Entrepreneurship, Saving and Social Mobility

Vincenzo Quadrini *
Pompeu Fabra University
Ramon Trias Fargas, 25-27
08005 Barcelona, Spain
Phone: +34-3-5422719
Fax: +34-3-5421746
e-mail: quadrini@upf.es

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Abstract

This paper examines entrepreneurship in order to analyze, first, the degree to which the opportunity to start or own a business affects the household's saving behavior and the implication of this behavior for the distribution of wealth and, second, the relationship between the extent of entrepreneurship in the economy and socioeconomic mobility, that is, the movement of families across wealth classes over time.

First, a number of stylized facts based on data from the Panel Study of Income Dynamics and the Survey of Consumer Finances are outlined. They show relevant differences in asset holdings and wealth mobility between *entrepreneurs*—economic agents that own a business—and *workers*. Second, a dynamic general equilibrium model of income and wealth distribution with an explicit entrepreneurial choice is developed. The model is then used to obtain an estimate of the quantitative importance for wealth concentration of households that undertake entrepreneurial activities, via their different microeconomic behavior. Through the modeling of the entrepreneurial activities, the model economy developed in this study generates a distribution of wealth with a degree of concentration that accounts for the inequality observed in the U. S. economy. The model also successfully replicates the main patterns of socioeconomic mobility in which entrepreneurs experience higher upward mobility than workers. (JEL E21,D31,J23)

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Introduction

Several empirical studies of income and wealth distribution show that household wealth is highly concentrated and substantially more concentrated than the distribution of income. (See, for example, Wolff (1995)). However, still unknown are the reasons why some families—notably those at the top of the wealth distribution—accumulate such a high level of wealth. The purpose of this paper is to explore the role of entrepreneurship with reference to this issue by addressing two questions. First, is entrepreneurship relevant in characterizing the different accumulation behavior of agents that are located at the top of the wealth distribution? Second, if entrepreneurship is relevant in differentiating the accumulation behavior of these agents, is this different behavior quantitatively important to generate higher concentration of wealth?

The analysis begins with the description of the main empirical differences in asset holdings between *entrepreneurs* and *workers*, where entrepreneurs are defined as families owning their own business, and workers are defined as all other families. Using data from the Panel Study of Income Dynamics and the Survey of Consumer Finances, the first section of the paper shows that there is a marked concentration of wealth that is held by entrepreneurs. Moreover, this concentration of wealth is not simply due to the higher incomes earned by entrepreneurs, since it is also true that they have a higher wealth-to-income ratio than workers. This finding suggests that not only is the higher asset holdings of entrepreneurs a consequence of the selection of entrepreneurs among richer families due to the presence of borrowing constraints (as in Evans & Jovanovic (1989)), but it can also be interpreted as evidence of their higher saving rates.

The hypothesis that the higher asset holdings of entrepreneurs may be a consequence of higher entrepreneurial saving, implies that in order to understand the mechanisms underlying the concentration of wealth, it is necessary to analyze the different accumulation behavior of these two categories of agents: namely, entrepreneurs and workers. This observation motivates the construction, in section II, of a general equilibrium model of income and wealth distribution that explicitly formalizes the agents' choice of undertaking an entrepreneurial endeavor. Two key elements determine this choice: the self-perceived ability of the agents to manage a business and their asset holdings. The ability to manage a business is modeled as a stochastic process that implicitly incorporates a learning process through which agents acquire the ability to run larger businesses by managing smaller ones. The level of asset holdings is important in the agents' decision to undertake an entrepreneurial activity due to the presence of borrowing constraints and financial intermediation costs.

When the different roles played by entrepreneurs and workers are considered, the model economy is able, first, to generate the different accumulation patterns observed for these two types of agents and, second, to reproduce the inequality in the distribution of wealth observed in the U. S. economy. This is an important result of the model that is developed in this study, given the inability of a large class of calibrated models to reproduce this inequality as shown in Quadrini & Ríos-Rull (1997). In particular, a standard model with uninsurable idiosyncratic shocks to labor earnings and borrowing constraints, as the one used in Aiyagari (1994), severely under-predicts the degree of wealth inequality, and this under-prediction is especially acute in the upper tail of the distribution. In the standard model with idiosyncratic shocks, the imposition of a borrowing limit induces agents to accumulate wealth in order to smooth consumption, that is, precautionary savings. Because each agent has a different history of earnings and therefore a different history of wealth accumulation, the level of asset holdings varies among agents. This is the mechanism through which the standard model generates wealth inequality. However, once the level of asset holdings has reached a certain level, agents no longer have incentives to accumulate wealth, and as a result, the model does not generate the high levels of asset holdings that are observed in the data. This implies that some other mechanism through which small groups of agents accumulate higher levels of wealth, relative to their income, must be at work. The strategy followed in this study, and suggested by the empirical analysis, is to introduce an additional incentive to save for a subgroup of agents, that is, for the subgroup of agents who have the opportunity to undertake an entrepreneurial activity.

In the model developed in this paper, there are three key factors that explain the change in saving behavior after or right before an entrepreneurial activity is undertaken. The first factor is the incentive of a household to accumulate the minimal capital requirements needed to engage in entrepreneurship or to implement larger projects. The second factor stems from the uninsurable entrepreneurial risk encountered by enterprising households. Because entrepreneurs face greater financial risks than dependent workers and are risk averse, their patterns of saving are more conservative. The third factor that underlies the difference or change in saving behavior results from the cost of external financing available to the potential entrepreneur. The high interest rate paid on borrowing increases the marginal return on saving for those entrepreneurs whose level of wealth is lower than the level of capital invested in their business. In the model economy, the higher cost of external financing results from an intermediation cost that is exogenously imposed. An alternative approach would be to model this cost explicitly as the result of optimal contracts between entrepreneurs and lenders in the presence of agency costs or moral hazard, a strategy taken by Bernanke & Gertler (1989) in the study of the business cycle. This alternative approach would highlight the importance of agency costs and moral hazard problems not only for business cycle fluctuations but also for wealth concentration and inequality.

In addition to analyzing the causes of wealth concentration outlined above, this study also focuses on the dynamic aspects of wealth distribution, that is, on the movement of households among wealth classes or socioeconomic mobility. Several empirical and theoretical studies analyze income and wealth mobility. Some empirical studies document intergenerational mobility, (see Behrman & Taubman (1990), Solon (1992), and Zimmerman (1992)) while others concentrate on the mobility of the same individual (see Duncan & Morgan (1984), Sawhill & Condon (1992) and Hungerford (1993)). Theoretical approaches typically examine intergenerational mobility (see for example Banerjee & Newman (1991), Banerjee & Newman (1993) and Aghion & Bolton (1993)). In contrast, this study is primarily interested in analyzing the mobility properties experienced by different economic agents, namely, enterprising households as compared to other households within one generation.

In the data analysis below, I show that entrepreneurs experience greater upward wealth mobility than other agents. It should be stressed that—similar to the higher levels of asset holdings—the higher upward mobility is not merely a consequence of their higher incomes, since entrepreneurs experience greater upward mobility in the ratio of wealth to income as well. These mobility features are replicated by the model economy developed in this paper, in addition to the generation of higher entrepreneurial assets. The analysis of social mobility is complementary to the analysis of the different accumulation patterns of workers and entrepreneurs: that is, the same factors which in the model generate the higher asset holdings of entrepreneurs, also generate their upward wealth mobility.

Financial elements are especially important in this study of social mobility. The presence of borrowing constraints and the higher cost of external financing make the undertaking of an entrepreneurial activity less likely for those households located in the lower portion of the wealth distribution: because the undertaking of an entrepreneurial activity increases a household's probability of moving to higher wealth classes, those households with lower levels of wealth—due to financial constraints and/or to the higher cost of external finance—have fewer opportunities to raise their class of wealth. This observation may have relevant policy implications for a government wishing to alter existing patterns of socioeconomic mobility.

The organization of the paper is as follows. Section I presents some stylized facts of wealth distribution and mobility. Section II develops a general equilibrium model of income and wealth distribution with an explicit formalization of entrepreneurial activities. Section III describes the calibration procedure, and Section IV uses the calibrated model to obtain an estimate of the quantitative importance of the accumulation pattern of enterprising households in generating wealth concentration and inequality. A sensitivity analysis with respect to some key parameters is also performed in order to evaluate the dependence of the obtained results from these parameters. Finally, Section V summarizes the results and concludes.

I Some empirical facts on wealth concentration and mobility

This section of the paper highlights some of the main differences in asset holdings and wealth mobility between workers and entrepreneurs resulting from the analysis of two sets of survey data: the Panel Study of Income Dynamics (PSID), which is a national survey that has been conducted annually in the United States, since 1968, on a sample of approximately 5,000 families, and the Survey of Consumer Finances (SCF), which has been conducted in the United States in several years on approximately 3,000 families. Although the PSID survey is conducted annually, the main variable of interest for this study—family wealth—is available for only three years: 1984, 1989 and 1994. Therefore, the main data analysis is based on these three years. With regard to the SCF, the analysis is based on the 1989 and 1992 surveys.

Two definitions of entrepreneurs can be adopted. According to the first definition, entrepreneurs are families that own a business or have a financial interest in some business enterprise, and workers are identified as all other families. According to the second definition, entrepreneurs are families in which the head of the household is self-employed in his or her main job, while workers are families in which the head of the household is a dependent worker. Given the similarity of the results obtained using the two definitions, the main statistics reported in this section are based on the first definition of entrepreneurs. A description of the main variables used in this study is provided in Section A of the Appendix.[1]

I.1 Entrepreneurship and wealth concentration

A well-known empirical fact is that wealth is highly concentrated and much more concentrated than income, as documented in Table 1. This table reports the percentiles and Gini indices for family wealth and income computed from the PSID and the SCF samples for selected years.[2]

Table 1: Distribution of U. S. household wealth and income.

	Top percentiles					Gini	Negative
	1%	*5%*	*10%*	*20%*	*30%*	**Index**	**and Zero**
Wealth							
- PSID 1984	30.0	49.2	61.7	76.6	85.8	0.76	10.6
- PSID 1989	25.4	47.0	60.9	77.1	86.9	0.76	12.3
- PSID 1994	22.6	44.8	59.1	75.9	85.9	0.75	12.9
- SCF 1989	35.7	58.0	70.1	83.7	91.8	0.86	11.7
- SCF 1992	29.5	53.5	66.1	79.5	87.6	0.78	6.9
Income							
- PSID 1984	7.5	19.4	30.2	46.9	60.0	0.43	0.5
- PSID 1989	8.1	20.6	31.6	48.2	61.0	0.45	0.5
- PSID 1992	7.2	19.9	31.1	48.4	61.7	0.45	0.7
- SCF 1988	16.9	31.7	42.3	57.2	68.8	0.54	0.7
- SCF 1991	18.5	34.4	45.1	59.9	70.9	0.57	1.2

The strong concentration of wealth can be summarized by the percentage of total wealth owned by the top 1 percent of asset holders. For example, according to the PSID data, the top 1 percent of families owned 30, 25 and 23 percent of total household wealth in 1984, 1989 and 1994 respectively. When the SCF data are used, the percentage of total wealth owned by the top 1 percent of families was 35.7 percent in 1989 and 29.5 percent in 1992. The distribution of income appears less concentrated: the top 1 percent of families earned 7.5, 8.1 and 7.2 percent of total income according to the two PSID surveys and 16.9 and 18.5 percent of total income

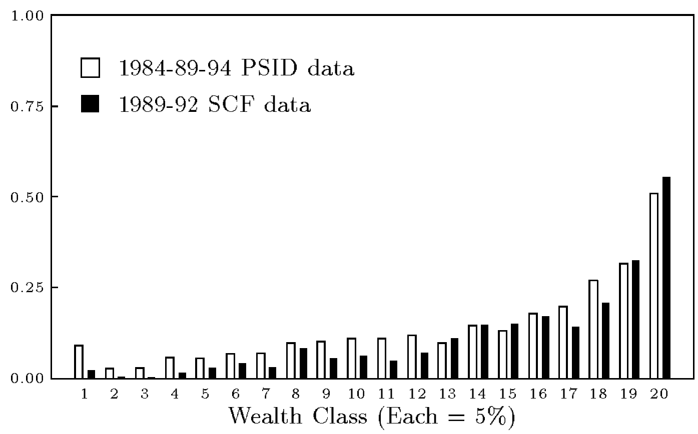
[1] A more extensive and technical analysis of the data is performed in Quadrini (1996).

