the chapter shows a possible rationale for the excessive short-term debt observed in emerging markets. Given the positive effect on the foreign investors, they will try to coordinate in order to achieve the short-term equilibrium. Thus, we model a different view of the financial markets, where there is

no competitive bond market. Instead, there are financial intermediaries that compete with each other to manage lenders' money. Once this stage is over, they negotiate with entrepreneurs. The result is that only short-term debt can be an equilibrium.

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