Inequality, bankruptcy and the macroeconomy

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Declaration

I certify that the thesis I have presented for examination for the PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

I warrant that this authorization does not, to the best of my belief, infringe the rights of any third party.

Declaration

I certify that chapters one and two of this thesis, "Entrepreneurship and Personal Bankruptcy Law: A Quantitative Assessment" and "Personal Bankruptcy Law, Debt Portfolios and Entrepreneurship", were coauthored with Jochen Mankart. Giacomo Rodano contributed 50 percent to the genesis of the project, 50 percent to the computational implementation, and 50 percent to the writing of the text. In addition, chapter 5 of this thesis, "The Causal effect of Bankruptcy Law on the Cost of Finance", was coauthored with Emanuele Tarantino e Nicolas Serrano-Velarde. Giacomo Rodano contributed 33 percent to the genesis of the project, 33 percent to the empirical implementation, and 33 percent to the writing of the text.

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Abstract

This thesis examines the determinants inequality and its effects on macroeconomic outcomes, and in particular the economic effects of bankruptcy law.

The first two chapters are joint work with Jochen Mankart. In the first chapter, we examine the effects of Chapter 7 of the US bankruptcy law on entrepreneurs. Entrepreneurs are subject to production risk. They can borrow and if they fail they can default on their debt. We examine the optimal wealth exemption level and the optimal credit market exclusion duration in this environment.

In the second chapter, we introduce secured credit, in addition to unsecured credit in a model that is similar to the one in the first chapter. Secured credit lowers the cost of a generous bankruptcy regime because agents who are rationed out of the unsecured credit market can still obtain secured credit. Therefore, the optimal exemption level is very high.

In the third chapter, I estimate stochastic process for earnings of Italian individuals. I find that individual's earnings present statistically significant heterogeneity both in levels and in growth rates that is determined before the beginning of economic activity.

In the fourth chapter, I analyze the quantitative effects of introducing immediate debt discharge (fresh start) in the procedures of personal bankruptcy law on the saving and default decisions of Italian household. I find that introducing fresh start in the Italian bankruptcy law would worsen credit conditions, without almost any benefit in terms of better insurance.

The fifth chapter is joint work with Emanuele Tarantino and Nicolas Serrano-Velarde. In this chapter we exploit the recent reform of bankruptcy law in Italy to analyze the effects of bankruptcy regulation on the cost of credit. We find that strengthening firms' rights to renegotiate outstanding deals with creditors increased the costs of funding, while simplifying the procedure of liquidation decreased the costs of funding.

In the sixth chapter, I show that credit market imperfections are not necessary to generate an individual poverty trap.

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Preface

This thesis examines the determinants inequality and its effects on macroeconomic outcomes. In particular in the first two chapters and in the fourth chapter, I analyze, with quantitative general equilibrium models with endogenously heterogeneous agents, how bankruptcy law affects inequality and how inequality shapes the effects of bankruptcy law on the economic outcomes. In the third and in the last chapter I analyze the determinants of inequality: in the third chapter I estimate the stochastic process governing individual earnings while in the last chapter I analyze the conditions for a poverty trap to emerge even in a world with perfect credit markets. In the fifth chapter I look at the effects of bankruptcy law on the cost of finance.

The first two chapters are joint work with Jochen Mankart. In the first chapter, we examine the effects of Chapter 7 of the US bankruptcy law on entrepreneurs. We develop a quantitative general equilibrium model of occupational choice that examines the effects of the US personal bankruptcy law on entrepreneurship. The model explicitly incorporates US personal bankruptcy law and matches empirical features of the US economy regarding entrepreneurship, wealth distribution, and bankruptcy filings by entrepreneurs. The option to declare bankruptcy encourages entrepreneurship through insurance since entrepreneurs may default in bad times. However, perfectly competitive financial intermediaries take the possibility of default into account. They charge higher interest rates which reflect these default probabilities. Thus, personal bankruptcy provides insurance at the cost of worsening credit conditions. Our quantitative evaluation shows that in the current US bankruptcy law the latter effect dominates. Halving the wealth exemption level from the current level would increase entrepreneurship, the median firm size, welfare, and social mobility, without increasing inequality. On the other hand, eliminating completely the possibility of bankruptcy would reduce welfare and entrepreneurship.

In the second chapter, we introduce secured credit, in addition to unsecured credit in a model that is similar to the one in the first chapter. We show that secured credit alters the results dramatically. The reason is that if secured credit is not available, a high exemption level leads to tight endogenous borrowing limits. This implies that some, in particular poor, agents will be excluded from borrowing because their ex post incentive to default is too high. However, if they can waive their right to default by using secured credit, i.e. by providing collateral, the negative effect of a generous bankruptcy law is lessened and so the optimal exemption level is a lot higher.

In the third chapter, I estimate the stochastic process for earnings of Italian individuals. My estimates show that Italian individual's earnings present statistically significant heterogeneity both in levels and in growth rates that is determined before the beginning of economic activity. At the same time I find that shocks affecting earnings during the life-cycle exhibit a very persistent component. However if we control for observables (in particular sex and education) the variance of the growth rate is much smaller. Our estimates suggest that the contribution to the variance of permanent income of factors that are already determined at the moment of entering the labour market is in the order of 80

In the fourth chapter, I focus on consumer bankruptcy. In particular I examine the effects of introducing immediate debt discharge (fresh start) in the procedures of personal bankruptcy law on the saving and default decisions of Italian households. The option to declare bankruptcy provides insurance against the downside of uninsurable earnings risk by discharging some or all the debt since consumers may default on their liabilities in bad times. However, financial intermediaries will consider the availability of debt discharge into account and they will charge higher interest rates on their loans. Thus immediate debt discharge provides better insurance at the cost of worse credit conditions. To quantify this trade-off we develop an overlapping generations, heterogeneous agents quantitative model of consumption, saving and bankruptcy decisions of Italian households. The model explicitly includes default consequences on the Italian legislative framework and replicates empirical features of the Italian economy regarding savings, debt, credit conditions and wealth distribution. Our quantitative evaluations show that the main effect of introducing fresh start in the Italian bankruptcy law would be that of worsening credit conditions. This would more that outweigh the benefits, if any, that fresh start provides in terms of better insurance. The overall effect would be a reduction in welfare of all the agents in the model. The magnitudes of the average welfare losses are in the order of a reduction of 0.1

The fifth chapter is joint work with with Emanuele Tarantino and Nicolas Serrano-Velarde. We study the effects of the 2005/06 reforms of Italian bankruptcy law on the costs of finance for small and medium sized firms. We exploit the quasi-experimental features of the policy change in combination with a unique loan-level dataset covering the universe of funding contracts. Our results indicate that the reforms significantly reduced the interest rates charged by banks on loans and overdrafts. The fact that the reforms were introduced in a piecemeal fashion allows us to separately identify the impacts of the two major bills composing the policy change. We find that the bill strengthening firms' rights to renegotiate outstanding deals with creditors increased the costs of funding, while the law simplifying the procedure of liquidation decreased the costs of funding.

In the sixth chapter I show that, contrary to what it is usually assumed in the development literature, credit market imperfections are not necessary to generate an individual poverty trap. If productivity is increasing in consumption a poverty trap can emerge from income effects even under perfect credit markets.

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Chapter 1

Personal Bankruptcy Law and Entrepreneurship: A Quantitative Assessment

1.1 Introduction

Entrepreneurs employ half of all workers in the US and they create three quarters of all new jobs.[1] Over time, successful small entrepreneurial firms grow into big firms and drive the technological progress. For example, four of the 20 largest companies in 2007, Microsoft, Cisco Systems, Google and Dell, were born in the last generation. Personal bankruptcy law is important for entrepreneurs because if an entrepreneur's firm is not incorporated he is personally liable for all the debts of his firm. And even if the firm is incorporated, the entrepreneur very often has to provide personal guarantees to secure a loan [Berkowitz / White 2004]. Ten percent of entrepreneurs go out of business each year, and out of these around twenty percent through bankruptcy.

This paper investigates quantitatively the effects of personal bankruptcy law on entrepreneurship. We focus on two key features of the personal bankruptcy procedures: the wealth exemption level and the duration of the credit market exclusion period. The wealth exemption level determines how much wealth a person can keep in case of a default. The length of the credit market exclusion period determines when someone who has defaulted in the past regains access to credit.

Bankruptcy introduces some contingency in a world of incomplete credit markets in which

[1] We thank Alex Michaelides for his continuous support and valuable comments, and Francesco Caselli and Maitreesh Ghatak for helpful comments at various stages of this research. We are also grateful to Daniel Becker, Wouter Den Haan, Emmanuel Frot, Alberto Galasso, Bernardo Guimaraes, Christian Julliard, Rachel Ngai, and participants at the LSE macro and development seminars, the 2008 EEA meeting and the 2008 SCE meeting.

only simple debt contracts are available. However, it provides only partial contingency and does not complete the markets fully. This contingency provides insurance against entrepreneurial failure at the cost of worsening credit conditions. If the bankruptcy law does not allow default under any circumstances, i.e. if there is full commitment, credit will be available at low interest rates because borrowers can not default. This comes at the expense of borrowers having no insurance against business failure. If, however, the bankruptcy law makes default very easy, borrowers might be insured against bad outcomes. But in order to compensate for the default risk banks have to charge higher interest rates or ration credit altogether. In both extreme cases the equilibrium outcome can be one of almost no credit. In the former case there is no demand for credit whereas in the latter there is no supply of credit. In this world many firms are inefficiently small, especially those owned by poorer entrepreneurs. This trade-off is at the center of recent public discussions and policy changes in Europe and the US. In Europe the bankruptcy law is much harsher than in the US. Many countries like for example Germany, Netherlands and the UK, made it more lenient with the explicit aim of fostering entrepreneurship.[2] The policy changes in the US went into the opposite direction. Following the huge increase in personal bankruptcy filings, US Congress in 2005 passed a law making personal bankruptcy less beneficial for filers. Even though the focus of the discussion has been on consumer bankruptcy, the effects on entrepreneurship are important because around 80,000 failed entrepreneurs file for bankruptcy each year. Our paper quantitatively assesses the relative strength of these two opposing forces, insurance versus credit conditions, on the number of entrepreneurs, on the access of poor agents to entrepreneurship, on firm size, and on welfare, inequality and social mobility.

We build an infinite horizon heterogeneous agent model which has an occupational choice problem at its core. Agents differ with respect to their entrepreneurial productivity and their working productivity. Each period they decide whether to become an entrepreneur or a worker, based on a noisy signal of their productivities. Cagetti / De Nardi [2006] also have this occupational choice at the center of their model. Their model is able to explain the US wealth distribution, in particular the extreme skewness at the top. However, in their model entrepreneurship is a risk-free activity because there is no uncertainty about current productivities. Thus there is no default in equilibrium and there is no insurance role for bankruptcy. In our model default exists because a significant fraction of entrepreneurs files for bankruptcy.

Starting with Athreya [2002], there is a growing literature on consumer bankruptcy. For example, Livshits et al. [2007] compare the US system under which future earnings are exempt after consumers have declared bankruptcy with a European type of system under which future earnings are garnished to repay creditors. They find that the welfare differences between the systems depend on the persistence and variance of the shocks. Chatterjee et al. [2007] show that a recent tightening of the law in the US implies large welfare gains.[3] We differ from all

[2] In a companion paper, we are currently investigating the effects of introducing a US type of law in Europe.
[3] Other papers in this growing literature are Athreya [2006], Athreya / Simpson [2006], Li / Sarte [2006], Mateos-Planas / Seccia [2006].

these papers by focusing on entrepreneurs.[4] Moreover, as Chatterjee et al. [2007], we focuses on the wealth distribution because the benefits of bankruptcy depend crucially on the wealth of an agent.

There are two closely related papers that analyze the effects of bankruptcy on entrepreneurship in a quantitative setting similar to our paper.[5] Akyol / Athreya [2007] use an overlapping generations, partial equilibrium framework. They have heterogeneity in human capital. Their main results is that the current system is too generous. Meh / Terajima [2008] have a similar framework (partial equilibrium OLG model) in which they analyze bankruptcy decisions of both consumers and entrepreneurs. Our paper differs from these in the following way: We have two types of shocks, one persistent and one transitory. This allows us to capture the feature that many agents enter and exit entrepreneurship frequently. This fact has been emphasized by Quadrini [2000]. Our model is a general equilibrium model. The importance of general equilibrium effects has been shown by Li / Sarte [2006].

Our model is able to replicate key macroeconomic variables of the US economy: capital output ratio, fraction of entrepreneurs in the population, exit rate, bankruptcy filings of entrepreneurs, wealth of entrepreneurs compared to workers. Based on this model we conduct two experiments to assess whether the current exemption level and the current exclusion period are optimal. Our main result is that the current system is too lenient with respect to the exemption level.

There are significant welfare gains from halving the current exemption level. These are in the order of 1.4% of annual consumption per household which corresponds to $700 in 2007. The welfare gains from lowering the exemption level do not only occur from an ex ante, expected utility, perspective but also across the entire wealth distribution. Both the rich and the poor would gain. The cause of this result is that the current system provides too much insurance. This worsens credit conditions for entrepreneurs so much that there are fewer of them. Entrepreneurship increases from 7.6% of the population to 8.6% if the exemption level is halved because credit gets cheaper. However, completely abolishing bankruptcy would lead to a welfare loss in the order of $60 per household since some insurance is valuable.

The effects of changing the exclusion period are small. Reducing it from six to two years yields a welfare gain in the order of $90 annually per household. Reducing the exclusion period allows the talented entrepreneurs who have defaulted in the past to regain access to credit sooner and therefore run bigger firms. In contrast to increasing the exemption level, this form of insurance, is less harmful for credit conditions since it does not reduce the amount the banks recover in the event of default. However, since the number of talented defaulters is small compared to all defaulters, these effects are quantitatively small.

[4] Zha [2001] is a theoretical investigation of similar issues. However his model abstracts from occupational choice, that we show to be the crucial channel through which bankruptcy law affects entrepreneurship. Moreover he does not calibrate his model to the US economy. Therefore his simulations give only qualitative suggestions.

[5] These two papers and ours' were developed independently. We published our first version in June 2007 on our website.

Our results are consistent with the empirical finding of Berkowitz / White [2004] who show that in states with higher exemption levels credit conditions are worse. Our results are partially consistent with the findings of Fan / White [2003]. They show that entrepreneurship increases when the exemption level is increased from a very low level. However we differ for high exemption levels: we find that high exemption levels lead to a decline in entrepreneurship while they find the opposite.

The paper is organized as follows, Section 2 provides an overview of US bankruptcy law and presents data on entrepreneurial failure. In Section 3 we present our model and discuss the equilibrium condition. In Section 4 we discuss our calibration strategy and present the baseline results. Section 5 explains the main mechanism of the model. In Section 6 we conduct the policy experiments and Section 7 concludes.

1.2 Entrepreneurial failure and personal bankruptcy in the US

Personal bankruptcy procedures in the US consist of two different procedures: Chapter 7 and Chapter 13. Under Chapter 7, all unsecured debt is discharged immediately. Future earnings cannot be garnished. This is why chapter 7 is known as providing a "fresh start". In exchange for this a person filing for bankruptcy has to surrender all wealth in excess of an exemption level. The exemption level varies across US states, ranging from $11,000 in Maryland to unlimited for housing wealth in some states, for example Florida. Following the literature, we calculate the population-weighted average across states. The resulting average exemption level is $77,591 in 1993.[6]

Under Chapter 13 agents can keep their wealth, debt is not discharged immediately and future earnings are garnished. Entrepreneurs are better off under Chapter 7 for three reasons: they have no non-exempt wealth, their debt is discharged immediately and they can start a new business straight away, since their income will not be subject to garnishment (see White, 2007). 70% of total bankruptcy cases involving entrepreneurs are under chapter 7. Therefore we will focus on Chapter 7 only.

Persons can file for bankruptcy only once every six years. The bankruptcy filing remains public information for ten years. But there is no formal rule about bankruptcy filers being excluded from credit. However,in practice, we observe that bankruptcy filers have difficulties obtaining credit for a periods ranging from 3 to 8 years after the filing [Athreya 2002].

The US. Small Business Administration reports an exit rate of on average 9.7% per annum for small firms in the period from 1990-2005.[7] Out of these failing firms 9.3% exit through

[6] The wealth exemption level does not change much over time. We choose 1993 because it is in the middle of the sample years for our data on entrepreneurship wealth distribution and bankruptcies.

[7] The U.S. Small Business Administration splits small firms into employer and non-employer firms. Employer firms have at least one employee working in the firm. There are roughly five million employer and 15 million non-employer firms in the U.S. Since the focus of our paper is on entrepreneurs who own and manage the firm we use only the data for employer firms since non-employer firms have in many cases the owner not working in

bankruptcy, according to the official data from the Administrative Office of the Courts.[8] Unfortunately, the official data on personal bankruptcy caused by a business failure seem to be severely downward biased. Lawless / Warren [2005] estimate that the true number could be three to four times as big. Their own study is based on an in-depth analysis of bankruptcy filers in five different judicial districts. Their explanation of this discrepancy is the emergence of automated classification of personal bankruptcy cases. Almost all software used in this area has "consumer case" as the default option. Thus reporting a personal bankruptcy case as a "business related" case requires some - even though small - effort while being completely inconsequential for the court proceedings. In addition to their own study they report data from Dun & Bradstreet according to which exit through bankruptcy is at least twice the official number[9].

In the calibration of our model we set the baseline exemption level equal to $77,591. The baseline exclusion period is set to six years. We calibrate the model such that the ratio of bankruptcies over exits is equal to 20%.

1.3 The model

Our economy is populated by a unit mass of infinitely lived heterogeneous agents. Agents face idiosyncratic uncertainty, but there is no aggregate uncertainty. At the beginning of every period, agents decide whether to become workers or entrepreneurs. An entrepreneur must decide how much to invest and, if he is allowed to, how much to borrow. An entrepreneur who has defaulted in the past is not allowed to borrow for some time. Since we focus on the implications of personal bankruptcy for entrepreneurs, workers are not allowed to borrow. Agents have only a noisy signal of their productivities and are subject to uninsurable risk. After the shocks are realized, production takes place. At the end of the period borrowers decide whether to repay or whether to default and how much to consume and how much to save. If they default, they will be borrowing constrained in the next period. Thus, they cannot borrow but they can still save. Anticipating this behavior banks vary the interest rate charged for each loan taking into account the individual borrower's default probability. The remainder of this section presents the details of the model.

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the firm. To ensure consistency across our three databases, when we use data from the Survey of Consumer Finance (SCF) and the Panel Study of Income Dynamics (PSID) we define entrepreneurs as business owners who manage a firm with at least one employee.

[8] While one can obtain exit rates from the PSID data (Quadrini, 2000), it is impossible to obtain reliable bankruptcy data from the PSID. There is only one wave in which respondents were asked about past bankruptcies.

[9] Dun & Bradstreet (D&B) is a credit-reporting and business information firm. D&B compiles its own independent business failure database. Until the emergence of automated software for law firms and courts in the mid 1980s, the official business bankruptcy data and the index compiled by D&B have a positive and significant correlation of 0.73. From 1986-1998 this correlation coefficient becomes negative and insignificant. Extrapolating from the historic relationship between the D&B index and personal bankruptcy cases caused by business failures leads to the conclusion that the official data underreport business bankruptcy cases at least by a factor of two.

1.3.1 Bankruptcy law and credit status

Agents who have borrowed can declare bankruptcy. In the event of a default the agent's debt is discharged, and at the same time any assets in excess of an exemption level X are liquidated. There are transaction costs in the liquidation process so that banks can only obtain a fraction f of each unit of capital they liquidate.

An agent who has declared bankruptcy in the past can save but he cannot borrow for a certain period of time. We call this agent *borrowing constrained* and we denote his credit status as BC. We assume that every *borrowing constrained* agent, whether worker or entrepreneur, faces a credit status shock at the end of the period. This probability captures the duration of the credit market exclusion period. With probability $(1 - \varrho)$ the agent remains borrowing constrained. With probability ϱ the agent can borrow again. He becomes an *unconstrained* agent with credit status UN[10]. ϱ is calibrated such that the average exclusion period is six years, the value observed in the data.

1.3.2 Households

Our economy is populated by a unit mass of infinitely lived heterogeneous agents. Each agent differs according to the level of assets a, the entrepreneurial productivity θ, the working productivity φ, and the credit status $S \in \{UN, BC\}$.

Preferences

For simplicity we abstract from labor-leisure choice. All agents supply their unit of labor inelastically either as workers or as entrepreneurs. There is no disutility of labor. Agents discount the future at the rate β. Therefore they maximize the following utility function

$$U = E\left\{\sum_{t=0}^{\infty} \beta^t u(c_t)\right\} \tag{1.1}$$

Productivities

Each agent is endowed with a couple of stochastic productivity levels: one as an entrepreneur θ and one as a worker φ. We make the simplifying assumption that the working and entrepreneurial ability processes are uncorrelated. At the beginning of each period the agent knows only his past productivities φ_{-1} and θ_{-1}, but his productivity as a worker and as entrepreneur during the current period, denoted by φ and θ, are revealed only after he has taken the occupational choice and investment decisions.

[10] The length of the exclusion period is transformed into a probability in order to avoid an additional state variable that keeps track of the numbers of years left before the solvency status is returned to UN. This procedure is standard in the literature, see Athreya [2002] and Chatterjee et al. [2007].

The workers' ability process. Following the literature[11] we assume that labor productivity follows the following AR(1) process[12]:

$$\log \varphi_t = (1-\rho)\,\mu + \rho \log \varphi_{t-1} + \varepsilon_t \tag{1.2}$$

where ε_t is *iid* and $\varepsilon \sim N(0, \sigma_\varepsilon)$. If the agent becomes a worker his labor income during current period is given by $w\varphi$.

The entrepreneurs' ability process. In contrast to the case of working ability, there are no reliable estimates of the functional form for the case of entrepreneurial ability. Therefore, following Cagetti / De Nardi [2006], we will assume a parsimonious specification where entrepreneurial productivity follows a 2-state Markov process with $\theta^L = 0$ and $\theta^H > 0$ and transition matrix

$$P_\theta = \begin{bmatrix} p^{LL} & 1-p^{LL} \\ 1-p^{HH} & p^{HH} \end{bmatrix} \tag{1.3}$$

We calibrate the 3 parameters (θ^H, p^{HH} and p^{LL}) to match some observed features of entrepreneurial activity in the US economy.

1.3.3 Technology

Entrepreneurial sector Every agent in the economy has access to a productive technology that, depending on her entrepreneurial productivity θ, produces output according to the production function

$$Y_i = \theta_i \chi_i k_i^\nu \tag{1.4}$$

where θ_i is agent $i's$ persistent entrepreneurial productivity described above. We assume that production is subject to an *iid* idiosyncratic shock with $\chi_i \in \{0,1\}$, where $\chi_i = 0$ happens with probability p^χ. This *iid* shock represents the possibility that an inherently talented entrepreneur (i.e. an agent with high and persistent θ_i) might choose the wrong project or could be hit by an adverse demand shock. Quadrini [2000] shows that the entry rate of workers with some entrepreneurial experience in the past, is much higher than the entry rate of those workers without any experience. Therefore it seems that entrepreneurs come mostly from a small subset of total population. If their firms fail, they are very likely to start a new firm within a few years. The *iid* shock χ_i helps us to capture this difference in the entry rates.

Corporate sector Many firms are both incorporated and big enough not to be subject to personal bankruptcy law. Therefore we follow Quadrini [2000] and Cagetti / De Nardi [2006] and assume a perfectly competitive corporate sector which is modeled as a Cobb-Douglas

[11] See for example Storesletten et al. [2004].
[12] In the simulation we discretize this process by methods based on Tauchen [1986a].

production function

$$F(K_c, L_c) = AK_c^{\xi} L_c^{1-\xi} \tag{1.5}$$

where K_c and L_c are capital and labor employed in this sector. Given perfect competition and constant returns to scale the corporate sector does not distribute any dividend. Capital depreciates at rate δ in both sectors.

1.3.4 Credit market

We assume that there is perfect competition in the credit market. Therefore banks must make zero profit on any contract[13]. The opportunity cost of the lending to entrepreneurs is the rate of return on capital in the corporate sector. This is also equal to the deposit rate.[14] Banks offer one period non-contingent debt contracts. The only agent who interacts with banks is the *unconstrained* entrepreneur. Banks know everything about the agent: his assets and his productivities. For any given value of $(a, \theta_{-1}, \varphi_{-1})$ and for any amount lent b, by anticipating the behavior of the entrepreneur, the banks are able to calculate the probability of default and how much they will get in the case of default. Perfect competition implies that they set the interest rate, $r(a, \theta_{-1}, \varphi_{-1}, b)$, such that they break even. Therefore, banks offer a menu of one period debt contracts which consists of an amount lent b and a corresponding interest rate $r(a, \theta_{-1}, \varphi_{-1}, b)$ to each agent $(a, \theta_{-1}, \varphi_{-1})$.

1.3.5 Timing

At the beginning of the period, agents who have defaulted in the past and who have not received the positive credit status shock are *borrowing constrained*. The other agents are *unconstrained*. All agents face an occupational choice: they choose whether they become entrepreneurs or workers. However they make this decision without knowing their productivities (θ, φ). Since these productivities follow a Markov process they use past productivities $(\theta_{-1}, \varphi_{-1})$ to forecast their current productivities (φ, θ).

Workers deposit all their wealth at the banks, receiving a rate of return r^d. After productivities are realized and production has taken place, they choose consumption and savings. At the end of the period the *borrowing constrained* worker receives the credit status shock. With probability ϱ he remains *borrowing constrained* next period (i.e. $S' = BC$). With probability $(1-\varrho)$ he becomes *unconstrained* next period (i.e. $S' = UN$).

The *borrowing constrained* entrepreneur can choose how much to invest in his firm before the current θ is realized. He deposits the remaining wealth at the bank. Thus the entrepreneur

[13] In many papers on consumer bankruptcy banks cross-subsidize loans. This implies however that a bank could make positive profits by denying credit to the most risky borrowers. (see Athreya [2002] and Li / Sarte [2006]). For an approach similar to ours, see Chatterjee et al. [2007].
By the law of large numbers average ex post profits will be zero too

[14] In our model the banks are isomorphic to a bond market in which each agent has the possibility to issue debt.

faces a portfolio choice between investing in his own firm (risky asset) or in a safe bank deposit. But he can not borrow. After (θ, φ) and χ are realized and production has taken place, he chooses consumption and savings. At the end of the period he receives the credit status shock.

The *unconstrained entrepreneur* can borrow from perfectly competitive banks. Before knowing (θ, φ) and χ, he chooses his capital stock by deciding how much to borrow (or invest at rate r^d). In case the entrepreneur borrows, by picking from the menu $\{b, r(a, \theta_{-1}, \varphi_{-1}.b)\}$ offered by banks, he invests everything in his own firm. After (θ, φ) and χ are realized and production has taken place, the entrepreneur can decide whether to repay his debt and be *unconstrained* next period (i.e. $S' = UN$) or whether to declare bankruptcy and be *borrowing constrained* next period(i.e. $S' = BC$). After that he chooses consumption and savings.

Summarizing, the timing is as follows:

1. The agent enters the period with a state $(a, \theta_{-1}, \varphi_{-1}, S)$;
2. The agent chooses whether to become a worker or an entrepreneur;
3. *Unconstrained* entrepreneurs choose from the menu $\{b, r(a, \theta_{-1}, \varphi_{-1}, b)\}$ offered by perfectly competitive banks;
4. Real and financial investment decisions are taken;
5. Productivities (θ, φ) and the *iid* shock $\chi \in \{0, 1\}$ are realized and production takes place;
6. Bankruptcy decisions are taken by the *unconstrained* entrepreneurs;
7. Consumption and saving decisions are taken;
8. The credit status shocks for all *borrowing constrained* agents are realized;
9. End of period: the new state is $(a', \theta, \varphi, S')$.

Since the credit state S consists only of the two states BC and UN, we define the individual state variable as $(a, \theta_{-1}, \varphi_{-1})$, and we solve for two value functions $V^{UN}(a, \theta_{-1}, \varphi_{-1})$ and $V^{BC}(a, \theta_{-1}, \varphi_{-1})$ one for each credit status.

1.3.6 The problem of the *borrowing constrained* agent

This agent cannot borrow, but he can save at an interest rate r^d. At the beginning of the period he can choose whether to become an entrepreneur, which gives utility $N^{BC}(a, \theta_{-1}, \varphi_{-1})$ or a worker which yields utility $W^{BC}(a, \theta_{-1}, \varphi_{-1})$. Therefore the value of being a *borrowing constrained* agent with state $(a, \theta_{-1}, \varphi_{-1})$ is

$$V^{BC}(a, \theta_{-1}, \varphi_{-1}) = \max \left\{ N^{BC}(a, \theta_{-1}, \varphi_{-1}), W^{BC}(a, \theta_{-1}, \varphi_{-1}) \right\} \tag{1.6}$$

where the "max" operator reflects the occupational choice.

Worker At the beginning of the period the *borrowing constrained* worker deposits all his wealth at the bank. Then (θ, φ) are realized, production takes place and he receives labor income $w\varphi$. At the end of the period, he chooses consumption and saving, taking into account that he will receive a credit status shock. With probability ϱ he will be still *borrowing constrained* next period with an utility $V^{BC}(a', \theta, \varphi)$, while with a probability $(1-\varrho)$ he will become *unconstrained* with an utility $V^{UN}(a', \theta, \varphi)$. Therefore the expected utility of a *borrowing constrained* worker with wealth a and productivities $(\theta_{-1}, \varphi_{-1})$ is

$$W^{BC}(a, \theta_{-1}, \varphi_{-1}) = E\left\{\begin{array}{l} \max\limits_{c,a'} \left\{u(c) + \beta\left[\varrho V^{BC}(a', \theta, \varphi) + (1-\varrho) V^{UN}(a', \theta, \varphi)\right]\right\} \\ s.t.\ c + a' = w\varphi + \left(1 + r^d\right) a \end{array}\right\} \tag{1.7}$$

Entrepreneur At the beginning of the period the *borrowing constrained* entrepreneur chooses the amount of capital, $k \in [0, a]$, to invest in his firm and the amount $a - k$ to deposit at the bank. After (θ, φ) and the shock χ are realized he will decide how to allocate the resources $\chi\theta k^{\nu} + (1-\delta)k + \left(1 + r^d\right)(a - k)$ among consumption and savings. Therefore the optimal value of the *borrowing constrained* entrepreneur is

$$N^{BC}(a, \theta_{-1}, \varphi_{-1}) = \max_{0 \le k \le a} E\left\{\begin{array}{l} \max\limits_{a',c} \left\{u(c) + \beta\left[\varrho V^{BC}(a', \theta, \varphi) + (1-\varrho) V^{UN}(a', \theta, \varphi)\right]\right\} \\ s.t.\ c + a' = \chi\theta k^{\nu} + (1-\delta)k + \left(1 + r^d\right)(a - k) \end{array}\right\} \tag{1.8}$$

where the expectation operator $E\{\cdot\}$ now considers also the temporary shock χ.

1.3.7 The problem of the *unconstrained* agent

At the beginning of the period the *unconstrained* agent faces the following occupational choice

$$V^{UN}(a, \theta_{-1}, \varphi_{-1}) = \max\left\{W^{UN}(a, \theta_{-1}, \varphi_{-1}), N^{UN}(a, \theta_{-1}, \varphi_{-1})\right\} \tag{1.9}$$

where $W^{UN}(a, \theta_{-1}, \varphi_{-1})$ is the utility of becoming a worker and $N^{UN}(a, \theta_{-1}, \varphi_{-1})$ of becoming an entrepreneur.

Worker The problem of the *unconstrained* worker is identical to the *borrowing constrained* one except that the agent will be *unconstrained* in the future for sure. His utility is

$$W^{UN}(a,\theta_{-1},\varphi_{-1}) = E\left\{ \begin{array}{l} \max\limits_{c,a'}\left\{u(c)+\beta V^{UN}(a',\theta,\varphi)\right\} \\ s.t.\ c+a' = w\varphi + \left(1+r^d\right)a \end{array} \right\} \tag{1.10}$$

Entrepreneur The *unconstrained entrepreneur* decides how much to invest in his firm $k = a + b$ by choosing how much to borrow ($b > 0$) or save at rate r^d ($b < 0$). If he borrows he can choose from the menu $\{b, r(a,\theta_{-1},\varphi_{-1},b)\}$ offered by the banks. After (θ,φ) and the shock χ are realized he can choose whether to declare bankruptcy (default) or whether to repay and how much to consume and save. He solves the problem backwards.

If he repays his debt, he has to choose how to allocate his resources, $\chi\theta k^{\nu} + (1-\delta)k - b[1 + r(a,\theta_{-1},\varphi_{-1},b)]$, between consumption and savings. Given that the decision of repaying is done when current productivities (θ,φ) and the shock χ are known, his utility from repaying is given by

$$N^{pay}(a,b,\theta,\varphi,\chi) = \max_{c,a'}\left\{u(c)+\beta V^{UN}(a',\theta,\varphi)\right\} \tag{1.11}$$

$$s.t.\ a'+c = \chi\theta k^{\nu} + (1-\delta)k - b[1+r(a,\theta_{-1},\varphi_{-1},b)] \tag{1.12}$$

$$k = a+b \tag{1.13}$$

If he defaults, his debt is discharged. But he loses all his assets in excess of the exemption level X. Thus, the resources to allocate between consumption and savings are $\min\{\chi\theta k^{\nu} + (1-\delta)k, X\}$. Moreover if he defaults he will be *borrowing constrained* next period. Therefore by declaring bankruptcy he gets

$$N^{bankr}(a,b,\theta,\varphi,\chi) = \max_{c,a'}\left\{u(c)+\beta V^{BC}(a',\theta,\varphi)\right\} \tag{1.14}$$

$$s.t.\ a'+c = \min\{\chi\theta k^{\nu} + (1-\delta)k, X\} \tag{1.15}$$

$$k = a+b \tag{1.16}$$

He will declare bankruptcy if $N^{bankr}(a,b,\theta,\varphi\,\chi) > N^{pay}(a,b,\theta,\varphi,\chi)$ and vice versa. Thus, at the beginning of the period the agent choose the optimal amount of b from the menu $\{b, r(a,\theta_{-1},\varphi_{-1},b)\}$ anticipating his future behavior. Therefore his utility is given by

$$N^{UN}(a,\theta_{-1},\varphi_{-1}) = \max_{\{b,r(a,\theta_{-1},\varphi_{-1},b)\}} E\left[\max\left\{N^{pay}(a,b,\theta,\varphi,\chi), N^{bankr}(a,b,\theta,\varphi,\chi)\right\}\right] \tag{1.17}$$

where the max operator inside the square brackets reflects the bankruptcy decision, and the max operator outside the square brackets reflects the borrowing decision.

1.3.8 The zero profit condition for the banks

We assume that the banks observe the state variables $(a, \theta_{-1}, \varphi_{-1})$ at the moment of offering the contract. For any given state $(a, \theta_{-1}, \varphi_{-1})$ and for any given loan b, the bank knows in which states of the world the agent will declare bankruptcy by solving the problem of the agent. Therefore it is able to calculate exactly the probability that a certain agent with characteristics $(a, \theta_{-1}, \varphi_{-1})$ will default for any given loan b. Denote this probability $\pi^{bankr}(a, \theta_{-1}, \varphi_{-1}, b)$.

If the agent repays the bank receives $[1 + r(a, \theta_{-1}, \varphi_{-1}, b)]\, b$. If the agent defaults the bank sells the firm's undepreciated capital and it does not obtain the full value, but only a fraction f. This captures two features. First, since business wealth is not exempt under Chapter 7, the agent will try to move as much wealth as possible out of his firm into exempt wealth, e.g. housing. Second, as for example shown by Ramey / Shapiro [2001], the sales value of business assets is below their value with the firm. Therefore the bank receives: nothing if $\chi\theta k^{\nu} + f(1-\delta)(a-b) < X$ while it receives $\chi\theta k^{\nu} + f(1-\delta)(a+b) - X$ otherwise.

The zero profit condition for the bank is given by

$$\left(\begin{array}{c} \left[1 - \pi^{bankr}(a, \theta_{-1}, \varphi_{-1}, b)\right] [1 + r(a, \theta_{-1}, \varphi_{-1}, b)]\, b + \\ \pi^{bankr}(a, \theta_{-1}, \varphi_{-1}, b) \max\left\{\chi\theta k^{\nu} + f(1-\delta)(a+b) - X, 0\right\} \end{array} \right) = (1 + r^d) b \tag{1.18}$$

1.3.9 Equilibrium

Let $\eta = (a, \theta_{-1}, \varphi_{-1}, S)$ be a state vector for an individual, where a denotes assets, θ_{-1} entrepreneurial productivity, φ_{-1} working productivity and S the credit status. From the optimal policy functions (savings, capital demand, default decisions), from the exogenous Markov process for productivity and from the credit status shocks, we can derive a transition function, that, for any distribution $\mu(\eta)$ over the state provides the next period distribution $\mu'(\eta)$. A stationary equilibrium is given by

- a deposit rate of return r^d and a wage rate w
- an interest rate function $r(\eta)$
- a set of policy functions $g(\eta)$ (consumption and saving, capital demand, bankruptcy decisions and the occupational choice)
- a constant distribution over the state η, $\mu^*(\eta)$

such as, given r^d and w:

- $g(\eta)$ solves the maximization problem of the agents;
- the corporate sector representative firm is optimizing;

- capital, labor and goods market clear:
  - capital demands come both from entrepreneurs and from the corporate sector, while supply comes from saving decisions of the agents;
  - labor demand comes from corporate sector, while labor supply come from the occupational choice of the agents;
- the function $r(\eta)$ reflects the zero profit condition of the banks
- The distribution $\mu^*(\eta)$ is the invariant distribution associated with the transition function generated by the optimal policy function $g(\eta)$ and the exogenous shocks.

The model has no analytical solution and must be solved numerically. The algorithm used to solve the model and other details are presented in the appendix.

1.4 Calibration and baseline results

1.4.1 Parametrization

Fixed parameters

Following standard practice in the literature we try to minimize the number of parameters of the model used to match the data. We therefore select some parameters which have already been estimated in the literature. We choose $\rho = 0.95$ for the auto-regressive coefficient of the earnings process[15]. The variance of the earnings process is chosen to match the Gini index of labor income as in PSID data which is 0.38[16]. The process is approximated using a 4-state Markov chain, using the Tauchen [1986a] method as suggested by Adda / Cooper [2003][17]. Total factor productivity is normalized to 1, while the share of capital in the Cobb-Douglas technology for the Corporate sector is set to $\xi = 0.36$. The depreciation rate is set $\delta = 0.08$. Felicity is assumed to be CRRA with coefficient of relative risk aversion $\sigma = 2$.

These parameters are summarized in table 1.1:

[15] In a life cycle setting, Storesletten et al. [2004, 2001] find ρ in the range between 0.95 and 0.98. We choose $\rho = 0.95$ to take into account that the agents in our model are infinitely lived. Since the intergenerational auto-regressive coefficient is lower. Solon [1992] estimates it around 0.4.

[16] The exact value of the variance is $\sigma_\varepsilon^2 = .08125$. This is higher than the estimate of Storesletten et al. [2004] of about 0.02. We abstract from many important factors that are empirically relevant for the earnings distribution, e.g. human capital, life-cycle savings. Therefore, in order to generate the observed inequality, we choose a higher variance of the earnings process.

[17] Floden [2007] shows that for highly correlated processes the method of Adda / Cooper [2003] achieves a higher accuracy than the original methods of Tauchen [1986a] and Tauchen / Hussey [1991].

Table 1.1: The fixed parameters

Parameter	Symbol	Baseline
TFP	A	1 (normalization)
Share of capital	ξ	0.36
Depreciation rate	δ	0.08
CRRA	σ	2
Working productivities	$\varphi_1 < \varphi_2 < \varphi_3 < \varphi_4$	$\begin{bmatrix} \varphi_1 = 0.316, \varphi_2 = 0.745 \\ \varphi_3 = 1.342, \varphi_4 = 3.163 \end{bmatrix}$
Transition matrix	P_φ	$\begin{bmatrix} 0.8393 & 0.1579 & 0.0028 & 0.0000 \\ 0.1579 & 0.6428 & 0.1965 & 0.0028 \\ 0.0028 & 0.1965 & 0.6428 & 0.1579 \\ 0.0000 & 0.0028 & 0.1579 & 0.8393 \end{bmatrix}$

Bankruptcy policy parameters

The two policy parameters are the exemption level X and the probability ϱ of remaining borrowing constrained. The law does not state any formal period of exclusion from credit after bankruptcy filing. For our baseline specification, we set $\varrho = 0.2$ which corresponds to an average exclusion period from credit of 5 years[18]. The exemption level differs across US states. Using state-level data for 1993, we calculate the population-weighted average exemption level across states.[19] ("homestead" plus "personal property" exemption). The resulting average exemption level is \$77,591, taking an average household labor income of \$45,000 corresponds to a value of **1.72** for the exemption/wage ratio. Table 1.2 summarizes the bankruptcy parameters:

Table 1.2: the bankruptcy parameters

Parameter	Symbol	Value
Exemption/wage	X/w	1.72
Exclusion period (expressed as probability)	ϱ	0.2

Calibrated parameters

We are left with the following 7 parameters to be calibrated: high entrepreneurial productivity (θ^H), entrepreneurial productivity transition matrix (p^{HH}, p^{LL}), concavity of entrepreneurial production function (ν), capital specificity (f), discount factor (β) and the probability of the transitory shock (p^χ).

We choose these 7 parameters such that the model matches the following 7 moments of

[18] This choice is in line with the consumer bankruptcy literature which sets the average length of exclusion in this range. Athreya [2002] sets this at 4 years, Li / Sarte [2006] to 5 years, Chatterjee et al. [2007] to 10 years.
[19] We took the data from Berkowitz / White [2004] and top-coded the unlimited homestead exemption to the maximum state exemption.

the US economy. First we want the model to match the *capital-output ratio* (K/Y) in US economy. In the literature we find values ranging from 2.5 to 3.1 We target it to be 2.8 and we check the sensitivity of the results to different values. We target the *fraction of exits through bankruptcy* (bankruptcy/exit). Given the discussion in Section 2 we set this equal to 20%.[20] The *fraction of entrepreneurs in the total population* is 7.6% in the Survey of Consumers Finances.[21] Based on data from the US Small Business Administration the *exit rate* of entrepreneurs is equal to 9.3%. Therefore we set the baseline target at 9.3%. However the exit rate based on the PSID is higher (around 13.6%).[22] Therefore we check the sensitivity of results to higher values.

Quadrini [2000] points out that the entry rate for workers who had some entrepreneurial experience in the past is much higher than the entry rate for those without any experience. It seems that entrepreneurs come mostly from a small subset of total population. If their firms fail, they are very likely to start a new firm within a few years. In the PSID the ratio of *entry rate of experienced entrepreneurs over the average entry rate* is 13. This is an important target because the bankruptcy law affects the possibility and the speed of re-entry for failed entrepreneurs.

Since the benefits of bankruptcy depend crucially on the wealth of an agent we match some features of the wealth distribution. The US wealth distribution is extremely skewed with the top 40% of richest households holding around 93% of total assets.[23] The Gini coefficient is very high, at around 0.8. There is a large literature that tries to match the wealth distribution in the US. The most difficult part is to match the extremely rich agents at the top end of the distribution. But, as we show below, for our model it is particularly important to match the lower end of the distribution. Therefore we target the *share of wealth held by the richest 40%*. As a last target we choose to match the *ratio of the median wealth of entrepreneurs to the median wealth in the whole population.* This target captures features of both the wealth distribution and entrepreneurial productivity and technology. We set the target to 5.6 as found in the SCF.[24]

The targets are summarized in the second column of table 4.

1.4.2 The baseline calibration

We first present the baseline version of the model. Table 1.3 reports the value of the calibrated parameters in the baseline specification

while table 1.4 reports the value of the targets and the actual results achieved in the

[20] Given the uncertainty about the estimates we check the sensitivity of results to changing this target to 10% and to 30%.
[21] See Appendix B for data sources, definitions and further details.
[22] One possible explanation for this difference could be that the PSID undersamples wealthy households. Therefore successful entrepreneurs are likely to be undersampled.
[23] See Appendix B for details.
[24] This ratio ranges from 4.8 to 5.6 in the SCF according to definitions of entrepreneurs and samples adopted.

Table 1.3: the calibrated parameters

Parameter	Symbol	Benchmark Value
High entrepreneurial productivity	θ^H	0.52
Entrepreneurial productivity transition	p^{HH}, p^{LL}	0.95 , 0.9937
Concavity of entrepreneurial technology	ν	0.875
Capital specificity	f	0.4
Discount factor	β	0.865
Probability of transitory shock	p^{χ}	0.185

baseline specification.