[2] Where possible the tables reports distributional statistics of income and wealth for the same years. For the PSID data this is possible for the years 1984 and 1989 but not for the 1994 given that the most recent final release PSID family data is the 1993 wave which reports data on the 1992 family income. Regarding the SCF, the Surveys report family income for the year preceding the relative Survey.

according to the two SCF surveys.

The purpose of this paper, however, is not to provide a detailed documentation of the high skewness in the distribution of wealth, as this has already been documented by others. (See, for example, Wolff (1995).) The purpose is to address the issue of whether entrepreneurship has an important role in generating this high concentration of wealth. Information in this direction is provided by Figure 1, which reports the proportion of entrepreneurs in different wealth classes, where each class includes 5 percent of the families.[3] As can been seen from the figure, the percentage of business families increases as we move to higher wealth classes, and about half of the families located in the top class are business families.[4]

Figure 1: Percentage of business families over wealth classes. Each class includes 5 percent of all families.



The fact that business families tend to be located in higher wealth classes, and therefore, they own more wealth than worker families, would not be of particular interest if business families also earned more income (in proportion to the ownership of wealth). To better evaluate the importance of entrepreneurship for wealth concentration, it is then necessary to analyze the joint distribution of income and wealth between these two categories of families, that is, business families and worker families.

Figure 2 reports the average per-family wealth of business and worker families located in

[3] Given the similarity of the 1984, 1989 and 1994 PSID data and the similarity of the 1989 and 1992 SCF data, the figure reports the averages over the corresponding years.

[4] Henceforth, I will use the terms entrepreneur, business family or enterprising family interchangeably.

each income decile as a proportion of total per-family wealth: the top graph uses PSID data and the bottom graph uses SCF data. In constructing these graphs, I have determined the income decile with respect to the total sample, and therefore, worker and business families located in the same income decile dispose of the same income. (Approximately and with the exception of the first and last decile.)

Figure 2: Wealth holdings of workers and entrepreneurs over income classes as fraction of average wealth. Each class includes 10 percent of all families. Panel A: Average 1984, 1989 and 1994 PSID data. Panel B: Average 1989 and 1992 SCF data.

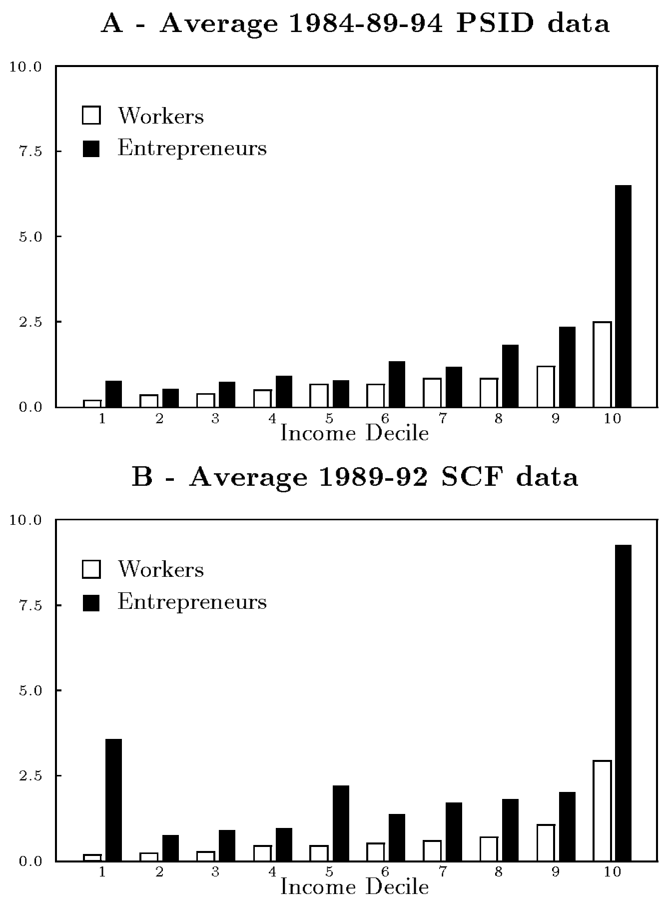


Figure 2 clearly shows that business families own, on average, higher levels of wealth relative to their income than do worker families. If we consider the total sample of business and worker families, the ratio of wealth to income is about twice as large for business families. In terms of total distribution, we find that approximately 14 percent of all families are business families in the PSID sample; they earn about 22 percent of the total income and they own 40 percent of the total wealth. Similar statistics are found in the SCF sample.[5] Therefore, there is a concentration of wealth among business families which is not purely explained by the concentration of income among these families.[6]

Several hypotheses can be formulated to explain the fact that business families own more wealth. One of those hypotheses is related to the existence of borrowing constraints: that is, the ownership of a business can only in part be financed with external funds, and therefore, only those having enough wealth are in a position to start a profitable business.[7] According to this hypothesis, there is a causal link between the endowment of wealth and the entrepreneurial choice. However, an inverse causation can also be hypothesized: business families own more wealth because they save more. Several factors may account for this. For instance, the presence of liquidity constraints may induce those families with higher entrepreneurial ability to accumulate the capital required to start a business.[8] Another reason may stem from the fact that agents are risk averse, and in order to face the high entrepreneurial risk, they accumulate more assets. Finally, the higher saving rate of business families may be the consequence of intermediation costs that make external financing more expensive, thereby implying that entrepreneurs with a lower level of wealth have a higher marginal return from saving. In other words, while the presence of liquidity constraints may have the effect of selecting entrepreneurs among richer families, these families may also have higher levels of wealth relative to income because their members save more. These features of the entrepreneurial activity will be formalized in the general equilibrium model developed in Section II.

[5] In Quadrini (1996) these differences are formally tested and found statistically significant.

[6] Demographic features and, in particular, the age of the components of the family might be important in explaining the high concentration of wealth toward business families. Because the acquisition of a business is less likely for younger families, the concentration of wealth toward business families might just be the consequence of a concentration of enterprising families in middle-aged classes that, in general, own higher levels of wealth. However, in Quadrini (1996), it is shown that the wealth-to-income ratios of business families are greater in all age classes.

[7] See, for example, Evans & Jovanovic (1989); Evans & Leighton (1989); and Holtz-Eakin, Joulfaian, & Rosen (1994). Another interpretation is based on the selection mechanism through which only successful entrepreneurs survive. Therefore, what we observe is the upper tail of the distribution of entrepreneurs among wealth classes.

[8] This is a *dynamic* interpretation of the effects of borrowing constraints as compared to a *static* interpretation that emphasizes the selection consequences of the borrowing constraints.

I.2 Entrepreneurship and social mobility

The top section of table 2 reports net wealth transition matrices of four subsamples of families in the period 1984-89 using PSID data.[9] The first subsample is composed of *staying workers*, that is, families that did not own a business in either 1984 or 1989. The second subsample is composed of *switching workers*, that is, families that owned a business in 1989 but not in 1984. The third subsample is composed of *switching entrepreneurs*, that is, families that owned a business in 1984 but not in 1989. The fourth subsample is composed of *staying entrepreneurs*, that is, families that owned a business in both 1984 and 1989. The selected subsamples have been divided into three classes according to the 1984 and 1989 net family wealth, where the class thresholds are determined by dividing the total sample into three wealth groups. Each group includes one-third of the families. Each row of the matrices specifies the class position in 1989 of families that were located in a particular 1984 class of wealth. The bottom section of table 2 reports the same information for the period 1989-94.

Looking at the transition matrices for families that at the beginning of the period (that is, in 1984 for the top section of the table and 1898 for the bottom section) did not own a business, we observe the following:

- In the lower class, the percentage of families that move to a higher class is greater for the subsample of workers who acquire a business than for staying workers.

- In the middle class, for the subsample of workers who become entrepreneurs, the percentage of upwardly mobile families is higher than the percentage of downwardly mobile families. The reverse is observed for staying workers.

- In the upper class, the percentage of families that fall to lower classes is smaller for switching workers than for staying workers.

Looking at the bottom section of Table 2, which reports data for families that at the beginning of the period owned a business (entrepreneurs), we observe the following:

[9] The selected sample is composed of PSID families that were interviewed in the initial and final years and headed by the same person in both years. I only use PSID data because the SCF does not keep track of the identity of the families.

Table 2: Five-year transition matrices for net family wealth. Sample period 1984-89 in panel A) and 1989-94 in panel B).

A) 1984-1989 transition

	Class I	Class II	Class III	Class I	Class II	Class III
	Staying Workers			**Switching Workers**		
Class I	0.81	0.17	0.02	0.52	0.31	0.17
Class II	0.22	0.65	0.13	0.12	0.51	0.37
Class III	0.02	0.22	0.76	0.00	0.20	0.80
	Switching Entrepreneurs			**Staying Entrepreneurs**		
Class I	0.81	0.14	0.05	0.25	0.49	0.26
Class II	0.23	0.58	0.19	0.17	0.37	0.46
Class III	0.01	0.21	0.78	0.02	0.09	0.89

B) 1989-1994 transition

	Class I	Class II	Class III	Class I	Class II	Class III
	Staying Workers			**Switching Workers**		
Class I	0.78	0.18	0.04	0.51	0.29	0.20
Class II	0.21	0.65	0.14	0.12	0.51	0.37
Class III	0.03	0.22	0.75	0.04	0.08	0.88
	Switching Entrepreneurs			**Staying Entrepreneurs**		
Class I	0.70	0.24	0.06	0.67	0.22	0.11
Class II	0.29	0.63	0.08	0.14	0.49	0.37
Class III	0.03	0.19	0.78	0.03	0.08	0.89

- In the lower class, the percentage of families that move to a higher class is greater for the subsample of staying entrepreneurs.
- In the middle class, for the subsample of staying entrepreneurs, the percentage of upwardly mobile families is higher than the percentage of downwardly mobile families. The reverse is observed for switching families.
- In the upper class, the percentage of families that fall to a lower class is smaller for non-switching families than for the other families.

The observations listed above point out substantial differences in the mobility patterns of entrepreneurs and workers. While worker families (both new and old) tend to stay in or move to lower positions of wealth, both new and old business families tend to stay in or move to higher positions. Therefore, the undertaking of an entrepreneurial activity is an important way for families to switch to higher wealth classes.[10]

The different wealth mobility patterns may reflect differences in earned income. In fact, it can be argued that the upward mobility experienced by entrepreneurs, as opposed to the downward mobility experienced by workers, is a consequence of higher incomes earned by entrepreneurs. However, Table 3 shows that the same mobility pattern can be found for the ratio of wealth to income as well.

The mobility properties shown by Tables 2 and 3 are consistent with the observation of higher asset holdings of entrepreneurs. More specifically, if entrepreneurs own more wealth, it is because they tend to move to higher wealth classes. At the same time, the upward mobility of entrepreneurs can be interpreted as evidence of the hypothesis that the accumulation behavior of entrepreneurs differs from the accumulation behavior of workers, with the former accumulating a higher level of wealth relative to income. According to this hypothesis, if we compare workers and business families that earn the same level of income and own the same level of wealth, the latter should save more on average. This difference in saving behavior contributes to generate a higher concentration of wealth.

I.3 Entrepreneurial persistence and turnover

One of the hypotheses underlying the higher asset holdings of entrepreneurs is that the household's saving behavior changes with the undertaking of an entrepreneurial activity. As a consequence of this change in the saving behavior, business families accumulate more wealth than workers and rapidly move to higher wealth classes (upward mobility). It is this mechanism that contributes to the generation of higher wealth concentration. In this dynamics, an important role is played by entrepreneurial persistence and duration: the longer the business life, the higher the wealth accumulated by business families. One way of looking at entrepreneurial persistence is to look at the exit and entrance rates from business activities for agents with different levels

[10] These differences are formally tested and found significant in Quadrini (1996).