Table 1.4: the baseline calibration targets

Moment	Target	Model
Fraction of Entrepreneurs (in %)	7.6	7.6
Ratio of medians (in %)	5.6	4.34
Share of net-worth of top 40%	93.0	89.4
K/Y	2.8	2.687
Exit Rate (in %)	9.3	9.4
Bankruptcy/Exit (in %)	20.0	22.0
Entry rate of experienced/Average entry rate	13.0	8.3

The equilibrium rate of return on capital in the corporate sector (r^d) is 7.81%. Since the equilibrium wage is 1.0207, each unit in our model correspond approximately to $44,000 in 1993. Less than one percent (0.79%) of the total population is borrowing constrained. Even though our model does not replicate exactly the ratio of medians and the share of the wealth held by the richest 40%, it captures the main features that entrepreneurs are several times richer than workers and that most of the wealth is held by the richest. Table 1.5 shows that our model does not replicate the wealth concentration at the top end of the wealth distribution. In particular the richest one percent hold 16% of total wealth in our model while they hold 35% in the data[25]. However for the purpose of our policy experiments it is important that the model replicates the middle and lower part of the wealth distribution since bankruptcy law affects almost exclusively these agents.

Table 1.5: wealth distribution: data and model

	percentage wealth in top				
	1%	5%	20%	40%	60%
US data (SCF 1995)	35	56	81	93	99
Benchmark model	16	38	65	84	95

Even though our model does not replicate the difference in the entry rate between experi-

[25] This is the reason that the Gini coefficient of wealth is 0.64 in the model, while it is 0.8 in the data. Cagetti / De Nardi [2006] and Castañeda et al. [2003] show that life-cycle savings and the bequest motive are essential to match the wealth distribution. Introducing these features in the model would be computationally too costly.

enced and inexperienced workers exactly it captures the fact that the former are many times more likely to enter entrepreneurship than the latter.

Quadrini [2000] reports that around 40% of total capital is invested in the entrepreneurial sector. In our baseline specification this fraction is slightly higher, around 45%. However the US. Small Business Administration estimates that the share of the entrepreneurial sector in terms of employment is 50%.

1.5 Investigating the model's mechanisms

1.5.1 Occupational choice

The key ingredient of the model is occupational choice. Figure 1.1 represents the occupational choice of an *unconstrained* agent with high entrepreneurial productivity and low working productivity. The dotted line shows the value function of becoming a worker, whereas the solid line shows the value function of becoming an entrepreneur[26].

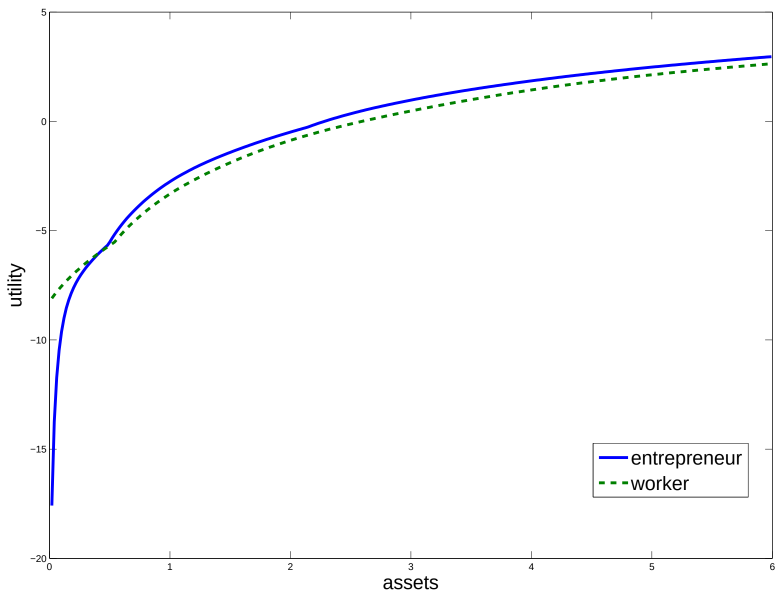

Figure 1.1: Occupational choice ($S = UN, \theta_{-1} = \theta^H, \varphi_{-1} = 0.316$)

The first result is that, otherwise identical agents choose differently according to their wealth: poor agents become workers while rich agents become entrepreneurs. This result is standard in the occupational choice under credit market imperfections literature [see for

[26] The value functions have kinks since the actual value function for an unconstrained agent is given by the upper envelop of the two functions in Figure 1.1. Therefore discounted utility tomorrow is kinked as well. The kinks do no coincide exactly with the intersection of the two functions. However the kinks must be close to the intersection of the two curves exactly because the value function tomorrow is identical for entrepreneur and worker.

example Banerjee / Newman 1993]. The main reasons are that poor agents have smaller firms and face higher interest rates. They have smaller firms because, being poor, they need to borrow more but they face higher rates on the loans. The cost of financing is higher for the poor for two reasons. First, they have a higher incentive to default. Defaulting rich agents have to give up all their wealth above the exemption level. Second, in the event of default the bank gets less when the agent is poor. Thus, to break even, the bank has to charge a higher interest rate. That is, in this model, wealth acts as collateral.

1.5.2 The behavior of the unconstrained agents

The second important ingredient is the decision of the *unconstrained* entrepreneurs. The solution of the entrepreneurs' problem is represented in Figure 1.2:

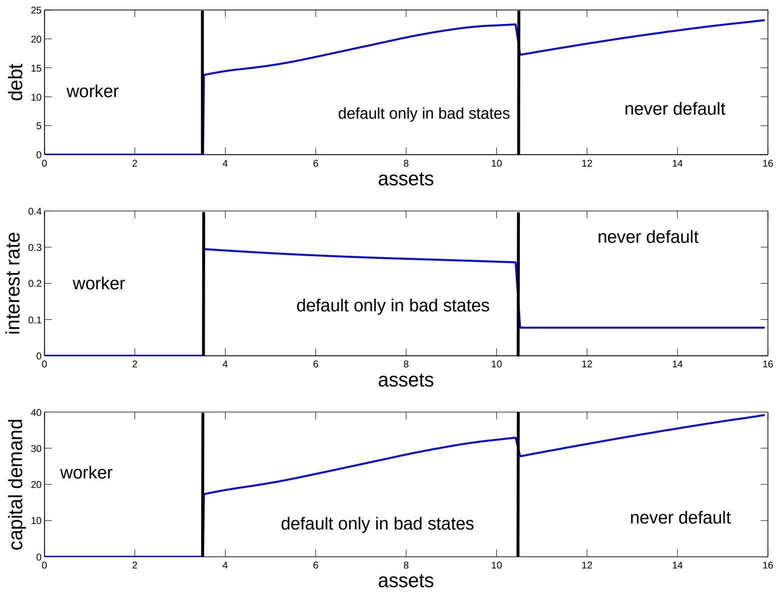

Figure 1.2: interest rate and firm size **(**$\theta_{-1} = \theta^H$**,** $\varphi_{-1} = 1.341$**)**

The upper panel shows credit demand (debt) of the entrepreneur, the middle panel represents the corresponding interest rate charged and the lower panel capital demand (firm size). As shown above the poorer agents (e.g. agents with assets $a = 2$) become workers while all the others become entrepreneurs ($a > 3.5$). The very rich entrepreneurs (e.g. $a = 14$) will never find it profitable to default. Their wealth is so high that defaulting is too costly for them. Therefore they can borrow at rate r^d. The "middle class" entrepreneurs (e.g. $a = 6$) will instead default if their productivity θ drops to θ^L or a bad shock ($\chi = 0$) happens, since the cost of bankruptcy is lower for them. Then the bank, in order to break even, must charge a higher interest rate. The interest rate depends (negatively) on the assets of the entrepreneur, because in the event of default the bank will be able to seize the difference between the assets of the entrepreneur and the exemption level. Capital demand for the "middle-class" entrepreneurs is increasing because the cost of borrowing is declining. The discontinuity in all three functions between "middle-class" and rich entrepreneurs (around $a = 10.5$) is due to the change in the default decision. Those who default are insured against the bad outcome whereas those who do not default are not. This explains why relatively poorer agents (e.g. $a = 10$) have slightly bigger firms than relatively richer agents (e.g. $a = 11$).

1.5.3 A first look at the effects of bankruptcy

Bankruptcy affects the problem of the unconstrained agents, because it changes credit conditions and the extent of insurance available. We examine these effects with the following experiment. We compare the behavior of the unconstrained agents and the banks in two different situations: one in which bankruptcy is allowed and one in which bankruptcy is absent. Figure 1.3 shows the capital demand function and the interest rate function in these situations.

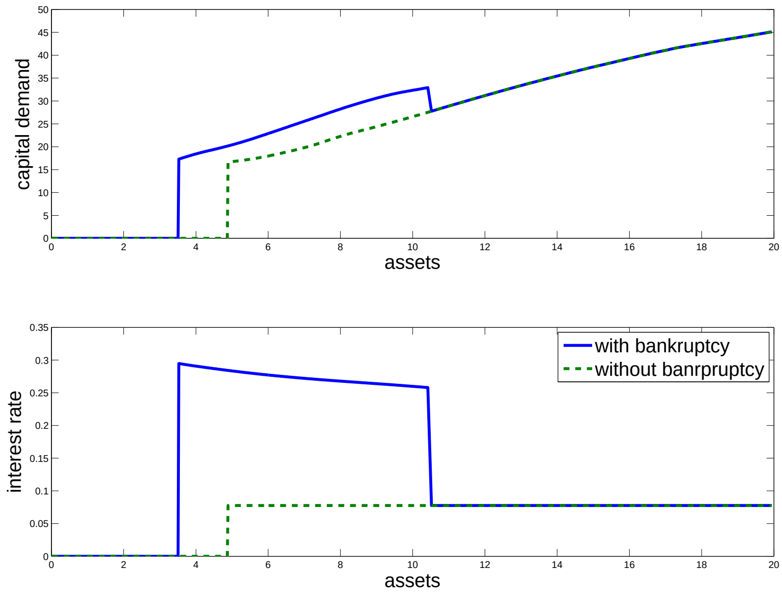

Figure 1.3: Firm size and interest rate ($S = UN, \theta_{-1} = \theta^H, \varphi_{-1} = 1.314$)

The effects of allowing bankruptcy depend on the wealth of the agent. First, the behavior of the very rich (e.g. $a = 12$) is not affected. They are entrepreneurs and they repay their debt even in the bad states. As explained above, even if bankruptcy is available, it is too costly for them. Second, allowing bankruptcy affects the behavior of the less rich agents (e.g. $a = 8$). They are entrepreneurs in both situations. But when bankruptcy is allowed they borrow more because they can and will default in the bad states. Therefore their firms are bigger (upper panel). This insurance comes at expense of higher interest rates (lower panel). Anticipating default in the bad states the banks have to charge higher interest rates in order to break even. We call this increase in the firm size the *intensive margin*. Third, the occupational choice of even less rich agents (e.g. $a = 4$) is affected. When bankruptcy is not allowed they are not insured against bad outcomes. Therefore they do not want to borrow, even though they could borrow at rate r^d. They become workers. When bankruptcy is allowed they are insured against bad outcomes. Therefore they borrow, even though they have to pay a high interest rate. This increases the rewards of entrepreneurship enough to change their occupational choice. We call this increase of the number of entrepreneurs the *extensive margin*. Fourth, the occupational choice of the very poor agents (e.g. $a = 2$) is not affected, they are workers in both situations.

In this particular experiment abolishing bankruptcy reduces entrepreneurship and firm size, the intensive and the extensive margins are negative. The negative effect of lowering the amount of insurance available dominates the positive effect of better credit conditions.

1.6 The effects of bankruptcy reforms

We now turn to analyze the effects of changes in the bankruptcy law. We conduct 2 different experiments:

1. we change the exemption level from zero, which corresponds to eliminating bankruptcy completely, to a very high level, twice the current level;
2. we change the length of the credit market exclusion period from two to 20 years.[27]

We will focus our attention mainly on changes in the following variables: entrepreneurship, the poor' access to entrepreneurship, welfare, distributional issues and social mobility.

1.6.1 Changing the exemption level

Our first policy experiment is to analyze the effects of changing the exemption level. First we inspect the changes in the policy functions and later we analyze the quantitative results. Figure 1.4 reports capital demand (upper panel) and the interest rate (lower panel) for 3 different values of X/w. It shows the effects of increasing the exemption level from $X/w = 0$, which corresponds to completely eliminating bankruptcy to an intermediate one ($X/w = 0.875$) and to the actual one ($X/w = 1.72$).

Increasing the exemption level, from zero to 0.875 has two effects. Both, the firms get bigger (intensive margin) and more agents enter entrepreneurship (extensive margin). The insurance effect is dominating. Further increasing the exemption level, to the current level of 1.72, has three effects. First, agents with assets around 3, who were entrepreneurs before, become workers because credit conditions worsen so much that they outweigh the increase

[27] In the model this corresponds to changing the probability of receiving a positive solvency shock ϱ from 0.5 to 0.05.

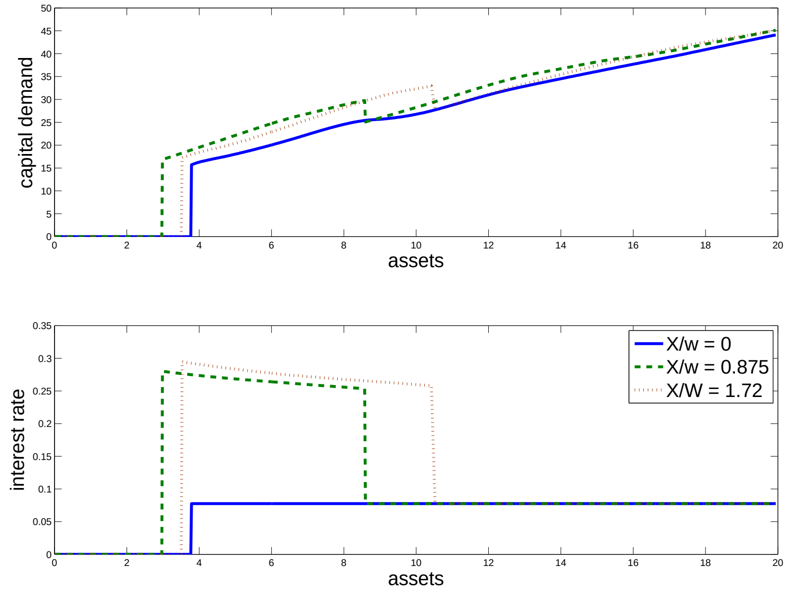

Figure 1.4: Firm size and interest rates, different exemption levels ($\theta_{-1} = \theta^H$,$\varphi_{-1} = 1.342$)

in insurance. The extensive margin is negative. Second, agents with assets around 6 are charged higher interest rates for the same reasons. Thus they run smaller firms. For these agents the intensive margin is negative. Third, agents with assets around 10 switch from never defaulting to defaulting in the bad states. Now they runs bigger firms, even if credit conditions are worse, because of the insurance effect. For these agents the intensive margin is positive.

The magnitude of these effects depends on the number of agents affected. The extensive margin is unambiguously positive. The sign of the intensive margin, however, is ambiguous. It depends on the wealth distribution. The increase in capital demand of agents with asset around 10 is bigger than the decrease in capital demand of agents with asset around 6. But the overall effects depend on the number of agents in these areas of the wealth distribution.

Table 1.6 reports the variables of interest for 5 values of X/w. Column 2 reports results when bankruptcy is absent ($X/w = 0$). Column 4 reports results for the baseline calibration ($X/w = 1.72$) and column 6 for doubling the current exemption level ($X/w = 3.5$).

The first pattern to notice is that no bankruptcy and extremely generous bankruptcy law produce very similar results (see column 2 and column 6). When bankruptcy is absent the demand for risky loans (loans with high interest rate due to high positive default probability) is zero. Entrepreneurial activity is so risky that only relatively rich agents, who always repay and get credit at rate r^d, become entrepreneurs. When bankruptcy law is very generous, the banks have to charge such high interest rates on risky loans that nobody demands them. Again, only rich agents become entrepreneurs. This also explains that the ratio of medians is highest in the case of no bankruptcy and very generous bankruptcy law. Even though for

Table 1.6: the effects of changes in the exemption level

X/w	**0**	**0.875**	**1.72**	**2.625**	**3.5**
Exit rate (in %)	9.5	9.9	**9.4**	9.6	9.6
Fraction of Entrepreneurs (in %)	7.4	8.1	**7.6**	7.4	7.4
Bankruptcy/Exit (in %)	0	45.9	**22.2**	0.2	0.3
Capital/Output	2.677	2.693	**2.677**	2.677	2.677
Median assets of Entr/ Median assets	4.467	4.157	**4.347**	4.429	4.429
Share of Capital in entr. sector (in %)	47.8	49.4	**47.9**	47.8	47.8
Gini of Assets	0.635	0.636	**0.635**	0.635	0.635
Share of assets in top 40% of pop (in %)	89.0	89.3	**89.0**	89.0	89.0
Median output in entrepreneurial sector	15.05	14.55	**14.58**	15.05	15.05
Welfare (%-change in cons.-equivalent)	-0.07	1.26	**0**	-0.05	-0.05
Welfare of the POOR	-0.09	1.27	**0**	-0.07	-0.06
Welfare of the RICH	-0.02	1.23	**0**	0.03	0

each level of assets entrepreneurs borrow less and therefore have smaller firms, the median firm size is bigger under extreme bankruptcy laws, see Figure 1.5[28]. The reason for this result is again that only rich agents, who have bigger firms, become entrepreneurs.

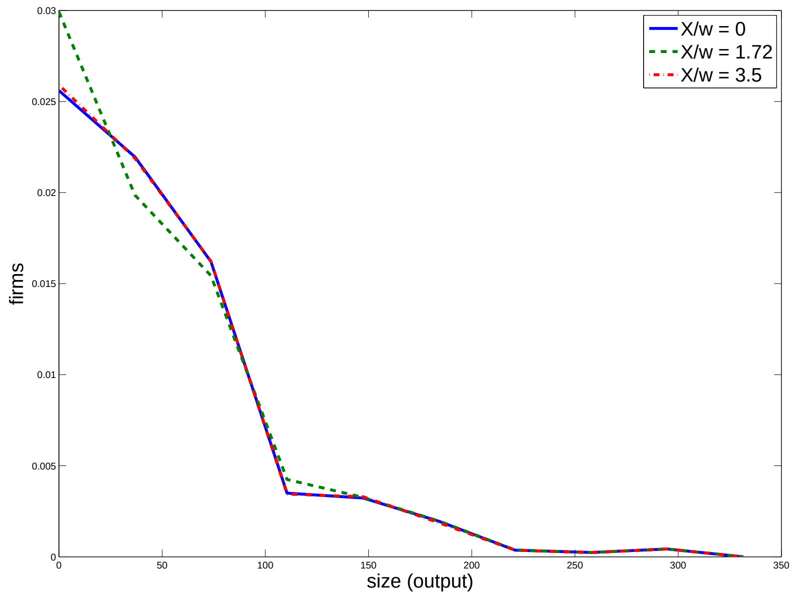

Figure 1.5: Firm size distribution for different exemption levels

Next we investigate the effects of increasing the exemption level gradually from $X/w = 0$ to $X/w = 3.5$ on entrepreneurship, the poor' access to entrepreneurship, welfare, wealth distribution and social mobility. As can be seen in table 1.6 almost all variables follow a hump-shaped pattern.

[28] We smoothed the firm size distribution by creating ten equally sized bins to make the figure easier to read.

Entrepreneurship Increasing the exemption level first increases and then decreases the fraction of entrepreneurs. The insurance effect dominates the credit market conditions effect for low exemption levels. The opposite is true for high exemption levels. The exit rate and the fraction of exits through bankruptcy follow the behavior of the fraction of entrepreneurs. The fraction of exits through bankruptcy first increases from zero percent to 46% when the exemption level increases from $X/w = 0$ to $X/w = 0.875$. As insurance is higher, a bigger fraction of exits happens through bankruptcy. When the exemption level increases further, from $X/w = 0.875$ to $X/w = 3.5$ the fraction falls gradually back to zero percent because only the rich, who never default, become entrepreneurs.

The impact of different exemption levels on the investment behavior of entrepreneurs can be understood from the firm size distribution, see Figure 1.6[29].

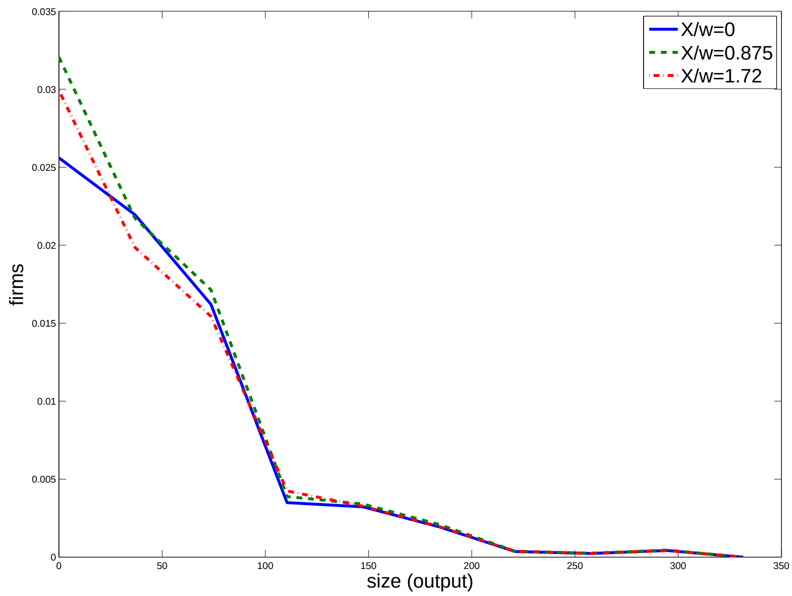

Figure 1.6: Firm size distribution (different exemption levels)

Increasing the exemption level from $X/w = 0$ to $X/w = 0.875$ leads to the creation of more small firms due to positive extensive and intensive margins, see also Figure 1.4. When we further increase the exemption level to $X/w = 1.72$ some of these new small firms disappear because the negative effect on credit market conditions dominates.

Access to entrepreneurship of the poor Next we turn to how bankruptcy law affects the determinants of entry into entrepreneurship. There is allocative inefficiency in our model because insurance markets are missing. Part of this inefficiency is reflected in some poor highly productive agents not becoming entrepreneurs, either because they receive too little insurance or because the conditions at which credit is available are too bad. Table 1.7

[29] As shown in Figure 1.5, the firm size distribution for higher exemption levels is identical to the case $X/w = 0$. Therefore in Figure 1.6 we report only the cases: $X/w = 0$, $X/w = 0.875$, and $X/w = 1.72$.

reports the effects of different exemption levels on the minimum assets needed for the highly productive ($\theta_{-1} = \theta^H$) agent to become an entrepreneur.

Table 1.7: minimum wealth for entrepreneurship

X/w	0	0.875	1.72	2.625	3.5
φ_{-1}= 0.316	0.481	0.160	0.421	0.381	0.361
φ_{-1}= 0.745	1.323	0.842	1.263	1.323	1.323
φ_{-1}= 1.342	3.768	2.946	3.507	3.768	3.768
φ_{-1}= 3.163	16.032	15.030	15.230	16.032	16.032

The rows show these values for the levels of working productivity (φ_{-1}). The attractiveness of becoming a worker is increasing in working productivity. Thus, in order to enter entrepreneurship, the expected profits must be higher for an agent with high working productivity. Since richer agents need to borrow relatively less and since they receive better credit conditions, their expected profits are higher. This implies that, to become an entrepreneur, an agent with high working productivity must be richer than an agent with low working productivity.

At each level of working productivity the wealth level at which an agent enters entrepreneurship is lowest when $X/w = 0.875$. Thus, even from an efficiency point of view a less generous bankruptcy law would improve upon the status quo. However, abolishing bankruptcy completely would make it more difficult for the poor to become entrepreneurs, thereby worsening allocative efficiency.

Welfare Following Aiyagari / Mcgrattan [1998], to assess welfare we first calculate expected utility in each bankruptcy policy regime separately

$$V = \int_{\eta} V(\eta) d\mu^* (\eta) \tag{1.19}$$

where $\eta = (a, \theta_{-1}, \varphi_{-1}, S)$ and $\mu^* (\eta)$ is the equilibrium steady state distribution. Thus, expected utility is measured over all asset levels, productivities and the credit status. This utilitarian social welfare function weights all households equally. Then we calculate the constant, at all states and dates, amount of consumption, *consumption equivalent*, that yields expected utility V.[30] We compare two bankruptcy policy regimes by calculating the percentage change in consumption equivalent that makes agents indifferent between the two regimes. For example, for a given regime Q, that yields utility V^Q, this percentage change in consumption equivalent is given by

$$\lambda^Q = \left(\frac{V^Q + 1/\left[(1-\sigma)(1-\beta)\right]}{V^{bench} + 1/\left[(1-\sigma)(1-\beta)\right]} \right)^{1/(1-\sigma)} - 1 \tag{1.20}$$

[30] Thus, we first calculate a constant $\bar{c}$ that yields that same utility as V. Given CRRA preferences this is the solution to:

$$\left(\frac{\bar{c}^{(1-\sigma)} - 1}{1-\sigma} \right) \frac{1}{1-\beta} = V \quad .$$

where a positive λ^Q implies that regime Q increases welfare with respect to the baseline regime.

Table 1.6 shows that welfare follows the same hump-shaped pattern as the other variables. In particular welfare is highest for exemption level $X/w = 0.875$. Thus, halving the current exemption level would increase welfare by 1.26%, which corresponds to an increase in annual consumption of approximately \$700 for the average household.

Table 1.6 also shows that there are no adverse distributional effects. Both, rich and poor agents[31] gain from reducing the exemption level from the current one.

Wealth distribution and social mobility Entrepreneurs are relatively less rich compared to the entire population when $X/w = 0.875$. This is shown by the ratio of median assets in table 1.6. This is again due to the fact that there are more poor entrepreneurs when $X/w = 0.875$ than for any other exemption level. However changing the exemption level has little effect on the wealth distribution: it does not change significantly the Gini coefficient and the share of wealth held by the richest agents. The changes in entrepreneurship and firm sizes are too small to significantly affect the wealth distribution.

We investigate the effects on social mobility by dividing all agents in 3 wealth classes: poor, middle-class and rich, where each class accounts for 1/3 of total population. Then we compute the transition between these classes over a 10 year horizon for the different values of the exemption level. The results are reported in tables 1.8 to 1.10[32].

Table 1.8: 10-years transition matrix: $X/w = 0$

	poor	middle-class	rich
poor	0.721	0.246	0.033
middle-class	0.277	0.482	0.241
rich	0.004	0.270	0.726

Table 1.9: 10-years transition matrix: $X/w = 0.875$

	poor	middle-class	rich
poor	0.717	0.249	0.034
middle-class	0.279	0.478	0.243
rich	0.004	0.274	0.722

These tables show that there is slightly more mobility in the intermediate case ($X/w = 0.875$) since the probabilities along the main diagonal are smaller. As shown in table 1.7, for intermediate exemption levels poorer agents have more insurance and therefore enter

[31] We define a poor agent as one with assets less than the median. Comparing the top and bottom quintiles yields similar results.

[32] Again, results for $X/w = 2.625$ and $X/w = 3.5$ are not reported. They are very similar to the case with $X/w = 0$.

Table 1.10: 10-years transition matrix: $X/w = 1.72$

	poor	middle-class	rich
poor	0.720	0.248	0.032
middle-class	0.276	0.480	0.244
rich	0.005	0.271	0.724

entrepreneurship. Thus, in our model, entrepreneurship is a vehicle of social mobility. This is consistent with the findings of Quadrini [2000].

1.6.2 Changing the exclusion period

The second policy experiment we conduct is to change the length of time an agent who has defaulted is excluded from borrowing[33]. As discussed above we model this as changes in the probability of a favorable credit status shock: ϱ. Therefore a low ϱ represents a long exclusion period while a high ϱ represents a short exclusion period.

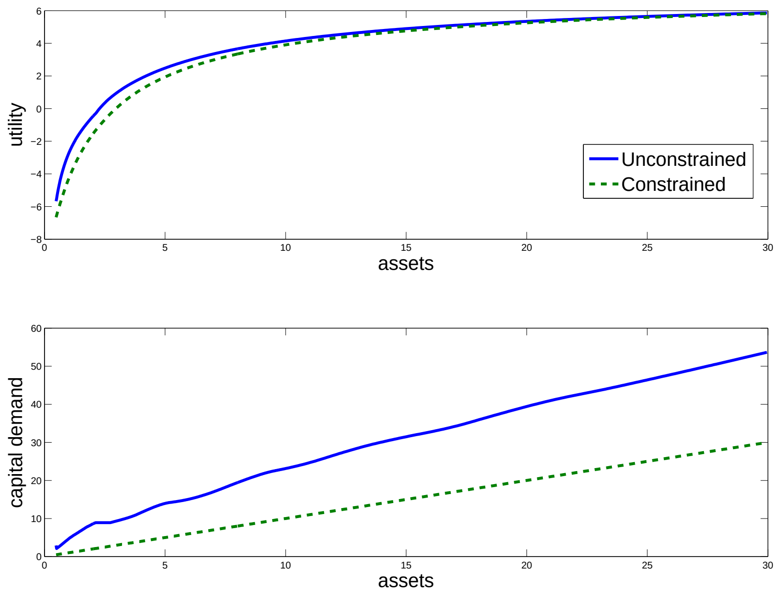

Figure 1.7: Utility and capital demand of *borrowing constrained* and *unconstrained* entrepreneur

Table 1.11 reports the effects of gradually increasing the exclusion period from two years ($\varrho = 0.5$) to 20 years ($\varrho = 0.05$) on the main variables. The baseline value of five years ($\varrho = 0.2$) is reported in column four.

Table 1.11 shows that reducing the length of the exclusion period increases welfare, and

[33] The length of the exclusion period is determined mainly by banks in the US, but in principle this could be regulated by a law.

Table 1.11: the effects of changes in the exclusion period

ϱ	**0.5**	**0.25**	**0.2**	**0.1**	**0.05**
Exit rate (in %)	9.3	9.4	**9.4**	9.6	9.8
Fraction of Entrepreneurs (in %)	7.7	7.6	**7.6**	7.5	7.4
Bankruptcy/Exit (in %)	23.6	22.7	**22.2**	21.1	20.1
Capital/Output	2.686	2.680	**2.678**	2.668	2.654
Median assets of Entr/ Median assets	4.431	4.388	**4.329**	4.225	4.156
Share of capital in entr. sector (in %)	48.8	48.0	**47.8**	46.7	45.4
Gini of Assets	0.065	0.065	**0.063**	0.064	0.063
Share of assets in top 40% of pop.(in %)	89.2	89.1	**89.0**	88.8	88.6
Median output in entrepreneurial sector	14.991	14.535	**14.576**	13.701	12.289
Welfare (%-change in cons.-equivalent)	0.12	0.02	**0**	-0.18	-0.43
Welfare of the POOR	0.05	-0.04	**0**	-0.09	-0.28
Welfare of the RICH	0.34	0.21	**0**	-0.46	-0.84

the fraction of entrepreneurs monotonically. However these changes are quantitatively much smaller than in the case of changing the exemption level. The main implication of increasing ϱ is to allow highly productive, failed agents to regain access to credit earlier. Figure 1.7 shows the difference in utility and the difference in firm size for a highly productive agent between being borrowing constrained and being unconstrained.

One important difference between changing the exemption level and changing the exclusion period is that the credit market conditions effects are smaller. Both, increasing the exemption level and lowering the exclusion period, increase the attractiveness of defaulting. However, the latter does not affect the amount recovered by banks in the event of a default. Therefore the interest rates charged by banks do not change for most agents, see for example the agents with assets between four and ten in Figure 1.8. These agents default in the bad states for all values of ϱ. However agents with assets around 10.5 change their behavior. Instead of repaying their debt in all states, as they do when $\varrho = 0.05$, they default in the bad states when $\varrho = 0.5$ because defaulting is more attractive. Therefore they borrow more and have bigger firms. For similar reasons, agents with assets around 3.5 enter entrepreneurship only when ϱ increases.

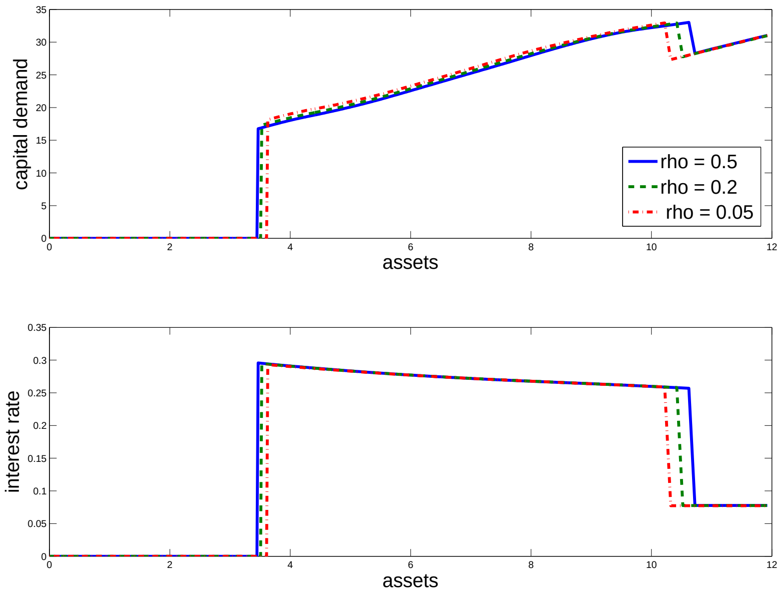

Figure 1.8: Capital demand and interest rate, different ϱ ($\theta_{-1} = \theta^H$,$\varphi_{-1} = 1.341$)

Some of the defaulters are hit by the very persistent change in entrepreneurial productivity. Therefore only a fraction of defaulters are still highly productive as entrepreneurs. This implies that the overall effects are small.

Next we investigate the effects of increasing the exclusion period from 2 years ($\varrho = 0.5$) to 20 years ($\varrho = 0.05$) on entrepreneurship, the poor' access to entrepreneurship, welfare, wealth distribution and social mobility in detail.

Increasing the exclusion period from 2 years ($\varrho = 0.5$) to 20 years ($\varrho = 0.05$) lowers the fraction of entrepreneurs. As shown in Figure 1.8, poorer agents do not enter entrepreneurship as often as before because the cost of defaulting is higher. The median firm size decreases because relatively rich entrepreneurs change their behavior. When they are hit by a bad shock they do not default anymore. This implies that they are fully exposed to the production risk. Therefore they operate smaller firms.

The wealth levels needed to become an entrepreneur, one for each level of working productivity, are reported in table 1.12.

Table 1.12: minimum wealth for entrepreneurship

ϱ	0.5	0.25	0.2	0.1	0.05
φ_{-1}= 0.316	0.38	0.42	0.42	0.46	0.48
φ_{-1}= 0.745	1.26	1.28	1.28	1.28	1.28
φ_{-1}= 1.342	3.47	3.53	3.53	3.59	3.63
φ_{-1}= 3.163	15.63	15.73	15.73	15.73	15.63

Increasing the exclusion period implies that more wealth is needed to enter entrepreneurship. Therefore it makes access to entrepreneurship more difficult for poor but highly productive agents. But these changes are small, in particular when compared to the changes when the exemption level is lowered.

Increasing the exclusion period also reduces welfare. Note that even though the Gini coefficient is highest for the shortest exclusion period ($\varrho = \mathbf{0.5}$), welfare for both, rich and poor, is highest in this case as well. Lowering the exclusion period from the current five years to two years would increase welfare by 0.12%, which corresponds to an increase in annual consumption of approximately $70 for the average household. Increasing the exclusion period to 20 years would yield a welfare loss of approximately 0.43%, which corresponds to a decrease in annual consumption of approximately $230 for the average household.

As tables 1.13 to 1.15 show there are hardly any changes in social mobility.

Table 1.13: 10-years transition matrix: $\varrho = 0.5$

	poor	middle-class	rich
poor	0.721	0.248	0.032
middle-class	0.276	0.480	0.244
rich	0.005	0.270	0.725

Table 1.14: 10-years transition matrix: $\varrho = 0.2$

	poor	middle-class	rich
poor	0.721	0.247	0.032
middle-class	0.276	0.479	0.244
rich	0.005	0.271	0.724

Table 1.15: 10-years transition matrix: $\varrho = 0.05$

	poor	middle-class	rich
poor	0.720	0.248	0.032
middle-class	0.276	0.480	0.244
rich	0.005	0.271	0.724

1.7 Conclusion

We explore quantitatively the effects of personal bankruptcy law on entrepreneurship in a general equilibrium setting with heterogeneous agents. We developed a dynamic general equilibrium model with occupational choice which explicitly incorporates the US bankruptcy law. Our model endogenously generates interest rates that reflect the different default probabilities of the agents. It accounts for the main facts on entrepreneurial bankruptcy, entrepreneurship, wealth distribution and macroeconomic aggregates in the US.

We used the model to quantitatively evaluate the effects of changing the US bankruptcy law. The simulation results show that reducing the exemption level would increase the fraction of entrepreneurs and welfare. These effects are significant: halving the exemption level would have positive welfare effects in the order of 1.4% of average consumption. All households, rich and poor, would be better off. However eliminating bankruptcy completely would reduce the number of entrepreneurs and welfare. The key mechanism driving most of our results is the occupational choice of agents. The fraction of entrepreneurs would increase by one percentage point if the exemption level were reduced by 50%.

We are currently extending our research program along two dimensions. First, we are incorporating the transition to the new steady state. So far, our results are based on a comparison of steady-states. Transitional effects might be important to evaluate welfare. In addition it might explain why the current law is too lenient. It could be that some groups lose during the transition and therefore oppose changes.

Second, we are expanding our model to incorporate explicitly a European type of bankruptcy law. The laws in European countries are much harsher than the law in the US. For example in Italy, debt is never discharged. A defaulter is liable forever. We are analyzing the effects of introducing a US type of law on the Italian economy.

1.8 Appendix

1.8.1 Computational strategy

The state vector for an individual is given by $\eta = (a, \theta_{-1}, \varphi_{-1}, S)$. The aggregate state variable is a density $\mu_t (a, \theta_{-1}, \varphi_{-1}, S)$ over the states. We assume that a take value on a grid G_a of dimension n_a. Therefore the dimension of the individual state space is $n = n_a \times n_\theta \times n_\varphi \times 2$ where $n_\theta = 2$ is the number of states for the entrepreneurial productivity and $n_\varphi = 4$ is the number of states for the working productivity.

In order to solve the model we use the following approach:

Algorithm 1 *Our solution algorithm is:*

1. *Assign all parameters values*
2. *Guess a value for the endogenous variable r.*
3. *Given r the FOC of the corporate sector uniquely pin down the wage rate w. The representative competitive firm in the corporate sector will choose K_c and L_c such that*

$$r^d = \xi A K_c^{\xi-1} L_c^{1-\xi} = \xi A \left(\frac{K_c^d}{L_c^d} \right)^{\xi-1} \tag{1.8-1}$$

$$w = (1-\xi) A K_c^{\xi} L_c^{-\xi} = (1-\xi) A \left(\frac{K_c^d}{L_c^d} \right)^{\xi} \tag{1.8-2}$$

   Therefore r uniquely pins down $\left(\frac{K_c}{L_c}\right)$ and in turn uniquely pins down w.

4. *Given (r, w) we solve for the optimal value functions and corresponding policy functions by value function iteration. The details of the zero profit conditions for the banks are presented in the next subsection.*

   a) First we solve for the following policy functions[34]*:*

   - *Saving policy function:* $\mathsf{a}' (a, \theta_{-1}, \varphi_{-1}, \theta, \varphi, S, OCC)$ *which for any state today $(\theta_{-1}, \varphi_{-1})$ and for any state tomorrow (θ, φ), for any given level of assets a, for any given credit status $S \in \{UN, BC\}$ and for any occupational choice $OC \in \{W = 0, E = 1\}$ gives us the optimal saving decision of the agent;*
   - *Capital demand function* $\mathsf{k} (a, \theta_{-1}, \varphi_{-1}, S, OCC)$ *for entrepreneurs;*
   - *default decision* $\mathsf{d} (a, \theta_{-1}, \varphi_{-1}, \theta, \varphi, S, OCC)$ *for unconstrained entrepreneur;*

[34] Note that given our timing the saving and bankruptcy decisions are taken when the uncertainty about $\theta'$and φ' has been resolved, therefore they appear as argument of the policy function.

b) The above policy functions allow us to calculate the implied value functions $V(a, \theta_{-1}, \varphi_{-1}, S, OCC)$

c) This in turn allows us to solve for the occupational choice function

$$\mathsf{OC}^*(a, \theta_{-1}, \varphi_{-1}, S) = \begin{cases} = 1 & V(a, \theta_{-1}, \varphi_{-1}, S, E) \geq V(a, \theta_{-1}, \varphi_{-1}, S, W) \\ = 0 & otherwise \end{cases} \tag{1.8-3}$$

5. *The policy functions, the exogenous transition matrix for the shocks (both for* θ_{-1} *and for* φ_{-1}*) and the credit status shock* ϱ *allow us to derive the probability that an agent in a certain state* η *will be in the state* η' *next period, for any give state* η*. Given the dimension of the state, all these probabilities form a transition matrix* P_η *of dimension* $n \times n$*.*

6. *The transition matrix* P_η *maps the current distribution*[35] μ_η *into a next period distribution* μ'_η

$$\mu_{\eta,t+1} = P'_\eta \times \mu_{\eta,t} \tag{1.8-4}$$

We calculate the steady state distribution over the state μ^*_η *by solving for a*

$$\mu^*_\eta = P'_\eta \times \mu^*_\eta \tag{1.8-5}$$

7. *From this we can derive the market clearing conditions*

- *the saving for the whole economy*

$$SA(r) = \sum_{i=1}^{na} \sum_{j=1}^{n_\theta} \sum_{v=1}^{n_\varphi} \sum_{u=1}^{2} a_i \times \mu^*(a_i, \theta_{-1j}, \varphi_{-1v}, S_u) \tag{1.8-6}$$

- *the supply of labor*

$$L^s(r) = \sum_{i,j,v,u} \mu^*(a_i, \theta_{-1j}, \varphi_{-1v}, S_u) \times [1 - \mathsf{OC}^*(a_i, \theta_{-1j}, \varphi_{-1v}, S_u)]\, \varphi_{-1v} \tag{1.8-7}$$

- *the demand of capital from the entrepreneurial sector*

$$\begin{aligned} K^d_{ENTR}(r) = & \sum_{i,j,v,u} \mathsf{p}^*(a_i, \theta_{-1j}, \varphi_{-1v}, S_u) \\ & \times \mathsf{OC}^*(a_i, \theta_{-1j}, \varphi_{-1v}, S_u) \times \mathsf{k}^*(a_i, \theta_{-1j}, \varphi_{-1v}, S_u) \end{aligned} \tag{1.8-8}$$

where $\mathsf{k}^*(a_i, \theta_{-1j}, \varphi_{-1v}, S_u) = \mathsf{k}[a_i, \theta_{-1j}, \varphi_{-1v}, S_u, OC^*(a_i, \theta_{-1j}, \varphi_{-1v}, S_u)]$

[35] Note that in our framework the distribution of household over the state μ_η, is vector of dimension n whose elements sum up to 1.

8. *Labor market clearing implies that labor supply $L^s(r)$ is equal to labor demand L_c^d. Plugging this into the FOC (1.8-1) of the corporate sector we get the capital demand in the corporate sector:*

$$K_c^d(r) = \left(\frac{r}{\xi A}\right)^{\frac{1}{\xi-1}} L^S(r) \tag{1.8-9}$$

9. *Now we look at capital market clearing:*

$$K_{ENTR}^d(r) + K_c^d(r) = SA(r) \tag{1.8-10}$$

10. *If there is not equilibrium at point 9 we adjust the interest rate, go back to point 3, and iterate until the market clears*[36]*.*

Value function iteration

Given the presence of kinks in the problem we use a value function iteration algorithm to solve for the value functions. We approximate the value functions using cubic splines.

The iteration goes as follows.

1. We guess a value function both for the UN and the BC agent: $V^{BC0}(a, \theta_{-1}, \varphi_{-1})$ and $V^{UN0}(a, \theta_{-1}, \varphi_{-1})$

2. Given the guesses, we solve for 4 value functions, two for the workers ($W^{BC}(a, \theta_{-1}, \varphi_{-1})$ and $W^{UN}(a, \theta_{-1}, \varphi_{-1})$) and two for the entrepreneurs ($N^{BC}(a, \theta_{-1}, \varphi_{-1})$ and $N^{UN}(a, \theta_{-1}, \varphi_{-1})$). The only non standard problem is to find $N^{UN}(a, \theta_{-1}, \varphi_{-1})$ where we take the zero profit condition of the bank into account. The solution is described in the next subsection.

3. Form the function we can derive a new guess for the value function

$$V^{BC1}(a, \theta_{-1}, \varphi_{-1}) = \max\left\{N^{BC}(a, \theta_{-1}, \varphi_{-1}), W^{BC}(a, \theta_{-1}, \varphi_{-1})\right\} \tag{1.8-11}$$

$$V^{UN1}(a, \theta_{-1}, \varphi_{-1}) = \max\left\{N^{UN}(a, \theta_{-1}, \varphi_{-1}), W^{UN}(a, \theta_{-1}, \varphi_{-1})\right\} \tag{1.8-12}$$

4. Therefore we can construct an iteration of the form

$$\begin{bmatrix} V^{BCj}(a, \eta) \\ V^{UNj}(a, \eta) \end{bmatrix} \to \begin{bmatrix} V^{BCj+1}(a, \eta) \\ V^{UNj+1}(a, \eta) \end{bmatrix} \tag{1.8-13}$$

[36] In practice we first run a grid search over different values for r and then bisect until we get market clearing.

The zero profit condition

In the derivation of the optimal choice of the unconstrained entrepreneur we assume that he can borrow from a perfectly competitive banking sector: that is there is free entry in the sector. This implies that the bank makes zero profit on each contract. What we need is a menu of contracts that the bank offers, where each contract is an amount lent $b\left(a,\theta_{-1},\varphi_{-1}\right)$ and an interest rate $r\left(a,\theta_{-1},\varphi_{-1},b\right)$ that, give the assumption of perfect symmetric information, can depend on the individual state of the agent

Banks will get repaid if the type-$(a,\theta_{-1},\varphi_{-1})$ agent finds it optimal not to declare bankruptcy at the end of the period, given the amount lent. We denote the probability of bankruptcy as $\pi^{bankr}\left(a,\theta_{-1},\varphi_{-1},b\right)$. Therefore the zero profit condition is given by

$$\left(\begin{array}{l}\left[1-\pi^{bankr}\left(a,\theta_{-1},\varphi_{-1},b\right)\right]\left[1+r(a,\theta_{-1},\varphi_{-1},b)\right]b+\\+\pi^{bankr}(a,\eta)\max\left\{\chi\theta k^{\nu}+f\left(1-\delta\right)\left(a-b\right)-X,0\right\}\end{array}\right)=(1+r)b \tag{1.8-14}$$

In order to find the equilibrium interest rate $r\left(a,\theta_{-1},\varphi_{-1},b\right)$ charged to each type of agent we must find the probability that the agent defaults. However, it is important to note that the contracts the bank offers must all make zero profits in expectations, also the out-of-equilibrium contracts (i.e. those the agent does not choose).

We solve the problem of unconstrained entrepreneurs over a grid. For any given type $(a,\theta_{-1},\varphi_{-1})$ we find the optimal choice given a grid of possible levels of loans: $b_i\in[b_{\min},b_{\max}]$. Given each value of $b_i>0$ (if $b_i<0$ the agent saves so he does not need the bank and gets an interest rate r) there are only three possibilities[37]:

- The agent always repays, both in the event of bad and in the event of a good shock to entrepreneurial productivity. In this case $\pi^{bankr}\left(a,\theta_{-1},\varphi_{-1},b\right)=1$, and therefore the only interest rate compatible with zero profits is r.
- The agent repays only in the case of a bad shock. In this case we know that $\pi^{bankr}\left(a,\theta^{H},\varphi_{-1},b\right)=1-p^{HH}$ and $\pi^{bankr}\left(a,\theta^{L},\varphi_{-1},b\right)=1-p^{LL}$ and we can calculate, for any b, the unique interest rate $r\left(a,\theta_{-1},\varphi_{-1},b\right)$ such that the bank breaks even.
- The agent never repays so he never gets credit.

Therefore our strategy is, for any $b_i\in[b_{\min},b_{\max}]$

1. First we check what happens if the agent is offered the rate r^d.
2. If the agent always repays we are done.
3. If the agent does not repay we check what would he do if he was offered the unique

[37] This is under the assumption of only two state for entrepreneurial talent and that this is the only case that matters.

interest compatible with his defaulting only in the bad state. If he actually defaults only in the bad state, we are done.

4. If at point 3 we find out that given the interest rate the agent will always default (in the good and in the bad state) we know that the agent will never get credit so we set his utility to $-\infty$.

5. We do this for all the $b_i \in [b_{\min}, b_{\max}]$ and then the agent picks the b_i that maximizes his utility.

1.8.2 Data on Entrepreneurship

To calibrate the model and to select a value for the targets we need a definition of an entrepreneur. Given the need to target bankruptcy, we are bounded in the choice by the availability of data on business bankruptcy filings. The main source for data on business bankruptcy is *The Small Business Economy* (2006) by the US Small Business Administration, Office of Advocacy[38]. Their definition of entrepreneurs (see Table 1.8-1) is a business owner who actually runs his business and has at least one employee. Given this definition the main data on entrepreneurs, entrepreneurs' termination and bankruptcy are reported in table 1.8-1.

To get the fraction of entrepreneurs in the population we apply the same definition of entrepreneurs to several waves of the Survey of Consumer Finances (1989-2004). We define an household as entrepreneurial if the head owns and runs a business with at least one employee. The fraction of the population engaged in entrepreneurial activity, for several waves of the SCF is reported in the last column of table 1.8-2. According to our definition, the fraction of entrepreneurial household in total population is given by **7.62%**. This number does not differ from the numbers obtained by using other definitions of entrepreneurship used in the literature[39]

Using the same definition we calculate the median net worth for entrepreneurial household and for the total population, using data from the Survey of Consumer Finances. The results are reported in table 1.8-3 which reports the median wealth based on other definition of entrepreneurship as well.

The corresponding ratio of the median entrepreneurial wealth to the median wealth in total population is **5.66**[40].

[38] The original sources of data are:

- for the employers, from the Bureau of Census and U.S. Department of Commerce
- for employer' births and terminations, from the Census Bureau
- for bankruptcies. from the Administrative Office of the U.S. Courts (business bankruptcy filings).

[39] Cagetti / De Nardi [2006] define as entrepreneurial an household whose head owns and runs a business and declares herself as self-employed. Gentry / Hubbard [2004] define as entrepreneurial an household who owns and runs a business with a total market value of at least 5000$.

[40] Using other definitions of entrepreneurship the ratio of median wealth of entrepreneurs is lower: 4.8 and 5.3

Table 1.8-1: entrepreneurship exit and bankruptcy

Year	Entrepreneurs	Exit	Exit Rate	Bankruptcy	Bankruptcy/Exit
1990	5073795	531400	0.105	64853	0.122
1991	5051025	546518	0.108	71549	0.131
1992	5095356	521606	0.102	70643	0.135
1993	5193642	492651	0.095	62304	0.126
1994	5276964	503563	0.095	52374	0.104
1995	5369068	497246	0.093	51959	0.104
1996	5478047	512402	0.094	53549	0.105
1997	5541918	530003	0.096	54027	0.102
1998	5579177	540601	0.097	44367	0.082
1999	5607743	544487	0.097	37884	0.070
2000	5652544	542831	0.096	35472	0.065
2001	5657774	553291	0.098	40099	0.072
2002	5697759	586890	0.103	38540	0.066
2003	5767127	540658	0.094	35037	0.065
2004	5865400	544300	0.093	34317	0.063
2005	5992400	544800	0.091	39201	0.072
Average	**5493734**	**533328**	**0.097**	**49136**	**0.093**

SOURCE: US Small Business Administration, Office of Advocacy (2006)

Table 1.8-2: fraction of entrepreneurs in total population

year	Cagetti and De Nardi	Gentry-Hubbard	Our definition
1989	0.076	0.067	0.085
1992	0.081	0.096	0.081
1995	0.067	0.071	0.068
1998	0.074	0.074	0.073
2001	0.078	0.081	0.076
2004	0.075	0.084	0.075
Average	**0.075**	**0.079**	**0.076**

SOURCE: Survey of Consumer Finances (1989-2004)

Table 1.8-3: median net worth of total population and of entrepreneurial household

year	Tot Population	Cagetti and De Nardi	Gentry-Hubbard	Our definition
1989	47060	265000	318680	275500
1992	49600	208680	234250	300100
1995	57650	213300	226820	245801
1998	71700	331650	342600	371800
2001	86610	458000	495400	528900
2004	93001	536000	562500	606160
average	**67603.5**	**335438.3**	**363375**	**388043.5**

SOURCE: Survey of Consumer Finances (1989-2004)

In the literature another source of data on entrepreneurship is the Panel Study on Income Dynamics [Quadrini 2000]. Given the panel structure it is particularly useful to calculate exit and entry rates. However, one major drawback is that it undersamples rich households, and therefore entrepreneurs. Unfortunately PSID does not report the number of employees per firm. We cannot use our definition. In the literature on entrepreneurship that uses PSID, Quadrini [2000], two definitions are adopted. According to the first an entrepreneur is someone who declares himself self employed (SELF). According to the second an entrepreneur is someone who owns a business (OWN). Both these definitions are less stringent than the one adopted above. Column 2 and 3 of table 1.8-4 report the fraction of entrepreneurs in PSID according to these definitions. The first definition yields an average fraction of entrepreneurs of 11%. The second definition yields a fraction of 13%. This is much higher than the figure derived from SCF data. Therefore we also use a third definition which is more restrictive: an agent is an entrepreneur if both he owns a business and is self employed. This yields a lower fraction of entrepreneurs, equal to 8%.

Given this discrepancy we avoid using PSID data unless it is strictly necessary. As a check of the SBA data we calculate the exit and entry rates according to the 3 definitions above. The entry rate in period t is defined as the ratio of the number of total households in the sample who were workers in period $t-1$ and were entrepreneurs in period t over the total number of workers in period $t-1$. The exit rate in period t is the ratio of those who were entrepreneurs in period $t-1$ and are worker in period t over the total number of entrepreneurs in period $t-1$. The results are reported in table A5.

These numbers are much higher than the number from the number of SBA. The reason is that the PSID undersamples rich household. Since successful entrepreneurs are richer and do not exit, this results could be biased. Therefore, we choose as the target for the exit rate 9.3%.

Quadrini [2000] points out that the entry rate of workers who have some entrepreneurial

when using Cagetti / De Nardi [2006] and Gentry / Hubbard [2004] definitions respectively.

Table 1.8-4: fraction of entrepreneurs

year	SELF	OWN	BOTH
1969	0.11	0.08	0.06
1970	0.10	0.09	0.06
1971	0.10	0.09	0.06
1972	0.10	0.09	0.05
1973	0.10	0.09	0.06
1974	0.10	0.08	0.05
1975	0.10	0.08	0.06
1976	0.10	0.09	0.07
1977	0.10	0.09	0.06
1978	0.10	0.10	0.06
1979	0.10	0.10	0.06
1980	0.10	0.09	0.07
1981	0.10	0.10	0.06
1982	0.11	0.10	0.07
1983	0.11	0.11	0.07
1984	0.12	0.12	0.08
1985	0.13	0.14	0.09
1986	0.12	0.15	0.09
1987	0.13	0.15	0.09
1988	0.13	0.16	0.10
1989	0.13	0.15	0.09
1990	0.13	0.14	0.09
1991	0.13	0.14	0.09
1992	0.13	0.15	0.09
1993	0.13	0.13	0.08
1994	0.13	0.14	0.08
1995	0.12	0.13	0.08
1996	0.12	0.16	0.09
1997	0.13	0.17	0.09
average	**0.11**	**0.12**	**0.08**

SOURCE: PSID (1969-1997)

Table 1.8-5: Exit and entry rates (different definitions of entrepreneurship)

year	$\text{EXIT}_{\textbf{OWN}}$	$\text{EXIT}_{\textbf{SELF}}$	$\text{EXIT}_{\textbf{BOTH}}$	$\text{ENTRY}_{\textbf{OWN}}$	$\text{ENTRY}_{\textbf{SELF}}$	$\text{ENTRY}_{\textbf{BOTH}}$
1970	0.17	0.13	0.13	0.02	0.02	0.01
1971	0.16	0.11	0.13	0.02	0.02	0.01
1972	0.19	0.15	0.18	0.02	0.02	0.01
1973	0.22	0.14	0.15	0.03	0.02	0.02
1974	0.28	0.13	0.21	0.02	0.02	0.01
1975	0.22	0.10	0.14	0.02	0.02	0.02
1976	0.15	0.08	0.11	0.03	0.01	0.02
1977	0.20	0.12	0.21	0.03	0.02	0.01
1978	0.22	0.10	0.13	0.03	0.02	0.02
1979	0.18	0.11	0.15	0.03	0.02	0.01
1980	0.27	0.10	0.12	0.02	0.01	0.01
1981	0.22	0.10	0.16	0.03	0.01	0.01
1982	0.23	0.07	0.14	0.03	0.02	0.02
1983	0.16	0.09	0.11	0.03	0.02	0.01
1984	0.20	0.11	0.13	0.03	0.01	0.01
1985	0.18	0.12	0.13	0.04	0.03	0.02
1986	0.20	0.14	0.13	0.04	0.02	0.02
1987	0.18	0.12	0.11	0.04	0.02	0.01
1988	0.20	0.13	0.13	0.05	0.03	0.02
1989	0.24	0.15	0.16	0.04	0.02	0.02
1990	0.20	0.13	0.15	0.04	0.02	0.02
1991	0.22	0.11	0.15	0.04	0.03	0.02
1992	0.23	0.12	0.17	0.05	0.02	0.02
1993	0.25	0.13	0.20	0.03	0.02	0.02
1994	0.22	0.15	0.21	0.04	0.02	0.02
1995	0.25	0.13	0.18	0.04	0.02	0.02
1996	0.19	0.10	0.12	0.04	0.02	0.02
1997	0.16	0.09	0.15	0.03	0.02	0.01
average	0.21	0.12	0.15	0.03	0.02	0.02

SOURCE: PSID (1969-1997)

experience in the past is much higher than the entry rate of those who has not got any experience. Using the PSID data we replicate his results. An agent is defined as "experienced" worker in $t-1$ if he is a worker in period t-1 and has been an entrepreneur in any of the three periods before ($t-2,\ t-3,\ t-4$). All the remaining workers in period $t-1$ are defined as non-experienced. The entry rate for experienced and non experienced workers, as well as the overall entry rate are reported in table 1.8-6.

Table 1.8-6: Entry rates (experienced and non experienced workers)

year	total pop	non experienced	experienced
1974	0.015	0.009	0.313
1975	0.017	0.012	0.298
1976	0.014	0.010	0.280
1977	0.018	0.012	0.311
1978	0.014	0.009	0.216
1979	0.013	0.010	0.171
1980	0.011	0.008	0.190
1981	0.015	0.010	0.268
1982	0.014	0.010	0.197
1983	0.014	0.009	0.265
1984	0.023	0.017	0.324
1985	0.019	0.014	0.264
1986	0.014	0.010	0.182
1987	0.020	0.017	0.136
1988	0.017	0.012	0.192
1989	0.018	0.013	0.140
1990	0.017	0.013	0.167
1991	0.019	0.013	0.196
1992	0.017	0.012	0.185
1993	0.018	0.010	0.230
1994	0.019	0.011	0.247
1995	0.017	0.011	0.200
1996	0.012	0.008	0.167
average	**0.016**	**0.011**	**0.223**

SOURCE: PSID (1969-1997)

The entry rate of experienced workers is 14 times higher than the entry rate of the total population.[41]

1.8.3 Formal definition of equilibrium

In our model the state space is given by 4 elements: the asset level a, the entrepreneurial productivity θ, the worker productivity φ and the credit status S. We discretize the asset

[41] If we restrict the sample period to 1989 to 1996,in order to be compatible with other data sources the ratio falls to 11. We set this as the target.

state space, assuming that assets can values on a grid of n_a elements $G_a \subseteq \Re_+^{n_a}$. Given the Markov approximation for the productivities processes we have that θ can take $n_\theta = 2$ values, $\theta \in \Theta \equiv \left\{0, \theta^H\right\}$, and φ can take $n_\varphi = 4$ values $\varphi \in \{\varphi_1, \varphi_2, \varphi_3, \varphi_4\} \equiv \Gamma$. Moreover $S \in \{BC, UN\} \equiv \Xi$. Following Huggett [1993], we can define the state space for the households as $\Omega = G_a \times \Theta \times \Phi \times \Xi$. Letting σ_Ω be the Borel σ-algebra on Ω and letting the optimal policy functions $PF(\omega), \omega \in \Omega$,(assets decisions, occupational choice, capital demand, bankruptcy decision) we have that the policy functions and the exogenous stochastic process imply a **transition function** $T(\omega, \varsigma), \forall \varsigma \in \sigma_\Omega$ on the measurable space (Ω, ω). This transition function implies a stationary probability measure $\mu(\varsigma), \forall \varsigma \in \sigma_\Omega$ that describes the distribution of households' assets holdings, productivity levels, and credit status. Stationarity implies

$$\mu(\varsigma) = \int_\Omega T(\omega, \varsigma)\, d\mu \tag{1.8-15}$$

After this bit of notation we can formally state the following definition of stationary equilibrium:

Definition 2 *A **stationary equilibrium** of the model is a four-tuple* $\{PF(\omega), \mu(\varsigma), (r, w), r(\omega)\}$ *such that:*

1. $PF(\omega)$ *is optimal for given* (r, w)
2. $\mu(\varsigma)$ *is the stationary distribution associated with the transition function generated by* $PF(\omega)$*, given* (r, w)
3. *The corporate sector representative firm is optimizing, given* (r, w)

$$r = \xi A K_c^{\xi-1} L_c^{1-\xi} = \xi A \left(\frac{K_c}{L_c}\right)^{\xi-1} \tag{1.8-16}$$

$$w = (1-\xi) A K_c^{\xi} L_c^{-\xi} = (1-\xi) A \left(\frac{K_c}{L_c}\right)^{\xi} \tag{1.8-17}$$

4. $r(\omega)$ *reflects the zero profit condition for the banking sector*
5. *Labor market and capital market clears.*

Chapter 2

Personal Bankruptcy Law, Debt Portfolios and Entrepreneurship

2.1 Introduction

Entrepreneurs employ half of all workers in the US and they create three quarters of all new jobs.[1] Over time, successful entrepreneurs, for example Bill Gates in 1978 or Larry Page and Sergey Brin in 1997, grow their small firms into big enterprises, for example Microsoft and Google today. Personal bankruptcy law is important for entrepreneurs because if an entrepreneur's firm is not incorporated he or she is personally liable for all the unsecured debts of this firm.[2] Many entrepreneurs fail each year, and around 60,000 file for bankruptcy.

This paper investigates quantitatively the effects of personal bankruptcy law on entrepreneurship. Bankruptcy introduces some contingency in a world of incomplete credit markets where only simple debt contracts are available. This contingency provides insurance against entrepreneurial failure at the cost of worsening credit conditions. If the bankruptcy law does not allow default under any circumstances, credit will be available at lower interest rates because borrowers will not default. This comes at the expense of borrowers having no insurance against business failure. If, however, the bankruptcy law makes default very easy, borrowers might be insured against bad outcomes. But in order to compensate for the default risk, banks have to charge higher interest rates or ration credit all together. In our model, as in the real world, entrepreneurs can also obtain secured credit. This modifies the trade-off between insurance and credit conditions by allowing agents, if they want to, to obtain cheap

[1] We thank Alex Michaelides for his continuous support and valuable comments, and Francesco Caselli and Maitreesh Ghatak for helpful comments at various stages of this research. We are also grateful to Orazio Attanasio, Daniel Becker, Chris Caroll, Wouter Den Haan, Eric Hurst, Bernardo Guimaraes, Christian Julliard, Winfried Koeniger, Tom Krebs, Dirk Krueger, Rachel Ngai, Vincenzo Quadrini, Victor Rios-Rull, Alwyn Young and participants at Fifth European Workshop in Macroeconomics, the Heterogeneous Agent Models in Macroeconomics workshop in Mannheim 2009 and the NBER 2009 Summer Institute EFACR workshop.

[2] Meh / Terajima [2008] report that unsecured debt accounts for around on e third of all debt.

(secured) credit even in a world with a very generous bankruptcy law. We find that allowing entrepreneurs to obtain both, secured and unsecured credit, has quantitatively important effects on the model economy.

The trade-off between insurance and credit conditions is at the center of recent public discussions and policy changes in Europe and the US. In Europe, the bankruptcy law is much harsher than in the US. Many countries, for example Germany, the Netherlands and the UK, have made legislation more lenient with the explicit aim of fostering entrepreneurship.[3] The policy changes in the US went in the opposite direction. Following the huge increase in personal bankruptcy filings, US Congress in 2005 passed a law making personal bankruptcy less beneficial for filers. Even though the focus of this discussion has been on consumer bankruptcy, the effects on entrepreneurship are important because around 60,000 failed entrepreneurs file for bankruptcy each year. Our paper quantitatively assesses the relative strength of these two opposing forces: insurance versus credit conditions, on the number of entrepreneurs, on the access of poor agents to entrepreneurship, on firm size, and on welfare, inequality and social mobility.

We build an infinite horizon heterogeneous agent model, which has an occupational choice problem at its core. Agents differ with respect to their entrepreneurial and working productivity. During each period, they decide whether to become an entrepreneur or a worker. Cagetti / De Nardi [2006] also have this occupational choice at the center of their model, which is able to explain US wealth distribution, in particular its extremely skewed nature at the top. However, in their model, entrepreneurship is a risk-free activity because there is no uncertainty about current productivities. Thus there is no default in equilibrium and there is no insurance role for bankruptcy. We have default in our model because in the US 2.25% of all entrepreneurs file for bankruptcy.

Despite the importance of personal bankruptcy law for entrepreneurship, there is little quantitative literature on this topic. Starting with Athreya [2002], the literature so far has focused almost exclusively on consumer bankruptcy. For example, Livshits et al. [2007] compare the US system under which future earnings are exempt after consumers have defaulted with a European type of system under which future earnings are garnished to repay creditors. They find that the welfare differences between the systems depend on the persistence and variance of the shocks. Chatterjee et al. [2007] show that the recent tightening of the law in the US implies large welfare gains.[4] In this literature there are few papers that focus on secured and unsecured borrowing. Athreya [2006] finds that welfare is increasing in the wealth exemption level. Hintermaier / Koeniger [2008] examine the reasons for the increase in consumer bankruptcies in a model with durable and nondurable goods.

There are three closely related papers that analyze the effects of bankruptcy on entrepreneurship in a quantitative setting similar to our paper. Akyol / Athreya [2007] use an

[3] In a companion paper, we are currently investigating the effects of introducing a US type of law in Europe.
[4] Other papers in this growing literature are Athreya [2006], Athreya / Simpson [2006], Li / Sarte [2006], Mateos-Planas / Seccia [2006].

overlapping generations, partial equilibrium framework with heterogeneity in human capital. Their main results is that the current system is too generous. Meh / Terajima [2008] have a similar framework (partial equilibrium OLG model) in which they analyze bankruptcy decisions of both consumers and entrepreneurs. Mankart / Rodano [2007] have a model with temporary and permanent productivity shocks. The main result of all three papers is that the current system is too generous.[5]

Our model is able to replicate key macroeconomic variables of the US economy: the capital output ratio, the fraction of entrepreneurs in the population, the exit rate, the bankruptcy filings of entrepreneurs, the wealth of entrepreneurs compared to workers. Based on this model, we can conduct a policy experiment to assess whether the current exemption level (how much wealth a person can keep in case of a default) is optimal.

Our main result is that the current system is too harsh with respect to the exemption level. There are welfare gains from increasing the current exemption level to the optimal one. Entrepreneurship would increase from 7.2% of the population to 7.4% if the exemption level were increased because of the increased insurance effect. Moreover, eliminating bankruptcy exemptions would lead to a reduction of welfare and a reduction in entrepreneurship to 6.6% of the population.

Our results are strikingly different from other papers in the literature. Meh / Terajima [2008], Akyol / Athreya [2007] and Mankart / Rodano [2007] find that the current system is too generous[6]. The main difference is that all these paper do not allow entrepreneurs to obtain secured, in addition to unsecured, credit.

In a counterfactual experiment we find that if we exclude secured credit we get similar results as the previous literature: the current law appears to be too lenient. The reason is the following. When we exclude secured credit some agents are credit rationed because their incentive to default is too high. Therefore they become workers. Increasing the exemption level worsens this problem. If instead these agents can obtain secured credit (i.e. pledge collateral), they can run bigger firms and therefore find it profitable to become entrepreneurs. Excluding secured credit from the analysis overstates the role of credit rationing. Thus, the policy conclusion reached in the previous literature might be premature.

Our results, as those from Meh / Terajima [2008], Akyol / Athreya [2007] and Mankart / Rodano [2007] are consistent with the empirical finding of Berkowitz / White [2004] who show that in states with higher exemption levels, credit conditions are worse. But our paper is also consistent with the findings of Fan / White [2003] that show that entrepreneurship is higher in states with a more lenient bankruptcy law. This is not true in the work of Meh / Terajima [2008], Akyol / Athreya [2007] and Mankart / Rodano [2007].

Moreover, we use Epstein-Zin preferences. This allows us to distinguish between risk aversion

[5] Zha [2001] is a theoretical investigation of similar issues. However his model abstracts from occupational choice, which we show to be the crucial channel through which bankruptcy law affects entrepreneurship.
[6] This result is also common to most papers in the consumer bankruptcy literature.

and intertemporal elasticity of substitution. This is particularly interesting, given that the costs of a generous bankruptcy system, in terms of higher interest rates, depend mainly on the elasticity of intertemporal substitution, while the benefits, in terms of insurance, depend on risk aversion. Our choice of preferences allows us to examine these effects separately. We find that the optimal exemption level increases with the elasticity of intertemporal substitution. This result is quite intuitive since agents who are more willing to substitute consumption across time are less affected by the higher borrowing rates resulting from higher exemption levels. We also find that the optimal exemption level increases with risk aversion. The more risk averse agents are the more they value insurance.

The paper is organized as follows, Section 2 provides an overview of US bankruptcy law and presents data on entrepreneurial failure. In Section 3 we present our model and discuss the equilibrium condition. In Section 4 we discuss our calibration strategy and present the baseline results. Section 5 explains the main mechanism of the model. In Section 6, we conduct the main policy experiment. In Section 7 we present the effects of excluding secured credit and some robustness checks. Section 8 concludes.

2.2 Entrepreneurial failure and personal bankruptcy in the US

Personal bankruptcy procedures in the US consist of two different procedures: Chapter 7 and Chapter 13. Under Chapter 7, all unsecured debt is discharged immediately, while a secured creditor can fully seize the assets pledged as collateral. Future earnings cannot be garnished. This is why Chapter 7 is known as providing a "fresh start". At the same time, a person filing for bankruptcy has to surrender all wealth in excess of an exemption level. The exemption level varies across US states, ranging from $11,000 in Maryland to unlimited for housing wealth in some states, for example Florida. Therefore, we calculate the population-weighted median across states. The resulting average exemption level is $47,800 in 1993.[7]

Under Chapter 13 agents can keep their wealth, debt is not discharged immediately and future earnings are garnished. Entrepreneurs are better off under Chapter 7 for three reasons: they have no non-exempt wealth, their debt is discharged immediately and they can start a new business straight away, since their income will not be subject to garnishment [see White 2007a]. 70% of total bankruptcy cases involving entrepreneurs are under Chapter 7. Therefore we will focus on Chapter 7 only.

Persons can file for bankruptcy only once every six years. The bankruptcy filing remains public information for ten years. Therefore, agents have difficulties obtaining unsecured credit for some time after having defaulted. Secured credit, credit that is collateralized, is always available.

The US. Small Business Administration reports an exit rate of on average 9.7% per annum

[7] The wealth exemption level does not change much over time. We choose 1993 because it is in the middle of the sample years for our data on entrepreneurship wealth distribution and bankruptcies.

for small firms in the period from 1990-2005.[8] Out of these failing firms 9.3% file for bankruptcy, according to the official data from the Administrative Office of the Courts.[9] Unfortunately, the official data on personal bankruptcy caused by a business failure seem to be severely downward biased. Lawless / Warren [2005] estimate that the true number could be three to four times as big. Their own study is based on an in-depth analysis of bankruptcy filers in five different judicial districts. Their explanation of this discrepancy is the emergence of automated classification of personal bankruptcy cases. Almost all software used in this area has "consumer case" as the default option. Thus reporting a personal bankruptcy case as a "business related" case requires some - even though small - effort while being completely inconsequential for the court proceedings. In addition to their own study they report data from Dun & Bradstreet according to which business bankruptcies are at least twice the official number.[10]

In the calibration of our model we set the baseline exemption level equal to $47,800. The baseline exclusion period is set to two year.[11] We calibrate the model such that the default rate of entrepreneurs is 2.25%.

2.3 The model

Our economy is populated by a unit mass of infinitely lived heterogeneous agents. Agents face idiosyncratic uncertainty, but there is no aggregate uncertainty. At the beginning of every period, agents decide whether to become workers or entrepreneurs. An entrepreneur must decide how much to invest, how much to borrow secured and, if he is allowed to, how much to borrow unsecured. An entrepreneur who has defaulted on unsecured credit is excluded from unsecured credit for two year but is allowed to obtain secured credit. Since we focus on the implications of personal bankruptcy for entrepreneurs, workers are not allowed to borrow. Agents productivities evolve over time and agents are subject to uninsurable production risk.

[8] The U.S. Small Business Administration splits small firms into employer and non-employer firms. Employer firms have at least one employee working in the firm. There are roughly five million employer and 15 million non-employer firms in the U.S. Since the focus of our paper is on entrepreneurs who own and manage the firm we use only the data for employer firms since non-employer firms have in many cases the owner not working in the firm. To ensure consistency across our three databases, when we use data from the Survey of Consumer Finance (SCF) and the Panel Study of Income Dynamics (PSID) we define entrepreneurs as business owners who manage a firm with at least one employee.

[9] While one can obtain exit rates from the PSID data [Quadrini 2000], it is impossible to obtain reliable bankruptcy data from the PSID. There is only one wave in which respondents were asked about past bankruptcies.

[10] Dun & Bradstreet (D&B) is a credit-reporting and business information firm. D&B compiles its own independent business failure database. Until the emergence of automated software for law firms and courts in the mid 1980s, the official business bankruptcy data and the index compiled by D&B have a positive and significant correlation of 0.73. From 1986-1998 this correlation coefficient becomes negative and insignificant. Extrapolating from the historic relationship between the D&B index and personal bankruptcy cases caused by business failures leads to the conclusion that the official data under report business bankruptcy cases at least by a factor of two.

[11] We choose a short exclusion period because there is evidence that entrepreneurs obtain unsecured credit even after defaulting. However as a robustness check, we set the exclusion period to six years and the results do not change much.

After the shocks are realized, production takes place. At the end of the period unsecured borrowers decide whether to repay or whether to default and how much to consume and how much to save. If they default, they will be borrowing constrained in the next period. Anticipating this behavior, banks who give unsecured credit vary the interest rate charged for each loan taking into account the individual borrower's default probability. The remainder of this section presents the details of the model.

2.3.1 Credit and bankruptcy law

Agents can get two types of credit: secured and unsecured. Both types of credit are subject to a limited commitment problem.[12] After getting credit, all borrowers have two options: take all liquid assets, their own wealth plus the amount borrowed, and run or start the entrepreneurial activity. If they run the agents can keep a fraction λ of the liquid assets. If the agents start the entrepreneurial activity then the only difference is that secured credit must be repaid (and it has priority in the bankruptcy proceedings), while unsecured credit is subject to Chapter 7 bankruptcy procedure, if the agent exercises his default option.

In the event of a default the agent still must repay her secured debt. Unsecured debt, however, is discharged. Any assets remaining after repaying the secured debt which is in excess of an exemption level X are liquidated.

An agent who has defaulted in the past is excluded from the market for unsecured credit for a certain period of time. During this period he still can obtained secured credit and can become an entrepreneur. We call this agent *borrowing constrained* and we denote his credit status as BC. It is important to note that this agent is not fully excluded from the credit market. He can still obtain *secured* credit. However he cannot obtain *unsecured* credit. We assume that every *borrowing constrained* agent, whether worker or entrepreneur, faces a credit status shock at the end of the period. With probability $(1 - \varrho)$ the agent remains *borrowing constrained*. With probability ϱ the agent regain access to *unsecured* credit. He becomes an *unconstrained* agent with credit status UN.[13] This probability ϱ captures the duration of exclusion period from the market of unsecured borrowing. It is calibrated such that the average exclusion period is two year.

2.3.2 Households

Our economy is populated by a unit mass of infinitely lived heterogeneous agents. Agents differ with respect to their level of assets a, their entrepreneurial productivity θ, their working productivity φ, and their credit market status $S \in \{UN, BC\}$.

[12] We introduce this limited commitment problem to obtain reasonable leverage ratios. As pointed out by Heaton / Lucas [2002] models without information asymmetries yield counterfactually large leverage ratios.
[13] The length of the exclusion period is transformed into a probability in order to avoid an additional state variable that keeps track of the numbers of years left before the solvency status is returned to UN. This procedure is standard in the literature, see Athreya [2002] and Chatterjee et al. [2007].

Preferences

For simplicity we abstract from labor-leisure choice. All agents supply their unit of labor inelastically either as workers or as entrepreneurs. In order to disentangle the effects of risk aversion from that of the elasticity of inetertemporal substitution we assume that agents have Epstein-Zin preferences. A stochastic consumption stream $\{c_t\}_{t=0}^{\infty}$ generates an utility $\{u_t\}_{t=0}^{\infty}$ according to

$$u_t = U(c_t) + \beta U\left(\mathbb{CE}_t\left[U^{-1}(u_{t+1})\right]\right)$$

where β is the discount rate and $\mathbb{CE}_t\left[U^{-1}(u_{t+1})\right] \equiv \Gamma^{-1}\left[\mathbb{E}_t\Gamma(u_{t+1})\right]$ is the consumption equivalent of u_{t+1} given information at period t. The utility function $U(c) = c^{1-\frac{1}{\psi}}/\left(1-\frac{1}{\psi}\right)$ aggregates consumption across dates and ψ is the intertemporal elasticity of substitution. The utility function $\Gamma(c) = c^{1-\gamma}/(1-\gamma)$ aggregates consumption across states and γ is the coefficient of relative risk aversion.

Productivities

Each agent is endowed with a couple of stochastic productivity levels which are known at the beginning of the period: one as an entrepreneur θ, and one as a worker φ. We make the simplifying assumption that the working and entrepreneurial ability processes are uncorrelated.

The workers' ability process Following the literature, we assume that labor productivity follows the following AR(1) process

$$\log\varphi_t = (1-\rho)\mu + \rho\log\varphi_{t-1} + \varepsilon_t$$

where ε_t is *iid* and $\varepsilon \sim N(0, \sigma_\varepsilon)$. If the agent becomes a worker his labor income during current period is given by $w\varphi$.

The entrepreneurs' ability process In contrast to the case of working ability, there are no reliable estimates of the functional form for the case of entrepreneurial ability. Therefore, following Cagetti / De Nardi [2006], we will assume a parsimonious specification where entrepreneurial productivity follows a 2-state Markov process with $\theta^L = 0$ and $\theta^H > 0$ and transition matrix

$$P_\theta = \begin{bmatrix} p^{LL} & 1-p^{LL} \\ 1-p^{HH} & p^{HH} \end{bmatrix}$$

We calibrate the 3 parameters (θ^H, p^{HH} and p^{LL}) to match some observed features of entrepreneurial activity in the US economy.

2.3.3 Technology

Entrepreneurial sector Every agent in the economy has access to a productive technology that, depending on her entrepreneurial productivity θ, produces output according to the production function

$$\begin{aligned} Y &= \theta k^{\nu} \\ k &= \chi I \end{aligned}$$

where θ is the agent's persistent entrepreneurial productivity described above.

We assume that investment is subject to an *iid* idiosyncratic shock. Each unit of the *numeraire* good which is invested in the entrepreneurial activity is transformed in χ units of capital with $log\chi \sim N(0, \sigma_{\chi})$ This *iid* shock represents the possibility that an inherently talented entrepreneur (i.e. an agent with high and persistent θ) might choose the wrong project or could be hit by an adverse demand shock. Quadrini [2000] shows that the entry rate of workers with some entrepreneurial experience in the past, is much higher than the entry rate of those workers without any experience. Therefore it seems that entrepreneurs come mostly from a small subset of total population. If their firms fail, they are very likely to start a new firm within a few years. The *iid* shock χ helps us to capture this difference in the entry rates.

Corporate sector Many firms are both incorporated and big enough not to be subject to personal bankruptcy law. Therefore we follow Quadrini [2000] and Cagetti / De Nardi [2006] and assume a perfectly competitive corporate sector which is modeled as a Cobb-Douglas production function

$$F(K_c, L_c) = AK_c^{\xi} L_c^{1-\xi}$$

where K_c and L_c are capital and labor employed in this sector. Given perfect competition and constant returns to scale the corporate sector does not distribute any dividend. Capital depreciates at rate δ in both sectors.

2.3.4 Credit market

We assume that there is perfect competition (free entry) in the credit market. Therefore banks must make zero expected profit on any contract. The opportunity cost of lending to entrepreneurs is the rate of return on capital in the corporate sector. This is also equal to the deposit rate.[14] Agents can get two types of credit: *secured* credit and *unsecured* credit. *Secured* credit represents collateralized borrowing. Thus, it is available at the risk free rate

[14] In our model, banks are isomorphic to a bond market in which each agent has the possibility to issue debt.

plus a small transaction cost ($r^s = r^s + \tau^s$). *Unsecured* credit requires higher transaction costs ($\tau^u > \tau^s$) that reflect the higher information costs which are present in the real world and from which we abstract in the model.

Both types of contracts are subject to a limited commitment constraint. Instead of investing the money in the entrepreneurial firm the agent can take the money and run away with a fraction λ of the credit plus assets. Anticipating this behavior, banks will never lend any amount such that the agent prefers to run.[15]

There are no information asymmetries in the credit market. Banks know the agent's assets, the amount he borrowed secured s and his productivities. For any given value of (a, s, θ, φ) and for any amount lent unsecured b, by anticipating the behavior of the entrepreneur, banks are able to calculate the probability of default and the recovery rate in case of default. Perfect competition implies that they set the interest rate, $r(a, s, \theta, \varphi, b, X)$, such that they expect to break even. This interest rate depends on the exemption level X because it affects the incentives to default and the amount the bank recovers in this event. Therefore banks offer a menu of one period debt contracts which consist of an amount lent b and a corresponding interest rate $r(a, s, \theta, \varphi, b, X)$ to each agent (a, s, θ, φ).

2.3.5 Timing

Figure 2.1 shows the timing of the model. Given the focus of the paper we choose the timing such that workers can never default. Entrepreneurs' borrowing and default decisions are taken within the period. At the beginning of the period all agents face an occupational choice: they choose whether they become entrepreneurs or workers. Agents know their current productivities (φ, θ).

Workers deposit all their wealth at the banks, receiving a rate of return r^d. After production has taken place, they choose consumption and savings. At the end of the period the *borrowing constrained* worker receives the credit status shock. With probability ϱ he remains *borrowing constrained* next period (i.e. $S' = BC$). With probability $(1 - \varrho)$ he becomes *unconstrained* next period (i.e. $S' = UN$).

The *borrowing constrained* entrepreneur chooses how much secured credit s to obtain or whether to save. After having obtained secured credit s, the *borrowing constrained* entrepreneur decides whether to take s and his own wealth a and run (with a fraction λ of it). In this case the bank receives nothing. Anticipating this, the bank will never lend an amount s with which the agent would run. The entrepreneur decides how much to invest before the *iid* shock χ is realized. After χ is realized and production has taken place, he chooses consumption and savings. At the end of the period he receives the credit status shock.

The *unconstrained entrepreneur* can obtain both: secured credit s and unsecured credit b.

[15] This means that running with the money is an out of equilibrium behavior. We introduce it to limit the leverage ratio to empirically plausible levels.

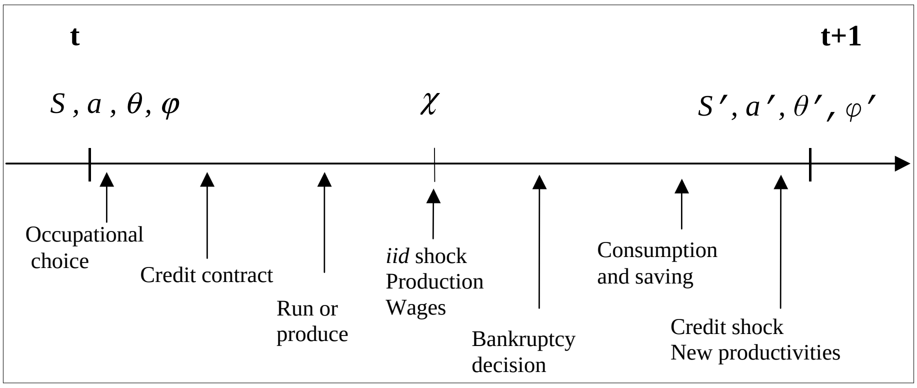

Figure 2.1: Timing of the model

Before knowing χ, he chooses his capital stock by deciding how much to borrow (or invest at rate r^d). He obtains secured credit s at the interest rate r^s. Unsecured borrowing is done by picking from the menu $\{b, r(a, \theta, \varphi, s, b, X)\}$ offered by the the banks. As for the *borrowing constrained*, the *unconstrained constrained* can take $a + b + s$ and run. And as before, the bank will never lend in a way that induces the agent to run. After χ is realized and production has taken place, the entrepreneur must repay his secured debt. Then he can decide whether to repay his unsecured debt as well and be *unconstrained* next period (i.e. $S' = UN$) or whether to declare bankruptcy and be *borrowing constrained* next period(i.e. $S' = BC$). After that he chooses consumption and savings.

Since the credit status S consists only of the two states BC and UN, we define the individual state variable as (a, θ, φ), and we solve for two value functions $V^{UN}(a, \theta, \varphi)$ and $V^{BC}(a, \theta, \varphi)$ one for each credit status.

2.3.6 The problem of the *borrowing constrained* agent

The *borrowing constrained* agent can only obtain secured credit. Therefore he can either save or borrow at a rate r^d subject to the limited commitment constraint. At the beginning of the period he can choose whether to become an entrepreneur, which gives utility $N^{BC}(a, \theta, \varphi)$ or a worker which yields utility $W^{BC}(a, \theta, \varphi)$. Therefore the value of being a *borrowing constrained* agent with state (a, θ, φ) is

$$V^{BC}(a, \theta, \varphi) = \max\left\{N^{BC}(a, \theta, \varphi), W^{BC}(a, \theta, \varphi)\right\}$$

where the "max" operator reflects the occupational choice.

Worker At the beginning of the period the *borrowing constrained* worker deposits all his wealth at the bank and he receives labor income $w\varphi$. At the end of the period, he chooses consumption and saving, taking into account that he will receive a credit status shock in addition to productivity shocks. With probability ϱ he will be still *borrowing constrained* next period which yields utility $V^{BC}(a', \theta, \varphi)$, while with probability $(1-\varrho)$ he will become *unconstrained* which yields utility $V^{UN}(a', \theta, \varphi)$. His saving problem is the following

$$\begin{aligned} W^{BC}(a, \theta, \varphi) &= \max_{c,a'} \left\{ U(c) + \beta U \left(\mathbb{CE}_t \left[\varrho V^{BC}(a', \theta', \varphi') + (1-\varrho) V^{UN}(a', \theta', \varphi') \right] \right) \right\} \\ s.t.\ c + a' &= w\varphi + \left(1 + r^d\right) a \\ a' &\geq 0 \end{aligned}$$

Entrepreneur At the beginning of the period the *borrowing constrained* entrepreneur decides how much to invest in his firm $I = a + s$ by choosing how much secured credit $(s > 0)$ or save, at rate r^d $(s < 0)$. Each unit of investment is transformed in χ units of capital, $(k = \chi I)$. After he has got credit he could take the money and run away with a fraction λ. If he does so his utility is given by

$$\begin{aligned} \Upsilon[a + s, \theta, \varphi] &= \max_{c,a'} \left\{ U(c) + \beta U \left[\mathbb{CE}_t V^{BC}(a', \theta', \varphi') \right] \right\} \\ s.t.\ c + a' &= \lambda (a + s) \\ a' &\geq 0 \end{aligned}$$

After the shock χ is realized he will decide how to allocate the resources $(\chi I)^{\nu} \theta + (1-\delta) \chi I - \left(1 + r^d\right) s$ among consumption and savings. His saving problem, after uncertainty is resolved,[16] is

$$\begin{aligned} \tilde{N}^{BC}(a, \theta, \varphi, \chi, s) &= \max_{a',c} \left\{ U(c) + \beta U \left(\mathbb{CE}_t \left[\varrho V^{BC}(a', \theta', \varphi') + (1-\varrho) V^{UN}(a', \theta', \varphi') \right] \right) \right\} \\ s.t.\ c + a' &= [\chi(a+s)]^{\nu} \theta + (1-\delta) \chi (a+s) - \left(1 + r^d\right) s \\ a' &\geq 0 \end{aligned}$$

Therefore the optimal investment decisions of the agent at the beginning of the period is

$$\begin{aligned} N^{BC}(a, \theta, \varphi) &= \max_{s} U \left(\mathbb{CE}_t \left\{ \tilde{N}^{BC}(a, \theta', \varphi', \chi, s) \right\} \right) \\ s.t.\ N^{BC}(a, \theta, \varphi) &> \Upsilon[a + s, \theta, \varphi] \end{aligned}$$

2.3.7 The problem of the *unconstrained* agent

At the beginning of the period the *unconstrained* agent faces the following occupational choice

$$V^{UN}(a, \theta, \varphi) = \max \left\{ W^{UN}(a, \theta, \varphi), N^{UN}(a, \theta, \varphi) \right\}$$

where $W^{UN}(a, \theta, \varphi)$ is the utility of becoming a worker and $N^{UN}(a, \theta, \varphi)$ of becoming an entrepreneur.