Table 3: Five-year transition matrices for family wealth-to-income ratio. Sample period 1984-89 in panel A) and 1989-94 in panel B).

A) 1984-1989 transition

	Class I	Class II	Class III	Class I	Class II	Class III
	Staying Workers			**Switching Workers**		
Class I	<u>0.79</u>	0.19	0.02	<u>0.54</u>	0.30	0.16
Class II	0.21	<u>0.61</u>	0.18	0.14	<u>0.46</u>	0.40
Class III	0.05	0.23	<u>0.72</u>	0.07	0.17	<u>0.76</u>
	Switching Entrepreneurs			**Staying Entrepreneurs**		
Class I	<u>0.71</u>	0.25	0.04	<u>0.42</u>	0.40	0.18
Class II	0.23	<u>0.55</u>	0.24	0.12	<u>0.46</u>	0.42
Class III	0.06	0.20	<u>0.74</u>	0.01	0.15	<u>0.84</u>

B) 1989-1994 transition

	Class I	Class II	Class III	Class I	Class II	Class III
	Staying Workers			**Switching Workers**		
Class I	<u>0.75</u>	0.20	0.05	<u>0.51</u>	0.25	0.24
Class II	0.22	<u>0.60</u>	0.18	0.15	<u>0.49</u>	0.37
Class III	0.07	0.19	<u>0.73</u>	0.03	0.23	<u>0.74</u>
	Switching Entrepreneurs			**Staying Entrepreneurs**		
Class I	<u>0.70</u>	0.22	0.09	<u>0.51</u>	0.22	0.27
Class II	0.25	<u>0.56</u>	0.20	0.16	<u>0.51</u>	0.32
Class III	0.03	0.32	<u>0.65</u>	0.03	0.25	<u>0.72</u>

of business experience.

The top section of table 4 reports the average exit rates from entrepreneurship for the whole sample of business families and for three subsamples: families with one year of business tenure, families with two years of business tenure, and families with three or more years of business tenure. The table distinguishes between two definitions of entrepreneurs—business owners and self-employed—and the numbers reported are averages over the sample period 1973-92.

As can be seen from the table, the exit rate is high for new entrants (those with one year of business tenure) but declines quickly for surviving entrepreneurs. This can be interpreted as evidence of the hypothesis that there is a learning process associated with the entrepreneurial

Table 4: Exit rates from entrepreneurship (top section) and entrance rates to entrepreneurship (bottom section). Annual values averaged over the sample period 1973-92.

	Exit rate	N. of families*
a) Business owners		
- All business families	24.2	522
- With one year of entrepreneurial tenure	44.7	151
- With two years of entrepreneurial tenure	30.8	80
- With three or more years of entr. tenure	13.4	291
b) Self-employed		
- All business families	13.6	384
- With one year of entrepreneurial tenure	35.2	75
- With two years of entrepreneurial tenure	19.1	48
- With three or more years of entr. tenure	7.2	261

	Entrance rate	N. of families*
a) Business owners		
- All worker families	3.7	4,722
- Without entrepreneurial experience	2.6	4,506
- With entrepreneurial experience	23.1	216
b) Self-employed		
- All worker families	2.9	2,837
- Without entrepreneurial experience	2.0	2,556
- With entrepreneurial experience	27.2	281

* The number of families is the average sample size in each year, from 1973 through 1992.

activity through which successful entrepreneurs maintain and consolidate their businesses: surviving entrepreneurs run better businesses and, consequently, face lower probabilities of exiting.

The bottom section of table 4 reports the entrance rates into entrepreneurship for the sample of all worker families and for two subsamples: worker families without business experience in all three years prior to initiating an entrepreneurial activity and worker families which engaged in an entrepreneurial activity during at least one of these years. The table reveals substantial differences between the entrance rates of experienced and inexperienced families. While the entrance rate for experienced families is greater than 20 percent, the entrance rate for inexperienced families is lower than 3 percent.

The combination of low exit rates and high entrance rates of experienced families implies that for this restricted group of families, the turnover rate in the business group is low, and the entrepreneurial persistence is high. It is this persistence that allows this restricted group of business families to accumulate higher levels of wealth relative to workers which, in turn, generates a higher concentration of wealth.

II A model with entrepreneurs

This section of the paper describes a general equilibrium model with an explicit formalization of the entrepreneurial choice. The economy is populated by a continuum of infinitely lived households, of total measure 1, that in each period decide whether to run an entrepreneurial activity in addition to or as an alternative to supplying their labor services to the market. In the description of the model, I distinguish three sectors: the household sector, the production sector, and the intermediation sector. I start with the description of the household sector.

II.1 Household sector

Preferences

Households maximize the expected lifetime utility:

$$E_0 \left\{ \sum_{t=0}^{\infty} \beta^t u(c_t) \right\} \tag{1}$$

where β is the intertemporal discount rate and $u(c_t)$ is a continuous and strictly concave utility function that depends on consumption c_t. It is also assumed that $\lim_{c \to 0} u(c) = -\infty$ and $\lim_{c \to \infty} u'(c) = 0$

Labor ability

Households are endowed with $\varepsilon \in \mathcal{E} = \{\varepsilon_1, ..., \varepsilon_{N_\varepsilon}\}$ units of labor efficiencies. These units can be directly employed in one's own business as specified below, or they can be supplied to the market in return of the wage rate w. I assume that for a household running its own business it is indifferent whether to employ its labor services directly into the business in substitution of hired labor or to supply them to the market. Therefore, in order to make the description of the model simpler, in the following I assume that the household supplies all the services of labor to the market. The variable ε is observed at the end of the period and follows a first order Markov process with transition probability $\Gamma(\varepsilon'/\varepsilon)$.

Entrepreneurial opportunity

In addition to supplying labor services to the market, the household can run a business project by implementing an entrepreneurial idea κ drawn in each period from the set $\mathcal{K} = \{0, k_1, ..., k_{N_k}\}$.

The first element of this set corresponds to the case in which there is no entrepreneurial idea and, thus, has been set to zero. This idea, together with the project implemented in the current period, form the set of projects with which the household can run a business in the following period. This variable, which is observed at the end of the period, is a stochastic control process with a probability distribution denoted by $P_k(\kappa)$, where the subscript k denotes the project implemented in the current period. The dependence of this probability on k formalizes the hypothesis that associated with the business activity, there is a learning process through which the probability of getting better entrepreneurial ideas increases if the agent is running better projects. The content of an entrepreneurial project will be specified below in the description of the production technology.

II.2 Production sector

There are two sectors of production. The first sector is characterized by small units of production (small firms), while the second is dominated by large units of production (large firms). Entrepreneurship is pursued by running business projects (firms) in the small sector of production. The main reason to separate a small sector of production from the rest of the economy is to isolate those business activities that are closely related to one or few specific households as opposed to the impersonality of big corporate organizations. For the present study, there are two important features that characterize and differentiate a small business as compared to a big corporation: the uninsurable entrepreneurial risk and the strictness of the financial constraints. On one hand, the greater difficulties of insuring and diversifying the risk of small entrepreneurial activities (for example, by transferring part of the ownership) make the whole household wealth involved in the result of the business. On the other hand, the strictness of financial constraints for small firms makes the capital endowment of these firms closely dependent on the asset holdings of the owners. This view is coherent with the one expressed by Fazzari, Hubbard, & Petersen (1988), Gertler & Gilchrist (1994) and Gilchrist & Himmelberg (1994).

Because most small activities are run in the form of noncorporate organizations, while big firms are generally organized as corporations, in the rest of this paper, I use the label *noncorporate sector* of production for the aggregation of all activities run by entrepreneurs and I label *corporate sector* of production the other production activities. These two sectors differ in the technologies employed to produce a homogeneous good that can be used for consumption and investment purposes. I describe first the noncorporate sector.

Noncorporate sector

The noncorporate sector of production is generated by the aggregation of all production technologies run by households engaging in entrepreneurial activities. As specified above, in each period, the households obtain an entrepreneurial idea κ from the set $\mathcal{K} = \{0, k_1, ..., k_{N_k}\}$ for the realization of an entrepreneurial project. The amount of capital required for the realization of an entrepreneurial project is indivisible. If the entrepreneur wants to run a business by implementing a specific project, he or she has to invest the fixed amount of capital required by that project. Given this assumption, the entrepreneurial idea is characterized by the amount of capital required for its implementation, and at the same time, κ identifies the entrepreneurial idea and the amount of capital to be invested.

The production technology associated with the project k is given by:

$$y = g(\eta, k, n) = \eta^{\nu} k^{\nu} n^{1-\nu} \qquad 0 < \nu < 1 \tag{2}$$

where n is the number of efficiency units of labor employed in production and $\eta \in \mathcal{N}_k = \{\eta_1, ..., \eta_{N_\eta}\}$ is an idiosyncratic technology shock observed at the beginning of the current period that follows a first order Markov process with transition probability $Q_k(\eta'/\eta)$. The set from which the shock η takes values, as well as its probability distribution, depend on the project k implemented. The first value of the shock η_1 is assumed to be a bad shock with high persistence. This implies that, in the event of this shock, the entrepreneur will decide to abandon the business activity, and η_1 acts as an absorbing shock for entrepreneurs.

The k units of capital had to be invested in the previous period, while the employment decision n is made after the observation of the shock η. Therefore, the production plan is determined in two sequential steps: at the end of the period, the entrepreneur decides which project to implement among the available ideas, and at the beginning of next period, after observing η, he or she decides how much labor to hire. I assume that the entrepreneur can always run the project implemented in the current period. Therefore, the set of implementable projects is given by the current project (if the agent is already an entrepreneur) and the obtained idea. The amount of capital invested is subject to stochastic depreciation. The assumption is that, at the end of the period, the value of the capital invested depends on the result of the entrepreneurial activity. If the result is positive, then the value of the invested capital is high; if the result is negative, then the value of the invested capital is low. The depreciation rate is denoted by δ_η, and it is a function of the shock η.[11]

Corporate sector

The technology employed in the corporate sector is given by the constant return to scale production function

$$Y_c = F(K_c, N_c) = K_c^\theta N_c^{1-\theta} \tag{3}$$

where Y_c is output, K_c is the input of capital, and N_c is the input of efficiency units of labor. Capital depreciates at rate δ_c.

II.3 Intermediation sector and borrowing constraints

In this economy, there is an intermediation sector which collects deposits from households with positive balances by paying the interest rate r_D and makes loans to households asking for funds and to the corporate sector. The lending activity is based on a constant return to scale technology with a proportional cost per unit of funds intermediated. While this cost is zero for funds intermediated to the corporate sector, the lending activity to households engaging in entrepreneurial activities implies a proportional cost ϕ per each unit of funds intermediated. Competition among banks makes intermediation profits zero and the lending rates equal r_D for loans to the corporate sector and $r_L = r_D + \phi$ for loans to the household sector.

Households can borrow only up to a maximum amount, the size of which depends on the lending policy of the intermediaries. This policy consists of lending up to the amount that the borrower will be able to repay with certainty at the end of the following period. Therefore, in this economy, bankruptcy is not allowed. For an agent who decides to be a worker, the maximum amount that the bank is willing to lend is given by his or her disposable income in the next period, discounted at the lending rate r_L. This limit imposes the following restriction on the

[11] Stochastic depreciation is introduced in order to allow for the possibility of large losses in the business activity. An alternative would have been to allow η to take negative values. But with negative values of the shock, the optimal quantity of labor to hire would be negative.

agent's net asset holdings:

$$a \geq -\frac{(\varepsilon w)}{1+r_L} \tag{4}$$

where a is the net value of assets.