[16] We denote with a "~" all the value functions, *after* uncertainty (about χ) is resolved. The value functions without "~" are *before* uncertainty is resolved.

Worker The problem of the *unconstrained* worker is identical to the *borrowing constrained* one except that the agent will be *unconstrained* in the future for sure. His saving problem is the following

$$\begin{aligned} W^{UN}(a,\theta,\varphi) &= \max_{c,a'} U(c) + \beta U\left(\mathbb{CE}_t\left[V^{UN}(a',\theta',\varphi')\right]\right) \\ s.t.\ c + a' &= w\varphi + \left(1+r^d\right)a \\ a' &\geq 0 \end{aligned}$$

Entrepreneur The *unconstrained entrepreneur* decides how much to invest in his firm $I = a + b + s$ by choosing how much to borrow from secured credit ($s > 0$) from unsecured credit ($b > 0$) or save at rate r^d ($s < 0$). If he borrows unsecured credit he can choose from the menu $\{b, r(a,\theta,\varphi,b,s,X)\}$ offered by competitive banks. After the shock χ is realized he can choose whether to declare bankruptcy (default) or whether to repay and how much to consume and save. He solves the problem backwards.

If he repays his unsecured debt, he has to choose how to allocate his resources, $\theta\left[(a+b+s)\chi\right]^{\nu} + (1-\delta)(a+b+s)\chi - b\left[1 + r(a,\theta,\varphi,b,s,X)\right] - (1+r^d)s$, between consumption and savings. Given that the decision of repaying is done when current productivities (θ,φ) and the shock χ are known, his utility from repaying is given by

$$\begin{aligned} \tilde{N}^{pay}(a,b,s,\theta,\varphi,\chi) &= \max_{c,a'}\left\{U(c) + \beta U\left(\mathbb{CE}_t\left[V^{UN}(a',\theta',\varphi')\right]\right)\right\} \\ s.t.\ a' + c &= \theta\left[(a+b+s)\chi\right]^{\nu} + (1-\delta)(a+b+s)\chi - \cdots \\ &\quad - b\left[1 + r(a,\theta,\varphi,b,s,X)\right] - (1+r^d)s \\ a' &\geq 0 \end{aligned}$$

If he defaults, his unsecured debt is discharged. But he must repay any secured debt he had and he loses all assets in excess of the exemption level X. Thus, the resources to allocate between consumption and savings are $\min\left\{\theta\left[(a+b+s)\chi\right]^{\nu} + (1-\delta)(a+b+s)\chi - (1+r^d)s, X\right\}$. Moreover if he defaults he will be *borrowing constrained* next period. Therefore by declaring bankruptcy he gets

$$\begin{aligned} \tilde{N}^{bankr}(a,b,s,\theta,\varphi,\chi) &= \max_{c,a'}\left\{U(c) + \beta U\left(\mathbb{CE}_t\left[V^{BC}(a',\theta',\varphi')\right]\right)\right\} \\ s.t.\ a' + c &= \min\left\{\theta\left[(a+b+s)\chi\right]^{\nu} + (1-\delta)(a+b+s)\chi - (1+r^d)s, X\right\} \\ a' &\geq 0 \end{aligned}$$

He will declare bankruptcy if $N^{bankr}(a,b,s,\theta,\varphi\,\chi) > N^{pay}(a,b,s,\theta,\varphi,\chi)$ and vice versa. Thus, at the beginning of the period the agent choose the optimal amount of b from the menu $\{b, r(a,\theta,\varphi,b,X)\}$ and the optimal s anticipating his future behavior. Therefore his utility is given by

$$\begin{aligned} N^{UN}(a,\theta,\varphi) &= \max_{\{b,r(\cdot)\},s} \mathbb{CE}_t \left[\max\left\{\tilde{N}^{pay}(a,b,s,\theta,\varphi,\chi), \tilde{N}^{bankr}(a,b,s,\theta,\varphi,\chi)\right\}\right] \\ s.t.\ N^{UN}(a,\theta,\varphi) &\geq \Upsilon^{UN}[a+s+b,\theta,\varphi] \end{aligned}$$

where the "max" operator inside the square brackets reflects the bankruptcy decision, and the "max" operator outside the square brackets reflects the borrowing decision. The last equation represents the limited commitment constraint where

$$\begin{aligned} \Upsilon[a+s+b,\theta,\varphi] &= \max_{c,a'}\left\{U(c)+\beta U\left[\mathbb{CE}_t V^{BC}(a',\theta',\varphi')\right]\right\} \\ s.t.\ c+a' &= \lambda(a+s+b) \\ a' &\geq 0 \end{aligned}$$

2.3.8 The zero profit condition of the banks

Banks observe the state variables (a,θ,φ) at the moment of offering the contract.There is perfect competition (free entry) in the credit market therefore banks make zero profit on each secured and unsecured loan contract. Therefore the bank is indifferent between issuing secured and unsecured loans. For each unit of secured credit the bank know that the agent will repay for sure: free entry will push the interest rate on secured credit to the risk free rate plus the transaction cost τ^s. For any given state (a,θ,φ) and for any given amount of secured borrowing the agent is doing (s) and for any unsecured loan (b), banks know in which states of the world the agent will file for bankruptcy. Therefore, they are able to calculate the probability that a certain agent with characteristics (a,θ,φ), and secured loan s, will default for any given amount b. This default probability, $\pi^{bankr}(a,\theta,\varphi,b,s,X)$, depends on the exemption level X because X affects the incentive to default directly.

If the agent repays banks receive $[1+r(a,\theta,\varphi,b,s,X)]\,b$. If the agent defaults banks sells the firm's un-depreciated capital. Therefore they receive: nothing if $\theta[(a+b+s)\chi]^{\nu}+(1-\delta)(a+b+s)\chi-\left(1+r^d\right)s<X$, while banks receive $\theta[(a+b+s)\chi]^{\nu}+(1-\delta)(a+b+s)\chi-\left(1+r^d\right)s-X$ otherwise.

The zero profit condition of the banks is given by

$$\left(\begin{array}{c} \left[1-\pi^{bankr}(a,\theta,\varphi,b,s,X)\right][1+r(a,\theta,\varphi,b,s,X)]\,b+ \\ +\pi^{bankr}(a,\theta,\varphi,b,s,X) \\ \max\left\{\theta[\chi I]^{\nu}+(1-\delta)\chi I-\left(1+r^d\right)s-X,0\right\} \end{array}\right)=(1+r^d)(1+\tau^u)b,$$

where $I=a+b+s$

2.3.9 Equilibrium

Let $\eta = (a, \theta, \varphi, S)$ be a state vector for an individual, where a denotes assets, θ entrepreneurial productivity, φ working productivity and S the credit status. From the optimal policy functions (savings, capital demand, default decisions), from the exogenous Markov process for productivity and from the credit status shocks, we can derive a transition function, that, for any distribution $\mu(\eta)$ over the state provides the next period distribution $\mu'(\eta)$. A stationary equilibrium is given by

- a deposit rate of return r^d and a wage rate w
- an interest rate function
- a set of policy functions $g(\eta)$ (consumption and saving, secured and unsecured borrowing, capital demand, bankruptcy decisions and occupational choice)
- a constant distribution over the state η, $\mu^*(\eta)$

such that, given r^d and w and a bankruptcy regime X and ϱ:

- $g(\eta)$ solves the maximization problem of the agents;
- the corporate sector representative firm is optimizing;
- capital, labor and goods market clear:
  - capital demand comes from both, entrepreneurs and the corporate sector, while supply comes from the saving decisions of the agents;
  - labor demand comes from the corporate sector, while labor supply comes from the occupational choice of the agents;
- the interest rate function reflects the zero profit condition of the banks
- The distribution $\mu^*(\eta)$ is the invariant distribution associated with the transition function generated by the optimal policy function $g(\eta)$ and the exogenous shocks.

The model has no analytical solution and must be solved numerically. The algorithm used to solve the model and other details are presented in the appendix.

2.4 Results

2.4.1 Parametrization

Fixed parameters

Following standard practice in the literature we try to minimize the number of parameters of the model used to match the data. We therefore select some parameters which have already been estimated in the literature. We choose $\rho = 0.95$ for the auto-regressive coefficient of the earnings process.[17] The variance of the earnings process is chosen to match the Gini index of labor income as observed in the PSID, where it is 0.38.[18] The process is approximated using a 4-state Markov chain, using the Tauchen [1986a] method as suggested by Adda / Cooper [2003].[19] Total factor productivity is normalized to 1, while the share of capital in the Cobb-Douglas technology for the corporate sector is set to $\xi = 0.36$. The depreciation rate is set $\delta = 0.08$. These parameters are summarized in table 2.4-1.

Table 2.4-1: The fixed parameters

Parameter	Symbol	Baseline
TFP	A	1 (normalization)
Share of capital	ξ	0.36
Transaction cost secured credit	τ^s	0.01
Transaction cost unsecured credit	τ^u	0.05
Depreciation rate	δ	0.08
Working productivities	φ	$\begin{bmatrix} \varphi_1 = 0.316, \varphi_2 = 0.745 \\ \varphi_3 = 1.342, \varphi_4 = 3.163 \end{bmatrix}$
Transition matrix	P_φ	$\begin{bmatrix} 0.8393 & 0.1579 & 0.0028 & 0.0000 \\ 0.1579 & 0.6428 & 0.1965 & 0.0028 \\ 0.0028 & 0.1965 & 0.6428 & 0.1579 \\ 0.0000 & 0.0028 & 0.1579 & 0.8393 \end{bmatrix}$

Preference parameters

The option to default provides agents with an insurance against bad outcomes. The value of this insurance depends crucially on the agents attitudes towards risk. As described above, the price of this insurance are worsened credit conditions. Agents who still borrow face higher

[17] In a life cycle setting, Storesletten et al. [2004] and Storesletten et al. [2001] find ρ in the range between 0.95 and 0.98. We choose $\rho = 0.95$ to take into account that the agents in our model are infinitely lived and that the intergenerational auto-regressive coefficient is lower. Solon [1992] estimates it around 0.4.

[18] The exact value of the variance is $\sigma_\varepsilon^2 = .08125$. This is higher than the estimate of Storesletten et al. [2004] of about 0.02. We abstract from many important factors that are empirically relevant for the earnings distribution, e.g. human capital, life-cycle savings. Therefore, in order to generate the observed inequality, we need a higher variance of the earnings process.

[19] Floden [2007] shows that for highly correlated processes the method of Adda / Cooper [2003] achieves a higher accuracy than the original methods of Tauchen [1986a] and Tauchen / Hussey [1991].

interest rates. Thus, the value of the costs of the insurance depends mainly on the agents elasticity of intertemporal substitution. Therefore, we separate these two parameters and conduct our main policy experiment for different values of these parameters. In the baseline model, we set the coefficient of relative risk aversion $\sigma = 3$ and the elasticity of intertemporal substitution $\psi = 1.1$. Later on we investigate values for σ ranging from 1.5 to 4.5 and ψ ranging from 0.5 to 1.5. Table 2.4-2 summarizes preferences.

Table 2.4-2: Preference parameters

Parameter	Symbol	Value
CRRA	σ	3
IES	ψ	1.1

Bankruptcy policy parameters

The two policy parameters are the exemption level X and the probability ϱ of being able to obtain unsecured credit again. The law does not state any formal period of exclusion from unsecured credit after a bankruptcy filing. For our baseline specification, we set $\varrho = 0.5$ which corresponds to an average exclusion period from credit of two years. This is lower than most values in the consumer bankruptcy literature.[20] We think that this is warranted since there is evidence the entrepreneurs have access to unsecured credits relatively fast after having defaulted, see for example Lawless / Warren [2005]. However, we conduct a robustness check and also investigate a considerably longer exclusion period of six years. The exemption level differs across US sates. Using US state-level data for 1993 we calculate the median across states of the total exemption[21] ("homestead" plus "personal property" exemption). The resulting median exemption level is \$47,800, taking an average household labor income of \$48,600 corresponds to a value of **0.98** for the exemption/wage ratio.[22] Table 2.4-3 summarizes the bankruptcy parameters.

Table 2.4-3: the bankruptcy parameters

Parameter	Symbol	Value
Exemption/wage	X/w	0.98
Unsecured credit exclusion (expressed as probability)	ϱ	0.5

[20] Athreya [2002] sets the exclusion period to 4 years, Li / Sarte [2006] to 5 years, Chatterjee et al. [2007] to 10 years.
[21] We took the data from Berkowitz / White [2004] and top-coded the unlimited homestead exemption to the maximum state exemption.
[22] As a further robustness check, we increase the exemption level by 50% and the results do not change

Calibrated parameters

We are left with the following 7 parameters to be calibrated: high entrepreneurial productivity (θ^H), entrepreneurial productivity transition matrix (p^{HH}, p^{LL}), concavity of entrepreneurial production function (ν), fraction of cash on hand with which an agent can run (λ), discount factor (β) and the variance of the transitory shock (σ_χ).

We choose these 7 parameters such that the model matches the following 7 moments of the US economy. First we want the model to match the *capital-output ratio* (K/Y) in the US economy. In the literature we find values ranging from 2.8 to 3.1. We target it to be 3.0. We target the *fraction of defaults*. Given the discussion in Section 2 we set this equal to 2.25%. The *fraction of entrepreneurs in the total population* is 7.3% in the Survey of Consumers Finances.[23] Based on PSID data the *exit rate* of entrepreneurs is equal to 15%. The median leverage ratio of entrepreneurs [24] in the SCF is around 15%.

Since the benefits of bankruptcy depend crucially on the wealth of an agent we match some features of the wealth distribution. The US wealth distribution is extremely skewed with the top 40% of richest households holding around 94% of total assets. As a last target we choose to match the *ratio of the median wealth of entrepreneurs to the median wealth in the whole population*. This target captures features of both the wealth distribution and entrepreneurial productivity and technology. We set the target to 6.3 as found in the SCF. The targets are summarized in the second column of Table 2.4-5.

2.4.2 The baseline calibration results

We first present the baseline version of the model. Table 2.4-4 reports the value of the calibrated parameters in the baseline specification.

Table 2.4-4: the calibrated parameters

Parameter	Symbol	Benchmark Value
High entrepreneurial productivity	θ^H	0.662
Entrepreneurial productivity transition	p^{HH}, p^{LL}	0.890 , 0.989
Concavity of entrepreneurial technology	ν	0.876
Fraction with which agent can run	λ	0.963
Discount factor	β	0.895
Variance of transitory shock	σ_χ	0.346

Table 2.4-5 reports the value of the targets and the actual results achieved in the baseline specification.

[23] See Mankart / Rodano [2007, appendix B] for data sources, definitions and further details.
[24] Leverage is defined as the ratio of debt to the sum of debt and equity.

Table 2.4-5: the baseline calibration targets

Moment	Target	Model
Fraction of Entrepreneurs (in %)	7.3	7.3
Ratio of medians (in %)	6.3	6.1
Share of net-worth of top 40%	94.0	94.1
K/Y	3.0	3.0
Exit Rate (in %)	15.0	15.0
Bankruptcy Rate (in %)	2.25	2.25
Median leverage (in %)	15.0	15.0

The marginal product of capital in the corporate sector (r^d) is 2.9%. Less than one percent (0.79%) of the total population is in the constrained state. Our model does replicate the ratio of medians and the share of the wealth held by the richest 40% fairly well. It captures the main features that entrepreneurs are several times richer than workers and that most of the wealth is held by the richest. The Gini coefficient of wealth is 0.83 in the model, slightly higher than the data (0.8). For the purpose of our policy experiments it is important that the model replicates the middle and lower part of the wealth distribution since bankruptcy law affects almost exclusively these agents.

Another feature that we do not target but that our model captures fairly well is the difference in the entry rate between workers with previous business experience and those without previous business experience. Based on PSID data[25], those who had some experience within the past three years are 13 times as likely to enter entrepreneurship than the average worker. In the model this ratio is 10.

Quadrini [2000] reports that around 35-40% of total capital is invested in the entrepreneurial sector. In our baseline specification this fraction is slightly lower, around 31.3%.

2.4.3 Investigating the model's mechanisms

Occupational choice

The key ingredient of the model is occupational choice. Figure 2.2 represents the occupational choice of an *unconstrained* agent with high entrepreneurial productivity and low working productivity.

The dotted line shows the value function of becoming a worker, whereas the solid line shows the value function of becoming an entrepreneur.

The first result is that, otherwise identical agents choose differently according to their wealth: poor agents become workers while rich agents become entrepreneurs. This result

[25] See Mankart / Rodano [2007, appendix B]

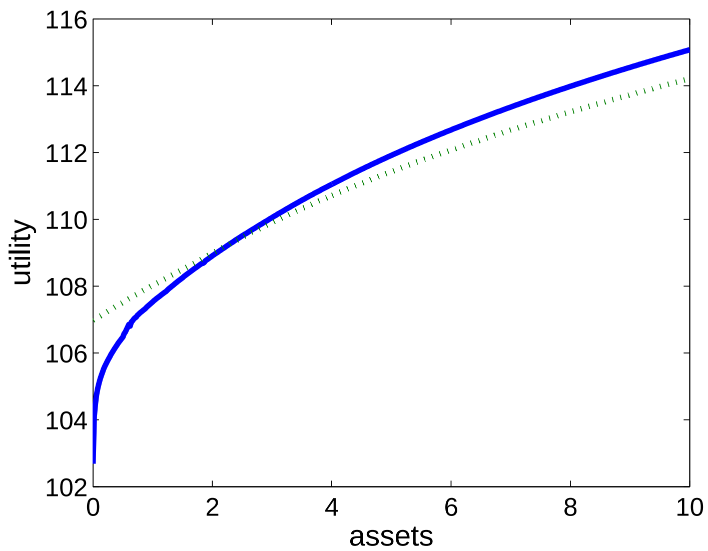

Figure 2.2: Occupational choice ($S = UN, \theta = \theta^H, \varphi = \varphi_3$)

is standard in the occupational choice under credit market imperfections literature [see e.g. Banerjee / Newman 1993]. The main reasons are that poor agents have smaller firms and face higher interest rates. They have smaller firms because, being poor, they need to borrow more but they face higher rates on the loans. The cost of financing is higher for the poor for two reasons. First, they have a higher incentive to default. Defaulting rich agents have to give up all their wealth above the exemption level. Second, in the event of default the bank gets less when the agent is poor. Thus, to break even, the bank has to charge a higher interest rate. That is, in this model, wealth acts as collateral.

The behavior of the unconstrained agents

The second important ingredient is the decision of the *unconstrained* entrepreneurs. The solution of the entrepreneurs' problem is represented in Figure 2.3.

The top panel shows demand for unsecured debt (b). The second panel shows demand for secured debt (s). The third panel shows the corresponding price of unsecured credit[26] The bottom panel shows the resulting firm size ($(a + b + s)$). Poorer agents (e.g. agents with assets $a < 0.8$) become workers while all the others become entrepreneurs ($a > 0.8$). The very rich entrepreneurs ($a > 2.4$) will never find it profitable to default. Their wealth is so high that defaulting is too costly for them. Therefore they borrow only secured since secured credit is cheaper than unsecured.[27] The "middle class" entrepreneurs (e.g. $a = 2$) will instead default if the shock is sufficiently bad, since the cost of bankruptcy is lower for them. In order to break even, the bank charges a higher interest rate, i.e. the unsecured credit is more expansive. The interest rate depends (negatively) on the assets of the entrepreneur, because in the event of default the bank will be able to seize the difference between the assets of the

[26] For readability, we show the price of credit instead of the interest rate.
[27] The transaction cost for secured credit is lower than for unsecured credit.

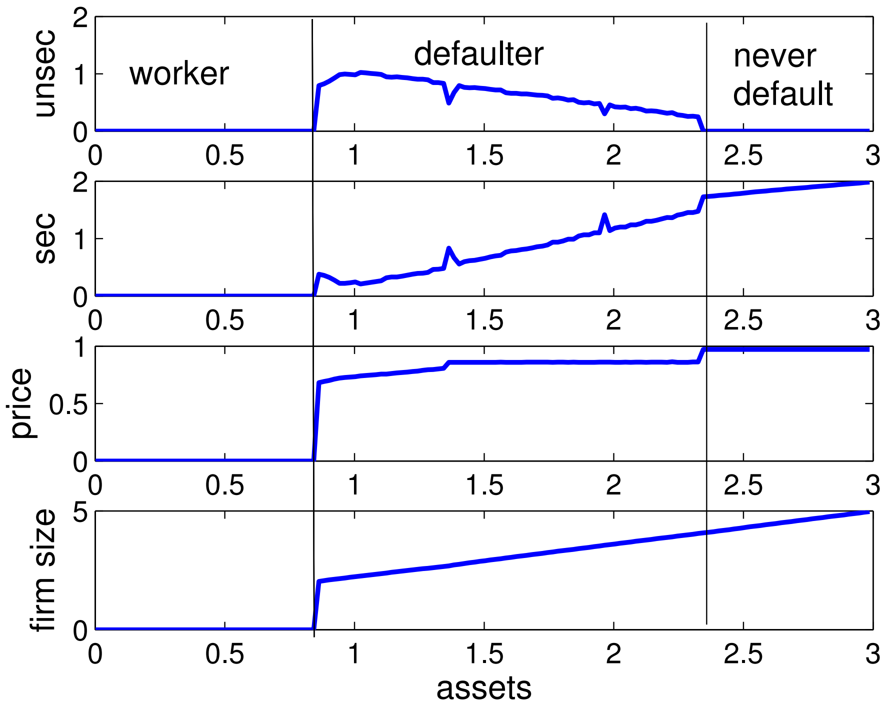

Figure 2.3: interest rate and firm size $(\theta = \theta^H,\ \varphi = \varphi_2)$

entrepreneur and the exemption level. Capital demand for the "middle-class" entrepreneurs is increasing because of the cost of borrowing is declining. The spikes in the demand for unsecured credit reflect the discretization of the investment shock.

A first look at the effects of bankruptcy

Bankruptcy affects the problem of the unconstrained agents, because it changes credit conditions and the amount of insurance available. We examine these effects with the following experiment. We compare the behavior of the unconstrained agents in two different situations: one in which bankruptcy is allowed and one in which bankruptcy is absent. Figure 2.4 shows the policy functions in these situations.

The effects of allowing bankruptcy depend on the wealth of the agent. First, the default behavior of the rich (e.g. $a > 2.4$) is not affected. They are entrepreneurs and they repay their debt even in the bad states. As explained above, even if bankruptcy is available, it is too costly for them. They demand a little bit more secured credit due to a general equilibrium effect. Second, allowing bankruptcy affects the behavior of the less rich agents (e.g. $a = 1.5$). They are entrepreneurs in both situations. But when bankruptcy is allowed they borrow more unsecured because they are better insured at cost of more expansive credit. We call this increase in the firm size the *intensive margin*. Third, the occupational choice of even less rich agents (e.g. $a = 1$) is affected. When bankruptcy is not allowed they are not insured against bad outcomes. Therefore they do not want to borrow, even though they could borrow at rate r^s. They become workers. When bankruptcy is allowed they are insured

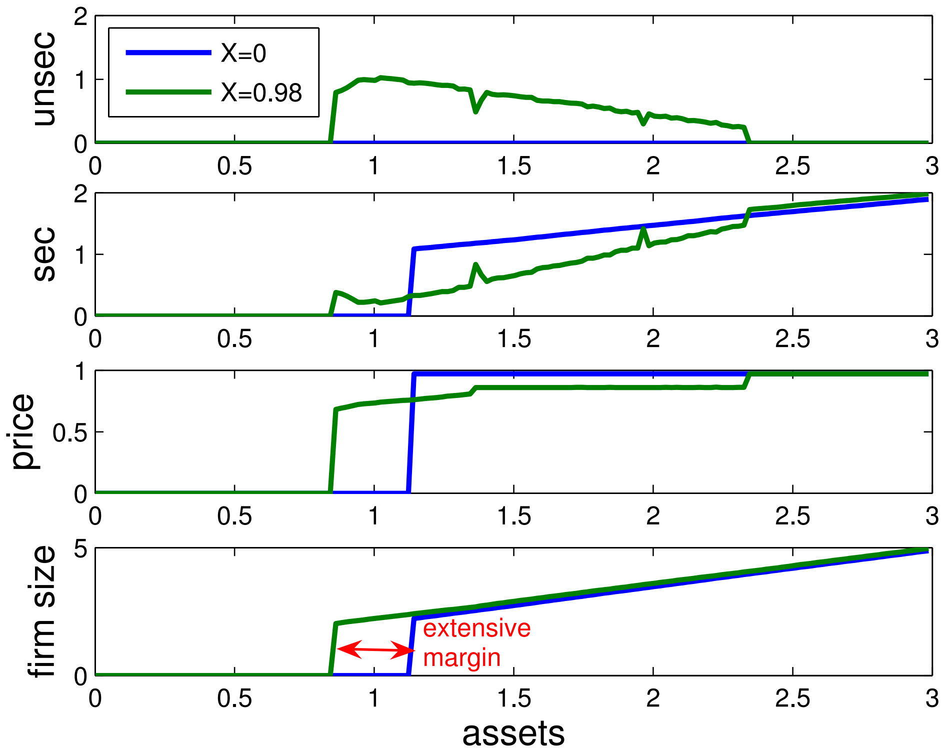

Figure 2.4: Firm size and interest rate ($S = UN, \theta = \theta^H, \varphi = \varphi_2$)

against bad outcomes. Therefore they borrow, even though they have to pay a high interest rate. This increases the rewards of entrepreneurship enough to change their occupational choice. We call this increase in the number of entrepreneurs the *extensive margin*. Fourth, the occupational choice of the very poor agents (e.g. $a < 0.7$) is not affected, they are workers in both situations.

In this particular experiment abolishing bankruptcy reduces entrepreneurship and firm size, the intensive and the extensive margins are negative. The negative effect of lowering the amount of insurance available dominates the positive effect of better credit conditions.

2.4.4 Changing the exemption level

Our main policy experiment is to analyze the effects of changing the exemption level.

Figure 2.5 shows the effects of changing the exemption level on welfare, entrepreneurship, exit rates and defaults. Table 2.4-6 reports the variables of interest for 3 values of X/w. Column 2 reports results when bankruptcy is very harsh ($X/w = 0$). Column 3 reports results for the baseline calibration ($X/w = 0.98$) and column 4 for the optimal exemption level ($X/w = 7.3$).

Welfare Increasing the exemption level from zero increases welfare. The insurance effect is dominating the worsening credit market effect. More agents become entrepreneurs (see

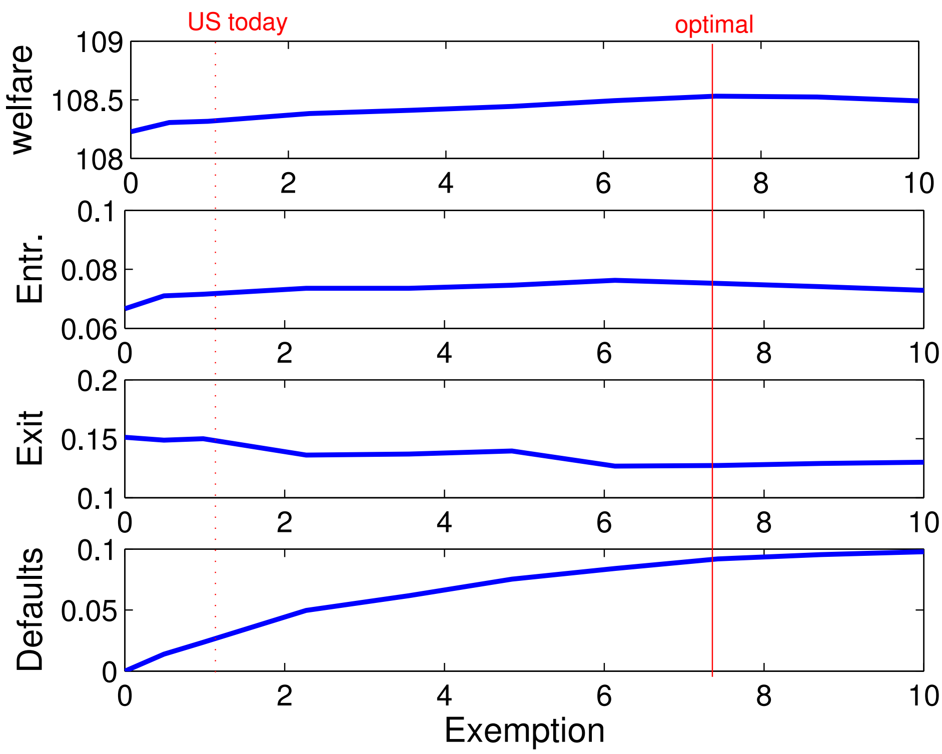

Figure 2.5: Changes in the exemption levels

also Table 2.4-6) and welfare increases. However, increasing the exemption level beyond the optimal level worsens credit market conditions so much that agents borrow less, and therefore fewer agents find it profitable to become entrepreneurs. The current exemption level in the US, $X/w = 0.98$, is too low. The bankruptcy law is too harsh. The welfare gains in increasing the exemption level are substantial. The change in consumption equivalent (see row 10 in 2.4-6) is 2.2% of annual consumption. The rich and the poor both gain from increasing the exemption level.

Entrepreneurs Increasing the exemption level increases the fraction of entrepreneurs by 0.2 percentage points. Thus, there is a positive extensive margin. In particular, the optimal exemption level allows entrepreneurs who have defaulted to remain entrepreneurs because they can keep more assets in the default case. However, as can be seen in figure 2.5, the entrepreneurship rate peaks earlier than welfare. This implies that the intensive margin, i.e. bigger firms, is important in explaining the welfare results. As expected the default rate is increasing in the exemption level. The exit rate however is declining in the exemption level. The reason for this is that entrepreneurs who have defaulted keep enough assets to remain entrepreneurs despite being excluded from unsecured credit.

Access to entrepreneurship of the poor Next we turn to how bankruptcy law affects the determinants of entry into entrepreneurship. There is allocative inefficiency in our model because insurance markets are missing. Part of this inefficiency is reflected in some poor

Table 2.4-6: the effects of changes in the exemption level

X/w	0	0.98	7.3
Exit rate (in %)	15.1	15.0	12.9
Fraction of Entrepreneurs (in %)	6.7	7.2	7.4
Bankruptcy/Exit (in %)	0	15.0	73.8
Capital/Output	3.02	3.02	3.02
Median assets of Entr/ Median assets	7.2	6.3	7.3
Share of Capital in entr. sector (in %)	30.9	31.4	33.2
Gini of Assets	0.84	0.84	0.83
Share of assets in top 40% of pop (in %)	94.6	94.6	94.5
Median output in entrepreneurial sector	9.7	8.9	11.4
Welfare in CE	-0.5	0.0	2.2
Welfare of rich in CE	-0.9	0.0	2.46
Welfare of poor in CE	0.1	0.0	2.02

highly productive agents not becoming entrepreneurs, either because they receive too little insurance or because the conditions at which credit is available are too bad. Table 2.4-7 reports the effects of different exemption levels on the minimum assets needed for the highly productive ($\theta_{-1} = \theta^H$) agent to become an entrepreneur.

The rows show these values for the levels of working productivity (φ). The attractiveness of becoming a worker is increasing in working productivity, i.e. the outside option of entrepreneurs is increasing in working productivity. Thus in order to enter entrepreneurship, the expected profits must be higher for an agent with high working productivity. Since richer agents need to borrow relatively less and since they receive better credit conditions, their expected profits are higher. This implies that, to become an entrepreneur, an agent with high working productivity must be richer than an agent with low working productivity to enter entrepreneurship.

Increasing the exemption level to the optimal induces agents with high levels of labor productivity to enter entrepreneurship earlier. Poorer agents however will enter only when they are richer. The reason for this is that the credit market conditions worsen so much that they can obtain only secured credit and therefore lose the insurance coming from unsecured credit.

Table 2.4-7: minimum wealth for entrepreneurship

MINIMUM WEALTH FOR ENTREPRENEURSHIP

X/w	0	0.98	7.3
$\varphi = 0.316$	0.32	0.28	0.32
$\varphi = 0.745$	1.14	0.86	1.08
$\varphi = 1.342$	2.34	2.24	2.20
$\varphi = 3.163$	6.87	6.83	6.75

2.4.5 Modeling of credit markets matter

Almost all paper in the bankruptcy literature allow unsecured borrowing only.[28] Notable exceptions are Athreya [2006] and Hintermaier / Koeniger [2008] in the consumption literature. The reason is that the computational burden of allowing for secured credit as well is considerable. However, according to data from Sullivan et al. [1989], secured borrowing is as important as unsecured borrowing.[29].

Not only is secured credit empirically relevant, but also, as we show in this section, it is crucial for the results. To show this, we set up a model identical to the one discussed so far except that there is no secured credit available, neither for the *borrowing constrained* nor for the *unconstrained* entrepreneur. This implies that the former cannot borrow at all and must finance his projects with his own wealth. We first recalibrate the model and then conduct the same policy experiment as before. The results in figure 2.6 are striking. The optimal bankruptcy law now would be to abolish bankruptcy completely. This would increase welfare and lead to a higher number of entrepreneurs.

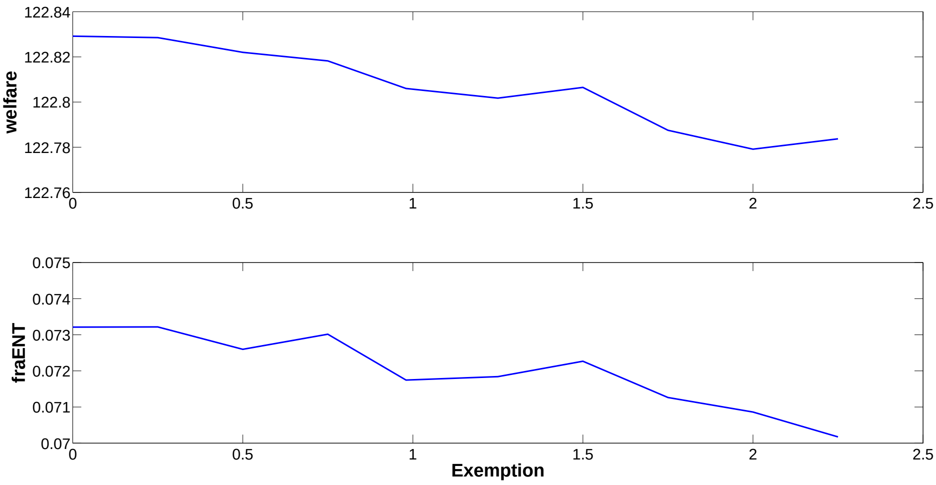

Figure 2.6: Welfare effects of changes in X if only secured credit available

Table 2.4-8: calibration unsecured credit only

Moment	Target	Unsec credit only	Sec and Unsec
Entrepreneurs (in %)	7.3	7.17	7.44
Exit Rate (in %)	15.0	13.55	12.76

Table 2.4-8 shows what happens if we use the calibrated parameters of the model without secured borrowing and now allow secured borrowing. Since the financial market is now relatively more complete, we see that there are more entrepreneurs and fewer exits.

[28] See for example Akyol / Athreya [2007], Meh / Terajima [2008], Athreya [2002], Livshits et al. [2007], Chatterjee et al. [2007], Athreya / Simpson [2006], Li / Sarte [2006], Mateos-Planas / Seccia [2006].
[29] Mean secured debt over mean total debt is about 55%

The reason for this can be seen in figure 2.7. All agents is region (2) are not able to obtain unsecured credit because their default incentive is too high. If secured credit is not available, these agents become workers. However, if secured credit is available, these agents can borrow secured and so become entrepreneurs. Agents in region (3) use secured credit to run bigger firms.

This mechanism explains why the optimal exemption level in a model with secured and unsecured credit is much higher than the optimal exemption level in a model with only unsecured credit. Absent secured credit, an increase in the exemption level prices out many more agents. It would expand regions (1) and (2). Thus, the agents become workers because they are credit rationed. The availability of secured credit dampens this negative effect.

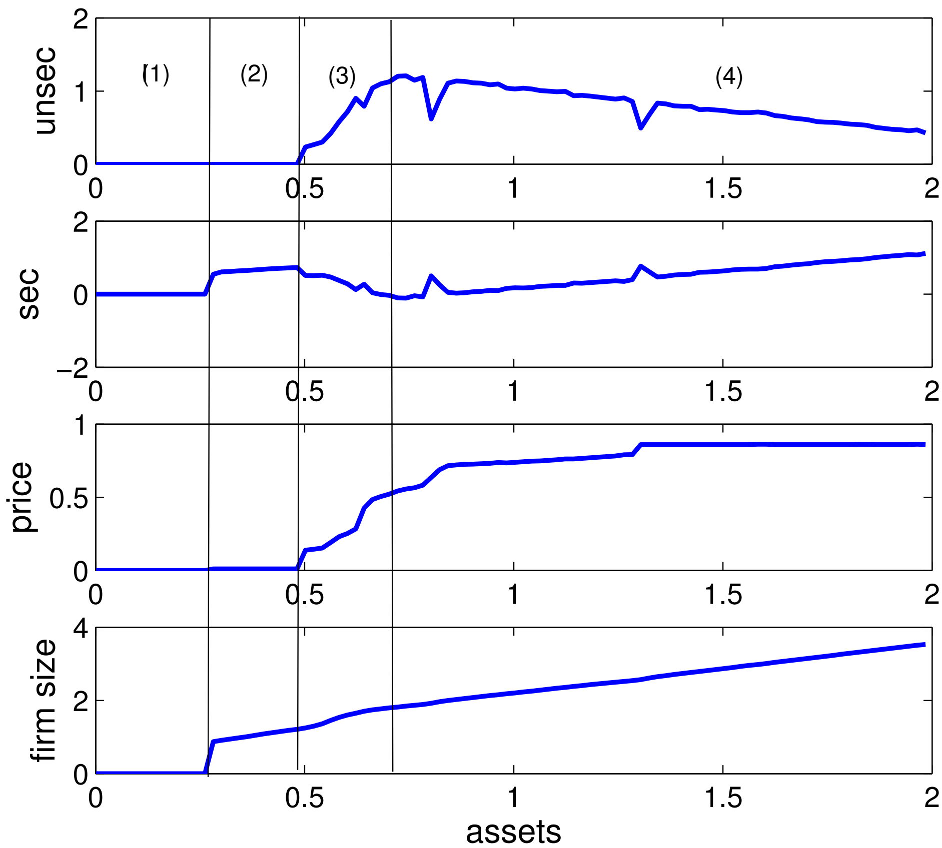

Figure 2.7: Policy functions with secured credit

Another way of looking at this is the following. The optimal policy is a very harsh bankruptcy law. This implies that the agents do not value the insurance that is provided by the bankruptcy law. They would like to have less insurance but therefore have better credit market conditions. This means essentially that the agents want a commitment device that takes away the default option. One way to achieve his is to make the law harsher. Another way, however, is to use secured credit. Secured credit is the commitment device that the agents want.

As already mentioned, most previous papers do not include secured credit in their models and most of them find that the current bankruptcy law is too lenient.[30] Our results imply that these results might not be robust towards including secured borrowing.

2.4.6 Robustness

In this section, we show the effects of changing the agent's preferences. We separate the elasticity of intertemporal substitution from the coefficient of relative risk aversion because they have different effects. With a standard utility function, one is the inverse of the other. In this case, an increase in risk aversion as for example examined in Athreya [2006] conflates two effects. On the one hand, since agents are more risk averse, they value insurance more so the optimal exemption level is likely to be higher. On the other hand, with standard preferences, an increase in risk aversion simultaneously lowers the elasticity of intertemporal substitution. Thus, agents are less willing to transfer consumption across time. But a higher exemption level will increase the interest rate agents face because banks have to charge higher interest rates in order to break even. Thus, a decrease in the elasticity of intertemporal substitution is likely to lead to a lower optimal exemption level. By not separating the two, one examines only their net effect. It is possible that each of these two effects is big but that they cancel each other so that the net effect is small.

Changing EIS

In this subsection we investigate the robustness of the results towards different values of elasticity of intertemporal substitution. The costs of a lenient bankruptcy law are higher interest rates which make substitution across time more costly. If agents' willingness to substitute consumption across period is low (i.e. eis is small), higher interest rates will be particularly costly. Therefore the optimal exemption level should be an increasing function of the elasticity of intertemporal substitution. We recalibrate the model once with a low elasticity of intertemporal substitution, ($\psi = 0.6$) and once with a high elasticity of intertemporal substitution ($\psi = 1.4$). We keep the coefficient of risk aversion constant. The results are shown in table 2.4-9. The optimal exemption level is increasing in the elasticity of intertemporal substitution as expected. While the magnitude of the effects is not huge, they are quantitatively significant.

Changing RRA

In this subsection we investigate the robustness of the results towards different degrees of risk aversion. The possibility to default provides insurance against bad outcomes. The value agents attach to this insurance depends on their risk aversion. We recalibrate the model once

[30] The two other papers (Akyol / Athreya [2007],Meh / Terajima [2008]) in the entrepreneurial bankruptcy literature find significant welfare gains from making the law harsher. The papers in the consumer bankruptcy literature reach similar conclusions.

Table 2.4-9: Optimal exemption level for different EIS

CRRA	Optimal X
0.6	6.7
1.1	7.3
1.4	7.9

with a low coefficient of risk aversion, ($\sigma = 1.5$) and once with a high coefficient of relative risk aversion ($\sigma = 4.5$). We keep the elasticity of intertemporal substitution constant since we want to isolate the importance of risk attitudes.

The optimal exemption level, the amount of insurance, is increasing in σ. This result is qualitatively not surprising. However it is also quantitatively important. If agents were less risk averse, the optimal exemption level would be 13% lower. However, the effects are rather small in welfare terms. Welfare never changes by more than a fraction of a percent. This is due to the fact that all exemption levels are pretty high.

Table 2.4-10: Optimal exemption level for different CRRA values

CRRA	Optimal X
1.5	6.3
3.0	7.3
4.5	8.7

2.5 Conclusion

This is the first paper to explore quantitatively the effects of personal bankruptcy law on entrepreneurship in a general equilibrium setting with heterogeneous agents and secured and unsecured credit. First, we developed a dynamic general equilibrium model with occupational choice which explicitly incorporates the US bankruptcy law. Our model endogenously generates interest rates that reflect the different default probabilities of the agents. Our model accounts for the main facts on entrepreneurial bankruptcy, entrepreneurship, wealth distribution and macroeconomic aggregates in the US.

Then, we used the model to quantitatively evaluate the effects of changing the US bankruptcy law. The simulation results show that increasing the exemption level would increase the fraction of entrepreneurs and welfare. These effects are significant: increasing the exemption level to the optimal one has positive welfare effects in the order of 2.2% of average consumption. All households, rich and poor, would be better off.

The most important contribution of our paper is to show that the modeling of the credit market matters. Investigating the optimal exemption level in a model without secured credit gives misleading results because it overstates credit rationing.

We are currently extending our research program along two dimensions. First, we are incorporating the transition to the new steady state. So far, our results are based on a comparison of steady-states. Transitional effects might be important to evaluate welfare. In addition it might explain why the current law is too lenient. It could be that some groups lose during the transition and therefore oppose changes.

Second, we are expanding our model to incorporate explicitly a European type of bankruptcy law. The laws in European countries are much harsher than the law in the US. For example in Italy, debt is never discharged. A defaulter is liable forever. We are analyzing the effects of introducing a US type of law on the Italian economy.

2.6 Appendix

2.6.1 Computational strategy

The state vector for an individual is given by $\eta = (a, \theta, \varphi, S)$. The aggregate state is a density $\mu_t (a, \theta, \varphi, S)$ over the individual state variables. We assume that a takes on value on a grid G_a of dimension n_a. Therefore the dimension of the individual state space is $n = n_a \times n_\theta \times n_\varphi \times 2$ where $n_\theta = 2$ is the number of states for the entrepreneurial productivity and $n_\varphi = 4$ is the number of states for the working productivity.

In order to solve the model we use the following:

Algorithm 3 *Our solution algorithm is:*

1. *Assign all parameters values*
2. *Guess a value for the endogenous variable r.*
3. *Given r the FOC of the corporate sector uniquely pin down the wage rate w. The representative competitive firm in the corporate sector will choose K_c and L_c such as*

$$r^d = \xi A K_c^{\xi-1} L_c^{1-\xi} = \xi A \left(\frac{K_c^d}{L_c^d}\right)^{\xi-1} \tag{2.6-1}$$

$$w = (1-\xi) A K_c^{\xi} L_c^{-\xi} = (1-\xi) A \left(\frac{K_c^d}{L_c^d}\right)^{\xi} \tag{2.6-2}$$

   Therefore r uniquely pins down $\left(\frac{K_c}{L_c}\right)$ and in turn uniquely pins down w.

4. *Given (r, w) we solve for the optimal value functions and corresponding policy functions by value function iteration. Within the period we solve backwards in time.*
   a) *We guess a value function $\mathsf{V}(\eta)$*
   b) *We solve the consumption-savings problem of the constrained and unconstrained agent for a grid of cash on hand.*
   c) *We approximate the resulting continuation value functions.*
   d) *Since the worker faces no uncertainty within the period, these value functions give us the values for the workers.*
   e) *Given the continuation value, we solve the problem of the unconstrained entrepreneur:*
      - *We set up a grid for secured credit.*
      - *For each value of secured credit, we set up a grid for unsecured credit.*

- *For each value of unsecured credit, we price the credit according to the zero profit condition.*
- *We identify the optimal grid point and then bisect around that optimal point to get a more accurate choice of unsecured credit.*
- *We calculate the value for each combination of secured.*

f) *The problem of the constrained entrepreneur is solved similarly.*

g) *Occupational choice gives us the updated value functions* $\hat{\mathsf{V}}(\eta)$.

h) *We iterate until convergence.*

i) *As a byproduct we obtain the policy functions.*

5. *The policy functions, the exogenous transition matrix for the shocks (both for* θ *and for* φ*), the* iid *investment shock and the credit status shock* ϱ *induce a transition matrix* P_η *over the state* η.

6. *The transition matrix* P_η *maps the any current distribution*[31] μ_η *into a next period distribution* μ'_η *by simply*
$$\mu_{\eta,t+1} = P'_\eta \times \mu_{\eta,t}$$
We calculate the steady state distribution over the state μ^*_η *by solving for a*
$$\mu^*_\eta = P'_\eta \times \mu^*_\eta$$

7. *From the policy functions and the steady state distribution, we derive the market clearing conditions*

8. *Labor market clearing implies that labor supply* $L^s(r)$ *is equal to labor demand (that comes from corporate*L^d_c*). Plugging this into the FOC (2.6-1) of the corporate sector we get capital demand from corporate sector:*
$$K^d_c(r) = \left(\frac{r}{\xi A}\right)^{\frac{1}{\xi-1}} L^S(r)$$

9. *Now we look at capital market clearing:*
$$K^d_{ENTR}(r) + K^d_c(r) = SA(r)$$

10. *If there is not equilibrium at point 9 we adjust interest rate, we go back to point 3 and we iterate until market clears*[32].

[31] Note that in our framework the distribution of household over the state μ_η, is vector of dimension n whose elements sum up to 1.
[32] In practice we first run a grid search over different values for r and then bisect until we get market clearing.

Chapter 3

An empirical investigation of Italian earnings process

3.1 Introduction

Many macroeconomic issues require a clear understanding and a quantitative measure of the risks economic agents are facing.[1] Therefore the answers to many of the most important questions in macroeconomics, like for example the size and of precautionary saving and wealth inequality [e.g. Aiyagari 1994, Castañeda et al. 2003], the extent of the welfare costs of business cycle [e.g. Lucas 2003] or the effects of personal bankruptcy law on saving choices [e.g. Livshits et al. 2007], depend on the nature of earnings process the economist assumes.

In this paper we posit and estimate a general specification for the stochastic process generating the earnings of Italian individuals. We do it by matching the theoretical age-specific second order moments implied by the statistical model to their empirical counterparts. There is a rich and long standing literature in labor economics dedicated to the estimation of the earnings process, dating back at least to Lillard / Weiss [1979] and MaCurdy [1982]. But only recently, with the diffusion of heterogeneous agents model with idiosinkratic risk [starting from Huggett 1993, Aiyagari 1994] the issue has attracted the attention of macroeconomists. The most popular approach among macroeconomists, adopted by almost all quantitative general equilibrium models with heterogeneous agents, dates back to MaCurdy [1982], and has been popularized among macroeconomists by Storesletten et al. [2004]. In order to explain the rising age profile of income inequality, it assumes that agents are subject, *during* their working life to extremely persistent shocks. Moreover they share similar deterministic earnings profiles, where only the level is determined by factors already determined *before* the

[1] I thank Alex Michaelides for his continuous support and valuable comments on this chapter. I am also grateful to Fabrizio Colonna, Alfonso Rosolia, Paolo Sestito and participants to lunch seminars in the Bank of Italy. This chapter started from extremely helpful discussion with Filippo Scoccianti, to whom it goes a special acknowledgment.

beginning of economic activity. In particular they all have the same deterministic growth rate. Following an older literature, dating back to Lillard / Weiss [1979], Guvenen [2009] questioned this view. He claims that rising heterogeneity with age can be mostly explained by individuals having heterogeneous growth rates that are already determined at the beginning of working activity. Estimating a more general model Guvenen [2009] finds a statistically significant heterogeneity in growth rates and a much lower persistence in the shocks during their working lifetimes.

A simple example, taken from Guvenen [2009], might help clarify the issue. Denote y_h^i the logarithm of earnings of an agent i with age h, and assume that its stochastic process can be represented by two just two components. The first is an individual-specific rate of growth β^i which has a cross sectional variance σ_β^2 and it is already realized at the moment of entering in the labor market. In this sense, from the point of view of the life cycle, it is deterministic, even though it might not be known to the agent. The second is a stochastic component z_h^i which it is assumed to be an AR(1) with innovation η_h^i, with variance σ_η^2, and persistence ρ. Formally

$$y_h^i = \beta^i h + z_h^i \tag{3.1-1}$$

and

$$z_h^i = \rho z_{h-1}^i + \eta_h^i \tag{3.1-2}$$

The standard approach assumes, that $\sigma_\beta^2 = 0$ and $\rho \approx 1$. Guvenen [2009] calls this earnings process *restricted income profile* (RIP) process, because it forces all agents to share the same deterministic growth rate[2]. The alternative view, *heterogeneous income profile* (HIP), allows $\sigma_\beta^2 \neq 0$ and finds $\rho < 1$. To contribute to this debate, in this paper we estimate, using a *minimum distance estimator*, a general version of the process above, with Italian data on earnings, where we allow both for $\sigma_\beta^2 \neq 0$ and for $\rho \neq 1$.

The main result of the paper is that we find some support for both the HIP and the RIP processes, only in a baseline version of the paper where we do not consider education and other observable variables. Our baseline model yield $\hat{\sigma}_\beta^2 = 0.00026$ with a standard error of 0.00006, and $\hat{\rho} = 0.956$ with a standard error of 0.048. Therefore we can strongly reject the hypothesis that $\sigma_\beta^2 = 0$ and we can not reject the hypothesis $\rho = 1$. However if we control for an additional series of observables (education, sex, area of birth) which are already determined at the beginning of working activity, our estimate of the variance of the growth rates becomes much smaller, $\hat{\sigma}_\beta^2 = 0.00004$, and statistically insignificant. Moreover, when we control for these observables, the estimated persistence of the life-cycle shocks, $\hat{\rho}$, falls to 0.72, casting some doubts on the RIP process as well. Among the control variables education seem to play a predominant role in determining the amount of pre-working heterogeneity.

This result is of particular interest for several reasons. The first is that it provides a very different picture of the nature of earnings process and of the risks the agents are

[2] We use the term "deterministic" to stress the point that the shock is already realized at the moment of entering the labor market.

facing, from both the HIP and the RIP models. Our results that once we consider education and other observables the stochastic process changes dramatically, especially with such a smaller persistence, can have important consequences on the results of quantitative models. Moreover it suggest that differentiating agents according to education might have crucial consequences on the risk agents are facing. This result is also interesting since it questions the results in Guvenen [2007], which is the main paper advocating the use of HIP processes in macroeconomics. He claims that introducing a HIP process in the standard model of consumption choices can help the model explain some stylized facts on consumption behavior that otherwise it would not be able to. However, in order to improve the explanatory power of the standard consumption model, HIP process must imply a difficult *learning* process by the agents, about their growth rate over the life-cycle. If we take our estimates at face value, it seems the agents are fairly able to predict their growth rate from their observables characteristics at the moment of beginning their economic activity, therefore leaving not much scope for learning. A third reason of interest in our results is that they provide a necessary input in any quantitative general equilibrium model with heterogeneous agents. Any economist wishing to set up a quantitative life-cycle model of the Italian economy where heterogeneity and risks are crucial ingredients, can take our estimates off the shelf and plug them in the model [e.g. Rodano / Scoccianti 2009, Rodano 2009, Scoccianti 2009]. This motivates the choice of our baseline specification as well. In fact, in most of these models agents are not differentiated according to education or sex.

With our estimates of the parameters of the stochastic process in hand we can contribute to the literature that tries to asses how much of earnings heterogeneity is due to factor already determined at the beginning of working life, and how much is instead the results of shocks happening during the life-cycle. Using the estimated stochastic process we can calculate the variance of permanent income (i.e. the present value of earnings) that we would observe if we were able to shut down all the shocks happening during the life-cycle. The result of this exercise is that the ratio of this counterfactual variance to the variance when we keep the life-cycle shocks in, is about 92%. Roughly speaking this implies that the variance of permanent income related to shocks during life-cycle is about 8%. Similar exercises for the US economy finds number ranging from 46% (Storesletten et al. [2004], under the RIP assumption) to a value of 10% found by Keane / Wolpin [1997] using a fully structural econometric model. This is an important issue especially from a policy perspective. Our results would suggest that, since most of the inequality in permanent income is due to factors already determined at the beginning of working life, the risk-sharing role of well developed financial markets (e.g. bankruptcy law) or government policy (e.g. unemployment insurance) is dampened. On the other side, policies affecting the conditions at the beginning of working activity might have much bigger effects, especially if the goal is to reduce inequality. In particular, given the big effects we get when controlling for education it seems that education policies could be particularly effective. We must point out that our empirical approach allows us a statistical analysis of earnings, without being able to say anything on consumption and welfare or the degree of self insurance that Italian household may achieve. Moreover our approach is much simpler (though much less demanding in terms of assumptions) than a fully structural, model-dependent approach on the lines of Keane / Wolpin [1997] or Kaplan [2008].

The remainder of the paper is organized as follows. In Section 2 we present our model of earnings. Section 3 presents our data and our empirical strategy In Section 4 we present the main results and in Section 5 some robustness checks. Section 6 concludes.

3.2 A stochastic model of earnings

We assume that the logarithm of earnings of agent i with age h, y_h^i is the sum of three components. Formally

$$y_h^i = g(h) + \left[\alpha^i + \beta^i h\right] + \left[z_h^i + \varepsilon_h^i\right] \tag{3.2-3}$$

The first term, $g(h)$, is a deterministic component where the function $g(h)$ is common to all agents. Depending on the particular application of the earnings process it might be useful/necessary to assume that the deterministic component is a function of other observables $g\left(h, x^i, w_h^i\right)$ where it might be important to distinguish between factor which are already determined at the beginning of the working period (x^i) and factor which might change over the whole life-cycle (w_h^i)[3].

The second term, $[\alpha^i + \beta^i h]$, is a stochastic fixed effect, already realized at the moment the agent enters in the labor market (and thus independent of age), that affects both the level (α^i) and the growth rate (β^i) of earnings. We assume that $\left(\alpha^i, \beta^i\right) \sim N_{iid}(0, \Sigma)$, with

$$\Sigma = \begin{pmatrix} \sigma_\alpha^2 & \sigma_{\alpha\beta} \\ \sigma_{\alpha\beta} & \sigma_\beta^2 \end{pmatrix} \tag{3.2-4}$$

being the covariance matrix.

The third term, $[z_h^i + \varepsilon_h^i]$, captures the shocks affecting individual earnings during life cycle and therefore it depends on age. These shocks can be temporary (ε_h^i) or persistent (z_h^i). We assume that the persistent shocks follow an AR(1) with persistence ρ and innovation η_h^i. That is:

$$z_h^i = \rho z_{h-1}^i + \eta_h^i \tag{3.2-5}$$

and $z_0^i = 0, \forall i$. By concentrating on an AR(1) rather than on a more complex ARMA structure, we depart from most of the econometric literature. The main justification is that the main focus of our analysis as in part of the literature, is to provide an input to a general equilibrium, heterogeneous agents life-cycle model. In all these models it is assumed

[3] For example, if the process is needed as the input of a general equilibrium model where the only heterogeneity is in earnings and assets (and not in education or other characteristics) then the best specification is $g(h)$. If instead we want to quantify the amount of uncertainty that is already predetermined at the beginning of the lifetime we might choose to control for x^i as well. If instead we want this process to project future earnings for a microsimulation exercise, we might get better prediction by controlling for as many variables as possible $g\left(h, x^i, w_h^i\right)$.

the earnings have the simple AR structure because it allows to save a state variable when computationally solving the model[4]. We assume that $\varepsilon_h^i \sim N_{iid}\left(0, \sigma_\varepsilon^2\right)$ and $\eta_h^i \sim N_{iid}\left(0, \sigma_\eta^2\right)$ and that the shocks are independent on each other and on the fixed effects shocks.

The parameters we want to estimate are: *i)* the variances and the covariance of the fixed effect shocks $\left(\sigma_\alpha^2, \sigma_\beta^2, \sigma_{\alpha\beta}\right)$; *ii)* the variance $\left(\sigma_\eta^2\right)$ of the persistent shock and its persistence (ρ); *iii)* the variance of the temporary shock (σ_ε^2). W set $\theta \equiv \left\{\sigma_\alpha^2, \sigma_\beta^2, \sigma_{\alpha\beta}, \sigma_\varepsilon^2, \sigma_\eta^2, \rho\right\}$.

The estimation method we use is a version of the method of moments, known as *minimum distance estimator* [Chamberlain 1994], which is standard in this kind of empirical research. The logic is to pick the parameters of the statistical model in order to minimize the distance between the theoretical moments derived from the model and their empirical counterparts. At a very abstract level, to be qualified below, letting the vector $\Theta(\theta) \in \mathbb{R}^N$ (with $\Theta_j(\theta)$, $j = 1, .., N$) be composed of N theoretical moment derived from the above model, and letting and the vector $\Xi \in \mathbb{R}^N$ (with Ξ_j, $j = 1, .., N$) be their empirical counterparts, our estimated parameters, $\hat{\theta}$ are given by

$$\hat{\theta} = \arg\min_\theta \left[\Theta(\theta) - \Xi\right]' \left[\Theta(\theta) - \Xi\right] = \arg\min_\theta \sum_{j=1}^{N} \left[\Theta(\theta)_j - \Xi_j\right]^2 \qquad (3.2\text{-}6)$$

In order to practically implement the procedure we must select which moments to match. Given the macroeconomic focus of the paper and its goal to provide an input to life-cycle models with heterogeneous agents, we choose to match age-specific cross sectional variances [e.g. Storesletten et al. 2004]. Moreover, since Guvenen [2007] shows that in order to identify the two processes we need to consider higher order autocovariances, we include among the empirical moments to match the age-specific q-th order autocovariances.

All the theoretical moments are derived from the *residual income* defined as $u_h^i \equiv y_h^i - g(h) = \alpha^i + \beta^i h + z_h^i + \varepsilon_h^i$. From this, for each age h, we can recover the cross sectional variance of the residual earnings as

$$var(h;\theta) = \mathbb{E}\left\{\left(u_j^i\right)^2 | j = h\right\} = \sigma_\alpha^2 + h^2\sigma_\beta^2 + 2h\sigma_{\alpha\beta} + \sigma_\varepsilon + \sigma_\eta^2 \sum_{j=1}^{h} \rho^{2(j-1)} \qquad (3.2\text{-}7)$$

and the q-th order autocovariance

$$cov(h,q;\theta) = \mathbb{E}\left\{\left(u_j^i, u_{j+q}^i\right) | j = h\right\} = \sigma_\alpha^2 + (h^2 + qh)\sigma_\beta^2 + (2h+q)\sigma_{\alpha\beta} + \sigma_\varepsilon + \rho^q \sigma_\eta^2 \sum_{j=1}^{h} \rho^{2(j-1)} \qquad (3.2\text{-}8)$$

[4] In order to allow this model to better predict future earnings for the microsimulation model of the Bank of Italy, we are currently working on allowing a richer ARMA structure, but results are too preliminary to be presented.

As explained below, we choose q as high as possible, conditionally of having enough data to properly estimate the empirical counterparts.

3.3 Data and estimation procedure

3.3.1 Data source

The data we use are taken from the Bank of Italy' "Survey of Household Income and Wealth", (SHIW) a representative sample of Italian population, with about 8000 households interviewed every year[5]. From 1987 to 2006 the SHIW was conducted every two years (with a three years gap between 1995 and 1998). In addition to the time series of repeated cross section, we need also a panel component in order to calculate the autocovariances. From 1987 onwards, the SHIW has re-interviewed part of the households from previous surveys. Every year some of the "panel" households in previous survey, together with some of the "non-panel" households are re-interviewed. Thus in the data we have a fairly big number of household which are interviewed for two consecutive surveys, a bit less for 3 surveys and a few that have been interviewed for all the 10 surveys and therefore span the whole 1987-2006 period.

For the purpose of the exercise we are running, a dataset with a longer and bigger panel data dimension would have probably been better[6]. However there are mainly two reasons for choosing this dataset. The first is that, by international standards, among the survey data, this dataset is considered as a high quality dataset [e.g. Krueger / Perri 2009]. The second and most important reason for using the SHIW is the amount of information available in this dataset. In fact the general equilibrium heterogeneous agents, to which this paper supplies a crucial input, are usually calibrated to match several features of Italian economy (e.g. wealth distribution) that can be derived from the SHIW as well, thus allowing a more homogeneous calibration of the models.

3.3.2 Variables description

For our baseline specification we take as the main variable of interest "earnings" as after tax earnings, excluding income from capital and pensions. The SHIW does not record gross earnings so we are forced to use net earnings. The main reason for excluding capital income and pensions, is that in most of the quantitative models that will use our estimates as an input the budget constraint of the working age agents is a version of the following

$$a_{t+1} = (1 + r)\, a_t + y_t - c_t$$

[5] More specifically we use the "Historical Database of the Survey of Italian Households Budgets, 1977-2006", which is publicly available (together with documentation in English) at the website http://www.bancaditalia.it/statistiche/indcamp/bilfait

[6] Most studies that replicate similar exercises for the US use the PSID.

where a_t is assets in period t (or at age t), y_t is earnings/income in period t and c_t is consumption in period t. Since in most of the models there is no distinction on where the earnings come from (working as an employee or self employed) we do not distinguish between them[7]. At the same time in all the models the saving choice is endogenous and therefore the stochastic process for the variable y_t clearly must exclude capital income $(1+r)\,a_t$.

The survey, in addition to after tax earnings provides information on a series of other variables that we use for our analysis:

- age;
- sex;
- educational qualification: a six values categorical variable that goes from 1, "none" to 6, "post graduate qualification";
- branch of activity: a nine values categorical variable where categories are agriculture, building and construction work, transports and communication, and the like;
- work status (self employed, employee, unemployed, retired, etc.);
- geographical area of birth: we create a four categories variable where categories are south and islands, center, north and abroad;
- geographical area of living at the moment of the interview: a three categories variable (south and islands, center, north)
- marital status (married, single, divorced/separated, widow/widower)
- number of household components

3.3.3 Selection criteria and unit of analysis

In our baseline specification we focus on household earnings and we associate household earnings to the earnings of the household head. We keep information on all the individuals in the sample who:

- are defined as household heads
- are between 25 and 55 years of age;
- are employee, self employed or unemployed (that is we exclude pensioners and first job seekers);
- have positive earnings (to take logs);

[7] In a robustness check we experiment with changing the main variable to income from employee only. This could be necessary for example in a model that feature occupational choice to model the exogenous earnings process for the workers

- have ages which are consistent (i.e. they are 24 in 1995 and 27 in 1998)[8].

This leaves us with a sample of 43513 observations, over 10 waves of the SHIW that span the period 1987-2006 of which only a subsample of them is interviewed more than once. In one of the robustness check we see how results change if we focus on all the individuals as well.

3.3.4 Estimation details

The deterministic component Since the theoretical moments are expressed in terms of the *residual income*, $u_h^i \equiv y_h^i - g(h)$, the first step of the estimation procedure is to eliminate the common deterministic component $g(h)$. To do so we have different strategies. In the baseline version we regress the logarithm of earnings on a set of ages dummies. To account for the possibility of time effects in the determination of the common deterministic trend function, that is to allow for $g_t(h)$, we estimate a separate regression for each cross section of the SHIW. The residuals from these regressions constitute our *residual income*, $u_h^i(t)$, where we make explicit the dependence on time, t. The main justification for the choice of the baseline version of the model is that in quantitative general equilibrium model very rarely heterogeneity in sex and education is explicitly considered. In order to understand better how these other observables matter, in other specifications we consider how results change if we consider a more general version of the function $g_t\left(h, \mathbf{x}^i, \mathbf{w}_h^i\right)$,where we add more controls to this regression. In one case we includes only controls for variables that are predetermined at the moment of entering the labor market ($\mathbf{x}^i$) like sex, education, and area of birth. In another case we include all the possible controls together ($\mathbf{x}^i$ and $\mathbf{w}_h^i$).

The age-specific variances The age-specific cross sectional variances, $\hat{\sigma}^2(h)$, are calculated in a standard way. Formally

$$\hat{\sigma}^2(h) = \frac{\sum_{t\in T}\sum_{i=1}^{n_t}[u_h^i(t) - \hat{\mu}(h)]^2 I_{\sigma^2}(i,h,t)}{N_h} \tag{3.3-9}$$

where $T \equiv \{87, 89, 91, 93, 95, 98, 00, 02, 04, 06\}$ is the set of years for which SHIW is conducted, n_t is the total number of individuals interviewed in year $t \in T$, $I_{\sigma^2}(i,h,t)$ is an indicator function which is equal to 1 if the agent i is "of age h" in year t, and $N_h = \sum_{t\in T}\sum_{i=1}^{n_t} I_{\sigma^2}(i,h,t)$ is the total number of age h individuals in the sample (considering all years) and where

$$\hat{\mu}(h) = \frac{\sum_{t\in T}\sum_{i=1}^{n_t}[u_h^i(t)]I_{\sigma^2}(i,h,t)}{N_h}$$

is the sample mean of *residual income* for all agents of a given age h (even in different years). In English this is to say that we calculate the variance of *residual income* across all agents

[8] With respect to ages we found that the great majority of agents interviewed in 1987 and in 1989 the difference in age was only one year, suggesting that there is a problem with those ages. We adjusted the age in 1987 accordingly.

"of age h" considering all the years of the survey. We do this for $h \in [25, 55]$.

The age specific autocovariances of order q The age-specific, for age h, autocovariances of order q, $\hat{\omega}^2(h, q)$, is calculated in a standard way as well. Formally we have

$$\hat{\omega}(h,q) = \frac{\sum_{t\in T}\sum_{i=1}^{n_t}[u_h^i(t) - \hat{\mu}_q(h)][u_{h+q}^i(t+q) - \hat{\mu}_q(h+q)]I_{\omega}(i,h,t,q)}{M_{h,q}} \tag{3.3-10}$$

where $I_{\omega^2}(i, h, t, q)$ is an indicator function which is equal to 1 if the agent i is "of age h" in year t and is re-interviewed q years after, and $M_{h,q} = \sum_{t\in T}\sum_{i=1}^{n_t} I_\omega(i, h, t, q)$ is the total number of individuals of age h in the whole sample that has been re-interviewed after q years, and $\mu_q(h)$,and $\mu_q(h + q)$ are

$$\hat{\mu}_q(h) = \frac{\sum_{t\in T}\sum_{i=1}^{n_t}[u_h^i(t)]I_{\omega}(i,h,t,q)}{M_{h,q}}$$
$$\hat{\mu}_q(h+q) = \frac{\sum_{t\in T}\sum_{i=1}^{n_t}[u_{h+q}^i(t+q)]I_{\omega}(i,h,t,q)}{M_{h,q}}$$

In English it means that, to calculate the autocovariance of order q for individuals "of age h", we select in all years those individuals of age h in a certain year t and are re-interviewed q years after. For all these agents we calculate the autocovariance of "residual income".

Implementation details In the definitions above we have been explicitly loose about agents being "of age h". This is because, as in most of the literature, when we calculate the empirical moment for a certain age, h, we consider "of age h" all the agents of age $[h - 1, h + 1]$[9]. This allows us to have a greater number of agents contributing to each moment.

In addition to this criterion we consider only those moments for which we have a minimum number of individuals contributing to a specific moment. This is done to avoid too excessive noise in the moments. In the baseline we set to 100 the minimum numbers of agents that must contribute to a certain moment, for that moment to be considered.

These criteria, together with the time structure of the SHIW allow us to use 198 moments. The number of individual contributing to each moment is reported in Table 3.7-8, while the corresponding empirical moments are reported in Table 3.7-9.

As shown in Table 3.7-8 the number of individuals contributing to the variances is much higher since we can consider all the individuals even those who do not happen to be reinterviewed in future years. As expected at ages neighboring the boundaries of the age span the number of agents contributing to each age-specific variance decreases as we are losing those who enters late in the labor market and those who retire early.

Table 3.7-9 and the above graph show that cross sectional variance increases almost linearly

[9] In the literature, most of the works consider "of age h" an agent of age $[h - 2, h + 2]$.

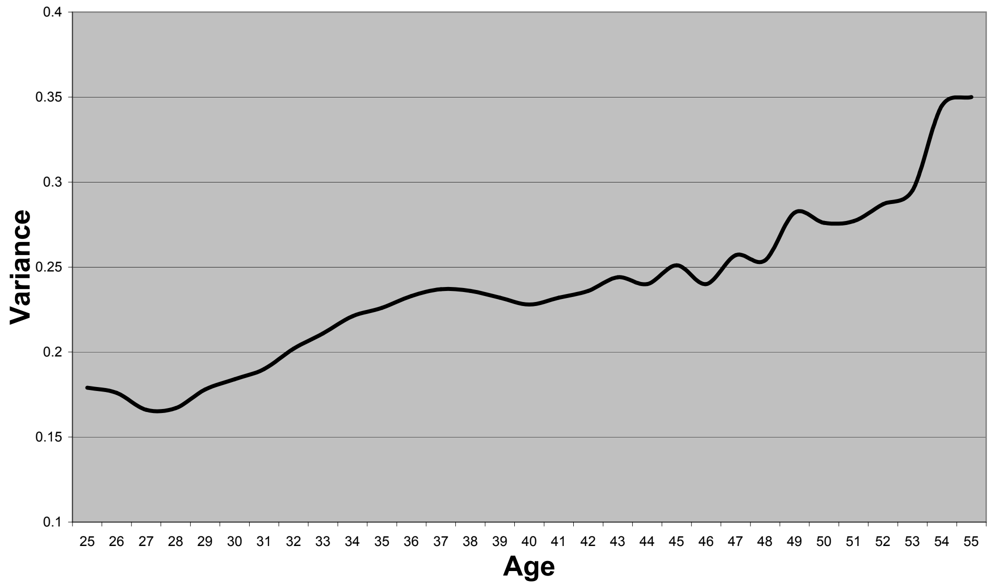

Figure 3.1: Age profile of cross sectional variances

with age. This is consistent both with the HIP and the RIP assumptions[10]. This is one of the reasons why we need higher order moments in order to identify the two processes.

Numerical implementation Stacking the theoretical moments from (3.2-7) and (3.2-8) in the vector $\Theta(\theta)$, and their empirical counterparts from (3.3-9) and (3.3-10) in the vector Ξ, we can solve the problem in (3.2-6), where $N = 198$, to get minimum distance estimator $\hat{\theta}$. $\hat{\theta}$ is consistent and asymptotically normal with covariance matrix $\Sigma = (D'D)^{-1} D'\Omega D (D'D)^{-1}$ where the matrix D is the Jacobian matrix of the moments and Ω is the covariance matrix of all the contributors to each moment.

The object to be minimized is not a smooth function over the parameter space. This presents two order of numerical problems. The first is that standard minimization routines, based on derivatives methods, often do not converge. For this reason we adopt a derivative-free minimization routine *à là* Nelder and Meade. The second problem is that even a more robust numerical minimization routine as the one we use in not guaranteed to yield a "global" minimum. To reduce the possibility of being stuck in a local minimum we repeat the minimization routine 100 times with random initial point. This last step of the procedure, together with the calculation of the standard errors is implemented in FORTRAN.[11]

[10] It is straightforward to prove that HIP implies a convex age profile for cross sectional variances, while the profile implied by RIP is at most linear (if $\rho \leq 1$).

[11] The code to replicate the results is available from the authors on request. The STATA code that retrieve

Implications Once we have estimated the parameters of the stochastic process, in addition to use them as inputs in a general equilibrium model, we can use them to contribute to the debate about how much heterogeneity is due to shocks during the working age period (i.e. during the life-cycle) and how much is due to features already predetermined at the moment of entering the labor market. In particular we look at the ratio between the counterfactual variance in permanent income (present value of discounted earnings) once we shut down life-cycle shocks, to the actual variance (including life-cycle shocks). To do so we use our estimated stochastic process for earnings to simulate the life-cycle earnings (u_h^i) for 10000 individuals and we calculate the following the following statistic

$$KW = \frac{VAR\left(\sum_{h=20}^{60}(1+r)^{-h}e^{u_h^i}|\sigma_\eta^2 = \sigma_\eta^2 = 0\right)}{VAR\left(\sum_{h=20}^{60}(1+r)^{-h}e^{u_h^i}\right)} \tag{3.3-11}$$

where the interest rate r is set to 6%.

3.4 Main results

Baseline results The main result of the paper is that we find some empirical evidence in favor of the HIP and RIP hypothesis only in a baseline specification where we do not control for any observable in determining the common deterministic trend $g(h)$. The baseline estimates are reported in the first column of Table 3.4-1 (BASE). The estimated variance of deterministic trends, determined at the beginning of the working life, $\hat{\sigma}_\beta^2$, is statistically significant and equal to 0.00026. This supports the HIP process. At the same time estimated autocorrelation coefficient of the persistent life-cycle shock, $\hat{\rho}$, is 0.956, smaller than one, as suggested by the HIP process. However the parameter is not precisely estimated and we can not statistically reject the hypothesis $\rho = 1$. Therefore from the baseline model it appears that the earnings process of Italian individuals is characterized both by heterogeneous growth rates, already determined at the moment of entering the labor market, and by the presence of very persistent shocks (almost permanent) during the life cycle.

As a rough comparison, we can look at the values for the parameters that Guvenen [2009] finds in a similar exercise, with a similar specification, for the US. For the parameters already predetermined at the beginning of working life, Guvenen [2009] finds that in the US there is much higher variance in the growth rate ($\sigma_{\beta,US}^2 = \hat{\sigma}_{\beta,US}^2 = 0.00038$ versus $\hat{\sigma}_{\beta,ITA}^2 = 0.00026$) while there much less variance in the levels ($\hat{\sigma}_{\alpha,US}^2 = 0.022$ and not statistically significant, versus $\hat{\sigma}_{\alpha,ITA}^2 = 0.072$). It seems that factors that are already determined at the moment of beginning the economic activity (sex, race, education, family background...) produce less inequality in the level of earnings in the US but more inequality in the growth rate. With respect to permanent shocks during life-cycle, Guvenen [2009] finds that in the US they are

relevant variable and produce the empirical moments to be used as an input for the minimization routine is fully replicable. The FORTRAN routine heavily uses the IMSL library which is not publicly available.

much less persistent ($\hat{\rho}_{US} = 0.821$ versus $\hat{\rho}_{ITA} = 0.956$) even though with a bigger variance in the innovation ($\hat{\sigma}^2_{\eta,US} = 0.029$ versus $\hat{\sigma}^2_{\eta,ITA} = 0.017$). These results are broadly consistent with the stereotypical view of labor markets in both countries. In Italy there is much higher role for active policy and labor markets are more sclerotic. This results in smaller but more persistent shocks during the life cycle. At the same time they are consistent with the view of the US as "the land opportunity" where "talent" is rewarded. There is little inequality in the level of permanent income but a bigger heterogeneity in growth rates.

Table 3.4-1: Baseline Results

	BASE	RIP	CONTR	ALLC
σ^2_β	0.00026	NA	0.00004	0.00003
	(0.000064)		(0.00005)	(0.00005)
ρ	0.956	0.97	0.72	0.73
	(0.048)	(0.00007)	(0.104)	(0.105)
σ^2_α	0.073	0.021	0.041	0.032
	(0.020)	(0.013)	(0.012)	(0.012)
$\sigma_{\alpha\beta}$	-0.004	NA	-.00018	.00013
	(0.0026)		(0.0008)	(0.0009)
σ^2_ε	0.084	0.105	0.057	0.060
	(0.0084)	(0.008)	(0.022)	(0.021)
σ^2_η	0.018	0.012	0.042	0.039
	(0.004)	(0.002)	(0.020)	(0.019)
KW	0.923	0.887	0.891	0.894

For completeness in the third column (RIP) of Table 3.4-1 we also report the estimates of the RIP process, obtained imposing $\sigma^2_\beta = \sigma_{\alpha\beta} = 0$. In this case we find that the estimated persistence of earnings shocks is slightly higher ($\hat{\rho} = 0.97$) and much more precisely estimated than in the HIP model. The variance of innovation is slightly higher than in the baseline model ($\sigma^2_\eta = 0.023$). These estimates are very close to those found for the US by Storesletten et al. [2004] and which form the basis from almost all the general equilibrium models with heterogeneous agents.

How important initial conditions are? The next step is to use our estimates to address the issue of how much of earnings inequality is due to shocks that are already realized at the moment the individuals starts their economic activity and how much is due to shocks realized during their working age. To this end we simulate 10000 individuals' histories using our estimated process and we calculate the variance of permanent income (discounted present value of earnings) both if we shut down the life cycle shocks (i.e. $\sigma^2_\eta = \sigma^2_\varepsilon = 0$) and if we leave them active. We choose to focus on permanent income since it is the closest measure to welfare that we can calculate with our approach. The last row of Table 3.4-1 reports the KW statistics defined in equation (3.3-11). In the baseline specification the ratio of the two variances is 0.923. Roughly speaking, we can interpret this result by saying that the contribution of life-cycle shocks to the total variance in present value of earnings is about 8%.

This results is quite close to what Keane / Wolpin [1997] find in a structural econometric exercise for the US. They find that about 90% of total variance is due to initial conditions. In a similar exercise, by imposing the RIP process, Storesletten et al. [2004] find a much smaller value of 0.58.

This has relevant policy implications as it signals the relative importance of the contributions to permanent income inequality of factors that are already determined before the beginning of economic activity (e.g. education, sex, family background) as opposed to factors happening during the life-cycle (e.g. promotions, unemployment). On the other side it tells how important are mechanism and policies that insure against risk life-cycle risk. Given that about 8% of the variance of permanent income is related to life-cycle shocks there seem to be a limited scope for unemployment insurance or bankruptcy law, while there seem to be much broader scope for policy affecting initial conditions (e.g. education policies, anti-discrimination, redistributive inheritance taxation...).

It is also interesting to point out that when we estimate the RIP process we find that the contribution of life-cycle shocks is slightly higher. The ratio of the variances in this case is 0.88, giving a contribution of life-cycle shocks to 12%. This has relevant consequences for the issue of modeling the earnings process correctly when doing general equilibrium models with heterogeneous agents. An example will clarify. Suppose you want to use one of these models to answer the question of what are the effects on consumption and saving decision of Italian households of introducing in Italy a personal bankruptcy law on the lines of the US one. The main trade-off behind introducing a bankruptcy law is that it provides insurance against otherwise uninsurable shocks (i.e. earnings shocks) at the cost of worsening credit conditions the consumers get (see Livshits et al. [2007] for an analysis of the US). If we assume that the earnings process is we assume the RIP process instead of the correct HIP in addressing this question we would overstate the risk the agents are facing and we should bias the results of the model (most likely in favor of introducing a very generous bankruptcy law since we are overstating the role of insurance).

What affects initial conditions? Given that about 92% of the total variance of permanent income is related to factor that are predetermined at the moment of starting economic activity, a natural step forward is to investigate what are the important factors. This is an interesting issue for policy makers, but it is also relevant for economists using these processes in general equilibrium models. Most of the renewed attention to the kind of earnings process economists use in their models stems from the paper of Guvenen [2007]. In this paper he claims that the standard precautionary saving model with the HIP process, is able to explain some stylized facts about consumption that it would not be able explain if we assume the RIP process. This result is conditional on agents not knowing their individual growth rate β^i and having to learn about it over the life cycle.

As a first step in this direction we relax the assumption made in the baseline version, that the common deterministic component of earnings is a (time dependent) function of age only $g_t(h)$. Instead we assume that this common component of earnings is a function of observable individual characteristics that are already determined at the moment of starting economic activity. That is we assume the common deterministic trend is $g_t(h, \mathbf{x}^i)$ where the variables in $\mathbf{x}^i$ are sex (S^i), education (E^i) and area of birth (B^i). To implement this we introduce these variables as controls in the time-dependent regressions we run to derive "residual income" $u_h^i(t)$., and then we check what happens to our model.

Table 3.4-2: The common deterministic component

	log of income
primary	0.172
	(0.079)
secondary	0.393
	(0.077)
highschool	0.598
	(0.077)
graduate	0.851
	(0.079)
postgraduate	1.013
	(0.161)
north	0.179
	(0.044)
center	0.072
	(0.045)
south and islands	-0.025
	(0.044)
sex	-0.181
	(0.019)
constant	4.923
	(0.111)
age dummies	yes

The results from one of these regressions, for the year 2000, are reported in Table 3.4-2 I where we report the coefficients for a series of education dummies (the excluded category is less than primary school), a sex dummy and a series of area of birth dummies (excluded category is abroad). The results are as expected. More education significantly increases income, while being a female significantly reduce it. Being born in the north significantly increases income as opposed to be born abroad, or in the center or in the south. Being born in the center is positively correlated with higher incomes but the differences with south and abroad are not significant.[12]

The results for this exercise are reported in the column 4 (CONTR) of Table 3.4-1. Once we control for education sex and area of birth the variance of individual growth rates is much smaller (0.00004 versus 0.00026) and statistically significant. Moreover once we control for observables in the common deterministic trend we can see that the estimated persistence

[12] Results when we introduce simply the categorical variables are essentially identical.

is drastically reduced. Now it is $\hat{\rho} = 0.72$. Much of the persistence in the baseline version is captured by the observables in the common deterministic trend. Once we control, in a very simple way, for variables that are already known at the moment of entering in the labor market, the nature of earnings process is drastically changes. First of all there is no more evidence of heterogeneous earnings profile. Therefore there seems to be little role for learning about the heterogeneous growth rates. The conclusion of the work by Guvenen [2007] are somewhat weakened. Moreover the amount and the kind of risks that agents are facing is dramatically different. [13].

Table 3.4-3: Sources of inequality

	BASE	SEX	EDU	NASC	CONTR
σ^2_β	0.00026	0.00026	0.000052	0.00025	0.00004
	(0.00006)	(0.00006)	(0.000057)	(0.00007)	(0.00005)
ρ	0.956	0.956	0.756	0.963	0.72
	(0.048)	(0.047)	(0.107)	(0.041)	(0.104)
σ^2_α	0.073	0.079	0.048	0.073	0.041
	(0.020)	(0.020)	(0.014)	(0.020)	(0.012)
$\sigma_{\alpha\beta}$	-0.004	-0.005	-0.002	-0.005	-0.00018
	(0.0026)	(0.0026)	(0.001)	(0.0023)	(0.0008)
σ^2_ε	0.084	0.081	0.064	0.082	0.057
	(0.0084)	(0.008)	(0.020)	(0.008)	(0.022)
σ^2_η	0.018	0.018	0.036	0.017	0.042
	(0.004)	(0.004)	(0.016)	(0.041)	(0.020)

Given how much the results change when we introduce the variables $\mathbf{x}^i$, our next step is to introduce each of these variables one at a time. The results are reported in Table 3.4-3. The first and the last column reports the baseline and the one where we control for all 3 variables together. The third column (SEX) and the fifth (NASC) show that controlling for sex and for the area of birth (which includes information about being born abroad) does not change the results. The big changes happens when we control for education, as shown in the fourth column (EDUC) which is very close tho the results when we control for all the 3 variables. This preliminary analysis show that the most important variable in affecting our estimates is education.

3.5 Robustness checks

In order to assess the strength of our results we run a series of robustness checks. In all cases we present the results for the baseline HIP estimation (BASEXXX) and for the estimation where we control for education sex and area of birth in deriving *residual income* (CONTRXXX).

[13] The last column of Table 3.4-1 (ALLC) reports the results when, in the time-dependent regressions to derive "residual income" we control for other observables which are not fixed at the moment of starting the economic activity, and are therefore age dependent. That is we assume $g_t\left(h, \mathbf{x}^i, \mathbf{w}^i_h\right)$, where the vector $\mathbf{w}^i_h$ includes the branch of activity, work status,the geographic area, the marriage status, and the qualification. As it can be seen, adding these additional controls does not change our estimates significantly.

In addition to check for the robustness of our main exercise, the goal of these experiments is also to provide valuable inputs for different researchers.

Employees only In the first one we check what happens if we change the object of the analysis. In the main estimation we assume that earnings are all net incomes excluding those from assets and pensions. In this check we estimate it for net labor income from the employee. This is an interesting exercise in itself, since for some macroeconomic models this is the correct input [e.g. for any occupational choice model, like for example Cagetti / DeNardi 2009]. The results are reported in Table 3.5-4. It can be seen that in the baseline HIP estimation (BASELAB) results are quite similar to our baseline estimates from the main exercise (see the first column of Table 3.4-1). The estimated parameters are similar in magnitudes even if the heterogeneity in growth rates is smaller in magnitude. This difference can be explained from part of the heterogeneity in deterministic profiles coming from agents sorting out between employee and self-employed. When we control for pre-working observables (CONTRLAB) we find that almost the same pattern happens as in the main exercise. The heterogeneity in life-cycle profiles falls significantly and is not statistically significant. However the persistence remains high. This can also be explained with the fact that by focusing on income from the employee only we are losing all the agents who shift from employee and self-employed and also to and from the unemployed.

Table 3.5-4: Robustness checks: labor income only

	BASELAB	CONTRLAB
σ^2_β	0.000175	0.000097
	(0.000047)	(0.000053)
ρ	0.953	0.97
	(0.050)	(0.03)
σ^2_α	0.06	0.054
	(0.015)	(0.017)
$\sigma_{\alpha\beta}$	-0.003	-0.003
	(0.0018)	(0.0010)
σ^2_ε	0.06	0.061
	(0.006)	(0.004)
σ^2_η	0.011	0.009
	(0.003)	(0.001)

All individuals In the second robustness check we look at all individuals income rather than focusing on household heads. This might be more interesting exercise for those economists that want to go beyond the household unit and focus on all individual income[14]. The results of this exercise are reported in Table 3.5-5. The most striking difference with the main exercise in the paper, even though not very surprising, is that there is much higher heterogeneity. The estimates of both $\hat{\sigma}^2_\alpha$ and of $\hat{\sigma}^2_\varepsilon$ in the baseline estimation (BASEIND) are much higher in

[14] For example this might be the most interesting exercise as an input in a microsimulation model.

value than the main exercise of the paper (see Table 3.4-1). It is quite intuitive that focusing on household head we are somehow restricting to a more homogeneous sample. The result of controlling for education sex and area of birth are similar to those of the main experiment even though in this case the heterogeneity in growth rate does not fall so much and remains (barely) statistically significant.