For an agent who decides to invest in the business activity, the determination of the borrowing limit is more complex. Because undertaking a business activity is risky (the entrepreneurial activity is subject to the technology shock), in case of a negative result, the household may not be able to fully pay back the amount borrowed and the interest. Cognizant of this, banks require collateral. Let η_{min} be the minimum possible value of the shock associated with the project k. If the entrepreneur invests k units of capital in the business, then the minimum amount of resources that can be disposed of at the end of the period and before repaying the debt, is given by

$$DR_{min} = \max_n\{\eta_{min}^{\nu} k^{\nu} n^{1-\nu} - nw\} - (1-\delta_{\eta_{min}})k + \varepsilon w \tag{5}$$

where DR_{min} stands for disposable resources when the shock takes the minimum possible value. In the above equation, it is implicitly assumed that $k > a$. This means that the entrepreneur is a net borrower, and therefore, the relevant interest rate is the lending rate r_L. The amount of funds that the entrepreneur has to pay back to the bank (that is, principle and interest) is given by $(k-a)(1+r_L)$. According to the lending policy of the bank, this has to be smaller than DR_{min}. Therefore, after we solve the entrepreneur optimization problem and do some algebraic manipulations, the restriction imposed on the net asset holdings is given by the inequality

$$a \geq -\frac{\varepsilon w + \nu\, \eta_{min} k \left(\frac{1-\nu}{w}\right)^{\frac{1-\nu}{\nu}} - (r_L + \delta_{\eta_{min}})k}{1+r_L} \tag{6}$$

Given the assumption that the household's utility function tends to $-\infty$ as consumption tends to zero, the borrowing limit is never binding. In fact, if the agent chooses to borrow up to the limit, there is a positive probability of zero consumption, which implies a value for the utility of $-\infty$. Therefore, it is never optimal to borrow up to the limit.

II.4 The cost of capital and business profits

If a household decided at the end of the previous period to run a business with the project k, then at the beginning of the current period, after observing the technology shock η, the household decides the quantity of labor services to hire by solving the following (profit) maximization problem

$$\pi(a,k,\eta) \quad = \quad \max_n \left\{\eta^{\nu} k^{\nu} n^{1-\nu} - nw - \delta_{\eta} k - rk\right\} \tag{7}$$

with

$$r \quad = \quad \begin{cases} r_D, & \text{if} \quad k \leq a \\ \\ r_D + \phi\left(\frac{k-a}{k}\right), & \text{if} \quad k > a \end{cases}$$

The variable r is the cost of capital from internal and external sources of financing and the definition of profit is net of the opportunity cost of capital. If $k \leq a$, then the project is entirely financed with internal sources, and the cost of capital is given by the opportunity cost r_D. If $k > a$, then part of the capital that is invested in the business is financed with debt, and the cost of capital is an increasing function of the ratio of debt to capital. The household takes r_D, r_L, and w as given, and the solution is given by

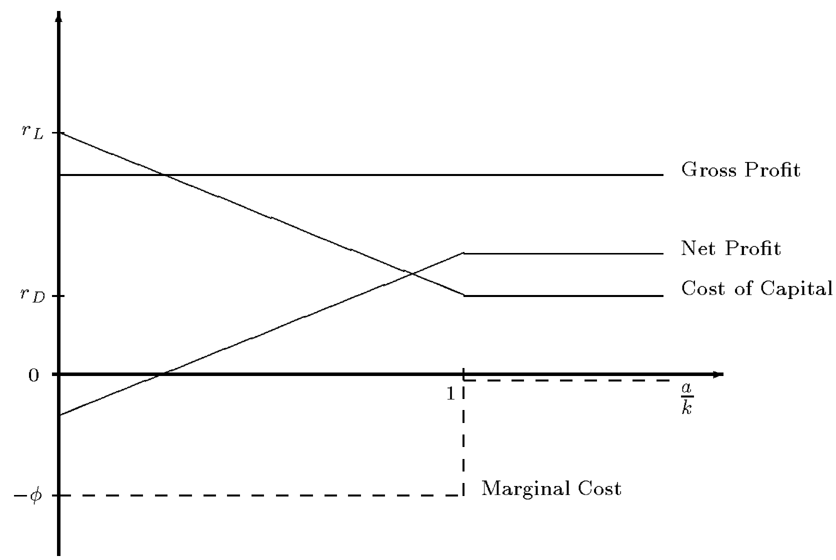
$$n(k,\eta) \quad = \quad \eta k \left(\frac{1-\nu}{w}\right)^{\frac{1}{\nu}} \tag{8}$$

Substituting equation (8) in (7) and rearranging, we obtain the ex post entrepreneur's profit:

$$\pi(a,k,\eta) \quad = \quad \nu\eta k \left(\frac{1-\nu}{w}\right)^{\frac{1-\nu}{\nu}} - \delta_{\eta} k - rk \tag{9}$$

Given the dependence of the cost of capital from the fraction financed with debt, profits are an increasing function of the ratio between the entrepreneur's net assets and the capital invested in the business. The expected profits per unit of invested capital, along with the average and marginal costs of capital, are plotted in Figure 3.

Figure 3: Cost of capital and profits as functions of internal sources of financing



Given the higher cost of external financing, business profits are negatively related to the asset holdings of the entrepreneur. For low values of the entrepreneur's net assets, business profits are negative, and this might prevent the entrepreneur from undertaking the business activity or investing in larger scale projects. Only those agents with asset holdings greater than a minimum threshold, which depends on the particular project, undertake the project, and therefore, the higher cost of external financing may have the same effect of the imposition of a borrowing limit. The marginal cost of capital, which determines the marginal return on savings, is negative and equal to $-\phi$ if $a < k$ and zero otherwise. This structure of the cost of capital plays an important role in determining different accumulation behaviors of workers and entrepreneurs.

II.5 Household's problem and definition of equilibrium

The household's object is the maximization of the expected lifetime utility and, in each period, it makes a set of decisions for which the timing is defined as follows.

- **Beginning of the period** – At the beginning of period, if the household run a business, then it observes the technology shock η, and given the invested capital k, it decides how much labor to hire.

- **End of the period** – At the end of the period, the household observes the entrepreneurial idea κ and the labor ability ε'. Then, knowing the implementable projects (k, κ) and the labor ability ε', the household decides, first, whether to invest in the business activity given the available projects and, second, how much to save and how much to consume.

At the beginning of the period, agents differ over several dimensions or states. The first state variable, which is not under the control of the agent, is represented by the labor ability ε. The other state variables are given by the net value of the asset a, the implemented project k (decided at the end of the previous period) and the technology shock η observed at the beginning of the current period. If $k = 0$, then the agent is a worker; in the other cases, the agent is an entrepreneur. Therefore, the full set of individual state variables at the beginning of the period is given by $(\varepsilon, a, k, \eta)$, while the aggregate states of the economy are given by the distribution of agents over individual states represented by the measure $\mu(\varepsilon, a, k, \eta)$. In this study, however, I consider only *steady state equilibria*, that is, equilibria in which the distribution of agents over individual states is constant over time. Consequently, all the aggregate variables (like the prices of capital and labor) are constant over time, and they can be treated parametrically in the optimization problem of the agent.

Define $v(\varepsilon, a, k, \eta)$ to be the beginning-of-period value function of an agent that at the end of the previous period decided to run (and invested in) the entrepreneurial project k, and $\tilde{v}(\varepsilon, a, k, \eta, \kappa, \varepsilon')$ the end-of-period value function after the realizations of κ and ε'.[12]

Let's consider first the agent's problem at the end of the period, after the observation of the variables κ and ε'. The agent's problem reads

$$\tilde{v}(\varepsilon, a, k, \eta, \kappa, \varepsilon') \;=\; \max_{c, a', k'} u(c) + \beta \sum_{\eta'} v(\varepsilon', a', k', \eta')\, Q_k(\eta'/\eta) \tag{10}$$

subject to

[12] The value functions also depend on the distribution of households over the individual states. However, because in a stationary equilibrium, the distribution of agents and all aggregate variables are constant over time, I do not include μ as an explicit argument.

$$c + a' = a(1 + r_D) + \pi(a, k, \eta) + \varepsilon w$$

$$a' \geq -\frac{\varepsilon' w + \nu \eta_{min} k' \left(\frac{1-\nu}{w}\right)^{\frac{1-\nu}{\nu}} - (r_L + \delta'_{\eta_{min}})k'}{1 + r_L}$$

$$k' \in \{k, \mathrm{K}\}$$

The conditions constraining the agent's problem are the budget constraint and the borrowing constraint. The function π in the budget constraint is the net income from the business (net of the opportunity cost of capital), and it is defined in (9). In solving this problem, the agent takes as given the wage rate w and the interest rates r_D and r_L, which are constant in the stationary equilibrium, and the solution is given by the state contingent functions $a'(\varepsilon, a, k, \eta, \mathrm{K}, \varepsilon')$ and $k'(\varepsilon, a, k, \eta, \mathrm{K}, \varepsilon')$.

The beginning-of-period value function can now be defined as the expected value of the end-of-period value function $\tilde{v}$, conditional on the information available at the beginning of the current period, that is,

$$v(\varepsilon, a, k, \eta) = \sum_{\mathrm{K}, \varepsilon'} \tilde{v}(\varepsilon, a, k, \eta, \mathrm{K}, \varepsilon')\, P_k(\mathrm{K})\, \Gamma(\varepsilon'/\varepsilon) \tag{11}$$

Definition II.1 (Steady state equilibrium) *A steady state recursive competitive equilibrium for this economy consists of: (a) Value functions* $v(\varepsilon, a, k, \eta)$*,* $\tilde{v}(\varepsilon, a, k, \eta, \mathrm{K}, \varepsilon')$*, and decision functions* $n(k, \eta)$*,* $a'(\varepsilon, a, k, \eta, \mathrm{K}, \varepsilon')$*, and* $k'(\varepsilon, a, k, \eta, \mathrm{K}, \varepsilon')$*; (b) Interest rates* r_D *and* r_L *and wage rate* w*; (c) Capital and labor demands* K_n *and* N_n *from the noncorporate sector; capital and labor demands* K_c *and* N_c *from the corporate sector; (d) A function* $\Psi(\mu)$ *mapping the space of households' distribution* μ *into the next period distribution and an invariant distribution of households* μ^**. Satisfying the conditions: (a) The decision rules* $a'(.)$ *and* $k'(.)$ *solve the agent's problem described in* (10)*, and the functions* $\tilde{v}(.)$ *and* $v(.)$ *are the associated value functions* (*at the end and at the beginning of the period*)*; the hiring choice* $n(.)$ *for entrepreneurs is profit maximizing and it solves problem* (7)*. (b) Prices are competitive. The wage rate* w *and interest* *rate r_D equal the marginal productivity of labor and capital (net of depreciation) in the corporate sector. The interest rate on loans r_L equals the interest rate on deposits plus the intermediation cost ϕ. (c) Capital and labor markets clear, that is*

$$\sum_{\varepsilon,k,\eta}\left\{\int_a k\,\mu(\varepsilon,a,k,\eta)\,da\right\}+K_c = \sum_{\varepsilon,k,\eta}\left\{\int_a a\,\mu(\varepsilon,a,k,\eta)\,da\right\} \tag{12}$$

$$\sum_{\varepsilon,k,\eta}\left\{\int_a n(k,\eta)\,\mu(\varepsilon,a,k,\eta)\,da\right\}+N_c = \sum_{\varepsilon,k,\eta}\left\{\int_a \varepsilon\,\mu(\varepsilon,a,k,\eta)\,da\right\} \tag{13}$$

(d) The distribution μ^* is a fixed point of the mapping Ψ which, given the subsets S_ε, S_a, S_k, S_η, is defined by the functional equation

$$\mu'(S_\varepsilon,S_a,S_k,S_\eta)=\Psi(S_\varepsilon,S_a,S_k,S_\eta)(\mu)=\textstyle\sum_{\varepsilon'\in S_\varepsilon}\sum_{k'\in S_k}\sum_{\eta'\in S_\eta} \tag{14}$$
$$\textstyle\int_{a'\in S_a}\left\{\sum_{\varepsilon,k,\eta}\sum_{\mathrm{K}}\left\{\int_a I(\varepsilon,a,k,\eta,\mathrm{K},\varepsilon')\,P_k(\mathrm{K})\,\Gamma(\varepsilon'/\varepsilon)\,Q_k(\eta'/\eta)\mu(\varepsilon,a,k,\eta)\,da\right\}da'\right\}$$

where $I(\varepsilon,a,k,\eta,\mathrm{K},\varepsilon')$ is an indicator function defined as

$$I(\varepsilon,a,k,\eta,\mathrm{K},\varepsilon')=\begin{cases}1, & \textit{if}\quad a'(\varepsilon,a,k,\eta,\mathrm{K},\varepsilon')\in S_a,\quad \textit{and}\quad k'(\varepsilon,a,k,\eta,\mathrm{K},\varepsilon')\in S_k\\[2ex] 0, & \textit{otherwise}\end{cases}$$

III Calibration

Four sets of parameters are calibrated. These parameters relate to i) household's preferences; ii) household's process for labor ability; iii) production technology in the corporate and noncorporate sectors; and iv) production technology in the intermediation sector. The calibration period is one year.