Table 3.5-5: Robustness checks: all agents

	BASEIND	CONTRIND
σ^2_β	0.000281	0.00014
	(0.0000145)	(0.000054)
ρ	0.975	0.805
	(0.041)	(0.08)
σ^2_α	0.14	0.105
	(0.023)	(0.017)
$\sigma_{\alpha\beta}$	-0.0065	-0.0025
	(0.0022)	(0.0010)
σ^2_ε	0.16	0.148
	(0.0087)	(0.008)
σ^2_η	0.016	0.029
	(0.004)	(0.013)

Stricter criteria In the third exercise we check what happens if we restrict the criterion of the minimum number of observations needed in order to include a moment in our estimation procedure. In the main experiment in the paper we use a moment if at least 100 observations contribute to the empirical counterpart. This leaves us with 198 moments and with auto-covariances of up to order 11. When we increase the minimum number of observations to 200 the number of moments falls to 101 and the highest order of autocorrelation is 7. The results reported in the second column of Table 3.5-6, ($min = 100$), show that the reduction in moments, especially in higher order autocorrelation has drastic effects on the estimates and on their precision. Numbers are literally all over the places. However we run also another experiment where we keep the high minimum number of observations, 200, but we increase the number of contributors to each age h moment. Rather than considering "of age h" any agents of age $h \in [h-1, h+1]$ as in the main exercise of the paper, we consider "of age h" all agents of age $h \in [h-2, h+2]$. In this case we have 184 moments and autocorrelations up to the order 11. The results, reported in third column of Table 3.5-6, ($min = 100$, $range = 2$) are back to familiar numbers pretty close to the (BASE) estimates in Table 3.4-1. These experiments suggests that including high order of autocorrelations and a sizable number of moments is needed in order to have reasonable estimates.[15]

[15] In a related work, following Hryshko [2009], we are currently working on devising a Montecarlo experiment that simulate a dataset with the characteristics of the SHIW in order to explore the ability of our estimation procedure to identify the parameters of our stochastic process.

Table 3.5-6: Robustness checks: stricter criteria

	$min = 200$	$min = 200$, $range = 2$
σ^2_β	0.000063	0.000189
	(0.000068)	(0.000152)
ρ	0.535	0.978
	(0.307)	(0.037)
σ^2_α	0.037	0.074
	(0.012)	(0.017)
$\sigma_{\alpha\beta}$	0.0011	-0.005
	(0.0011)	(0.002)
σ^2_ε	0.00000	0.089
	(0.12)	(0.007)
σ^2_η	0.103	0.016
	(0.12)	(0.003)

Splitting the sample according to education The last robustness check is to split the sample according to education of the agents. We assume that an agent has high education if she has at least a high school degree. In doing so we have to relax our criteria for the selection of the moments due to sample reduction. We lower the minimum number of moments to 50 and we increase the range of agents "of age h" to ± 2. The results are reported in Table 3.5-7. The estimates of the parameters are less well estimated than in the main exercise of the paper an the numbers must be interpreted with some cautions. There are few things to note. Comparing the high (BASEEDUC) to the low (BASENOEDUC) education estimates we can see that among high education agents there is less heterogeneity in the growth rates but more heterogeneity in the level of permanent shocks. Taking these estimates at face value most of permanent inequalities (due to factor that are already determined at the beginning of working activity) within the high education group do not increase inequality during the life cycle but are mostly in the level of income throughout the working. Instead within the low education group there pre-working age characteristics are reflected mostly in growth rate differences. At the same time during the working life the high education agents are exposed to less shocks that are more persistent over time than the low education group.[16] Further controlling for education sex and area of birth does not affects estimates for the high education group, while it seems to matter for the low education groups.

[16] Given the imprecision in the estimates of the ρ parameter these conclusion are particularly speculative

Table 3.5-7: Robustness checks: education

	BASEEDUC	CONTREDUC	BASENOEDUC	CONTRNODUC
σ^2_β	0.000155	0.00015	0.00029	0.00003
	(0.000083)	(0.000067)	(0.00009)	(0.00005)
ρ	0.899	0.92	0.72	0.63
	(0.078)	(0.07)	(0.104)	(0.15)
σ^2_α	0.056	0.068	0.037	0.032
	(0.019)	(0.019)	(0.024)	(0.020)
$\sigma_{\alpha\beta}$	-0.002	-0.0028	.00038	.0006
	(0.002)	(0.002)	(0.0018)	(0.001)
σ^2_ε	0.080	0.080	0.055	0.025
	(0.012)	(0.008)	(0.024)	(0.05)
σ^2_η	0.019	0.013	0.034	0.07
	(0.008)	(0.005)	(0.021)	(0.05)

3.6 Conclusion

In this paper we have posed and estimated a stochastic process for the earnings of Italian households. We estimated the parameters that minimize the distance between the theoretical cross sectional age-specific variances and autocovariances and their empirical counterparts, using Italian data from the SHIW. We find evidence of heterogeneity in deterministic trends, determined at the beginning of working activity (the variance of the growth rate is $\hat{\sigma}^2_\beta$=0.00026) and of very persistent life-cycle shocks ($\hat{\rho} = 0.956$). Once we control, in a very simple way, for other observable characteristics that are fixed at the moment of starting the economic activity (like sex, area of birth and in particular education) we find that the variance in the deterministic growth rate falls to 0.00004 and it is not statistically different from zero and the persistence of the life-cycle shocks falls to 0.72. as we find that Italian agents have heterogeneous growth rates that are determined before the beginning of economic activity. At the same, time we find that during the life-cycle agents are hit by very persistent shocks as suggested by the proponents of the RIP process.

Our estimated process provides a necessary input for any economist willing to use a life-cycle, quantitative equilibrium model with heterogeneous agents to study issues like social security, housing decision, precautionary saving in Italy. We also show that a mis-specified earnings process might lead to bias in the quantitative results of such models, by overstating the role of risk faced by the agents during the life-cycle. We are currently using these estimates in some related work [e.g. Rodano / Scoccianti 2009, Rodano 2009, Scoccianti 2009].

These estimates allow a first, rough, assessment of the relative importance of pre-working age shocks and life-cycle shocks in determining the heterogeneity in earnings in the Italian population. We find that, if we shut down life cycle shocks, the variance in permanent income would be 90% of the one we would obtain if we leave them in. This suggests a more limited role for policies oriented at copying with life-cycle risk, with respect to the one assumed by most of the literature. Even if our approach, being mostly statistical, has the advantage of not requiring too many assumptions [especially if compared to more structured approaches like for example Keane / Wolpin 1997], it does not allow any analysis of the consequences of the inequality of earnings process on consumption decisions and therefore on welfare. A next step we are planning to do in the next future is to embed this stochastic process in a calibrated life-cycle version of the Aiyagari-Bewley model to see which are the welfare effects of different assumptions about the earnings process. Moreover, even if it allows a useful decomposition, our approach is almost silent on what determines these pre-working age factors that seems to play such a big role in affecting permanent income inequality. Some preliminary calculations seem to point out that an important role is played by education, but further research, possibly with a more structural approach, is certainly needed.

3.7 Appendix: additional tables

Table 3.7-8: Number of individuals contributing to each moment

age	**Order of Autocovariances**								
	var	**2**	**3**	**4**	**5**	**6**	**7**	**9**	**11**
25	1759	227	NA	NA	NA	NA	NA	NA	NA
26	2073	298	NA	100	NA	NA	NA	NA	NA
27	2410	399	NA	135	NA	NA	NA	NA	NA
28	2770	485	NA	167	NA	NA	NA	NA	NA
29	3109	567	NA	215	NA	NA	NA	NA	NA
30	3305	610	NA	250	106	NA	124	109	NA
31	3571	711	NA	309	117	122	129	115	NA
32	3713	775	NA	322	132	121	148	142	NA
33	3949	900	NA	373	138	134	160	140	NA
34	4017	905	107	377	166	127	184	147	100
35	4197	968	115	412	170	140	187	141	112
36	4289	978	124	422	188	146	191	137	117
37	4403	1049	125	444	187	151	191	148	135
38	4560	1103	123	470	193	164	194	154	138
39	4745	1160	124	467	189	163	207	172	141
40	4828	1194	128	480	196	182	212	179	142
41	4841	1202	131	496	210	191	231	189	136
42	4722	1171	134	516	209	194	234	191	135
43	4776	1225	137	549	209	208	247	185	129
44	4762	1210	145	528	209	204	242	178	121
45	4863	1258	143	552	208	217	225	160	NA
46	4757	1202	143	535	207	202	206	136	NA
47	4765	1257	134	557	193	206	188	NA	NA
48	4727	1249	134	520	183	179	167	NA	NA
49	4793	1281	126	511	168	186	102	NA	NA
50	4674	1197	119	462	147	116	NA	NA	NA
51	4586	1127	111	448	NA	NA	NA	NA	NA
52	4298	1011	106	284	NA	NA	NA	NA	NA
53	4103	933	NA	NA	NA	NA	NA	NA	NA
54	3738	583	NA	NA	NA	NA	NA	NA	NA
55	3539	283	NA	NA	NA	NA	NA	NA	NA

Table 3.7-9: Empirical moments (baseline specification)

age	Order of Autocovariances								
	var	**2**	**3**	**4**	**5**	**6**	**7**	**9**	**11**
25	0.179	0.064	NA	NA	NA	NA	NA	NA	NA
26	0.176	0.092	NA	0.085	NA	NA	NA	NA	NA
27	0.166	0.104	NA	0.093	NA	NA	NA	NA	NA
28	0.167	0.104	NA	0.060	NA	NA	NA	NA	NA
29	0.178	0.093	NA	0.070	NA	NA	NA	NA	NA
30	0.184	0.096	NA	0.052	0.148	NA	0.045	0.098	NA
31	0.190	0.102	NA	0.061	0.149	0.036	0.067	0.088	NA
32	0.202	0.115	NA	0.053	0.148	0.023	0.078	0.095	NA
33	0.211	0.106	NA	0.062	0.098	0.044	0.067	0.101	NA
34	0.221	0.103	0.124	0.063	0.096	0.051	0.065	0.095	0.056
35	0.226	0.115	0.070	0.080	0.093	0.061	0.086	0.087	0.051
36	0.233	0.133	0.113	0.099	0.105	0.101	0.091	0.059	0.058
37	0.237	0.141	0.142	0.094	0.127	0.096	0.102	0.073	0.082
38	0.236	0.136	0.146	0.090	0.135	0.120	0.082	0.080	0.078
39	0.232	0.143	0.150	0.084	0.156	0.086	0.107	0.126	0.065
40	0.228	0.143	0.122	0.115	0.142	0.101	0.117	0.121	0.062
41	0.232	0.143	0.181	0.130	0.151	0.100	0.148	0.124	0.077
42	0.236	0.136	0.179	0.126	0.129	0.115	0.122	0.081	0.087
43	0.244	0.150	0.160	0.126	0.119	0.153	0.120	0.103	0.094
44	0.240	0.152	0.106	0.125	0.101	0.140	0.087	0.095	0.089
45	0.251	0.166	0.102	0.139	0.106	0.145	0.126	0.115	NA
46	0.240	0.159	0.116	0.124	0.120	0.103	0.130	0.114	NA
47	0.257	0.163	0.135	0.133	0.157	0.112	0.151	NA	NA
48	0.254	0.167	0.138	0.146	0.197	0.129	0.146	NA	NA
49	0.282	0.179	0.161	0.172	0.214	0.133	0.165	NA	NA
50	0.276	0.186	0.256	0.176	0.207	0.144	NA	NA	NA
51	0.277	0.187	0.241	0.167	NA	NA	NA	NA	NA
52	0.287	0.188	0.215	0.154	NA	NA	NA	NA	NA
53	0.295	0.199	NA	NA	NA	NA	NA	NA	NA
54	0.345	0.196	NA	NA	NA	NA	NA	NA	NA
55	0.350	0.214	NA	NA	NA	NA	NA	NA	NA

Chapter 4

Personal Bankruptcy Law in Italy

4.1 Introduction

Personal bankruptcy law is a legal procedure that specifies how much an insolvent debtor, who holds unsecured debt, must repay and how much each creditor gets.[1] In most cases the debtor must repay from her assets and/or from future earnings. At the same time bankruptcy procedure protects debtors from harsh collection practices from creditors by setting part of both earnings and assets as exempt and establishing how much each creditor gets.

The main economic rationale for having a personal bankruptcy law revolves around borrowing decisions. Households that wants to smooth consumption across time periods and small firms that want to finance risky investment projects will take the legal framework about bankruptcy into account [White 2007b]. In fact these decisions are made in an uncertain environment in which explicit insurance mechanisms are mostly absent. Bankruptcy law provides a form of consumption insurance either by discharging part of the debt or by limiting the amount creditors can try to seize from insolvent debtors assets and earnings. If debtors are risk averse consumption insurance increases their utility and their willingness to borrow and invest. At the same time, there are several costs associated with bankruptcy procedure. A generous bankruptcy law might allow opportunistic behavior from the debtors that file even when not insolvent. Moreover, even in the case of non opportunistic behavior, debt discharge and debtor protection increases the costs of lending for the creditors inducing them to increase interest rate or even ration credit. Thus the main trade-off related to personal bankruptcy law is between better insurance, provided by a debtor friendly legislation, at the cost of worse credit conditions. This trade-off is not the unique economic feature relevant for bankruptcy legislation. Other costs includes legal costs of bankruptcy procedures and low effort after bankruptcy due to seizing of earnings, while other benefits include debtor

[1] I thank Alex Michaelides for his continuous support and valuable comments on this chapter. I am also grateful to Alfonso Rosolia, Filippo Scoccianti, Paolo Sestito and participants to lunch seminars in the Bank of Italy.

protection from excessive garnishment of her earnings from the creditors and coordination among multiple lenders in the event of default.

This trade-off is at the center of recent public discussions and policy changes in Europe and the U.S. In Europe, the bankruptcy law is much harsher than in the US [White 2007b]. In most European countries debt is discharged after several years (e.g. 8-10 years in France, 6 years in Germany). In the U.S. instead, bankruptcy law is very generous with debtor. Up to 2005, insolvent debtors could choose between two different procedures: Chapter 7, in which they would partly repay their debt using non-exempt assets and the remaining part is immediately discharged; chapter 13, in which they can keep their assets and must repay out of future earnings (but not more than they would have under Chapter 7). Since most agents do not have much non-exempt assets they ended up filing under Chapter 7 and pay nothing. In this sense the U.S. is said to provide a "fresh start". However the U.S. Congress has recently passed a law in 2005 making personal bankruptcy less beneficial for filers, by introducing "means testing" and by increasing filing costs for debtors. At the same time, in Europe, many countries, like for example Germany and Greece, the Netherlands and the UK, have made legislation more lenient by reducing the number of years before debt is discharged [see, for example, Armour / Cumming 2008].

In Italy, there is no formal bankruptcy law that allow discharge. An insolvent debtor is obliged to repay her debt out of post bankruptcy earnings until debt is completely repaid. There has been an ongoing debate about reforming the personal bankruptcy law[2] but even a recently proposed reform, recently approved in the Italian Senate on April 2009, does not allow any debt discharge [see Marcucci / Sabbatini 2009].

In this paper we address the quantitative effects of the introduction of debt discharge in a personal bankruptcy law on saving decisions of Italian households. The focus of this paper is only on the above trade-off related to fresh start: better insurance at the cost of worse credit conditions. To quantify this trade off, we set up a life-cycle model of consumption and saving decisions, very close to Livshits et al. [2007], where heterogeneous households face uncertain and uninsurable labor earnings risk. The model explicitly model the bankruptcy procedure on the Italian legal framework. This in turn will endogenously affect the borrowing interest rate the agents are offered by the banking system when they borrow and therefore their saving and borrowing decisions.

Our modeling strategy is a very parsimonious one. We choose a simple stylized model with few ingredients and we parametrize it from microeconomic evidence whenever it is possible. With just two free parameters, the discount factor and the transaction costs in the intermediation sector, we are able to have a model that is broadly consistent with some stylized facts of the Italian economy about debt, wealth distribution and the life-cycle behavior of the most important variables (consumption income and assets accumulation). Moreover our calibration is very neat: our free parameters are calibrated to targets that are very close

[2] See for example Stanghellini [1997] and more recently Porrini [2009].

to each of them: discount factor is set to match the wealth to income ratio and the transaction costs in intermediation to match spread between borrowing and lending rate. The alternative strategy would have been to add several fine details (e.g. bequest motives, more complex demographic structure, stigma costs, labor leisure choice...) and free parameters in order to achieve a better fit to the data. We discarded this approach in order not to run into the costs of a much murkier intuition of where the results are coming from and what are the driving forces.

We use the model to simulate the effects of introducing debt discharge (fresh start) on saving and bankruptcy decisions of Italian households. All the simulations show that the negative effects of the introduction of the fresh start in bankruptcy procedures, in terms of worse credit conditions, will outweigh the benefits in terms of better insurance against negative income shocks. The main effect of introducing fresh start after bankruptcy would be to make borrowing more costly and make intertemporal allocation of consumption much more difficult. At the same time there seem to be no much gains in terms of better insurances across different states of the world.

The microfounded nature of the model allow us to conduct welfare comparisons. The welfare of all agents would be reduced from the introduction of fresh start. The effects would be much higher the more generous the new system would be for the insolvent debtor. The welfare costs are distributed among all the population and their magnitude is equivalent to a reduction of average consumption between 1%, in the most debtor frienly scenario, and 0.1% in the harshest one. The agents who are most affected are those with steepest earning profile. These results are quantitatively slightly bigger than the effects found in similar exercises for the US. As a further comparison a reduction by half of the transaction costs in intermediation, an unambiguously welfare improving policy, would increase welfare of the same magnitude of the reduction of welfare caused by the extremely debtor friendly policy experiment.

In a series of robustness check we show that our results are robust to the specification of the two most important ingredients of the model: the specification of the earnings shock and the degree of risk aversion/intertemporal elasticity of substitution. Varying the coefficient of risk aversion (which also controls the intertemporal elasticity of substitution) points in the direction that what really matters for the saving decisions of the agents, at least in the model, is not so much the substitution across states of the world but rather intertemporal allocation of consumption.

Related literature There is a large amount of literature that tries to analyze the effects of different personal bankruptcy law. There are two main approaches to address this issue. On one side[3], some papers try to exploit the differences across U.S. states in bankruptcy law (e.g. in exemption level for wealth) to see the effects of different laws on households' saving and default decisions [e.g. Gropp et al. 1997], on credit conditions for households

[3] See White [2007b] for a thorough survey of this approach.

[Fay et al. 2002] and for small businesses [Berkowitz / White 2004], and on entrepreneurial decisions [Fan / White 2003]. On the other side, there is a rich literature that try to address the same issue using calibrated quantitative models. This "equilibrium" approach [Athreya 2005] has focused mostly on households consumption and saving decisions [among others Athreya 2002, Chatterjee et al. 2007, Livshits et al. 2007, Li / Sarte 2006, Athreya 2008] and on entrepreneurial decisions [Mankart / Rodano 2008, Akyol / Athreya 2007, Meh / Terajima 2008]. By explicitly microfounding the optimal choice of the agents as a function of the policy variables, these type of model allows allow counter factual simulated scenario analysis that is robust to the Lucas' critique. Moreover, by assuming heterogeneous agents, where heterogeneity is in wealth, earnings age, these models allow to understand winners and losers from each policy experiment.

Our paper belongs to this second stream of literature and is most closely related to Livshits et al. [2007] and to Athreya [2008]. It is related because it shares with them a similar overlapping generation structure. Similarly to Athreya [2008], it also have a rich earnings process for the agents, estimated by Rodano [2009] for Italian households using the methods by Guvenen [2009] and Storesletten et al. [2004]. But there are two main differences. First of all this is the first quantitative model that analyses the effects of introducing fresh start in Italy, while all the other papers model the U.S. economy. This is a particularly useful tool given that in Italy we can not exploit the differences in assets exemption level across U.S. states to gather further evidence on the effects of bankruptcy law credit conditions using microeconometric analysis. Second, it is the first paper to adopt a richer earnings process that allow for heterogeneity in the growth rate among agents [see Guvenen 2009] and to check whether this makes any difference. This is relevant because agents saving decisions (their willingness to borrow) depends on the steepness of their income profile.

The remainder of the paper is structured as follows. In Section 2 we quickly discuss the legal personal bankruptcy framework in Italy and in the US. Section 3 presents the model. Section 4 presents the main results and Section 5 concludes.

4.2 The legal framework

In Italy there is still no formal personal bankruptcy law for consumers[4]. An insolvent household is forced to surrender all its assets, if any, to the creditor. At the same time the creditor can size up to a 1/5 of the income the household is earning and any outstanding debt is rolled over at a legal interest rate or at the borrowing interest rate, whichever is higher[5]. The insolvent household is not allowed to save or borrow.

In the US insolvent households can choose between two different procedures. Under

[4] Bankruptcy is only allowed to "entrepreneurs" that satisfy certain conditions on size, revenues and so on.
[5] Which was 5% up to 1990, 10% from 1991 to 1996, 5% from 1997 to 1998 and between 2.5% and 3.5% from 1999 onwards.

Chapter 7, all debt (unsecured debt) is immediately discharged and current earnings cannot be garnished by the creditor. This is why Chapter 7 is known as providing a "fresh start". At the same time, a person filing for bankruptcy has to surrender all wealth in excess of an exemption level. Under Chapter 13 instead agents keep their wealth, but debt is not discharged immediately. Creditors can size current and future earnings. And even if filing under Chapter 13 the present value of earnings that the creditors can recover can't be greater than the amount they would recover under Chapter 7. Since most of the insolvent households are asset-poor most of the bankrupt households file under Chapter 7 [see e.g. White 2007b]. Persons can file for bankruptcy only once every 6 years. The bankruptcy filing remains public information for ten years. But there is no formal rule about former bankruptcy filers being excluded from credit.

In this paper we focus on the role of discharge. In modeling the counter factual bankruptcy law, the "fresh start" system, we follow Livshits et al. [2007]. We assume that agents who defaults are subject to wage garnishment only for the period in which they declare bankruptcy[6] but then debt is immediately discharged.

4.3 The model

The model is similar to the one considered by Livshits et al. [2007]. We consider an overlapping generations life-cycle model with heterogeneous agents *à là* Huggett [1996]. Agents work for N_w periods and live the remaining periods as retired until they die with certainty after N periods. There is a continuum of measure one of agents for each age. In addition to heterogeneity in age, agents are heterogeneous along two other dimensions: income, which is exogenous and stochastic; wealth during the life cycle which is endogenously determined by agents' saving choices[7]. There is one homogeneous good in the economy. Financial markets are perfectly competitive: there is free entry in the credit market where a single non-contingent one period bond is traded. The assumption of non-contingent bonds rules out any insurance market. Perfectly informed lender will price the bonds taking the individual potential creditor characteristics and the bankruptcy framework into account. The only source of uncertainty is in households' earnings. They face idiosyncratic uncertainty but there is no aggregate uncertainty. Since Italy is a small country, interest rate is given (and equal to the US one) and we abstract from production side of the economy.

[6] This is done for two reasons. On one side, bankruptcy filings are subject to court approval which requires "good faith" on the side of the petitioner. Following Livshits et al. [2007] we can interpret the garnishment as necessary to establish this "good faith". on the other side it allows us to experiment with different degrees of severity of the counter factual "fresh start" system.

[7] All agents are born without wealth.

4.3.1 Households

Preferences The households maximize expected utility from the consumption stream over their entire life according to the utility function

$$U = \mathbb{E}\left\{\sum_{h=1}^{N} \beta^{h-1} u\left(c_h\right)\right\} \tag{4.3-1}$$

where β is the discount factor, c_h is consumption at age h and the felicity function is assumed to be take the CRRA form

$$u(c) = \frac{c^{1-\sigma} - 1}{(1-\sigma)} \tag{4.3-2}$$

where σ is the risk aversion parameter.

Earnings process For the first N_w periods of their life an individual i of age h receive an earning Y_h^i. The stochastic process for earnings represents all the uncertainty agents are facing in this model. We assume that $y_h^i = \log Y_h^i$, the logarithm of earnings of households i of age h, is represented by a stochastic process of the following form

$$y_h^i = g\left(h\right) + \left[\alpha^i + \beta^i h\right] + \left[z_h^i + \varepsilon_h^i\right] \tag{4.3-3}$$

There are three main component of earnings. The first component, $g\left(h\right)$, is a deterministic trend where the function $g\left(h\right)$ is common to all agents. In the baseline version we assume that it is a function of age only while in robustness check we allow it to depend on education as well. The second component, $\left[\alpha^i + \beta^i h\right]$, is a stochastic fixed effect, realized before entering in the model, that affects both the level (α^i) and the growth rate (β^i) of earnings. We assume that $\left(\alpha^i, \beta^i\right) \sim N_{iid}\left(0, \Sigma\right)$, with

$$\Sigma = \begin{pmatrix} \sigma_\alpha^2 & \sigma_{\alpha\beta} \\ \sigma_{\alpha\beta} & \sigma_\beta^2 \end{pmatrix} \tag{4.3-4}$$

being the covariance matrix. The third component, $\left[z_h^i + \varepsilon_h^i\right]$, captures the shocks affecting individual earnings during life cycle (thus it depends on age). These shocks can be temporary (ε_h^i) or persistent (z_h^i). We assume that the persistent shocks follow an AR(1) with persistence ρ and innovation η_h^i. That is:

$$z_h^i = \rho z_{h-1}^i + \eta_h^i \tag{4.3-5}$$

and $z_0^i = 0, \forall i$. We assume that $\varepsilon_h^i \sim N_{iid}\left(0, \sigma_\varepsilon^2\right)$ and $\eta_h^i \sim N_{iid}\left(0, \sigma_\eta^2\right)$ and the shocks are independent on each other (and on the fixed effects shocks). The stochastic process of earnings is characterized by six parameters that we denote with the vector $\theta \equiv \left\{\sigma_\alpha^2, \sigma_{\alpha\beta}, \sigma_\beta^2, \rho, \sigma_\eta^2, \sigma_\varepsilon^2\right\}$.

For each period of retirement the household receives a fraction ζ of her own average lifetime earnings during lifetime.

4.3.2 Credit market and bankruptcy law

Credit market We assume that for the Italian economy the saving interest rate is given, and equal to r which we calibrate to the return on assets in the US. We assume a perfectly competitive credit market (i.e. there is free entry) where only a one year non-contingent bond is traded. The fact that bonds are non contingent rules out any possibility fro the agents of explicitly buy any insurance. All the insurance they have is provided by self insurance by saving assets. There is no asymmetric information. Banks perfectly observe all borrower characteristics. But the option of bankruptcy creates a limited commitment problem. After the realization of the shocks during the period the agent has the option of filing for bankruptcy. The different bankruptcy legislation will determine both the amount of resources that the bank will recover and the probability of default, therefore affecting endogenously the price of credit. The specific contract specify the price q of one unit of consumption good in the future[8]. There are some transaction costs τ only on loans that will generate a positive spread between lending and borrowing rate even if the bank can forecast that borrower will never default under any contingency. Pricing of the loan is determined by the free entry and by the forward looking behavior of the banks: given the information the bank can fully forecast the probability of default and the amount that it will recover in the event of default. Since information is perfectly symmetric and there is free entry each bank makes zero profit on each single loan they make. There is no cross subsidization.

Bankruptcy law Household can declare bankruptcy and what happens is determined by the legal framework. The model of Italian legal framework is as follows: if an agent defaults, she must surrender all her asset and, if this is not enough as it is the case in our model[9], the bank seizes a fraction γ of agent's salary. Any outstanding debt is rolled over at at a legal rate, $\overline{r}$ fixed by the law. Wage garnishment goes on until debt is totally repaid or the agents die. In modeling the alternative system we assume that in the period in which agents declare bankruptcy a fraction γ of their wages are garnished by the bank. After that debt is immediately discharged and the defaulting agent is free of any outstanding liabilities. There is no exclusion from credit after bankruptcy.

4.3.3 The timing

Within the period the timing is as follow:

- The agent wakes up at dawn with a certain debts/savings d. If $d > 0$ she was a borrower in the past and now she must repay, while if $d < 0$ she was saving in the past. She is of age h and her current period earnings shocks z and ε are already realized and known to

[8] Some notation: we call d' the face value of the bond which is traded in the current period and $q < 1$ its price. We assume that if $d' > 0$ the agent is incurring debt. That is she is liable for an amount d' next period, and she has a (positive) additional amount or resources qd' available for consumption today.
[9] Given that there is a single asset, the agent is either a saver or a borrower.

everybody. The household is also characterized by the fixed effects α and β which are also known. Instead when she is retired, she is characterized only by her debts/savings, by her age h and by her fixed effects (α, β) that determine her retirement earnings[10].

- Then the borrower decides whether to file for bankruptcy or repay her debt.
  - If she defaults her earnings are seized, she must consume the share of earnings left and any outstanding debt is rolled over to next period
  - If she repays she can allocate remaining cash on hand between consumption and saving/borrowing.
- The saver only chooses how much to consume and how much to borrow

4.3.4 The households optimization problem

The current Italian system Let's define the value function associated with the problem of the households. At the moment of taking her decisions an agent of age h is characterized by her individual state variable $(d, \alpha, \beta, z, \varepsilon, h)$ which is composed by her age, h, her outstanding debt, d, by her earnings fixed effects (α, β) by the persistent z and by the transitory ε earning shocks. The first decision is whether to repay or declare bankruptcy. That is

$$V(d, \alpha, \beta, z, \varepsilon, h) = \max \left\{ V^D(d, \alpha, \beta, z, \varepsilon, h), V^R(d, \alpha, \beta, z, \varepsilon, h) \right\} \tag{4.3-6}$$

where $V^D(\cdot)$ is the utility from defaulting and $V^R(\cdot)$ the utility from repaying of an agent with state variable $(d, \alpha, \beta, z, \varepsilon, h)$.

If the agent repays she has resources given by her earnings $Y(\alpha, \beta, z, \varepsilon, h)$ minus her debt repayment $(-d)$, to be used on consumption c and on new saving/borrowing $-q(d', \alpha, \beta, z, h)\, d'$, where we have made explicit that the price of new loans, $q(\cdot)$, depends on the size of the loan, d' and on the individual characteristics (α, β, z, h)[11]. Then her budget constraint is given by

$$c - q^b(d', \alpha, z, h)d' = Y(\alpha, \beta, z, \varepsilon, h) - d \tag{4.3-7}$$

and her value function if she repays is given by

$$V^R(d, \alpha, \beta, z, \varepsilon, h) = \max_{c, d'} u(c) + \beta \mathbb{E} \left\{ V(d', \alpha, \beta, z', \varepsilon', h+1) \right\} \tag{4.3-8}$$

where maximization is subject to (4.3-7) and the expectation is taken on the future value of the life-cycle earnings shocks (z', ε').

If the agent defaults her consumption is given by the fraction $(1-\gamma)$ of her earnings that

[10] In what follow we omit the presentation of the retired agent problem given that is just a simplified version of the one presented here.
[11] The specific way in which the bank price the loan is described below.

is not seized by the banks, and the outstanding debt is rolled over at rate $\bar{r}$. That is her utility is given by

$$V^D(d,\alpha,\beta,z,\varepsilon,h) = u(c) + \beta\mathbb{E}\left\{V\left(d',\alpha,\beta,z',\varepsilon',h+1\right)\right\} \tag{4.3-9}$$

where

$$\begin{aligned} c &= (1-\gamma)\,Y(\cdot) \\ d' &= \max\left\{\left[(d-\gamma Y(\cdot)\right],0\right\}(1+\bar{r}) \end{aligned} \tag{4.3-10}$$

The counterfactual scenario Under the counterfactual scenario the state variable is the same as in the current Italian system and the bankruptcy decision is the same as in the equation (4.3-6) as it is the value from repaying given by equations (4.3-8) and (4.3-7)[12]. The only differences in what happens to the defaulting households. In this case the current earnings are still garnished[13] for one period but debt is immediately discharged. Therefore the value of defaulting, in this case it is equal to

$$V^D(d,\alpha,\beta,z,\varepsilon,h) = u(c) + \beta\mathbb{E}\left\{V\left(d',\alpha,\beta,z',\varepsilon',h+1\right)\right\} \tag{4.3-11}$$

where

$$\begin{aligned} c &= (1-\gamma)\,Y(\cdot) \\ d' &= 0 \end{aligned} \tag{4.3-12}$$

4.3.5 Banks

The current Italian system Free entry in the credit market will force the banks to make zero expected profits on each contract (i.e. on each individual). For each type of agent, $\omega \equiv (\alpha,\beta,z,\varepsilon,h)$, and for each loan of size d' the bank can anticipate the probability of default $\pi(d',\omega)$ next period. If the probability of default is zero, given the transaction costs τ, the bank will offer a price of loan $q^b(d',\omega) = 1/(1+r+\tau)$. If the agent defaults then the bank recovers the garnished earnings $\gamma Y(\omega')$ and the value of rolled over debt, $d''q(d'',\omega')$ where $d'' = (\max\{[d'-\gamma Y(\omega')],0\})(1+\bar{r})$. Therefore the price of a bond of face value d' for an agent with state ω is

$$q^b(d',\omega) = \frac{1-\pi(d',\omega)}{1+r+\tau} + \frac{\pi(d',\omega)}{1+r+\tau}\mathbb{E}\left\{\frac{d''q^b(d'',\omega') + Y(\omega')\gamma}{d'}\right\} \tag{4.3-13}$$

The counterfactual scenario In the counterfactual scenario, in the event of a default the bank collects only the wage garnished in the next period but debt is immediately discharged.

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[12] Even if the structure of the problem is identical the different bankruptcy frameworks affect the specific form of the pricing function, as shown in next paragraph.
[13] In the policy experiment we consider also the case where $\gamma = 0$.

Therefore the price of a bond of face value d', for an agent with state ω, is given by

$$q^b(d',\omega) = \frac{1-\pi(d',\omega)}{1+r+\tau} + \frac{\pi(d',\omega)}{1+r+\tau}\mathbb{E}\left\{\frac{Y(\omega')\gamma}{d'}\right\} \tag{4.3-14}$$

4.3.6 Equilibrium

Given a certain interest rate, a recursive competitive equilibrium is given by:

- a collection of value functions and policy functions that solve the problems above
- a collection of default probabilities that are coherent with the optimal bankruptcy decision
- a collection of bond prices that solve the zero profit condition, given the above optimal decision and default probabilities

The equilibrium is computed by backward induction. Therefore we already know the default probabilities from the future, which implies a certain price, and then we solve the optimal saving problem of the agents.

These problems endogenously determine a wealth distribution for each age that we use to calculate aggregate statistics. In order to recover the steady state distribution of wealth we simulate a large number of agent's lifetimes and we derive all the relevant model statistics.

4.4 Results

4.4.1 Parametrization

Our parametrization is the most conservative as possible. We choose as many parameters as possible from micro evidence available and we try to avoid to use free parameters to match targets in the Italian economy. The goal is to keep the model as simple and stark as possible but at the same time get a reasonable picture of the phenomenon we are studying.

The model period is 3 years. Agents enter the labor market at age 24, they all retire exogenously at 56 and die at 86 leaving no bequests. The preferences of the agents are characterized by the discount factor and by the risk aversion parameter. Following the literature we assume the CRRA specification with $u(c) = c^{1-\sigma}/(1-\sigma)$ where σ is the risk aversion parameter. We set to $\sigma = 2$ and we conduct some robustness checks on it. The discount factor is calibrated to match the ratio of financial wealth to income in the economy. Coherently with the small open economy interpretation of our partial equilibrium model, we set the interest rate equal to 4% which is the average rate of return on capital in the US [McGrattan / Prescott 2001]. In the model period it gives us $r = 0.12$. Another parameter is the exogenously given transaction cost on borrowing, τ, which yield a spread between riskless borrowing and lending rates in the model. We first show that when we set $\tau = 0$ the model calibration is rather poor. Therefore in order to get a better calibration we choose τ we choose it to match the observed spread between borrowing and lending in Italian data (which we set at 6%, taking as the borrowing rate the rate on consumer credit).

To represent the bankruptcy law we need two parameters: the share of earnings that the bank can seize if the household file for bankruptcy, γ and the legal interest rate at which the debt is rolled over in the event of default. $\bar{r}$. Given the legal features already described we set the first equal to 1/5, ($\gamma = 0.2$), and the second equal to the borrowing rate $\bar{r} = r_b$.

The earnings process The earnings process is represented by 4.3-3 which is characterized by the parameters $\theta = \left\{\sigma^2_\alpha, \sigma_{\alpha\beta}, \sigma^2_\beta, \rho, \sigma^2_\eta, \sigma^2_\varepsilon\right\}$ and by the common deterministic trend $g(h)$. It represents all the uncertainty agents are facing in this model. In a companion paper [Rodano 2009], following Storesletten et al. [2004] and Guvenen [2009], we estimate the earnings process in (4.3-3). The minimum distance estimates of the parameters we find are reported in Table 4.4-1.

Table 4.4-1: Earnings process estimates

	HIP	RIP	EDUC
σ^2_β	0.00026	NA	0.00004
	(0.000064)		(0.00005)
ρ	0.956	0.97	0.72
	(0.048)	(0.00007)	(0.104)
σ^2_α	0.073	0.021	0.041
	0.020	0.013	0.012
$\sigma_{\alpha\beta}$	-0.004	NA	-.00018
	(0.0026)		(0.0008)
σ^2_ε	0.084	0.105	0.057
	0.0084	0.008	0.022
σ^2_η	0.018	0.012	0.042
	(0.004)	(0.002)	(0.020)

In our baseline model we adopt the specification that allow for heterogeneity in the growth rates (HIP process). The estimates are reported in the first column of Table 4.4-1. We are the first to allow heterogeneity in the growth rate in a model of bankruptcy in general equilibrium.[14] For simplicity, since $\sigma_{\alpha\beta}$ is not statistically different from zero we assume that α^i and β^i are independent.

Given the importance of the earnings process we look at what happens if we assume two other specifications in the robustness checks. In the first we follow what most of the

[14] The first paper to adopt this earning process and to explore its consequences for consumption choices is Guvenen [2007]. He assumes that agents do not know their specific deterministic growth rate β^i, but have to learn it through their life-time. We assume that agents already know their β^i. The reason for this assumption is that once we control for variables already known at the moment of entering the model σ^2_β is statistically insignificant [for details see Rodano 2009]. Since in this baseline specification we do not differentiate the agents by education or sex we keep the heterogeneity in growth rate but we assume no learning.

quantitative literature on consumer bankruptcy done. Following Storesletten et al. [2004], we assume $\sigma_\beta^2 = 0$ (RIP process) and we get the estimates reported in the second column of Table 4.4-1. In the second we assume that agents are born, exogenously either with either high or low education and that education affects only the deterministic profile $g(h, E^i)$, but not the stochastic process[15]. When we estimate the parameters of the model under these conditions, we get the estimates of the parameters in the third column of Table 4.4-1. Since σ_β^2 is not significantly different from zero we set both $\sigma_\beta^2 = \sigma_{\alpha\beta} = 0$. In this case we have also to assume the fraction of low education agents in the economy. We do two exercises: one in which an high education agent has at least a bachelor's degree and one in which she has at least an high school degree. In this robustness check we also assume that agents have a different deterministic earnings age-profile according to their education. The earnings profiles for the case in which education is given by an high school degree are reported in the Figure 4.1 where the "all" refers to the general case where we do not differentiate with respect to education (i.e. the case when the deterministic trend is $g(h)$). These are derived from regressing the logarithm of earnings on a series of age and time dummies, on an education dummy and on the interaction of age and education dummies[16]. In addition to the robustness check on income we also run some robustness checks on the risk aversion coefficient.

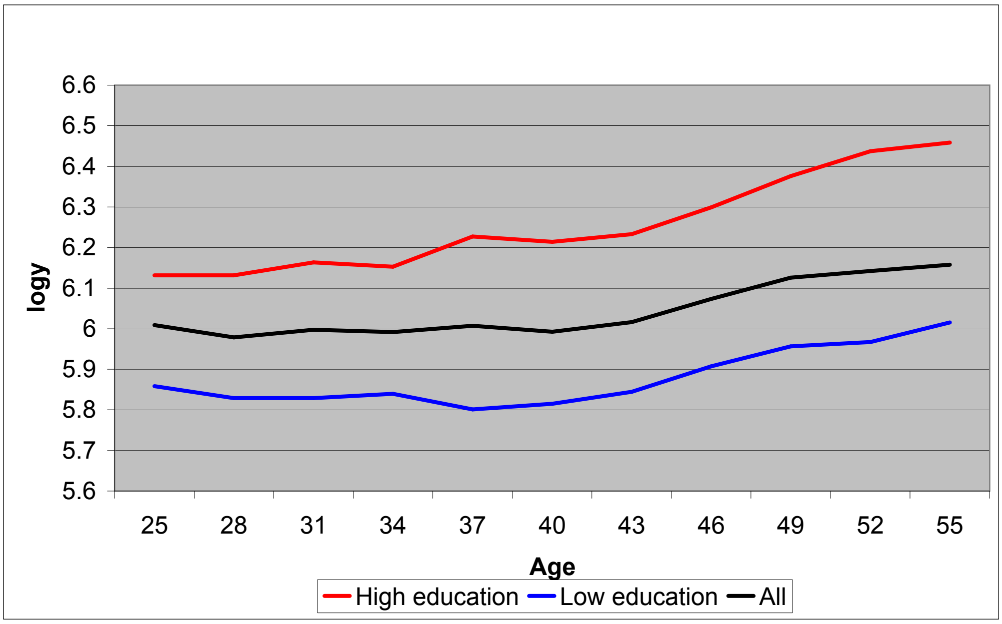


Figure 4.1: Common deterministic life cycle profiles (high and low education)

[15] As shown in the robustness checks in Rodano [2009], we are not able to properly estimate the process separately for high and low education agents separately.

[16] Unless otherwise specified, all the data on the Italian economy used in this paper comes from the Bank of Italy' "Survey of Household Income and Wealth", (SHIW) a representative sample of Italian population, with about 8000 households interviewed every year.

We assume that the social security replacement ratio is $\zeta = 0.7$ [see for example Brugiavini 1997]. That implies that when retired each individual will receive an income which is equal to 70% of her average income.

In transforming the yearly values from the table we set $\tilde{\rho} = \rho^3$ and $\tilde{\sigma}_\eta^2 = \sigma_\eta^2 (1 + \rho^2 + \rho^4)$. All shocks are discretized using the method suggested by Tauchen [1986b]. For the persistent shock z_h^i we have an age-specific Markov chain, while for all other shock we discretized the shocks[17].

4.4.2 The baseline specification results

In order to yield useful policy predictions the model should fit reasonably well some stylized facts of Italian economy which are relevant for the phenomenon we are interested in. At the same time, in order to discipline the model, we do not want to abuse of calibration and choose too many free parameters.

Table 4.4-2: The baseline specifications and the data

	DATA	NOTC	BASE
Financial wealth to income ratio	3	3	3
Spread borrowing lending rate	0.06	0.002	0.059
Share of population with positive debt	0.11 (0.2)	0.25	0.11
Debt/income ratio for those in debt	0.3 (0.8)	0.86	0.66
Consumption/Income	0.84	1.11	1.11
Gini of financial wealth	0.77	0.98	0.78

In order to judge the ability of our model in replicating the behavior of Italian households we report in Table 4.4-2 some statistics taken from the Italian data (DATA) and the corresponding numbers generated from the model[18]. We report the results from two baseline specifications, one without transaction costs (NOTC) and one where we calibrate τ in order to match the spread (BASE) between borrowing and lending rate. As it can be seen from the comparison between the first and the second column, when we do not consider transaction costs the calibration is not very good. The borrowing rate is too low an this imply that the fraction of borrowers is too high and the agents borrow too much. Consumption over income is too high as well as the Gini index of financial wealth. When we introduce transaction costs, and we set τ to match the spread between borrowing and lending rate, we manage to match it very well. The value of τ that matches the spread in rates is 0.2. But now the model does much better in matching both the fraction of borrowers and the Gini index of financial wealth. The model does slightly better with respect to the average debt to income ratio for those in debt

[17] In all specification we choose $N_\varepsilon = 3$. In the baseline HIP specification of the earnings process we choose $N_\alpha = N_\beta = 3$ while in the RIP specification we choose $N_\alpha = 9$. In the specification with heterogeneity in skill we assume $N_\alpha = 4$ for each of the low and high education groups.

[18] The data are all taken from the SHIW, with the exception of the financial wealth to income ratio, which is taken from Bartiloro et al. [2008]. In general the absolute numbers of wealth from the SHIW seem to underestimate the number from other sources.

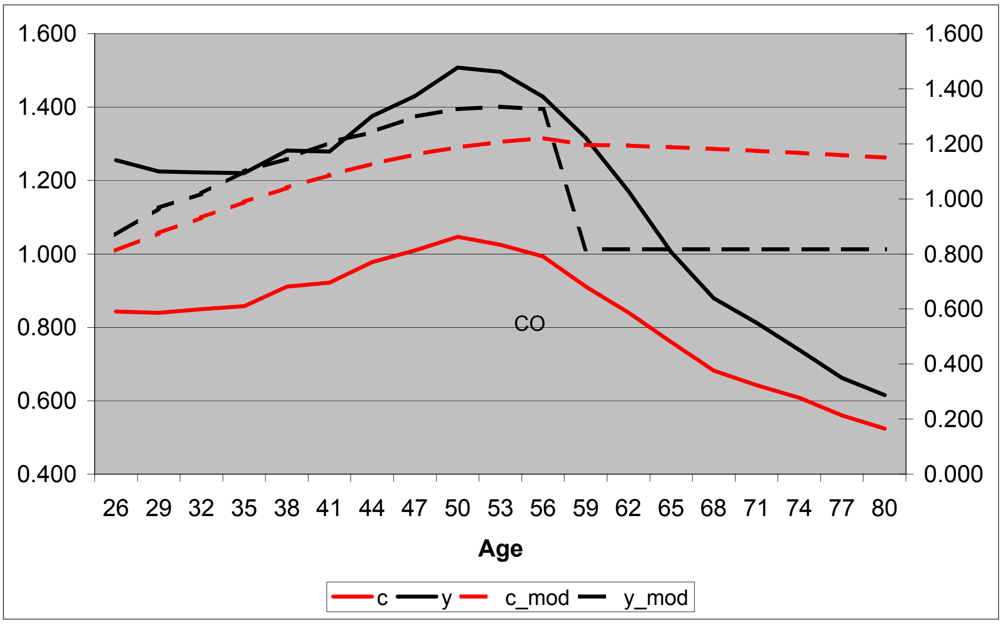


Figure 4.2: Consumption and income over the life cycle (data and model)

but it still too high as well[19]. This is true also for the fraction of total debt which is defaulted on which is too big as compared with the Italian data[20]. The consumption to income ratio is higher in the model than in the real data, but this might be due to the absence of bequest motive and to the assumption that all agents are born with zero wealth. The discount factor that allows to match the financial wealth to income ratio is equal to 0.875020 which in yearly term is 0.957, well within the range commonly used in the standard macroeconomic literature.

Given the better performance of the model with transaction costs, from now on all results we report includes $\tau = 0.2$. Another aspect where the model perform reasonably well, especially in the light of its simplicity, is the life-cycle behavior of the most important variables, income, consumption and financial wealth. The model is able to replicate the life-cycle pattern of both average consumption and average income as can be seen from Figure 4.2. In the graph the dotted lines are the model-generated data of consumption (red) and income (black). The solid lines are the Italian data data taken from the SHIW[21]. As it can be seen, apart from

[19] The numbers we derive for the Italian data are derived when we exclude from debt calculations the debt related to housing (i.e. mortgages). We chose this definition since we exclude housing decisions from the model. The number in parenthesis are those that we get if we include housing related debt

[20] This number is not reported in the table. It should be possible to match also this target by introducing some non monetary bankruptcy costs (e.g. stigma) but, for the sake of clarity, we prefer not pursue this road here.

[21] Given some normalization issues the two sets of series have different units of measure. The model-generated variables values must be read on the right hand axis while those of Italian data from the left hand axis. This is true also for Figure 4.3

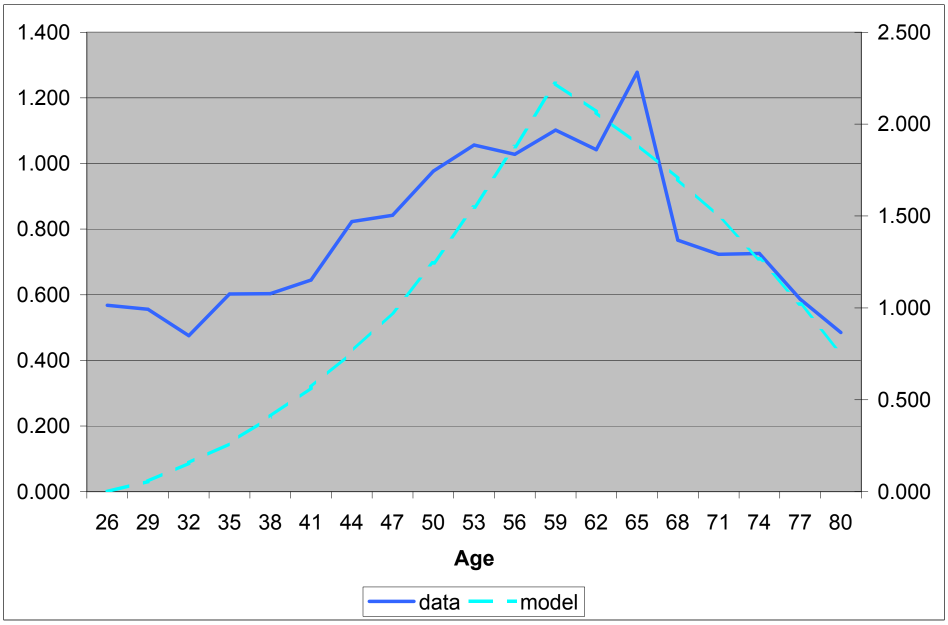


Figure 4.3: Financial wealth over the life cycle (data and model)

the drastic fall in income in the model around retirement age, which is due to our coarse assumption about retirement, the qualitative pattern of the model-generated variables seem to fit reasonably well the one of the true data. Consumption tracks income pretty closely and both model and data series peak roughly at the same time. The fit is particularly good during the working age (up to age 55), which is where all the action in our model happens, since there are no shocks to earnings after retirement. A similar pattern can be seen also from the pattern of financial wealth in Figure 4.3. Both series share the same qualitative pattern, even though, by abstracting from bequest motives and by assigning zero wealth to the new entrants in the market we do not capture exactly the same magnitudes.

4.4.3 The policy experiment

Confident that the model perform reasonably well in representing saving decisions of Italian households, we are now able to analyze the effects on these choices of the introduction of a system close to the US one which allow the bankrupt household a fresh start. More specifically the bankrupt household has a fraction (γ) of the earnings garnished by the creditor for one period and after that her debt is completely discharged. We repeat the exercise for three values of γ between 0.01 to 0.5, where the lower the parameter γ the more generous for the debtor is the bankruptcy legal framework.

Table 4.4-3: The main policy experiment results

	BASE	$\gamma = 0.01$	$\gamma = 0.2$	$\gamma = 0.5$
Financial wealth to income ratio	3	3.39	3.27	3.15
Spread borrowing lending rate	0.059	0.16	0.07	0.06
Share of population with positive debt	0.11	0.001	0.06	0.1
Debt/income ratio for those in debt	0.66	0	0.11	0.21
Consumption/Income	1.11	1.12	1.12	1.11
Gini of financial wealth	0.78	0.63	0.66	0.69
Welfare	0	-0.010	-0.005	-0.001

The results for the main variables and for a measure of welfare[22] are reported in Table 4.4-3. It is evident that introducing fresh start has a negative effect on welfare. As explained the main trade-off related to the introduction is between insurance provision on one side and the cost of credit on the other. As expected introducing fresh start has a negative effect on the borrowing interest rate. The spread between lending rate and borrowing rate increases and the increase is higher the more generous for the borrower is the bankruptcy code (i.e. the lower is the fraction of earnings that the lender can garnish, γ). The increase in the cost of borrowing reduces significantly both the number of borrowers and the amount borrowed. This is the bad side of "fresh start": agents can do less consumption smoothing over time because they are borrowing constrained, especially when young. This can be better seen from the Figure 4.4 that plots the life-cycle profile of the average consumption under the baseline specification and the extremely borrower friendly case $\gamma = 0.01$. Very young agents, in the life-cycle model would like to borrow, since they face a rising income profile. Under the current system, interest rates are low, borrowing is not so costly and they can smooth consumption over time much better. At the same time we would expect a better ability of the agents under a fresh start system to smooth consumption across states of the world. Ceteris paribus this should result in a lower variability of consumption at each age, provided agents are not borrowing constrained[23]. The Figure 4.5 shows that this is not happening. For the young the variance of consumption is lower under the baseline than under the fresh start. This is somehow expected since the young are borrowing constrained and the positive effects of better smoothing across states of the world does not apply to them. Given that a fresh start exacerbates the credit conditions, younger agents are actually *more* borrowing constrained and this explain why their consumption have higher variance under the counter factual scenario. If there was to be a positive side of the fresh start it should have been for the middle aged agents. But this simply does not happen in any significant amount: the variance of consumption of the middle aged is basically the same under both scenarios.

[22] Our measure of welfare is, as it is standard in this literature, the change in consumption equivalent. What is reported is the percentage change of constant consumption over the life-cycle that would make the agents indifferent between the status quo and any of the counter factual scenarios. A negative number (e.g. -0.01) means that agents are worse off in the counterfactual scenario than in the status quo and in order to be indifferent between the 2 situations the consumption of the status quo should be reduced by 1%.

[23] If an agent is borrowing constrained then she can not smooth the shocks either and this positive effect would not happen.

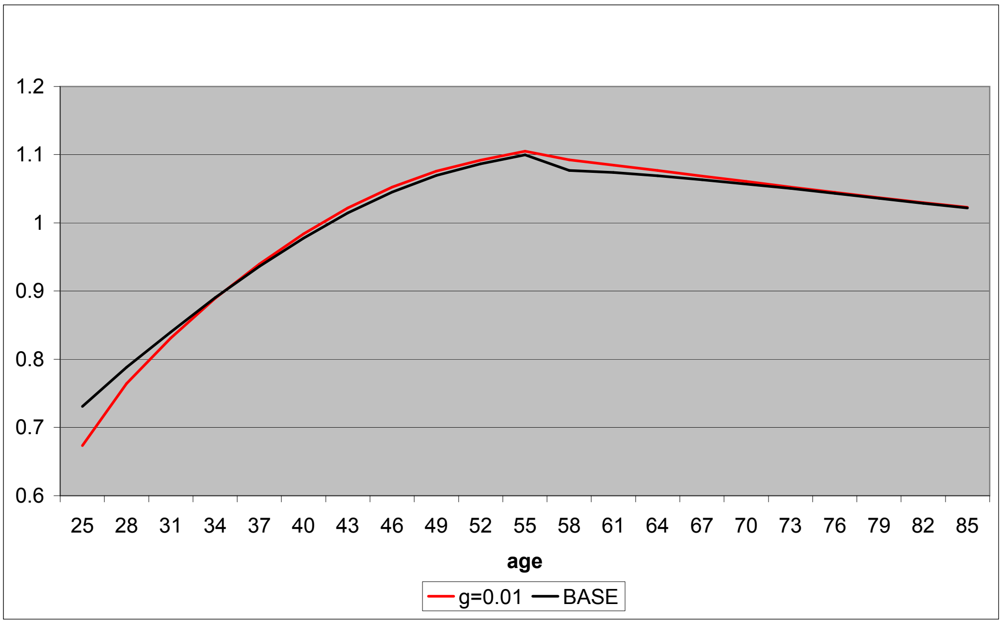


Figure 4.4: Consumption over the life cycle (baseline and $\gamma = 0.01$)

Given the heterogeneity in the deterministic profile, we can seek confirmation of the intuition behind these results by looking at welfare changes across classes of permanent income agents. Agents are characterized, at the beginning of their lifetime, by a draw of α the permanent income level and by β the deterministic growth rate of output. If the main effect of the introduction of fresh start is a worsening of credit constraints and an increase in borrowing constrained agents, we would expect that the most affected among all the agents should be the those with a high deterministic growth rate β since they are those which are more willing to borrow. The results in Table 4.4-4, where we report our welfare measure under all scenarios for different type of agents, confirms this intuition. There are no winners under any circumstances. But the worse losers from all fresh start policies are those agents with a fast growing earnings profile (i.e. high β). Those with low β are barely affected by the policy. Their incentive to borrow are lower since they have a relatively flat profile. The bulk of the losses (and they are pretty big losses, in the order of 2.5% of their current consumption) comes from the high β agents. The conclusion we can draw from this kind of experiment is that fresh start is not a good policy for Italy. The benefits, in terms of better smoothing of consumption across different states of the world, if there, are completely outweighed by the costs of worsening the credit conditions. In order to have an idea of the magnitudes we show in Table 4.4-5 the welfare effects of halving the transaction costs on intermediation, a policy which has unambiguous beneficial effects. These are bigger, in absolute value, than the case $\gamma = 0.5$ but smaller than the case $\gamma = 0.01$.

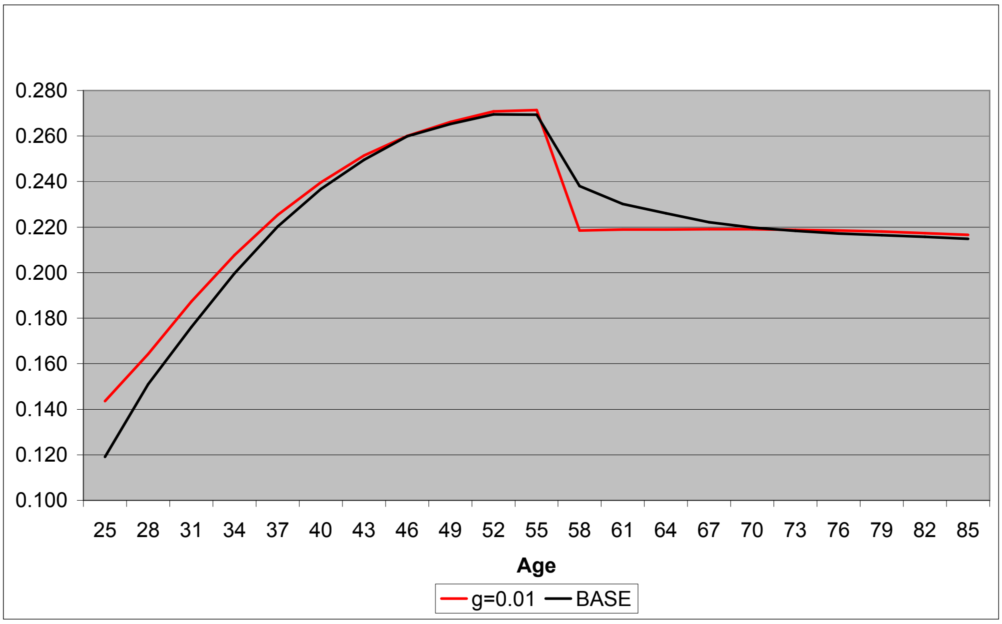


Figure 4.5: Variance of log of consumption over the life cycle (baseline and $\gamma = 0.01$)

4.4.4 Robustness checks and further intuition

The main result of the paper is that introducing a bankruptcy legislation that is very generous towards the defaulting borrowers has negative effects on welfare because the effect of worse credit conditions dominates the improved insurance against bad shocks. Even if our very conservative strategy would suggest that our results are robust, we replicate the baseline version of the model and the policy experiment changing some of the ingredients. Throughout these robustness checks we keep $\tau = 0.2$, but we recalibrate the discount factor to match the financial wealth to income ratio.

Changing the earnings process The first ingredient we change is the earnings process. Since income is the only source of risk we want to make sure that our results do not depend on the specific formulation of the earnings process we assume. With respect to earnings process we two main experiments. The first to use the estimated earnings process under the RIP assumption [see Guvenen 2009, Storesletten et al. 2004]. This is done mainly for comparison with the previous literature on bankruptcy in quantitative equilibrium models which mostly uses this kind of process. The second is to adopt a common deterministic function of earnings that depend on education as well as on age. That is we assume the form $g\left(h, E^i\right)$. We do it in two ways which differ for the assumption on what we mean by high and low education in the Italian data: in one case we assume that high education agents are those with a

Table 4.4-4: Welfare effects for different permanent income levels and growth rates

	base	$\gamma = 0.01$	$\gamma = 0.2$	$\gamma = 0.5$
low α low β	0	-0.002	0.000	0.000
low α middle β	0	-0.008	-0.002	0.000
low α high β	0	-0.025	-0.014	-0.004
middle α low β	0	-0.001	0.000	0.001
middle α middle β	0	-0.008	-0.002	0.000
middle α high β	0	-0.025	-0.013	-0.003
high α low β	0	-0.002	-0.001	0.000
high α middle β	0	-0.008	-0.003	0.000
high α high β	0	-0.025	-0.012	-0.003

Table 4.4-5: Welfare effects of a reduction in transaction costs

	base	$\tau = 0.01$
aggregate	0	0.008
low α low β	0	0.002
low α middle β	0	0.008
low α high β	0	0.022
middle α low β	0	0.003
middle α middle β	0	0.008
middle α high β	0	0.022
high α low β	0	0.002
high α middle β	0	0.007
high α high β	0	0.022

bachelor's degree (ba) and in the other agents with high school degree (high). The results of the baseline version of these 3 cases are reported in Table 4.4-6 together with Italian data (data) and the baseline specification (base). As it can be seen from the Table 4.4-6 none of the different assumptions on earning provide significant improvement in the calibration of the baseline model. Using the (rip) assumption gives us a slightly better average debt to income ratio, but a worse financial wealth distribution and a slightly off target fraction of borrowers. The two education experiments (ba) and (high) instead give much worse financial wealth distribution and worse fraction of borrowers and no significant improvement. The next step is to repeat the policy experiment we run before and see what are the effects on some important variables and on welfare of moving to a fresh start system with different

Table 4.4-6: The earnings robustness check (baseline calibrations)

	data	base	RIP	ba	high
Financial wealth to income ratio	3	3	3	3	3
Spread borrowing lending rate	0.06	0.06	0.06	0.06	0.06
Share of population with positive debt	0.11 (0.2)	0.11	0.09	0.07	0.06
Debt/income ratio for those in debt	0.3 (0.8)	0.66	0.37	0.37	0.36
Consumption/Income	0.84	1.11	1.1	1.1	1.1
Gini of financial wealth	0.77	0.78	0.69	0.59	0.58

level of wage garnishment. The results are reported in Table 4.4-8. The main message is the same as in the baseline case. Introducing fresh start worsen credit market conditions and by doing so it worsen the welfare of the agents. Even if the magnitudes are slightly different the behavior of all the main variables considered is remarkably similar across all specifications of the earnings process.

Changing the risk aversion coefficient The other main robustness check that we run is to see whether the assumption we made about the preferences parameter, risk aversion, is in any way driving the results. Risk aversion is a very important parameter, as it affects the magnitude of the gain from better insurance that the household will get if we change to a fresh start system. However since we have assumed standard separable utility and CRRA preferences by changing risk aversion we are also changing the interetemporal elasticity of substitution which affects the costs in term of less consumption smoothing across time derived from worsening credit conditions. It is therefore not clear which way a change of risk aversion will affects our results[24]. The baseline results for $\sigma \in \{1.01, 2, 3, 4\}$, where $\sigma = 2$ is the BASE

Table 4.4-7: The robustness checks with respect to σ (baseline calibrations)

	DATA	$\sigma = 1$	BASE	$\sigma = 3$	$\sigma = 4$
Financial wealth to income ratio	3	3	3	3	3
Spread borrowing lending rate	0.06	0.06	0.06	0.06	0.06
Share of population with positive debt	0.11 (0.2)	0.06	0.11	0.12	0.12
Debt/income ratio for those in debt	0.3 (0.8)	0.22	0.66	1.03	1.17
Consumption/Income	0.84	1.1	1.11	1.11	1.11
Gini of financial wealth	0.77	0.69	0.78	0.87	0.87

column, are reported in Table 4.4-7. We can see that high values of risk aversion produce a much higher debt to income ratio and a much more unequal distribution of financial wealth. The explanation for the first result is that what is really playing a major role here is not risk aversion but the intertemporal elasticity of substitution. Higher risk aversion means low intertemporal elasticity of substitution. This implies that agents want a really flat profile of consumption and therefore incur in the higher debt to smooth the rising profile of income. The calibration of the model is much better with lower values of σ, thus supporting our baseline choice of $\sigma = 2$. With $\sigma = 1.01$, the debt to income ratio is lower than the baseline value (thus closer to the Italian data) and there are less borrowers (too few as compared with the data). This confirms that what is really playing a role is the intertemporal elasticity of substitution. Indirectly this confirms our intuition that of the two margins that are involved in the trade-off related to bankruptcy law the most prominent one is the smoothing over time relate to credit market conditions, and this explains the results we get in the paper. If our intuition is correct the results of the policy experiment should point out that welfare is much less affected when elasticity of substitution is high (σ is low), because in this case the weight

[24] We are currently working on extending the model to allow Epstein-Zin type of preferences that allow to disentangle risk aversion and elasticity of substitution and include standard CRRA preferences as a special case. This will allow to analyze separately the role of risk aversion and of intertemporal elasticity of substitution.

Table 4.4-8: Policy experiment with different earnings processes

The policy experiment under RIP process

	RIP	$\gamma = 0.01$	$\gamma = 0.2$	$\gamma = 0.5$
Financial wealth to income ratio	3.00	3.24	3.12	3.06
Spread borrowing lending rate	0.06	0.16	0.07	0.06
Share of population with positive debt	0.09	0.0004	0.06	0.08
Debt/income ratio for those in debt	0.37	0.03	0.12	0.16
Consumption/Income	1.10	1.10	1.11	1.11
Gini of financial wealth	0.69	0.61	0.64	0.66
Welfare	0	-0.009	-0.003	-0.001

The policy experiment with earnings dependent on education (BA)

	BA	$\gamma = 0.01$	$\gamma = 0.2$	$\gamma = 0.5$
Financial wealth to income ratio	3	3.27	3.15	3.03
Spread borrowing lending rate	0.059	0.15	0.07	0.06
Share of population with positive debt	0.07	0.0007	0.04	0.07
Debt/income ratio for those in debt	0.37	0.00	0.12	0.21
Consumption/Income	1.1	1.12	1.11	1.11
Gini of financial wealth	0.59	0.61	0.55	0.57
Welfare	0	-0.006	-0.002	0.000

The policy experiment with earnings dependen on education (HIGH)

	HIGH	$\gamma = 0.01$	$\gamma = 0.2$	$\gamma = 0.5$
Financial wealth to income ratio	3	3.27	3.15	3.03
Spread borrowing lending rate	0.059	0.15	0.06	0.06
Share of population with positive debt	0.06	0.0004	0.04	0.06
Debt/income ratio for those in debt	0.36	0.00	0.11	0.20
Consumption/Income	1.1	1.12	1.11	1.11
Gini of financial wealth	0.58	0.52	0.54	0.56
Welfare	0.000	-0.006	-0.002	0.000

given by individuals to the worsening of credit conditions is much lower. When we look at the results of the policy experiment in Table 4.4-9, we see that our intuition is confirmed. Welfare falls much more for high risk aversion/low elasticity of substitution (high σ) agents. It is also interesting to see that for very high elasticity of substitution ($\sigma = 1$) among the fresh start scenarios, the best policy is not the harshest ($\gamma = 0.5$) but the intermediate one ($\gamma = 0.2$) which is basically equivalent to the status quo. The qualitative pattern of all the variables is unchanged.

Table 4.4-9: Policy experiment with different levels of σ

The policy experiment with $\sigma = 1$

	$\sigma = 1$	$\gamma = 0.01$	$\gamma = 0.2$	$\gamma = 0.5$
Financial wealth to income ratio	3.00	3.09	3.00	3.01
Spread borrowing lending rate	0.06	0.15	0.08	0.06
Share of population with positive debt	0.06	0.0010	0.05	0.06
Debt/income ratio for those in debt	0.22	0.00	0.11	0.13
Consumption/Income	1.1	1.11	1.11	1.11
Gini of financial wealth	0.69	0.65	0.67	0.68
Welfare	0.000	-0.001	0.000	-0.001

The policy experiment with $\sigma = 3$

	$\sigma = 3$	$\gamma = 0.01$	$\gamma = 0.2$	$\gamma = 0.5$
Financial wealth to income ratio	3	3.60	3.48	3.33
Spread borrowing lending rate	0.06	0.16	0.07	0.06
Share of population with positive debt	0.12	0.0030	0.06	0.11
Debt/income ratio for those in debt	1.03	0.00	0.11	0.23
Consumption/Income	1.11	1.13	1.13	1.12
Gini of financial wealth	0.87	0.62	0.64	0.68
Welfare	0.000	-0.019	-0.010	-0.003

The policy experiment with $\sigma = 4$

	$\sigma = 4$	$\gamma = 0.01$	$\gamma = 0.2$	$\gamma = 0.5$
Financial wealth to income ratio	3	3.72	3.60	3.42
Spread borrowing lending rate	0.06	0.16	0.06	0.06
Share of population with positive debt	0.12	0.0050	0.05	0.11
Debt/income ratio for those in debt	1.17	0.01	0.11	0.25
Consumption/Income	1.11	1.13	1.13	1.12
Gini of financial wealth	0.87	0.61	0.63	0.67
Welfare	0.000	-0.029	-0.015	-0.003

4.5 Conclusions

In this paper we analyze the effects of introducing fresh start in bankruptcy on the saving decisions and welfare of Italian households. Our main result is that introducing more generous bankruptcy procedures will have strong negative effects on the cost of borrowing (borrowing rates would increase) and will not provide much gains in terms of improved insurance. Therefore if we focus on the trade off between better insurance against worse credit conditions, to introduce a new bankruptcy law that features immediate debt discharge is not a good policy. This result is robust to alternative specifications of the risk the agents are subject to and to alternative values of the main preference parameters. From the model the picture that emerges is that, differently from the U.S., there is not much need of an insurance role for bankruptcy legislation, maybe because the insurance role is already played by other institutions, like a more generous welfare state or social security.

But there are several other features of bankruptcy law that this model does not address. First, one of the main costs of the actual Italian system could be related to the disincentive to work that the wage garnishment implies. Extending the model to allow for a leisure-labor choice might shed further light on this role of bankruptcy regulation and change our conclusion about the introduction of fresh start. Second, as shown by some works about the US, [Fan / White 2003, Berkowitz / White 2004, Akyol / Athreya 2007, Meh / Terajima 2008, Mankart / Rodano 2008, 2009] personal bankruptcy is very important for the credit conditions and the investment decisions of small firms that finance themselves with unsecured credit. Third, there is a series of coordination issues among multiple lenders that might induce them to garnish excessively the debtor wages. We abstract from all these aspects in this work. Therefore our strong negative answer regarding the introduction of fresh start must be interpreted in relation to the specific trade-off we are addressing: there is still further research to be conducted in order to address some of these issues.

Our results show that there is an important role for borrowing constraints. In this respect it is not completely satisfying that the model does not generate endogenously a spread between a borrowing and a lending rate as a reaction to the the bankruptcy decisions. There is a small margin produced endogenously by the model but the effects are not enough to generate all the spread unless we assume some exogenous transactions costs. Given the importance of the banking side for the issue we are addressing, further investigation of the way banks deal with consumer credit could shed some further light on the phenomenon we are studying.

The results from the robustness checks on the role of risk aversion/elasticity of substitution suggests that the most important parameter in affecting the magnitude of our results is the intertemporal elasticity of substitution rather than the risk aversion. To further strengthen this claim and to disentangle the role of risk aversion from that of the intertemporal elasticity of substitution we are currently extending the model to incorporate the Epstein-Zin kind of preferences that allow to separate these two parameters.

Chapter 5

The Causal Effect of Bankruptcy Law on the Cost of Finance

5.1 Introduction

Bankruptcy law deals with firm distress by means of two procedures: firm reorganization and firm liquidation. While both procedures attempt to mitigate creditors' conflicting positions, reorganization procedures also need to balance these considerations against the need to preserve firm's incentives to repay outstanding liabilities.[1] Moreover, since financial contracts take into account how bankruptcy law deals with conflicts among the stakeholders of a firm, both procedures are likely to affect a firm's cost of finance. In most OECD countries reforms of the bankruptcy code generally modify both procedures at the same time, thus complicating the empirical assessment of the distinct impact of each procedure on firms' cost of finance.[2]

In this paper we exploit the staggered nature of the Italian corporate bankruptcy reform of 2005-2006, which was imposed through two laws. The first law *de facto* introduced a reorganization procedure for firms in distress.[3] The second law significantly accelerated firm liquidation procedures. We investigate the impacts of this reform using a unique loan-level dataset covering the universe of bank funding contracts to firms. This allows us to disentangle how the changes to reorganization and liquidation procedures affect the costs of funding borne by small- and medium-sized manufacturing firms.

We present two major findings. Our first result is that the introduction of a reorganization

[1] We thank Steve Bond for invaluable discussions. This paper also benefited from comments by Laurent Bach, Magda Bianco, Nick Bloom, Graziella Capello, Raj Chetty, Mike Devereux, Roberto Felici, Nicola Gennaioli, Augustin Landier, Fabiano Schivardi, Enrico Sette, Lorenzo Stanghellini, Giorgio Topa, Elu von Thadden, Greg Udell, Fabian Waldinger, Pierre-Olivier Weill, Michelle White.

[2] The most recent examples include Spain, France, and Brazil. The Spanish reform of 2004 merged the two bankruptcy procedures into one; in 2005, Brazil and France each amended both procedures simultaneously.

[3] As we will discuss in section 5.2, pre-reform reorganization procedures formally existed but were hardly used because of the numerous constraints imposed on their content and their legal contestability.

procedure increased the interest rates on loan-financing for firms by up to 0.2 percentage points, or 20 basis points. In principle, the introduction of a reorganization procedure gives rise to two opposite effects. The first is to lower interest payments because of efficiency gains from improved creditor coordination. In the absence of a clear legal procedure, if each creditor negotiates with the firm about the enforcement of respective claims, strategic holdout by other debt-holders may penalize those that reach a deal. As a result, the firm may inefficiently shut down. At the same time, reorganization may exacerbate the debtor's incentives to behave in an opportunistic way, and thus increase the ex-ante cost of financing. If the firm has greater value as a going concern than in liquidation, banks are tempted to agree on continuation. Reorganization thus weakens banks' commitment to punishment, and lowers entrepreneurs' incentives to behave [Hart / Moore 1998, Fudenberg / Tirole 1990]. Our results therefore show that worse repayment incentives outweigh efficiency gains from improved creditor coordination.

Our second result is that the reform of the liquidation procedure has produced a substantial decrease in the cost of finance. The legislation was intended to make the distribution of liquidation proceeds happen more quickly, and in a more orderly fashion. This led to creditor expectation that bankruptcy recovery rates would improve. Importantly, we also show that the reduction of the cost of finance caused by the liquidation reform has also lessened firms' credit constraints.[4]

We interpret our results as causal because our identification strategy exploits the exogenous change in Italian bankruptcy law and combines it with a feature of Italian bank lending that allows us to implement a differences-in-differences (henceforth DID) methodology. The original Italian bankruptcy code dated back to 1942; the legal change was triggered by one of Europe's biggest corporate governance scandals, which ended with the bankruptcy of the Italian Parmalat corporation at the end of 2003. To avoid violation of European regulations, the Italian government had to act quickly to reform Italian bankruptcy law. Our DID framework also takes advantage of an important feature of Italian bank lending: banks observe the same measure of firm default probability, the Z-score. Therefore, we compare interest rates for firms that are perceived to be at no risk of default with the interest rates of firms for which banks perceive a non-zero probability of default.

To support the interpretation of our results we extend our analysis in several ways. First we analyze how the impact of the procedures varies with the number and concentration of firm-bank relationships. We show that firms with a large number of bank relationships, or a low degree of loan concentration, where gains from creditor coordination are higher, experience a lower increase in interest rates after reorganization is introduced. Secondly, we use CEO forecasts on sales, prices, and production capacity to show that there is no contemporaneous change on the demand side that could rationalize our results. Finally, we address the concern that our results are driven by credit cycles by controlling for the difference between yields on triple A-rated US corporate bonds and Baa-rated bonds.

[4] Defined as firms demanding more credit but being rejected by banks.

Italy offers a particularly advantageous environment to test the issues at stake for several reasons. Banking finance is the major source of finance for small- and medium-sized enterprises in Italy, accounting for around 80% of funding sources.[5] In addition, banks' loan contracts are mostly short-term, which implies that the procedures affecting the scope for renegotiation of the terms of funding contracts are compelling for banks' loan pricing decisions. Finally, multi-bank borrowing is a pervasive aspect of firm financing in Italy, with a median of five banks per firm.

A large body of the literature on corporate bankruptcy has studied the ex-post consequences of bankruptcy-law design, in terms of the direct costs they generate and the associated continuation and liquidation rates (e.g., Weiss [1990]; Franks / Torous [1994]; Stromberg [2000]; Bris et al. [2006]).[6] Lately, a number of contributions have also investigated the indirect costs of bankruptcy, by looking at its impact on corporate financial and real decisions under a cross-country perspective, e.g., Acharya et al. [2010], Qian / Strahan [2007], Djankov et al. [2008], Acharya / Subramanian [2009],Bae / Goyal [2009]. More specifically, Djankov et al. [2008] analyze the debt-enforcement process in 88 countries and find that it is an important predictor of the level of per-capita income and debt-market development. Bae / Goyal [2009] exploit the differences in creditors' legal protection across 48 countries to show that banks respond to poor debt enforcement by reducing loan amounts, shortening loan maturities, and increasing loan spreads. Davydenko / Franks [2008] use a sample of small- and medium-sized enterprises that defaulted on bank debt in France, Germany, and the UK to show that banks adjust lending and reorganization procedures so as to mitigate costly aspects of bankruptcy codes. By means of a cross-country panel of large firms, Qian / Strahan [2007] finds that higher creditor protection is associated with lower interest rates, longer-term lending, and more concentrated loan ownership.

A second strand of the literature has documented the impact of bankruptcy on firms' credit conditions by employing a within-country perspective. For example, Benmelech / Bergman [2011] shows that waves of bankruptcies in a given industry have an adverse impact on the cost of debt borne by firms in the same industry. Franks / Sussman [2005] shows that in England banks commit to a severe stance towards debt renegotiations, and argue that this is done to avoid firms' strategic default. Interestingly, they also find little evidence of creditors' mis-coordination. Vig [2008] analyses the impact of the 2002 Indian bankruptcy reform on the volume of secured credit, and finds that strengthening creditor rights reduces the demand for secured credit, because borrowers anticipate a greater liquidation bias in bankruptcy.

Our study is directly related to the articles that analyze the effect of bankruptcy reforms on the cost of funding, e.g. Scott / Smith [1986], Berkowitz / White [2004], Araujo et al. [2011]. Using cross-sectional data, Scott / Smith [1986] finds that the 1978 U.S. corporate bankruptcy law reform has raised the cost of funding by introducing several novelties, such as

[5] See *Bank of Italy Annual Report*, 2009.
[6] Direct bankruptcy costs comprise all the expenses necessary to carry out the process of reorganization and liquidation. Indirect costs are those generated by the corporate response at the prospect of a given legal procedure. See Senbet / Seward [1995] for a survey of the indirect and direct costs of bankruptcy.

expanding the list of personal property exemptions, and allowing the entrepreneur to invoke the automatic stay of creditors' claims. We improve on Scott / Smith [1986] because the timeline of the Italian bankruptcy law reform allows us to disentangle the impacts of both the new reorganization procedure and the new liquidation procedure on the cost of debt financing. Araujo et al. [2011] use the recent Brazilian bankruptcy reform as a natural experiment and compare the average cost of debt financing for Brazilian firms with that of firms in other South American countries. They show that the simultaneous reform of liquidation and reorganization procedures has significantly decreased the average cost of funding borne by publicly traded firms. Our results suggest however that distinct changes in each procedure can have opposite effects on a firms' cost of finance. Finally, Berkowitz / White [2004] documents that the provision of larger exemptions in personal bankruptcy has worsened the conditions applied to business loans.[7] Although their results share similarities with ours, the theoretical underpinnings are somewhat different. Indeed, the outcomes in Berkowitz / White [2004] hinge on the response made by creditors to a reduction of borrowers' degree of liability. In our study, the new reorganization procedure generates a theoretical trade-off that could have resulted in improved firms' credit conditions. We show that the introduction of reorganization procedures that reinforce entrepreneurs' rights to restructure a firm in difficulty triggers a significant increase of the cost of finance to small- and medium-sized firms.

The rest of the paper is organized as follows. Section 5.2 describes Italian bankruptcy law and the legal changes that occurred in 2005 and 2006. Section 5.3 describes the data set and the variables used in the analysis, and provides descriptives statistics. Section 5.4 presents the underlying theoretical framework to be tested and discusses our identification strategy. Section 5.5 presents the empirical results. Section 5.6 addresses threats to the causal interpretation of the results. Section 5.7 concludes.

5.2 The Italian Bankruptcy Law Reform

5.2.1 The Pre-Reform Regime

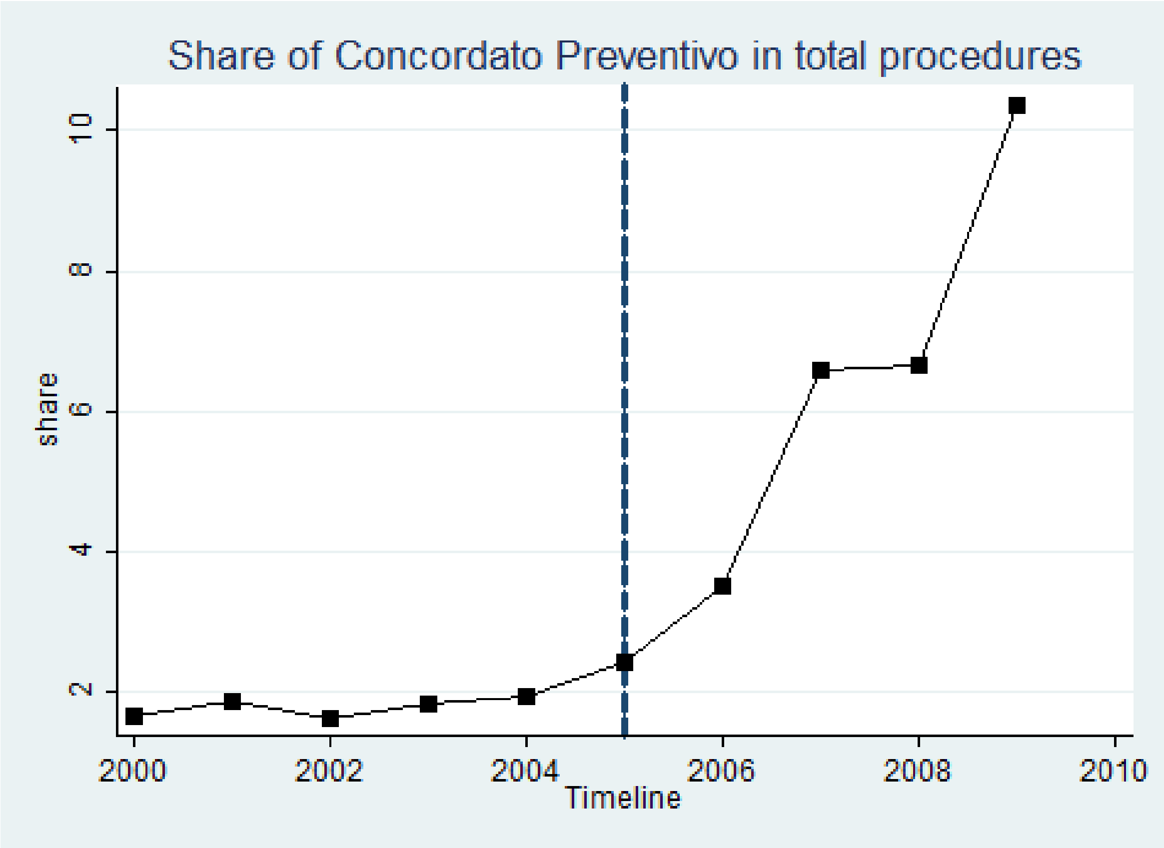
Under the 1942 Italian bankruptcy act, the insolvent entrepreneur could try and settle with creditors by opening an in-court procedure of reorganization (*concordato preventivo*).[8] However, the pre-reform reorganization procedure was extremely difficult to implement for a number of reasons. First, an entrepreneur's settlement plan needed to feature the full repayment of secured creditors and at least 40% of unsecured creditors' claims. In this way, the law constrained parties' freedom to negotiate, potentially inhibiting the implementation of viable agreements. Moreover, before opening negotiations the court had to assess whether

[7] Analogously, Gropp et al. [1997] studies the impact of exemptions in personal bankruptcy on non-business loans, and also finds that the cost of financing increased.
[8] The synopsis in this section is based on Stanghellini [2008], chapter 9.

the distressed entrepreneur "deserved" the chance to reorganize, on the grounds that he had been unlucky but was fundamentally honest. Again, even profitable proposals could be rejected for arguments not grounded on efficiency reasons. Finally, in the pre-reform regime the entrepreneur was not protected by the automatic stay of creditors (a provision that protects the entrepreneur during the reorganization process by introducing a standstill on creditor's right to ask for the reimbursement of their claims).

Figure 5.1 uses data from Italian chambers of commerce to plot the share of opened in-court procedures of reorganization in total bankruptcy procedures across time. In the early 2000s, only 1% of the total new bankruptcy procedures were reorganizations, *concordato preventivo*, highlighting its inefficiency as an instrument of negotiation with banks in the pre-reform regime.

Figure 5.1: Share of Renegotiation Procedures in Total Distress Procedures Over Time



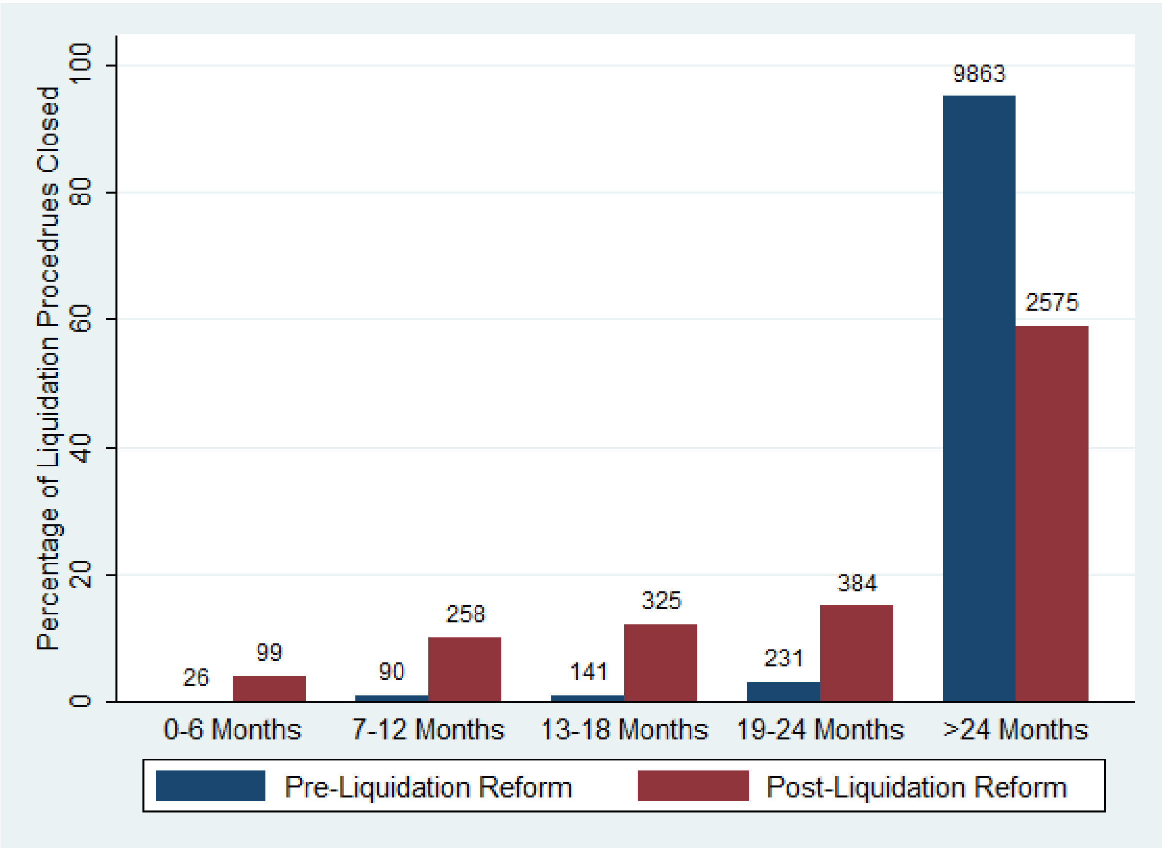
Note: Plot of the ratio between the number of opened procedures of Concordato Preventivo over the total number of opened procedures. Source: Chamber of Commerce.

Entrepreneurs in difficulty could renegotiate with creditors out-of-court (*accordo stragiudiziale*). However, a deal reached out-of court between the parties could subsequently be nullified by the trustee during bankruptcy proceedings, thereby undermining the certainty of negotiations' effects [Costantini 2009].

Thus the main instrument for dealing with firms in distress at this time was the liquidation procedure. Under the pre-reform liquidation procedure, proceeds were distributed to creditors by a court-appointed trustee, and creditors could neither control nor veto the decisions taken by the trustee, who decided with full autonomy. The combined effect of a judicially directed liquidation procedure, coupled with insufficient creditor power to control the trustee, made the pre-reform liquidation procedure a poor instrument to protect creditor interests and preserve the value of the bankrupt enterprise.