As shown below, some parameters are calibrated using equilibrium conditions that can be verified only by solving the model. The complexity of the model economy, however, does not allow for the derivation of analytical solutions, and consequently, some numerical methods are applied. These methods are described in Section B of the Appendix.

III.1 Household's preferences

The household maximizes the expected lifetime utility $E_0 \sum_{t=0}^{\infty} \beta^t u(c_t)$, where the per-period utility is assumed to be of the relative risk aversion form $u(c_t) = c_t^{1-\sigma}/(1-\sigma)$.

The risk aversion coefficient σ is assumed to be 2.0 and the discount factor β is calibrated such that in equilibrium, the annual interest rate on deposits r_D equals the value representative of all financial investments. Mehra & Prescott (1985) report that the return on government bonds, representative of risk-free assets, in the postwar period, averaged 0.5 percent while for the same period the return on risky financial assets averaged 6.5 percent. In the model economy developed in this study, deposits are representative of both risky and risk-free financial investments. Because the average return on these deposits should be between 0.5 percent and 6.5 percent, I use the mean value, and I set $r_D = 0.035$.

III.2 Labor ability

The labor ability ε is assumed to follow a four-state Markov process with transition probability matrix Γ. In order to calibrate this process I make the following assumptions.

Each household is thought of as a sequence of finitely lived generations. In each period, there is a positive probability p that the current generation is replaced by a new generation. Different generations are characterized by different earning processes. When an old generation is replaced by a new one, the earning type assumed by the new generation is based on a stochastic process that depends on the earning type of the generation from which it descended. Therefore, each household faces a positive probability of switching to a new earning type when a new generation replaces the old one, and this replacement happens with probability p. This probability is calibrated assuming an average generation duration of 35 years.[13]

For each generation, the logarithm of the household's labor ability ε is assumed to follow the autoregressive process:

$$\ln(\varepsilon_{i,t+1}) = \alpha_i + \rho \ln(\varepsilon_{i,t}) + v_{t+1} \qquad v_{t+1} \sim N(0, \sigma_v^2) \tag{15}$$

[13] The duration of a generation does not correspond to the life of the individuals of that particular generation. We can approximately think of the duration of a generation as the period that extends from the time in which the children of a generation get married and form new families to the time when the newborns of these new families get married and form new families themselves.

where i is the index for the generation type and the parameter α_i is the generation-specific earning parameter characterizing the mean of the earning process. Therefore, the log-earning process of different generation types has the same variance but different means.

The autocorrelation coefficient ρ and the standard deviation σ_v of the earning process (15) are estimated using PSID data for the period 1970-92. Household earnings are defined as the sum of three components: *a*) the wages and salaries of the household head and spouse; *b*) the imputed labor income portion of other incomes of the household head and spouse (like business incomes); *c*) the monetary transfers of the household head and spouse. The imputation of the labor portion of other incomes (the second component of earnings) and, in particular, of business income, is required by the hypothesized earning process that is assumed in the model economy.[14] The addition of monetary transfers (the third component of earnings) is justified by the absence of a government.[15] After selecting those families that were interviewed in the years from 1970 to 1992 and that reported positive earnings[16], I estimate the following equation:

$$\ln(E_{i,t+1}) = \alpha_i + \varphi_1 A_{i,t} + \varphi_2 A_{i,t}^2 + \varphi_3 A_{i,t}^3 + \rho \ln(E_{i,t}) + v_{i,t+1} \tag{16}$$

where $E_{i,t}$ is the earnings of family i at time t, α_i is the household-specific earning parameter, and $A_{i,t}$ is its age. On the right side of the regression, the cubic polynomial in age is included in order to detect possible life-cycle patterns of earnings. The estimation results are reported in Table 5.[17]

After estimating the two parameters ρ and σ_v, I approximate the labor ability ε of a generation with a specific earning parameter α_i by using a two-state Markov process with a symmetric transition probability matrix $\Gamma_i(\varepsilon/\varepsilon)$. The three moments used to pin down the parameters of this process are: (i) the unconditional mean of $\ln(\varepsilon)$, which is equal to $\alpha_i/(1-\rho)$; (ii) the

[14] In this process, the owner of a business is indifferent when it comes to supplying his or her labor services to the market in return for the wage rate w or directly working in the business in substitution of hired labor. Given this assumption, I also assume that agents undertaking entrepreneurial activities always supply their labor services to the market rather than working in the business, and therefore, the measure of earnings should also include the opportunity cost of the labor employed in the business.

[15] However, due to the absence of data, I do not subtract income taxes paid on that income.

[16] The selection of families with positive earnings is required because the estimation of the earning process is based on the log-transformation. However, the number of families with zero earnings is small compared to the selected sample, and therefore, the estimation bias should be negligible.

[17] The estimations of the autocorrelation coefficient and standard deviation are close to the estimations of Abowd & Card (1989) that are conducted on several sets of data other than the PSID.

Table 5: Estimation of the earning equation. Dependent variable $\ln(E_{i,t+1})$.

	$A_{i,t}/100$	$A^2_{i,t}/1000$	$A^3_{i,t}/10000$	$\ln(E_{i,t})$
Coefficients	9.436	-1.642	0.080	0.496
Standard errors	(0.411)	(0.080)	(0.005)	(0.005)
t-Statistic	22.94	-20.43	16.07	107.67

Standard error $\sigma_v = 0.332$
Number of cross sectional units = 1717
Number of periods = 22
$R^2 = 0.349$

autocorrelation ρ; and (iii) the standard deviation $\sigma_v/\sqrt{1-\rho^2}$.

Regarding the number of household or generation types, I assume that in the economy, there are only two household types of equal measure, and the parameters μ_i are pinned down such that the Gini index for earnings in the model economy equals 0.38, which is the average of the Gini index found in the PSID data for the period 1970-92. The transition probability for generation types is assumed to be symmetric and is determined to match the intergenerational correlation in earnings. Behrman & Taubman (1990) use PSID data to estimate the intergenerational correlation between long-run measures of parental income and child earnings. Their estimations suggest an intergenerational correlation of over 0.50. Solon (1992) also uses PSID data to estimate the intergenerational earning correlations; he finds estimation values in the neighborhood of 0.4. A different set of data—specifically, data from the National Longitudinal Survey—is used by Zimmerman (1992) to estimate the intergenerational correlation in income. The values found by Zimmerman are on the order of 0.4. Based on the results of the above studies, I set the value of the intergenerational correlation to 0.5. This value implies a 75 percent probability for a new generation to be of the same earning type as the generation it descended from.

In summary, the calibration values for the labor ability process are given by:

$$\varepsilon \in \{e^{-1.095}, e^{-0.329}, e^{0.329}, e^{1.095}\}$$

$$\Gamma = \left\{ \begin{array}{cccc} 0.7427 & 0.2502 & 0.0053 & 0.0018 \\ 0.2502 & 0.7427 & 0.0018 & 0.0053 \\ 0.0053 & 0.0018 & 0.7427 & 0.2502 \\ 0.0018 & 0.0053 & 0.2502 & 0.7427 \end{array} \right\}$$

III.3 Production technology

In the economy, there are two sectors of production: the corporate sector and the noncorporate sector. The corporate technology is represented by a Cobb-Douglas production function, with an income share parameter θ, and capital depreciates at rate δ_c. The noncorporate sector of the economy is generated by the aggregation of all entrepreneurial activities, where an entrepreneurial activity is based on the following production technology:

$$y = \eta^{\nu} k^{\nu} n^{1-\nu} \tag{17}$$

Here, η is an idiosyncratic technology shock observed after the investment of k units of capital, and n is the amount of efficiency units of labor employed in production after the observation of the shock. The stock of capital depreciates at the stochastic rate δ_η.

The first step in the calibration of the production sector is to specify a consistent measurement of aggregate capital that best fits the notion of capital adopted in the model economy and to determine the percentage of that capital employed in the two sectors of production, that is, the corporate and the noncorporate sectors.

Given the absence of a government, I abstract from public capital, and I consider only private tangible assets. An estimate of the stock of tangible assets privately owned is provided by the Federal Reserve Board with the flow of funds in The Balance Sheet for The U.S. Economy (1990). The flow of funds account distinguishes five types of assets—*plant and equipment*, *inventories*, *land at the market value*, *residential structures*, and *consumer durables*—and report the distribution of them among five sectors of the economy—*households and nonprofit institutions*, *farm business*, *nonfarm noncorporate business*, *nonfarm nonfinancial corporations*, and *financial institutions*.

Among the five types of tangible assets privately owned, a particular role is played by consumer durables. Given the difficulty of quantifying the market value for these assets and the values of their services, I exclude consumer durables from the measurement of aggregate capital. Consequently, the adopted notion of aggregate capital results from the aggregation of the following components of private tangible assets: plant and equipment, inventories, land at market value, and residential structures. This is a notion of capital that is consistent with a measurement of output given by the gross domestic product (GDP).[18] Using this notion of capital and measuring output with GDP, the average capital-to-output ratio in the period 1957-90 is 2.65. Therefore, this is the value that the capital-to-output ratio in the artificial economy has to match.

After defining the empirical counterpart of the adopted notion of aggregate capital, I have to determine the fraction of this capital employed in the two sectors of production. In the model economy, the noncorporate sector includes all business activities that are closely related to one or few specific households as opposed to the impersonality of big corporations that, instead, are part of the corporate sector of production. As a first approximation, the capital employed in the small sector of the economy can be identified with the assets owned by farms and unincorporated businesses, while the stock of capital employed in the corporate sector gathers the assets owned by the other sectors of the economy, that is, nonprofit institutions and households, nonfinancial corporations, and financial institutions. Using this criterion, I estimate the average fraction of capital employed in the noncorporate sector in the period 1957-90 as on the order of 0.30. This number, however, underestimates the size of the noncorporate sector of the economy, as thought in the theoretical model. In fact, there are several firms that are organized in the form of a corporation, but the equities of these firms are owned by a limited number of shareholders (sometimes only one family). The dimensions of these firms are typically small relative to other corporate organizations, and they are closer to the notion of entrepreneurial businesses, as thought in the model. Consequently, they should be included in the noncorporate sector of the economy, and the percentage of total capital employed in this sector should be larger than 30 percent. As a compromise, I assume that 40 percent of aggregate capital is employed in the noncorporate sector of the economy.

[18] In fact, the GDP does not include either an estimation of the services from the stock of government capital or an estimation of the services from the stock of consumer durables. However, it includes the imputed rents of owner-occupied houses.

At this stage of the calibration, I impose two restrictions that simplify the assignment of the parameter values of the production technologies. First, I assume that both the corporate and the noncorporate sectors of production have the same capital income shares, that is, $\theta = \nu$. Second, I assume that the stocks of aggregate capital employed in the two sectors depreciate at the same rate δ. Based on these assumptions, the capital income share is determined according to the equation

$$\theta = (r + \delta)(s_c + \bar{\eta} s_n)\frac{K}{Y} \tag{18}$$

where K/Y is the aggregate capital-to-output ratio, s_c is the fraction of capital employed in the corporate sector, s_n is the fraction of capital employed in the noncorporate sector, and $\bar{\eta}$ is the average productivity parameter in the noncorporate sector. I assume that the mean of the shock to entrepreneurial activities is the same for all entrepreneurs, and therefore, the average productivity parameter $\bar{\eta}$ is given by the mean of the technology shock η. Given the parameterization of $\bar{\eta}$ specified below, θ takes the value of 0.33.

The calibration of the depreciation rate is based on the aggregate capital accumulation equation $K_{t+1} = (1 - \delta)K_t + I_t$, where K_t is the aggregate stock of capital, and I_t is the aggregate investment at time t. After imposing the steady state conditions, we get

$$\gamma + \delta = \frac{(I/Y)}{(K/Y)} \tag{19}$$

where γ is the steady state growth rate of the economy and Y is the aggregate output. The capital-to-output ratio has been set above to 2.65, and the investment-to-output ratio is determined using data from the national income and product account (NIPA). Aggregate investment is measured as the sum of expenditures on producer durables, residential structures, and changes in the value of inventories; output is measured with GDP. Because the artificial economy is normalized such that in equilibrium no growth is displayed, the value assigned to the depreciation rate is given by $\gamma + \delta$. In the calibration period 1957-90, the average value of $\gamma + \delta$ is 0.062. Given the value of 0.035 assigned to the interest rate r_D, the calibration of the depreciation rate implies a capital-to-output ratio of 0.34 in the corporate sector. Given the calibration of $\bar{\eta}$ specified below, the capital-to-output ratio in the noncorporate sector equals 2.0.

Noncorporate technology

The capital income share parameter ν and the average depreciation rate of capital δ equal the values for the aggregate economy, and they have been calibrated above to 0.33 and 0.062, respectively.

Regarding the number of entrepreneurial projects, I assume that only three projects—identified by the capital inputs k_1, k_2, and k_3—are implementable. The calibration of the capital required for the implementation of each project is based on the households' distribution of business wealth. Table 6 reports the decile distribution of business wealth among families reporting a net value of the business greater than zero, using data from the 1989 and 1992 SCF.[19] The table shows a very concentrated distribution of business wealth. In order to better approximate the skewness of the distribution of this capital, I assign smaller percentages of entrepreneurs to larger projects, with 60 percent running the smallest project, 30 percent the mid-sized project, and 10 percent the largest project. After selecting families with a net value of the business greater than zero, I divide these families into three groups according to their business wealth, with each group counting 60, 30 and 10 percent, respectively. The ratios among the average values of business wealth in each group define the relative distribution of business capital. Combining 1989 and 1992 data, I set $k_2/k_1 = 10$ and $k_3/k_1 = 100$.

Table 6: Percentage of business wealth owned by group percentiles in the SCF.

	Business wealth decile									
	1st	*2nd*	*3rd*	*4th*	*5th*	*6th*	*7th*	*8th*	*9th*	*10th*
1989 SCF	0.02	0.12	0.33	0.75	1.30	1.91	3.08	5.35	10.53	76.61
1992 SCF	0.08	0.28	0.52	0.91	1.45	2.34	3.65	6.22	11.71	72.84

The entrepreneurial idea κ, that is, the project that the entrepreneur is able to implement in the following period, is modeled as a stochastic process with four possible states. The first state corresponds to the event in which there is no entrepreneurial idea, while the second through the fourth states correspond to the entrepreneurial projects k_1, k_2, and k_3. The probability distribution of κ depends only on the project implemented in the current period, and it is denoted by $P_k(\kappa)$. I assume that the probabilities of new ideas are positive only for the projects

[19] I use the SCF data rather than the PSID data because the PSID does not report the value of the households' business wealth.

closer to the ones currently being run. This implies that in order to run a large-scale project, it is first necessary to run a smaller one. The assumption is a simple way to formalize the hypothesis of the existence of a learning process through which the profitability of the business activity increases with entrepreneurial tenure. This assumption, together with the assumption that an entrepreneur can always run the project implemented in the previous period, simplifies the calibration of the vectors P_k, for $k \in \{0, k_1, k_2, k_3\}$. What is relevant is only the probability of getting the higher (and closer) idea; therefore, only one component of each vector P_k needs to be calibrated. At the same time, the probability distribution for an entrepreneur running the largest project is irrelevant because a large-scale entrepreneur never chooses to reduce the scale of his or her activity, if he or she realizes a positive value of the shock. Therefore, only three parameters need to be calibrated, and they are determined such that in equilibrium, the distribution of entrepreneurs equals the imposed distribution of entrepreneurs among the four projects—60, 30, and 10 percent, respectively—and the total fraction of entrepreneurs equals 0.12. This fraction of entrepreneurs is the average value found in the PSID data for the period 1970-92 and in the SCF data for the years 1989-92. The values of these probabilities are determined iteratively in the computational procedure described in Section B of the Appendix, which for the baseline model are $P_0(k_1) = 0.0249$, $P_{k_1}(k_2) = 0.0811$, and $P_{k_2}(k_3) = 0.0358$.

The technology shock takes only two values, $\eta \in \{\eta_1, \eta_2\}$, and it follows a first order Markov process with a transition probability $Q_k(\eta'/\eta)$. I assume that the first component of the technology shock equals zero and it is highly persistent with $Q_k(\eta_1'/\eta_1) = 1$. This implies that the entrepreneur will abandon his or her business when a low value of the shock is realized. Given these assumptions, only one component for each of the four transition probability matrices Q_k, for $k \in \{0, k_1, k_2, k_3\}$, needs to be determined. The calibration of these components is based on the exit rates from entrepreneurship according to the following principles. First, as shown by Table 4 in Section I.3 of this paper, the exit rate from entrepreneurship is very high for new entrants, and then it quickly declines with entrepreneurial tenure. According to the process for the entrepreneurial idea described above, households running larger projects are households with higher entrepreneurial tenure, and therefore, smaller probabilities of the low shock should be assigned to larger projects. Second, as observed in Section I, the exit rates from entrepreneurship underestimate business persistence because the entrance rate of households with business experience is higher. Therefore, in order to take into account the higher probability of reentering entrepreneurship for experienced agents, the values assigned to the probabilities of the low shock for agents running larger projects should be smaller. Taking into consideration these principles, I assign the value of 0.25 to the smallest project, 0.08 to the mid-sized project, and 0.03 to the largest project. This implies an average exit rate from entrepreneurship of 18 percent, which is between the average exit rates resulting from the two definitions of entrepreneurs: business owners and self-employed.

In order to determine the second component of the technology shock η_2, I assume that the mean value of that shock (conditional on the realization of $\eta = \eta_2$ in the previous period) is the same for all projects. Given the transition probabilities and the mean value of the shock, I can determine η_2 for all business projects. Finally, the mean of η is determined such that the percentage of total income earned by entrepreneurs is 22 percent, which is the average percentage found in the PSID data. The value assigned is 1.7.

What still have to be calibrated are the depreciation rates associated with the high and low values of the technology shock. The average depreciation rate for all projects equals the aggregate depreciation rate, which has been set to 0.062. The values assigned to the shock-specific depreciation rates determine the riskiness of the business activity, that is, the volatility of business income, and the borrowing limits. In the baseline model, I set $\delta_{\eta_1} = \delta$. With the assignment of this value, the conditional standard deviation of business income is 1.34 for the smallest project, 0.83 for the mid-sized project, and 0.42 for the largest project. This can be compared with the conditional standard deviation for the earning process, which is 0.33. Therefore, experienced entrepreneurs tend to run larger and less risky projects.

III.4 Intermediation technology

The banking sector intermediates funds to noncorporate businesses at the proportional cost ϕ. This cost determines the difference between the interest rate on loans r_L and the interest rate on deposits r_D.Diaz-Gimenez, Prescott, Alvarez, & Fitzgerald (1992) report the average interest rates paid on various categories of household borrowing and lending to banks and other intermediaries for selected years. Based on these data, they calibrate the nominal interest spread at 5.5 percent. In the baseline model, I set $r_L - r_D = \phi = 0.045$. A sensitivity analysis will be conducted in order to analyze the importance of this parameter for the obtained results.

IV Results

In this section, the model economy described in Section II and calibrated in Section III is used to evaluate quantitatively the importance of entrepreneurship for wealth concentration and mobility. First, I evaluate the model's ability to replicate the main differences in asset holdings and wealth mobility between workers and entrepreneurs as well as its ability to generate the same concentration of wealth as observed in the data. Then, I examine the importance of entrepreneurship for wealth concentration by comparing the distribution of wealth generated by the model economy with the distribution generated by an alternative model that abstracts from entrepreneurial activities. Finally, I perform a sensitivity analysis in order to examine the importance of some of the model parameters for the obtained results.

IV.1 Asset holdings and wealth mobility of workers and entrepreneurs

The top section of Table 7 reports the average wealth-to-income ratio of workers and entrepreneurs found in the stationary equilibrium of the model economy described in Section II. Agents are grouped into three income classes, where each class includes one-third of the population. In order to compare this ratio with that for the U. S. economy, the bottom section of the table reports the same statistics computed from the PSID data as averages of the 1984 and 1989 samples.

One important result is the sizable differences in the ratio of wealth to income between workers and entrepreneurs in all income groups. The lower section of Table 7 shows that this finding is consistent with the empirical evidence for the U. S. economy. Note that due to different data used to calibrate the capital-to-output ratio, the wealth-to-income ratios in the model economy are smaller than the wealth-to-income ratios found in the PSID data. Therefore, the right way to evaluate the performance of the model is to compare the differences in the ratios of wealth to income between workers and entrepreneurs generated by the model, with the same differences found in the data, rather than comparing the absolute values of these ratios. In the artificial economy, the ratio of wealth to income for the total population of entrepreneurs is almost twice as large as the ratio for the total population of workers; in the PSID data, it is

Table 7: Wealth-to-income ratio of workers and entrepreneurs. Model economy and average 1984, 1989 and 1994 PSID data.

	Workers		Entrepreneurs	
	% of Househ.	Wea-Inc Ratio	% of Househ.	Wea-Inc Ratio
Model economy				
- Income Class I	31.0	1.32	2.3	12.51
- Income Class II	30.1	2.41	3.3	2.48
- Income Class III	26.9	3.04	6.4	5.36
- Total	88.0	2.68	12.0	5.15
PSID data				
- Income Class I	31.4	3.74	2.0	11.68
- Income Class II	29.7	2.82	3.6	4.52
- Income Class III	25.2	2.71	8.1	5.90
- Total	86.3	2.86	13.7	5.83

more than twice as large for business families.

Another way to evaluate the performance of the model economy is to look at the distribution of workers and entrepreneurs over wealth classes. Table 8 reports the percentage of workers and entrepreneurs in each wealth class for the model economy and for the PSID data. Each class includes one-third of the agents. As in the PSID data, in the stationary equilibrium of the calibrated economy, entrepreneurs tend to be concentrated in the upper wealth class. The model also performs well in replicating the proportion of workers and entrepreneurs with negative or zero wealth. (See the last row of Table 8.) In the model economy, as in the data, the fraction of agents with negative or zero wealth undertaking an entrepreneurial activity is almost zero. At the same time, the percentage of workers with negative wealth is not very different from the data.

In order to evaluate the performance of the model economy in replicating the main properties of wealth mobility observed in the data, Table 9 reports five-year wealth transition matrices of four subgroups of agents: (a) *staying workers*, that is, agents that do not own a business both at the beginning and at the end of the five-year period; (b) *switching workers*, that is, agents that do not own a business at the beginning of the period but acquire one by the end of the period; (c) *switching entrepreneurs*, that is, agents that own a business at the beginning of the period but lose the business by the end of the period; and (d) *staying entrepreneurs*, that is, agents

Table 8: Distribution of agents among wealth classes. Model economy and average 1984, 1989 and 1994 PSID data.

	Model economy		**PSID data**	
	% of Workers.	% of Entrepr	% of Workers	% of Entrepr
Wealth Class I	31.6	1.7	31.6	1.8
Wealth Class II	29.4	3.9	29.8	3.5
Wealth Class III	27.0	6.4	24.9	8.4
Total	88.0	12.0	86.4	13.6
Neg & Zero	15.5	0.6	11.3	0.6

that own a business both at the beginning and at the end of the five-year period. Table 9, which is the analog of Table 2 of Section I.2, is constructed by simulating the artificial economy for five periods, where a period is calibrated to be one year.

Table 9: Transition matrices for net family wealth. Five-period simulation.

	Class I	**Class II**	**Class III**	**Class I**	**Class II**	**Class III**
	Staying Workers			**Switching Workers**		
Class I	<u>0.81</u>	0.19	0.00	<u>0.61</u>	0.38	0.01
Class II	0.22	<u>0.64</u>	0.14	0.13	<u>0.71</u>	0.16
Class III	0.00	0.18	<u>0.82</u>	0.00	0.15	<u>0.85</u>
	Switching Entrepreneurs			**Staying Entrepreneurs**		
Class I	<u>0.77</u>	0.23	0.00	<u>0.40</u>	0.58	0.02
Class II	0.23	<u>0.66</u>	0.11	0.03	<u>0.64</u>	0.33
Class III	0.00	0.15	<u>0.85</u>	0.00	0.02	<u>0.98</u>

The transition matrices generated by the simulation of the calibrated model are, in general, consistent with the empirical matrices constructed in Section I.2. More specifically, looking at agents that at the beginning of the simulation period are workers (in the top section of the table), we observe the following.

- In the lower class, the percentage of agents moving to higher classes is greater for switching workers than for staying workers.
- In the middle class, the percentage of upwardly mobile agents among switching workers

is higher than the percentage of downwardly mobile agents. The reverse is observed for staying workers.

- In the upper class, the percentage of agents falling to a lower class is smaller for switching workers than for the other workers.

Looking at agents that at the beginning of the simulation period were entrepreneurs (in the bottom section of Table 9), we observe the following mobility patterns.

- In the lower class, the percentage of agents moving to higher classes is greater for staying entrepreneurs.
- In the middle class, the percentage of upwardly mobile agents among the staying entrepreneurs, is higher than the percentage of downwardly mobile agents. The reverse is observed for switching entrepreneurs.
- In the upper class, the percentage of agents falling to a lower class is smaller for staying entrepreneurs than for the other agents.

In summary, the general mobility patterns that are generated in the model economy resemble the empirical mobility properties described in section I of this paper and are characterized by entrepreneurs who tend to stay in or move to higher wealth classes and by workers who tend to stay in or move to lower wealth classes. These different mobility properties of workers and entrepreneurs are consequences of the higher saving behavior of entrepreneurs, and they motivate, from a dynamic point of view, the entrepreneurs' higher asset holdings.

IV.2 Entrepreneurship and concentration of wealth

After showing the performance of the model economy in generating the main differences in asset holdings and wealth mobility between workers and entrepreneurs, this section analyzes the ability of the model to generate a distribution of wealth with a degree of concentration similar to the one observed in the data. The first row of Table 10 reports the top percentiles and the Gini index for the distribution of wealth generated in the stationary equilibrium of the model economy. These statistics are compared with the empirical ones reported in the second row of the table that are based on PSID data. The wealth concentration generated by the model economy is remarkable: the Gini index takes the value of 0.74, and the top 1 and 5 percent of agents hold, respectively, 24.9 and 45.8 percent of total wealth, almost exactly those in the PSID data. The second section of Table 10 reports distributional statistics for income. The concentration of income in the model economy is similar to the empirical one. This is a consequence of the exogenous calibration of most components of income (like labor earnings), and therefore, it is not a dimension along which the performance of the model can be evaluated.

Table 10: Percentage of total wealth and income held by percentile groups and gini Indexes. Model economy and average 1984, 1989 and 1994 PSID data.

	Top percentiles					**Gini**	**Zero**
	1%	*5%*	*10%*	*20%*	*30%*	**Index**	**&Neg**
Wealth							
- Model economy	24.9	45.8	57.1	73.2	84.0	0.74	15.9
- PSID data	26.0	47.0	60.6	76.5	86.2	0.76	11.9
- Only workers	4.2	15.3	26.2	44.5	58.3	0.55	10.1
Income							
- Model economy	7.9	18.2	28.5	46.8	64.0	0.45	0.1
- PSID data	7.6	19.9	30.9	47.8	60.9	0.44	0.6
- Only workers	3.8	13.4	24.4	45.7	60.2	0.42	0.0

The fact that the model economy is able to generate a high degree of inequality in the distribution of wealth does not necessarily imply that entrepreneurship plays an important role in generating that inequality. Therefore, the next question addressed is whether the modeling of the entrepreneurial activities is relevant in generating this concentration of wealth. The strategy followed to answer this question is to compare the model economy developed in this study with an alternative economy which abstracts from the entrepreneurial activities. In this alternative model, all agents are workers facing the same earning uncertainty and liquidity constraints faced by the workers in the model with entrepreneurs. Labor services are supplied to the production sector represented by a Cobb-Douglas production function, with labor and capital inputs, calibrated to match aggregate statistics. This model is similar to the model that is analyzed in Aiyagari (1994), except that the calibration of the earning process has been modified in order to generate a degree of earning inequality similar to the one observed in the data.[20]

The Gini indexes and the top percentiles of wealth and income generated by this model are reported in Table 10 under the heading *Only workers*. It is clearly evident that this model generates a much lower concentration of wealth than the model with entrepreneurs. The Gini index is 0.55, and the top 1 percent of agents own only 4.2 percent of total wealth. If we quantify the importance of entrepreneurs in generating wealth inequalities by the increase of the Gini index, then we can state that 34 percent of wealth concentration is attributable to the existence of the business sector. However, the Gini index is only a summary measure of inequality, and a more detailed description of wealth concentration is given by the percentages of total wealth owned by top wealth holders. It is in this respect that the modeling of the entrepreneurial activities becomes crucial. In the model with only workers, the top 1 percent of agents hold only 4.2 percent of total wealth, but once entrepreneurs are included in the model, this percentage jumps to 24.9 percent. Therefore, the model with entrepreneurs generates a higher concentration of wealth at the upper tail of the distribution, with distributional statistics closer to the ones found in the data.

IV.3 Discussion

After showing the importance of entrepreneurship in generating a higher concentration of wealth, one may wonder why the model without entrepreneurs does not generate such a concentration, while the model with entrepreneurs does. The problem is that in the standard model with uninsurable risks to labor earnings, the only motive to save is precautionary: in order to smooth consumption, agents build a buffer of wealth. However, once the buffer has reached a certain level, the incentive to save disappears. The introduction of life cycle features, like in Huggett (1996), increases the concentration of wealth as measured by the Gini index. However, the model generates this higher concentration of wealth by increasing the proportion of households with zero or negative wealth, rather than by generating a higher concentration at the top of the

[20] In Aiyagari (1994), as in this study, the logarithm of earnings is assumed to follow a first order autoregressive process. However, while in Aiyagari all agents have the same unconditional mean of the earning process, the model developed in this study assumes that in each period, the economy is populated by agents of different types where types, are characterized by a different unconditional mean of the earning process. The autocorrelation coefficient and the standard deviation of the log-earning process, instead, are the same across types, and the calibrated values are similar to the values used in the baseline model by Aiyagari. See section III for more details.

distribution. [21]

Therefore, there must be other mechanisms inducing some agents to accumulate and maintain very high levels of wealth. The hypothesis developed in this paper is that opportunities are related to wealth. On one hand, due to borrowing constraints and the higher cost of external financing, only agents endowed with enough wealth are able to enter entrepreneurship or to take advantage of better businesses. On the other hand, the accumulation of more wealth allows entrepreneurs to save the higher cost of external financing (debt), thereby to increase profits. At the same time, the higher risk associated with entrepreneurial activities further increases the conservative saving of these agents.

In summary, three main factors contribute to generate the higher accumulation pattern of entrepreneurs. The first factor is the incentive to save in order to undertake an entrepreneurial activity or to implement larger projects in the presence of borrowing constraints. The second factor is the cost of external financing. In this economy, there are financial intermediation costs that make external financing more expensive. This implies that for those entrepreneurs with a level of wealth lower than the capital invested in the business, the marginal return on saving and, therefore, the incentive to save are higher. The third factor is the uninsurable entrepreneurial risk: when the agent makes the occupational choice, the agent knows with certainty the income he or she will earn if worker. However, if he or she decides to become an entrepreneur, then the agent's income depends on the realization of the shock, which is unknown when the decision is made. Therefore, by undertaking an entrepreneurial activity, the agent faces a higher income uncertainty that induces him or her to save more for precautionary motives.

Along with these three factors that directly influence the entrepreneur's saving behavior, the higher asset holdings generated by the model economy are also a consequence of a selection mechanism. On one hand, the existence of borrowing constraints have the effect of selecting entrepreneurs among richer workers. On the other hand, only successful entrepreneurs are able to keep their business, and because they are successful, they are also able to accumulate more wealth. An important role in concentrating wealth in the hands of entrepreneurs is played by business persistence and turnover. The modeling of a learning process in the business ability is

[21] Huggett (1996) analyzes an overlapping generation economy where agents face two types of risks: earnings uncertainty and lifetime uncertainty. In that economy, the obtained Gini coefficient for wealth is close to the empirical one, but the asset holdings of the top 1 and 5 percent of asset holders is well below the observed values.

such that experienced households face lower probabilities of exiting entrepreneurship. This implies that a restricted percentage of families (those with business experience) spend, on average, a great deal of time in the business group, and given their higher saving rates, this allows them to accumulate a consistent amount of wealth.

IV.4 Sensitivity Analysis

In order to analyze the importance of some key parameters for the performance of the model economy, in this section I conduct a sensitivity analysis with respect to two main parameters: the intermediation cost ϕ and the depreciation of business capital. The analysis evaluates the importance of the parameters underlying two of the main mechanisms that in the model economy generate the concentration of wealth. The first mechanism is derived from the accumulation of assets that are induced by the higher marginal return on savings as a consequence of the higher cost of external financing. The second mechanism is derived from the higher savings that are induced by the riskiness of the business activity (precautionary motives) and from the incentive to overcome the borrowing limits. Because the stochastic properties of the shock determine the minimum value of assets that are necessary to start a business or to implement larger projects, that is, the borrowing limits, the sensitivity analysis with respect to this parameter provides a joint evaluation of the importance of the riskiness of the business and the borrowing limits.

The first line of Table 11 reports distributional statistics for the economy without intermediation cost ϕ, and therefore, the marginal return on savings is the same for workers and entrepreneurs. These statistics can be compared with the same statistics for the baseline model that are reported at the bottom of the table. As can be seen, the degree of inequality decreases after the elimination of the intermediation cost.

The riskiness of the business and the borrowing limits also have distributional consequences, as can be seen in the middle section of Table 11 which reports distributional statistics when the idiosyncratic technological shock takes the mean value $\bar{\eta}$ (low risk) and when the depreciation rate associated with a low value of the shock is doubled (high risk). Note that when $\eta_1 = \eta_2 = \bar{\eta}$, entrepreneurs still face the risk of loosing the business, even though without losses.

Finally, the third section of the table reports concentration statistics for the case in which both the intermediation cost and the technology shock are eliminated. This version of the econ-

Table 11: Sensitivity analysis with respect to the cost of capital and the entrepreneurial risk. Numbers are in percentage term.

	Top percentiles					**Gini**	**Zero**
	1%	*5%*	*10%*	*20%*	*30%*	**Index**	**&Neg**
Zero intermediation cost	19.1	39.2	51.6	68.3	81.2	0.69	14.2
Low entrepreneurial risk	19.7	40.0.	52.1	69.2	82.0	0.70	14.9
High entrepreneurial risk	26.1	47.2	58.4	74.3	85.5	0.75	17.1
Without cost and low risk	14.9	34.2	45.7	64.8	77.6	0.66	13.1
Baseline economy	24.9	45.8	57.1	73.2	84.0	0.74	15.9

omy is similar to the economy without entrepreneurs, but with a modified labor earning process that includes the profits from business activities. Looking at these distributional statistics, we see the importance of the intermediation cost and the riskiness of the business in generating wealth concentration. If we reinterpret the intermediation cost as a result of optimal contracts between lenders and borrowers in the presence of agency costs or moral hazard problems and the borrowing limits as the minimum value of collateral such that these contracts are optimal for the lenders, then the findings of this study show that these costs have important consequences for wealth concentration and inequality, in addition to the importance for business fluctuations as emphasized by Bernanke & Gertler (1989).

It is important to point out that the version of the model without intermediation cost and low entrepreneurial risk is not able to generate substantial differences in asset holdings and wealth mobility between workers and entrepreneurs.[22] This result shows that the different saving behavior of workers and entrepreneurs is the key element underlying the different asset holdings and mobility between these two categories of agents. Once the key factors driving the different saving behaviors are eliminated (cost of external financing and riskiness of the business), the model does not generate the differences in asset holdings and mobility between these two categories of agents observed in the data.

[22]For economy of space, these statistics are not reported.

V Conclusion

The object of this paper is to study the importance of entrepreneurship for wealth concentration and mobility. The study begins with the analysis of data from the PSID and the SCF, which reveals substantial differences in asset holdings and wealth mobility between workers and entrepreneurs. In particular, the empirical analysis shows a significant concentration of wealth among business families which, at least in part, is responsible for the high concentration of wealth observed in the data. Consequently, the study of the accumulation behavior of entrepreneurs represents an important step toward understanding wealth concentration and inequality.

The key properties of wealth concentration and mobility are further analyzed through the construction of a general equilibrium model of income and wealth distribution which formalizes the agents' choice of engaging in entrepreneurial activities. By explicitly modeling the entrepreneurial choice, the model economy developed in this study is able, first, to generate the higher asset holdings of entrepreneurs observed in the data and, second, to reproduce the whole inequality in the distribution of wealth. This is an important result of this study when we consider that the standard model with heterogeneous agents affected by idiosyncratic shocks to labor earnings and subject to liquidity constraints—but which abstracts from entrepreneurial activities—fails to account for such a concentration. Therefore, the modeling of entrepreneurial activities is essential in order to explain the high concentration of wealth observed in the U. S. economy.

Three main elements in the model economy generate higher asset holdings for entrepreneurs. First, the presence of borrowing constraints induces some agents—those with entrepreneurial ideas—to accumulate more wealth in order to reach minimal capital requirements. Second, the presence of financial intermediation costs makes the marginal return from saving higher for an agent with a level of wealth lower than the amount of capital invested in the business. Therefore, for these agents, the incentive to save is greater. Third, the risk associated with an entrepreneurial activity leads entrepreneurs to take precautionary measures. Because agents are risk averse, they save more to counter their assumed risk. Along with these two factors, there are also two selection mechanisms that play a role in generating the concentration of wealth among entrepreneurs. One selection mechanism is due to the existence of borrowing constraints and the higher cost of external finance, which both result in selecting entrepreneurs among richer workers. The other selection mechanism stems from the fact that only successful entrepreneurs remain in the business: since they are running successful activities, they have higher incomes and, therefore, greater opportunity to accumulate more wealth.

The different accumulation patterns of workers and entrepreneurs also have important implications for shaping the different wealth mobility patterns that characterize the two types of agents. In fact, as a consequence of the higher saving behavior of entrepreneurs relative to workers, the model economy is able to replicate the upward wealth mobility experienced by the former and the downward wealth mobility experienced by the latter.

The analysis conducted in this study, while essentially positive in substance, holds interesting normative implications for policy design and raises some important policy questions: can the mobility properties of the whole society be altered by implementing policies which increase the extent of entrepreneurship in the economy? Moreover, what are the indirect effects on socioeconomic mobility of those government policies which reduce the saving incentive for agents located at the lower end of the distribution? An example of these policies are the mean-tested policies considered by Hubbard, Skinner, & Zeldes (1995). As constructed, the model economy allows for the analysis of several other issues such as the effect of entrepreneur-directed incentives on aggregate savings and mobility. These and other important issues are potential areas of future research.

A Data appendix

PSID data

In the Panel Study of Income Dynamics (PSID) *family wealth* is defined as the sum of the net worth of all family members that results from the aggregation of the following components: house (main home), other real estate, vehicles, farms and businesses, stocks, cash accounts, and other assets. *Family income* is defined as the sum of income coming from all sources plus transfers of all family members.

According to the first definition of entrepreneurs, *entrepreneurs* are families that own a business. This definition is based on the PSID variable *Whether Business* which is based on the following interview question: "Did you (Head) or anyone else in the family own a business at any time during the previous year or have a financial interest in any business enterprise? " Therefore, a broad definition of entrepreneur is adopted: the business ownership of only one member of the family is sufficient to include the whole family in the business group. Moreover, the business activity does not have to be the main occupation of the owner. According to the second definition of entrepreneurs, *entrepreneurs* are families in which the head is self-employed in his or her main job, while *workers* are identified as families in which the head is a dependent worker. More specifically, the classification is based on the following PSID interview question: "In your main job, are you (Head) self-employed or do you work for someone else?"

SCF data

In the Survey of Consumer Finances (SCF), *family wealth* is defined as the net worth of households. This includes the value of financial and real assets of all kinds, net of all kinds of debt. Specifically, the definition includes the following assets: residences and other real estate; farms and all other businesses; checking accounts, certificates of deposit, and other banking accounts; IRA/Keogh accounts, money market accounts, mutual funds, bonds and stocks, cash and call money at a stock brokerage, and all annuities, trusts, and managed investment accounts; vehicles; the cash value of term life insurance policies and other policies; money owed by friends, relatives, businesses, and others; pension plans accumulated in accounts; and other assets. *Family income* is defined as the sum of all kinds of income before taxes received by all members of the family. Specifically, the definition includes the following sources: wages and salaries; income (whether positive or negative) from professional practices, businesses and farms; interest income, dividends, gains or losses from the sale of stocks, bonds, and real estate; rent, trust income, and royalties from any other investment or business; unemployment and worker compensation; child support and alimony; Aid to Dependent Children, Aid to Families with Dependent Children, food stamps, and other forms of welfare and assistance; income from social security and other pensions, annuities, compensation for disabilities, and retirement programs; income from all other sources such as settlements, prizes, scholarships and grants, inheritances, gifts, and so on.

According to the first definition of entrepreneurs, *entrepreneurs* are families for which the dollar value of the business is greater than zero. According to the second definition, *entrepreneurs* are families for which the head is self-employed in his or her main job.

Business wealth is the market value of the business, that is, the dollar amount that the owner would get if he or she sold the business.

B Computational procedure

Given the complexity of the model, an analytical solution is not available; therefore, the calibrated model is solved by applying numerical methods. The numerical technique consists of dividing the state space in a finite number of points (discrete grid). An interval of asset holdings is approximated with 3,000 discrete points with the lower bound determined as the negative of the maximum amount that an agent can ever borrow, while the chosen upper bound is such that in the stationary equilibrium, the measure of agents with this level of asset is zero. The distance between contingent points is chosen to be finer at lower levels of assets and coarser at higher levels. After approximating the state space with discrete points, the household problem is a finite-state discounted dynamic problem with the value function taking $96,000$ possible values.

The computational procedure used to solve for the stationary equilibrium starts by guessing five parameter values: the discount factor β; the mean of the technology shock in the noncorporate sector $\bar{\eta}$; and the probabilities $P_0(\kappa = k_1)$, $P_{k_1}(\kappa = k_2)$, and $P_{k_2}(\kappa = k_3)$. Subsequently, the household problem is solved by iterating on the value functions. Then, using the resulting decision rules, we seek a stationary distribution by iterating on the measure μ. Once the stationary distribution has been found, the corporate capital-to-labor ratio that is generated in this stationary distribution is compared with the capital-to-labor ratio that is implied by the calibration of the corporate technology. If the difference is greater than the tolerance value, the intertemporal discount rate β is updated, and the whole procedure is repeated until convergence. At this point, we have to check that the distribution of entrepreneurs among the four projects, generated in the stationary distribution, equals the targeted distribution (7.2, 3.6, and 1.2 percent, respectively) and check that the percentage of income earned by entrepreneurs is equal to 21 percent. If not, the guessed probabilities P_k, for $k \in \{0, k_1, k_2\}$, and $\bar{\eta}$ are updated, and the whole procedure is repeated until convergence. The program code is written in C and it is available upon request from the author.

References

Abowd, J. M. & Card, D. (1989). On the covariance structure of earnings and hours changes. *Econometrica*, *57*(2), 411–45.

Aghion, P. & Bolton, P. (1993). A theory of trickle-down growth and development with debt-overhang. Manuscript.

Aiyagari, S. R. (1994). Uninsured idiosyncratic risk, and aggregate saving. *Quarterly Journal of Economics*, *CIX*(3), 659–84.

Banerjee, A. V. & Newman, A. F. (1991). Risk-bearing and the theory of income distribution. *Review of Economic Studies*, *58*(2), 211–35.

Banerjee, A. V. & Newman, A. F. (1993). Occupational choice and the process of development. *Journal of Political Economy*, *101*(2), 274–98.

Behrman, J. R. & Taubman, P. (1990). The intergenerational correlation between children's adult earnings and their parents' income: results from the michigan panel survey of income dynamics. *Review of Income and Wealth*, *36*(2), 115–27.

Bernanke, B. & Gertler, M. (1989). Agency costs, net worth, and business fluctuations. *American Economic Review*, *79*(1), 14–31.

Diaz-Gimenez, J., Prescott, E. C., Alvarez, F., & Fitzgerald, T. (1992). Banking in computable general equilibrium economies. *Journal of Economic Dynamics and Control*, *16*, 533–59.

Duncan, G. J. & Morgan, G. N. (1984). *An Overview of Family Economic Mobility.* Institute for Social Research, University of Michigan. in Duncan, Greg J et al.

Evans, D. S. & Jovanovic, B. (1989). An estimated model of entrepreneurial choice under liquidity constraints. *Journal of Political Economy*, *97*(4), 808–27.

Evans, D. S. & Leighton, S. L. (1989). Some empirical aspects of entrepreneurship. *American Economic Review*, *79*(3), 519–35.

Fazzari, S. M., Hubbard, R. G., & Petersen, B. C. (1988). Financing constraints and corporate investment. *Brookings Papers on Economic Activity*, *88*(1), 141–95.

Federal Reserve Board (1990). Distribution of tangible assets by sector. *Balance Sheet for the U.S. Economy*, *1*, 13–18.

Gertler, M. & Gilchrist, S. (1994). Monetary policy, business cycles, and the behavior of small manufacturing firms. *Quarterly Journal of Economics*, *CIX*(2), 309–40.

Gilchrist, S. & Himmelberg, C. P. (1994). Evidence on the role of cash flow for investment. *Journal of Monetary Economics*, *36*(3), 541–72.

Holtz-Eakin, D., Joulfaian, D., & Rosen, H. S. (1994). Sticking it out: entrepreneurial survival and liquidity constraints. *Journal of Political Economy*, *102*(1), 53–75.

Hubbard, R. G., Skinner, J., & Zeldes, S. P. (1995). Precautionary saving and social insurance. *Journal of Political Economy*, *103*(2), 360–99.

Huggett, M. (1996). Wealth distribution in life-cycle economies. *Journal of Monetary Economics*, *38*(3), 469–494.

Hungerford, T. L. (1993). U.s. income mobility in the seventies and eighties. *Review of Income and Wealth*, *39*(4), 403–17.

Mehra, R. & Prescott, E. (1985). The equity premium: a puzzle. *Journal of Monetary Economics*, *15*, 145–61.

Quadrini, V. (1996). The importance of entrepreneurship for wealth concentration and mobility. Unpublished Manuscript. University of Pennsylvania.

Quadrini, V. & Ríos-Rull, J.-V. (1997). Understanding the u.s. distribution of wealth. *Quarterly Review of The Federal Reserve Bank of Minneapolis*, *21*(2), 22–36.

Sawhill, I. V. & Condon, M. (1992). Is u.s. income inequality really growing?. *Policy Bites*, *The Urban Institute*(2).

Solon, G. (1992). Intergenerational income mobility in the united states. *American Economic Review*, *82*(3), 393–408.

Wolff, E. N. (1995). *Top heavy - A study of the increasing inequality of wealth in America*. The Twentieth Century Fund Press, New York.

Zimmerman, D. (1992). Regression toward mediocrity in economic stature. *American Economic Review, 82*(3), 409–29.