As a consequence, liquidation procedures were very lengthy. Figure 5.2 uses data from Unicredit SpA, one of Italy's largest retail banks, to plot the distribution of liquidation procedures according to their duration. The blue bars indicate the distribution of liquidation procedures in the pre-reform regime. Figure 5.2 shows that approximately 95% of the liquidation procedures before 2005 lasted for more than 24 months.[9]

Figure 5.2: Duration of Liquidation Procedures Before and After Law 5 Reform



Note: Plot of the percentage of liquidation procedures closed within X months before and after Law 5 reform. Totals reported on top of bars. Source: Unicredit.

Overall, the 1942 bankruptcy act was not able to resolve the problems of distressed firms. The chance to reform such an obsolete system came in the aftermath of the Parmalat crash. Parmalat SpA was a multinational Italian dairy and food corporation. The company collapsed in late 2003 with a EU14 billion ($20bn; £13bn) hole in its accounts, in what remains one of Europe's biggest corporate bankruptcies. The pre-reform Italian bankruptcy law also

[9] In an interview given to an Italian press agency (ANSA) in 2005, Giuseppe Zadra, general director of the Italian Banks Association, stated that the lengthiness of the Italian liquidation procedures generated high costs for banks, inevitably leading to higher interest rates for firms.

included an ad hoc procedure to rescue big, distressed enterprises without compromising their long-term viability. However, Italy had already been condemned twice by the E.C. Court of Justice because these types of procedures were deemed to constitute a form of illegal state aid. Therefore, the government needed to intervene so as to avoid an infringement of the European regulations and at the same time restructure Parmalat. To accomplish both objectives, reform of the Italian law governing reorganization was required.

5.2.2 The Reform of Reorganization Procedures – Decree 35

In February 2004, the Trevisanato parliamentary committee was set up to restructure the procedures to reorganize distressed firms. At the end of December 2004, the committee proposed the scheme that dictated the terms of the final draft of Decree 35 (in other words, the content of Decree 35 was known to banks and firms by the end of December 2004). It is important to underline that Decree 35 reformed only the in-court and out-of-court reorganization procedures, and did not involve or discuss any reform of the liquidation procedure.[10]

Decree 35 empowered the legal instruments that parties could use to resolve insolvency by renegotiating outstanding financial contracts either in-court or out-of-court. More specifically, Decree 35 introduced two crucial reforms: first, it strengthened the judicial validity of out-of-court agreements by limiting the impact of claw-back provisions. In the pre-reform regime, these had constituted the main impediment to the effectiveness of out-of-court restructuring. Second, it greatly reformed the in-court reorganization procedure (*concordato preventivo*). The new law prescribes that the debtor is the sole party entitled to open the procedure and formulate a restructuring plan, while continuing to run the company under the protection of an automatic stay of creditors' claims. The court ratifies the debtor's proposal if the majority of creditors vote for it,[11] or if the judge believes that, even if creditors reject the plan, they will be made no worse off by the proposal than under any alternative.[12]

Figure 5.1 suggests that Decree 35 has had significant impact on the relative use of reorganization procedures. Indeed the share of reorganization procedures has increased from approximately 1% of total procedures before 2005, to over 10% of the total number of procedures opened in 2009.

[10] The reconstruction of the timeline of the Italian reform is based on research conducted using the Lexis-Nexis database, on Italian press articles related to the 2005/2006 bankruptcy reforms. Keywords "legge fallimentare", time span January 2004 - December 2006.

[11] The new law also allows the debtor to discriminate among creditors by class. In this case, for the agreement to be approved, a majority vote is not sufficient, and a more sophisticated system of qualified majorities is devised.

[12] This is similar to what happens in the U.S. under Chapter 11 with judge's *cramdown* decision.

5.2.3 The Reform of Liquidation Procedures – Law 5

In May 2005, the government was mandated to amend the liquidation procedure. The declared objective of this reform should have been to speed up the liquidation procedure. However, although major stakeholders (e.g., the banks association) had lobbied intensively for a change of the liquidation phase, the reform of liquidation procedures finally took place on January 9, 2006, when parliament enacted Law 5.

The new law set in place a system that was able to preserve creditors' interest in the reimbursement of their claims and avoid conflicts among them. Law 5 prescribes that proceeds' distribution must respect the Absolute Priority Rule (APR).[13] To speed up the procedure the law prescribes that creditors can set up a committee, which can be composed of three or five members, and must represent all the classes of creditors equally.[14] Under the new regime, the creditors' committee can ask for the substitution of the trustee, must give its consent to the trustee's actions, and, most importantly, can veto the continuation of the firm's activity if this harms creditors' interests. Finally, the committee can suspend the liquidation phase if it approves a settlement agreement proposed by the same creditors, the trustee, a third party, or the debtor.

Figure 5.2 shows that Law 5 significantly reduced the time taken by liquidation procedures. The red bars indicate the distribution of liquidation procedures after Law 5 was introduced. Whereas approximately 95% of the liquidation procedures before 2005 lasted for more than 24 months, the share of such durations decreased below 60%. More than 25% of the procedures were closed within 18 months after the introduction of Law 5, as opposed to 2% pre-reform.[15]

5.3 Data

An empirical investigation of the relationship between bankruptcy law and the cost of finance of firms requires extensive data. This should comprise information not only about loans, but also concerning the financing structure and balance sheet characteristics of firms. In addition, given the high incidence of multi-bank lending in Italy[Detragiache et al. 2000], it is desirable to identify all the contracts in which the firm has engaged.

[13] The APR determines the order of reimbursement of creditor claims in bankruptcy. It states that creditors who have secured their loans have seniority over other creditors and, therefore, have the right to be paid back first.

[14] Members are formally appointed by the bankruptcy judge, but following creditors' indications.

[15] We provide a discussion comparing the Italian bankruptcy following its reform, with the US bankruptcy law.

5.3.1 Data sources

We obtained information on interest rates charged to firms from the *Taxia* dataset. This dataset is a subset of the Central Credit Register (*Centrale dei Rischi*), and we mainly used it to compute aggregate financial characteristics of firms. Finally, balance sheet data on the universe of Italian companies came from the *Cerved* database.

The Central Credit Register In order to comply with Italian banking regulation, all financial intermediaries operating in Italy (banks, special purpose vehicles, other financial intermediaries providing credit) have to report financial information, on a monthly basis, for each borrower whose aggregate exposure exceeds 75,000 Euros. For each borrower-bank relation we thus have information on financing levels, granted and utilized, for three broad categories of financing: term loans, revolving credit lines, and loans backed by account receivables. The information on term loans is further broken down by other financial characteristics, such as maturity, presence of real and/or personal guarantees, and status of the loan (restructured or not). Note that the information in the Central Credit Register is collected, maintained, and thoroughly scrutinized by the Italian Central Bank, the Bank of Italy, and is an essential component of its banking sector supervision activity.[16] The Central Credit Register also includes unique firm and bank identifiers that enable us to match this dataset with interest rates and balance sheet data.

Taxia The information in Taxia is collected by the Bank of Italy as part of its supervision of the banking sector, in addition to the Central Credit Register. It covers a subgroup of banks which accounts for more than 80 percent of total bank lending in Italy. This dataset provides us, on a quarterly basis, with detailed information on the interest rates that banks charge to individual borrowers on newly issued term loans and outstanding credit lines. In addition, the dataset provides information on the amount and maturity of all newly issued term loans. The data collection process of *Taxia* was introduced in 2004, so we have reliable loan-level information starting from the second quarter of 2004.

Cerved database Balance sheets as well as profit and loss accounts of firms come from the Cerved database, collected by the private company Cerved Group. This data covers the universe of Italian corporations (about 800,000 firms) and is used, amongst others things, for the purpose of credit risk evaluation by banks. One of the unique features of this dataset is that it provides extensive coverage of privately owned small- and medium-sized firms. This is particularly important for our purposes, since the bankruptcy law we are interested in applies to this type of firm. From this dataset, we collect yearly balance-sheet information on assets, revenues, value added, and other characteristics such as location, date of constitution, and

[16] This dataset has been used by several papers, including Detragiache et al. [2000], Sapienza [2002], Patti / Gobbi [2007].

industry. In addition, the Cerved data provides an indicator of the default probability of each firm, the *Score* variable, that will play a crucial role in our analysis.

Other Data Sources In addition to these data sources, we use complementary information from the Invind survey. Invind is a yearly survey of a subsample of manufacturing firms, run by Bank of Italy. The survey collects, amongst other data, information about CEO forecasts of sales growth, prices, and other qualitative information, such as production capacity and capacity utilization. The number of firms in each cross section is around 1,500 and the representativeness of the survey is ensured by the stratification of the sample by sector of activity, firm size, and region.

Since only small- and medium-sized firms were affected by the policy change, we omitted data on firms with more than 500 recorded employees.[17] Further details on data organization and data cleaning can be found in Appendix A. The final dataset is of quarterly frequency, and runs from the second quarter of 2004 to the last quarter of 2007, for a total of 203,355 distinct firms and 1,097 banks.

5.3.2 Variables and Descriptive Statistics

Interest Rates The dependent variable of interest is *Loan Interest Rate*, which computes the gross annual interest rate for newly issued term loans, inclusive of participation fees, loan origination fees, monthly service charges, and late fees. This rate is calculated so that the present value of loan installments equals the present value of payments. We also define the following term loan characteristics: *Size of Loan* is the amount of the issued term loan; *Maturity* is a set of binary variables indicating whether the maturity of the newly issued loans is up to one year, between one and five years, or more than five years; *Guarantee* is a set of binary variables indicating whether the loan has no collateral (Unsecured), only real collateral (Real), only personal collateral (Personal), both (Real and Personal), or is unmatched (Other).

We also compute a price measure for revolving credit lines, *Credit Line Interest Rate*, as the average net annual interest rate on the credit line. Unlike loans, credit lines are a relatively more homogeneous financial product, and we consider only two main characteristics: *Use of Credit Lines* is the total amount on the credit lines utilized by the firm during a quarter; *Granted Credit Lines* is the total credit line the firm was granted by the bank for a quarter.

Table 5.3-1 presents descriptive statistics on interest rates for newly issued term loans, and for credit lines between the second quarter of 2004 and the last quarter of 2007.

The interest rate charged for a loan in the sample period is 5.15%. However these rates varied substantially since at the lowest and at the highest quartiles of the distribution, the

[17] Firms above this threshold have access to a different set of procedures.

Table 5.3-1: Nominal Interest Rates on Newly Issued Loans and Credit Lines

Variable	Mean	25th Percentile	Median	75th Percentile	Standard Deviation	Min	Max	N
Newly issued loans: all								
Loan Rates	5.15	4.06	5.00	6.03	1.43	0.10	9.42	361310
Size of Loan	383.64	50.00	120.00	300.00	2078.08	1.00	750168.44	361310
Newly issued loans: rates by maturity								
Short-Term (< 1 Year)	5.24	4.10	5.07	6.25	1.53	0.28	9.42	235460
Medium-Term (1 - 5 Years)	5.08	4.10	4.99	5.93	1.26	0.10	9.42	85234
Long-Term (> 5 Years)	4.74	3.84	4.63	5.49	1.09	0.44	9.40	40616
Newly issued loans: rates by guarantee								
Unsecured	4.79	3.80	4.66	5.59	1.33	0.10	9.42	151693
Real	4.51	3.63	4.34	5.29	1.10	0.31	9.24	6944
Personal	5.49	4.38	5.36	6.44	1.45	0.10	9.42	170979
Real+Personal	4.92	3.94	4.81	5.75	1.22	0.44	9.39	12684
Other	5.35	4.22	5.21	6.31	1.50	0.69	9.42	19010
Credit Lines								
Credit Line Rates	9.03	7.22	8.75	10.84	2.65	2.79	22.81	2864748
Granted Credit Line	123.94	20.00	45.89	100.00	926.97	0.00	470000.00	4207552

Notes: Pooled loan-level data for the period 2004.Q2-2007.Q4. Observations are at the loan-quarter level and monetary values are expressed in KE (1,000 Euros). *Loan Rate* is gross annual interest rate inclusive of participation fees, loan origination fees, monthly service charges, and late fees. *Size of Loan* is the granted amount of the issued term loan. *Maturity* is a set of binary variables indicating whether the maturity of the newly issued loans is up to 1 year, between 1 and 5 years, and more than 5 years. *Guarantee* is a set of binary variables indicating whether the loan had no collateral (Unsecured), only real collateral (Real), only personal collateral (Personal), both (Real+Personal), unmatched (Other). *Credit Line Rate* is the net annual interest rate on the credit line. *Granted Credit Line* is the total credit line the firm was granted by the bank for a quarter.

interest rates were 4.06% and 6.03%, respectively. The average loan in the sample amounted to approximately 383,000 Euros. However, in our data we capture loans as small as 1,000 Euros, and the loan at the median of the distribution amounted to 120,000 Euros. The lower panels of Table 5.3-1 explore heterogeneity in annual interest rates across loan characteristics.

The second panel relates interest rates to the maturity of loans. On the one hand, liabilities with longer maturity may face greater credit risk, but, on the other hand, they are more likely to be granted to creditworthy firms. As in Strahan [1999] and Santos [2011], we find that short-term loans with less than one-year's maturity, which constitute around two-thirds of all loans, have a significantly higher interest rate than medium- or long-term loans.

The third panel relates interest rates to the presence of collateral as measured by the existence of guarantees. All else being equal, collateral should make the loan safer. However, because of a self-selection effect, banks may require collateral from firms that they consider riskier [Berger / Udell 1990], so collateral can be associated with both higher and lower rates. We find that loans guaranteed by real securities have significantly lower interest rates attached to them. However, as can be seen from the sample size, only a minority of firms seem to guarantee loans with real securities. Instead, we find that personal guarantees are much more prevalent as collateral in Italy, and that the interest charged on these loans is significantly higher than the interest charged on loans with real guarantees.

The bottom panel of Table 5.3-1 shows that the average interest rate charged on credit lines is 9.03%, and is significantly higher than the rate for loans. Credit lines are not only associated with higher mean rates, but also to a greater dispersion around the mean, as measured by the higher standard deviation and the higher inter-quartile differences. Finally, firms have on average 123,000 Euros of credit lines granted.

Aggregate Financing Variables We use information from the Credit Register to compute aggregate variables describing the financial structure of firms. *Credit Lines/Tot.Fin* is the firm's total amount of credit lines divided by the total amount of bank financing granted for all loan categories. *Advances/Tot.Fin* is the firm's total amount of loans, backed by account receivables, divided by the total amount of bank financing granted for all loan categories. *Loans/Tot.Fin* is the firm's total amount of term loans, divided by the total amount of bank financing granted for all loan categories. The first panel in Table 5.3-2 describes the financing structure of the firm.

Consistent with previous evidence on Italian firms, we find that loan financing accounts for a substantial share of bank financing. Term loans represent, on average, 37% of total bank financing of the firm, while credit lines represent on average 14% of total bank financing. Even though backed loans account for 49% of total bank financing, they are mostly used for liquidity purposes. Finally, total bank financing represents 57% in terms of book value of assets of the firm.

Table 5.3-2: Financing Structure & Balance Sheet Information

Variable	Mean	25th Percentile	Median	75th Percentile	Standard Deviation	Min	Max	N
Financing Structure								
Term Loans / Total Bank Fin.	0.37	0.19	0.35	0.52	0.22	0.00	1.00	240277
Credit Lines / Total Bank Fin.	0.14	0.05	0.10	0.19	0.13	0.00	1.00	240277
Backed Loans / Total Bank Fin.	0.49	0.33	0.50	0.66	0.22	0.00	1.00	240277
Total Bank Fin. / Assets	0.57	0.41	0.58	0.74	0.22	0.10	1.00	163997
Balance Sheet Information								
Age of Firm	15.54	6.00	13.00	22.00	12.57	1.00	147.00	420083
Score	5.06	4.00	5.00	7.00	2.01	1.00	9.00	351428
Leverage	0.74	0.64	0.78	0.88	0.18	0.00	1.00	221788
Total Sales	5531.36	660.00	1596.00	4306.00	28095.94	0.00	6398586.00	351460

Notes: Pooled data for the period 2004-2007. Observations are at the firm-year level and monetary values are expressed in KE (1,000 Euros). *Loans/Tot. Bank Fin.* is the firms' total amount of term loans granted divided by the total amount of bank financing granted for all categories (Loans, Credit Lines, Backed Loans). *Credit Lines/Tot. Bank Fin.* is the firms' total amount of credit lines granted divided by the total amount of bank financing granted for all categories (Loans, Credit Lines, Backed Loans). *Backed Loans/Tot. Bank Fin.* is the firms' total amount of loans granted backed by account receivables and divided by the total amount of bank financing granted for all categories (Loans, Credit Lines, Backed Loans). *Total Bank Fin. / Assets* is the firms' total amount of bank financing granted (Loans, Credit Lines, Backed Loans) divided by total assets. *Age of Firm* is defined as the difference between current year and the year of incorporation of the firm. *Total Sales* is firm revenues. *Score* is an indicator of the risk profile of each firm computed as in Altman (1968). *Leverage* is defined as the ratio of debt (both short- and long-term) over total assets as taken from balance sheet data.

Balance Sheet Variables On the basis of balance sheets we compute several characteristics of firms. Note that in our empirical framework these variables are lagged one year with respect to financial variables. We define *Age of Firm* as the difference between current year and year of incorporation of the firm. *Value Added* and *Total Assets* are defined on the basis of the Balance Sheet accounts. *Total Sales* are firm revenues, as taken from the profit and loss accounts. *Group Ownership* is a binary variable equal to one if the firm belongs to a group. *Score* is an indicator of the default probability of each firm that takes a value from one (the safest) to nine (the most risky) and is computed using balance sheet indicators (assets, rate of return, debts, etc.) according to the methodology described in Altman (1968) and Altman, Marco and Varetto (1994). Cerved Group classifies firms into four categories on the basis of the *Score* variable: (i) "safe" (*Score* =1,2), (ii) "solvent" (*Score* =3,4), (iii) "vulnerable" (*Score* =5,6), and (iv) "risky" (*Score* =7,8,9). *Leverage* is defined as the ratio of debt (both short- and long-term) over total assets, as taken from balance sheet data.

The bottom panel in Table 5.3-2 provides an overview of the main balance sheet characteristics of Italian manufacturing firms in terms of unique firm-year observations. As the variation in firm age suggests, the sample includes not only newly created firms, but also relatively old firms. Similarly, sales vary between 0.66 ME at the bottom quartile of the distribution to over 4.3 ME at the top quartile of the distribution. Finally, note that default risk, as proxied by Score, varies considerably. At the lowest quartile, firms are solvent, but at the median, firms are already classified as vulnerable by banks.

5.4 Theoretical and Empirical Framework

A naive comparison of financing conditions of firms before and after the legal changes could be misleading, because such differences might also reflect unobserved economic conditions. We therefore examine the impact of the reforms on the financing conditions of firms by employing a differences-in-differences methodology. We introduce a simple theoretical framework to motivate our empirical strategy and to explain the choice of the control group. Moreover, this framework helps to illustrate the theoretical predictions that we bring to the data in our empirical analysis.

5.4.1 Testable Predictions

Assume the economy is populated by risk-neutral banks and firms. As is standard in the corporate finance literature we assume that banks operate in perfectly competitive financial markets and firms have all the bargaining power. Each firm is identified by its investment project, which can be either *safe* or *risky*.[18] Firms need banking capital to finance their

[18] To simplify matters, in our framework the project type is not chosen by firms but is assigned by nature.

projects. All investment projects last two periods, with the difference that the *safe* ones always succeed whereas the *risky* ones might fail, with some probability at the end of the first period. In the case of first period failure, the continuation of the *risky* projects depends on the bankruptcy code: either the project is automatically liquidated following failure, or the law may allow the entrepreneur to open a reorganization procedure. Again, this applies only to *risky* firms, because the *safe* ones never fail.

As we document below, banks in our sample can identify those companies that carry out projects with almost no probability of default (*safe*), and those with projects that are likely to fail (*risky* types). This naturally maps into our DID framework, as the latter assesses how the introduction of each new bill has had an impact on the spread between two groups of firms: one group that comprises all firms logically unaffected by bankruptcy codes because never at risk of failure (*control* group), and one group of firms whose cost of finance depends on bankruptcy law because their business project is at risk of failure (*treatment* group).

Decree 35—Reorganization Procedures The reform of the reorganization procedure has reinforced an entrepreneurs' right to open a restructuring phase either in-court or out-of-court while staying in control of the firm. To understand the impact of this reform on spreads, we distinguish between two scenarios for the contracting environment.

In the first scenario we consider, agents in the economy negotiate in the absence of agency costs. Following this presumption, a strand of the literature on bankruptcy has shown that the existence of a structured procedure of reorganization in bankruptcy can spur investment by distressed firms. This is because, in the absence of a clear renegotiation procedure, the conflicts between creditors would be exacerbated [Gertner / Scharfstein 1991]. This is demonstrated by the following example: if the continuation value of a risky project is positive following first period failure, the efficient decision from the banks' point of view features the negotiation of a haircut on respective claims. This enables the entrepreneur to bring the project to completion and avoid inefficient liquidation. However, in the absence of a structured procedure of negotiation a problem of strategic holdout may arise. If a single bank negotiates a haircut to let the firm continue, all the others have an incentive to free-ride and preserve the value of their claims. Therefore, under this scenario the introduction of a renewed reorganization phase should have reduced the interest rate difference between *safe* and *risky* firms.

In the second scenario, the contracting environment is characterized by a problem of repeated agency costs. This agency problem reduces the value of the risky projects' pledgeable income to the bank.[19] Indeed, the literature has shown that in the presence of asymmetric information renegotiation impairs the contract's ability to cope with agency problems (e.g., Hart / Moore

[19] For instance, this may be consistent with a model in which the entrepreneur needs to put effort into a risky project (and this decision is unobservable and unverifiable), otherwise the success probability of the project is lower and the entrepreneur gains private benefits. Note that by pledgeable income we mean the surplus delivered by a project net of the cost related to the investment allotment and private benefits [Tirole 2006].

[1998]; Tirole [2006]; Fudenberg / Tirole [1990]). To clarify this point, consider a risky project that fails at the end of the first period because the entrepreneur has behaved opportunistically. In these circumstances, the optimal contract would require the project's termination. However, if the project's continuation value is positive, there are rents to be shared via renegotiation. The presence of a reorganization procedure offers a natural environment in which parties can find an agreement to let the venture continue. Now, consider the consequences of this outcome on the first-period contracting stage: the entrepreneur knows that behaving opportunistically does not harm his chances to complete the project, therefore he requires a larger agency rent to implement the project, and this reduces the bank's pledgeable income.

Prediction 1 *The introduction of a reorganization procedure can either increase or reduce the interest rates' difference between firms into the* risky *and into the* safe *groups. This depends on whether the gains from creditor coordination offset the costs caused by the agency problem.*

The structured reorganization phase means reduced creditors' conflicts. Since these remain despite the agency problem, the next corollary follows.

Corollary 1 *The higher the number of a firm's bank relations, and the lower a firm's loan concentration, the greater should be the decrease in interest-rates differences due to gains from creditor coordination.*

Law 5—Liquidation Procedure Law 5 has considerably improved creditors' ability to take coordinated decisions and control the phase of liquidation. At the same time, the law prescribes that the failed entrepreneur is dismissed from the venture. Independent of the presence of asymmetric information, we expect that these changes will result in larger recovery rates for the banks and reduced interest rate spreads between *safe* and *risky* firms.

Prediction 2 *The reform of the liquidation procedures should have reduced the interest rates' difference between* risky *and* safe *firms.*

As for Decree 35, the reduction in interest-rate differences should be stronger if there are greater potential coordination gains.

5.4.2 Empirical Framework and Predictions

Our dependent variable of interest is the firm's cost of finance which we measure through the interest rate charged on newly issued loans. This is the main source of investment financing for firms in Italy. Unlike measures of the average cost of finance, the interest rate on newly issued loans should directly capture the impact of the legal changes.

Differences-In-Differences In our theoretical framework, we argued that the cost of finance for firms with a zero probability of distress was not affected by the bankruptcy code. Hence, changes in the financing conditions of these firms should only reflect changes in the bankruptcy-free cost of finance, and allow the econometrician to account for unobserved changes in market fundamentals. This suggests that assignment to treatment and control groups in the DID setting should be based on a measure of the perception of the firm's default risk **at** the time a funding contract is negotiated.

The identification strategy takes advantage of a feature of Italian bank lending: Italian banks observe a common Z-score (henceforth Score) to measure the default probabilities of firms. Our idea is to compare interest rates for firms that, on the basis of Score, are considered at no risk of default with those for which banks perceive a non-zero probability of default. Since Score will play the crucial role of assignment variable in our empirical strategy, we discuss in greater detail its computation, timing, and release in what follows.

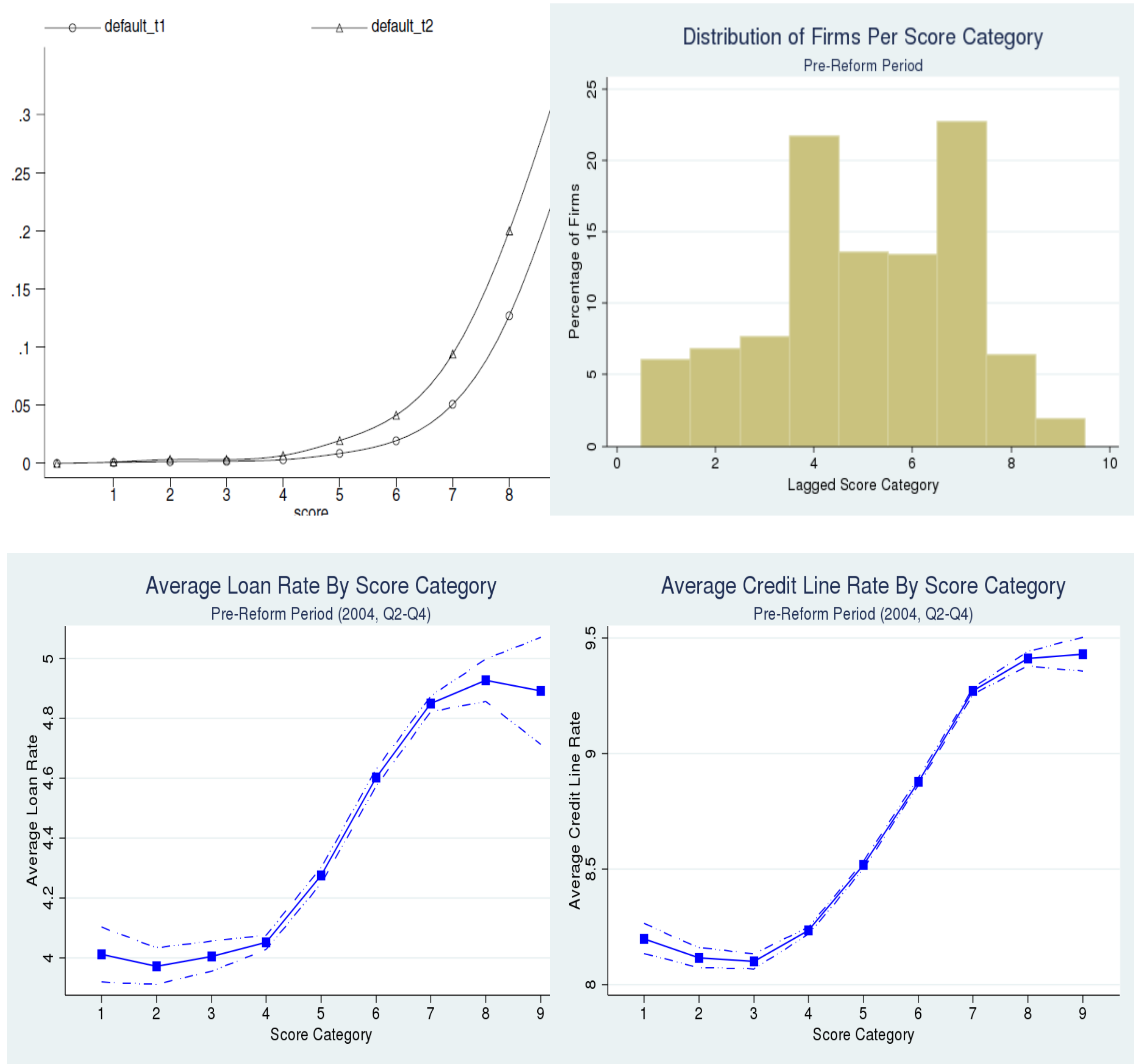
The first advantage of our assignment variable is that the same firm Score is observed by all the banks, and they use it before making loan decisions. The second advantage of our assignment variable is that the algorithm for the computation of Score did not change in response to the bankruptcy reform. A third advantage of Score is that it is predetermined at the moment of the reform. Indeed, the Score of a firm in a given year is, due to accounting rules and data collection requirements, computed on the basis of lagged balance sheet information. This implies that firms, at the time of the reforms, could not self-select into Score categories based on the anticipated costs or benefits of the same reforms.

Empirical Features of Score Figure 5.3 summarizes the key features of our assignment variable. The top-left panel of Figure 5.3 is taken from Panetta et al. [2009][20] and plots the Score variable against an indicator of actual default incidence. The remaining figures are computed on the basis of our pre-reform sample. The top-right panel of Figure 5.3 plots the distribution of firms into each Score category. The bottom panels plot the Score variable against the interest-rate spreads on loans (bottom-left) and credit lines (bottom-right).

The top left panel of Figure 5.3 shows that Score is an accurate predictor of actual default incidence among Italian firms. Firms with a Score of three in a given year have a probability of defaulting within the next two years (i.e., during years t or $t+1$) of less than 1%, but this probability rises to 10% for firms with a Score of 7. The top right panel of Figure 5.3 shows that there are relatively few firms at the extremes of the Score classification. Only 5% of the firms in our sample belong to the first Score category, and only 2% of our sample firms belong to the highest Score category. The panels at the bottom show that there is a strong positive relation between Score and interest rates on loans and credit lines. The best Score in terms of creditworthiness is on average associated with a loan interest rate of 4%, whereas the worst category has an average loan interest rate of around 5%. Note also that in most figures

[20] Panetta et al. [2009] analyzes the importance of merger informational effects on bank lending between 1988 and 1998.

Figure 5.3: Characteristics of the Score Assignment Variable



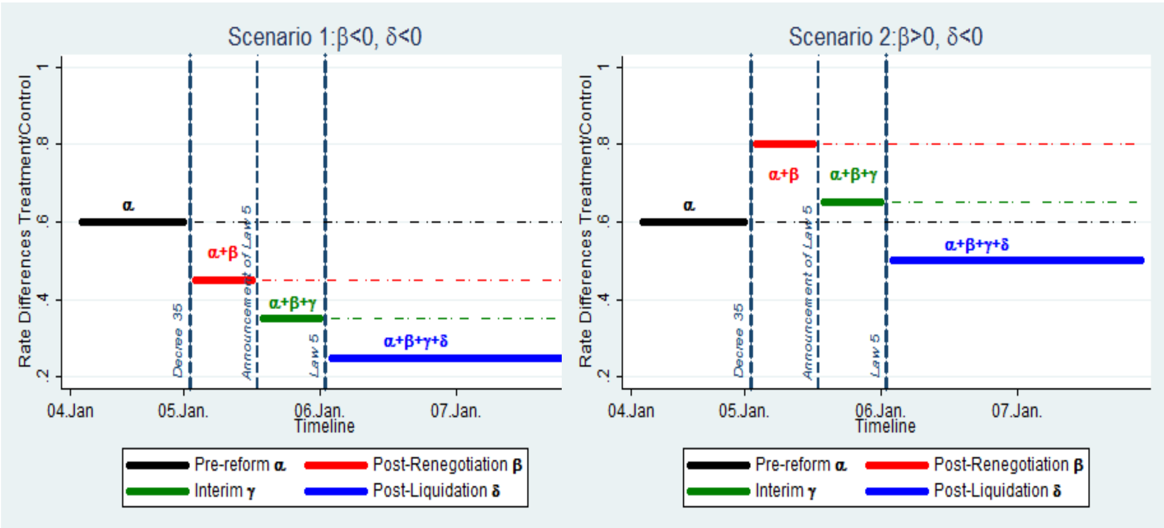
*Note:*The top left panel is taken from Panetta et al. [2009] who, using the same data for the period between 1988 to 1998, plots the Score variable against an indicator of default within the next one (circle) and two years (triangle). The top right panel plots, for our pre-reform sample (2004.Q2-2004.Q4), the share of firms within each Score category. The bottom panel, computed on the basis of our pre-reform sample (2004.Q2-2004.Q4), plots the Score variable against the average interest rate on loans (bottom-left) and credit lines (bottom-right).

the main distinction seems to be between between Score one to four, not Score five to nine.

Specification and Hypothesis Testing These empirical patterns suggest, as a first step, that we should assign firms in Score categories one to four to the control group, and compare them to a treatment group composed of firms in Score categories five to nine. This classification has two advantages. First, it mirrors the split of the Score categories at which bankruptcy rates and interest-rate spreads start to increase significantly. Secondly, it enables the construction of larger treatment and control groups, and so limits the influence of extreme observations.

Figure 5.4 gives a graphical representation of our empirical framework. There are potentially three relevant dates. The first threshold corresponds to the announcement and implementation of Decree 35 in the first quarter of 2005. The second threshold corresponds to the announcement of a future reform on liquidation procedures at the beginning of the third quarter of 2005.Q3. The last threshold corresponds to the announcement and implementation of Law 5 on liquidation procedures in the first quarter of 2006. β, γ and δ correspond respectively to estimates of the differences in the dependent variable between treatment and control group across these thresholds, whereas α represents baseline differences before the reform.

Figure 5.4: Treatment Effects from Differences-In-Differences Specification.



*Note:*Graphical representation of treatment effects across reforms. α, β, γ and δ correspond to estimates of the differences in the dependent variable between treatment and control group across time. Vertical lines represent legislative reforms that occurred in the first quarter of 2005 for Decree 35, and in the first quarter of 2006 for Law 5. The left panel illustrates the hypothesis that both reforms lowered the interest rate differences between treatment and control groups. The right panel illustrates the alternative hypothesis that the renegotiation reform increased the interest rate differences between treatment and control groups.

The left panel and right panels depict the two distinct scenarios outlined in the theoretical framework. Under the first scenario β and δ are both negative, i.e., they decrease the spreads between treatment and control groups across reforms. Under the alternative scenario β is positive and δ negative, i.e., the reorganization reform increased spreads, while the liquidation reform decreased them. In both cases the sign of γ is undetermined, as it potentially captures anticipation effects of the liquidation reform.

Multivariate Analysis Let Y_{ijlt} denote the interest rate to firm i by bank j on loan l at time t.

$$
\begin{aligned}
Y_{ijlt} \quad = \quad constant + \alpha Treatment_i \quad & + \quad \beta \quad (Treatment_i \times After\ Reorganization) \\
& + \quad \gamma \quad (Treatment_i \times Interim\ Period) \\
& + \quad \delta \quad (Treatment_i \times After\ Liquidation) \\
& + \quad X_{ijlt}\kappa + Z_{it}\omega + B_{it-1}\mu \\
& + \quad Firm \times Bank + Quarter_t + \epsilon_{ijlt}
\end{aligned}
$$

where $Treatment_i$ is a dummy variable equal to one for firms that, in 2004, have a Score between five and nine, 0 otherwise. $After\ Reorganization$, $Interim\ Period$ and $After\ Liquidation$ are time dummies associated to the thresholds of the reforms described in the previous paragraph. These dummies take the value 0 before the date of the reform and one afterwards. The model includes also a rich set of loan and firm characteristics. X_{ijlt} are loan characteristics such as maturity, collateral, or loan size. Z_{it} denotes firm financing characteristics as constructed from the Central Credit Register. B_{it-1} are balance sheet variables measured in the calendar year prior to the contract. ϵ_{ijlt} denotes the error term, clustered at the firm level.

We estimate two versions of this model: one specification including only quarter and industry fixed effects, and a second specification including $Firm \times Bank$ fixed effects. In the former case, we allow for composition effects in treatment and control groups whereas in the latter case, we exploit specific variation within the firm-bank relationships. Note that we separately address composition effects and market participation as outcomes of the reforms.[21]

5.5 Results

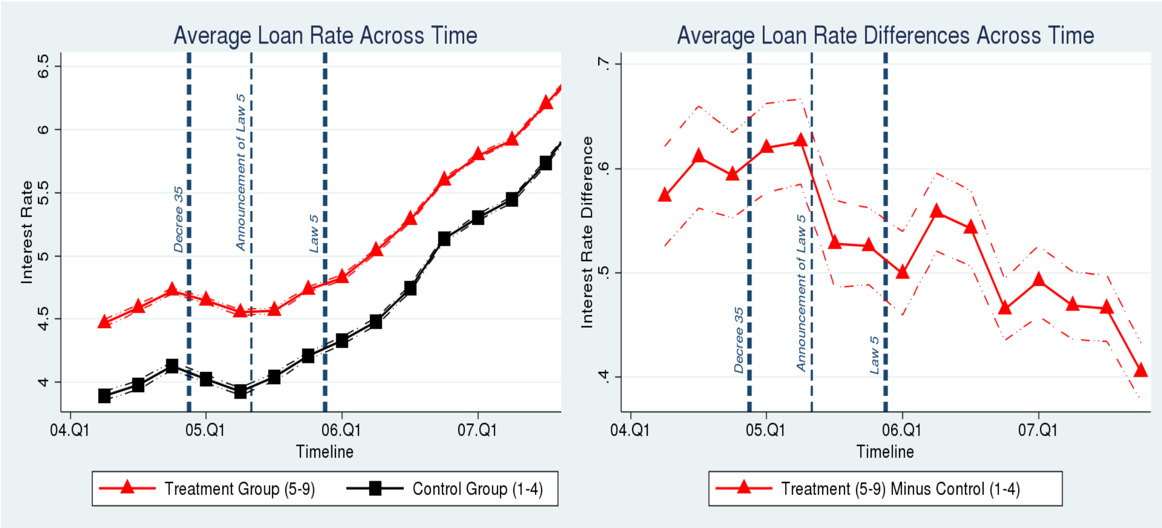
5.5.1 Cost of Finance

Differences-In-Differences Plots Figure 5.5 provides a first insight into changes of average interest rate set on newly issued loans between the second quarter of 2004 and the fourth quarter of 2007. The left panel of figure 5.5 separately plots average interest rates on loans for control firms (black line, square) and average interest rates on loans for treated firms (red line, triangle). The right panel plots the difference in average interest rates on loans between the two groups of firms for each quarter. Vertical lines represent legislative reforms that occurred in the first quarter of 2005 for Decree 35 and in the first quarter of 2006 for Law 5.

The left panel of figure 5.5 shows that average loan interest rates increased between the beginning of 2004 and the end of 2007. During this period, the average loan interest rate

[21] We thank Laurent Bach for enlightening discussions on this issue.

Figure 5.5: Differences-in-Differences Plot of Loan Interest Rates



Note: The left panel of the figure separately plots average interest rates on loans for control firms (black line) and average interest rates on loans for treated firm categories (red line). The right panel plots the difference in average interest rates on loans between the two groups of firms for each quarter. Vertical lines represent legislative reforms that occurred in the first quarter of 2005 for Decree 35, and in the first quarter of 2006 for Law 5.

of control firms increased from 3.89 percentage points in the second quarter of 2004 to 6.09 percentage points in the last quarter of 2007. Similarly, average interest rates charged on loans of treated firms increased from 4.46 to 6.49 percentage points during the same period.

The right panel of figure 5.5 shows that differences in average loan interest rates before Decree 35 were stable at around 57 basis points. The fact that loan rates of both groups of firms were on similar time trends before the first reform seems to validate the common trend assumption embedded in the DID setting. When Decree 35 was announced at the beginning of 2005 the difference in loan rates increased slightly, before experiencing a significant drop of approximately ten basis points upon the announcement of Law 5. This suggests that anticipation effects in the 'intermediate' period might complicate the empirical assessment of the liquidation reform.[22] After Law 5 was passed, differences then decreased again to around 45 basis points. To better judge the statistical significance of these variations in interest rates we turn to multivariate analysis.

Multivariate Analysis Table 5.5-3 estimates the DID specification by OLS, clustering standard errors at the firm level. Columns 1 and 3 of table 5.5-3 control for loan and firm characteristics, whereas columns 2 and 4 also include $Firm \times Bank$ fixed effects.

Our results reject the prediction that both reforms decreased the marginal cost of loan

[22] For instance, in a press release to ANSA (Italian press agency) in November 2005, Giuseppe Zadra (the general director of the Italian Banks Association) stated that the approach taken by the government with respect to the reform of the liquidation procedure was perfectly agreeable, but it was still necessary to implement it as soon as possible.

Table 5.5-3: Impact of Reforms on Loan Interest Rates

Dependent Variable: Interest Rates on Loans

	All Firms		1-4 vs 7-9	
	(1)	(2)	(3)	(4)
Treatment	0.246***		0.401***	
	(0.021)		(0.028)	
After Reorganization*Treatment	0.028	0.043***	0.069***	0.067***
	(0.019)	(0.016)	(0.024)	(0.021)
Interim Period*Treatment	-0.059***	0.005	-0.102***	-0.005
	(0.016)	(0.014)	(0.020)	(0.017)
After Liquidation*Treatment	-0.036**	-0.045***	-0.074***	-0.049***
	(0.015)	(0.014)	(0.019)	(0.018)
Real Guarantee	0.151***	-0.015	0.170***	-0.012
	(0.022)	(0.028)	(0.027)	(0.034)
Personal Guarantee	0.297***	0.036***	0.279***	0.029
	(0.013)	(0.014)	(0.016)	(0.018)
Personal+Real Guarantees	0.175***	-0.191***	0.141***	-0.231***
	(0.020)	(0.025)	(0.024)	(0.032)
Personal+Real Guarantees	0.327***	0.042***	0.321***	0.030*
	(0.020)	(0.013)	(0.026)	(0.018)
Maturity: 1-5 Years	-0.243***	-0.285***	-0.234***	-0.295***
	(0.010)	(0.012)	(0.013)	(0.016)
Maturity: >5 Years	-0.413***	-0.511***	-0.413***	-0.515***
	(0.012)	(0.016)	(0.015)	(0.021)
Log Size of Loan	-0.212***	-0.085***	-0.215***	-0.093***
	(0.005)	(0.003)	(0.006)	(0.004)
Credit Lines/Tot.Fin.	-0.161**	0.143**	-0.130	0.154*
	(0.066)	(0.071)	(0.080)	(0.090)
Loans/Tot.Fin.	-0.330***	-0.156***	-0.262***	-0.128***
	(0.034)	(0.039)	(0.041)	(0.048)
Log Value Added	0.035***	-0.013	0.036**	-0.014
	(0.012)	(0.013)	(0.014)	(0.017)
Leverage	0.678***	0.481***	0.516***	0.458***
	(0.055)	(0.085)	(0.061)	(0.101)
Log Total Assets	0.215***	0.123***	0.178***	0.121***
	(0.015)	(0.027)	(0.018)	(0.036)
Log Total Sales	-0.427***	-0.166***	-0.381***	-0.132***
	(0.017)	(0.024)	(0.020)	(0.029)
Age of Firm	-0.011	-0.100	-0.009	-0.149*
	(0.010)	(0.068)	(0.013)	(0.079)
Group Ownership	-0.008	0.013	0.017	0.056
	(0.046)	(0.048)	(0.060)	(0.074)
Firm*Bank FE	No	Yes	No	Yes
Industry FE	Yes	-	Yes	-
Quarterly FE	Yes	Yes	Yes	Yes
R-squared	0.501	0.559	0.518	0.552
N	226422	183498	132436	104782

The table reports OLS estimation of the impact of the bankruptcy reforms on loan interest rates. Columns 1 and 2 use the entire range of Score observations. Columns 3 and 4 use the range of Score observations between 1-4 and 7-9. *After Reorganization* is a binary variable equal to 1 beginning in January 2005 (2005.Q1). *Interim Period* is a binary variable equal to 1 beginning in June 2005 (2005.Q3). *After Liquidation* is a binary variable equal to 1 beginning in January 2006 (2006.Q1). *Treatment* is a binary variable indicating whether the loan was made by a firm which had a Score above 4 in 2004. See Table 5.3-1 and 5.3-2 for the definition of the remaining variables. Omitted categories are "Unsecured" in the case of *Guarantees* and "Backed Loans/Tot.Fin." in the case of financing structure variables. Robust, firm clustered standard errors are reported in parentheses. ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

financing of firms. The DID estimates of the impact of the reorganization reform suggest that the reform increased the cost of loan financing for treated firms relative to control firms. While the difference is small and not statistically significant in the cross section, it increases to 4.3 basis points when exploiting variation within firm-bank relationships. The increase in interest rates is especially strong in columns 3 and 4 when comparing control group firms to a subsample of treated firms that are perceived to be significantly more likely to default. Indeed, the seven basis points increase in the cost of financing of treated firms following Decree 35, corresponds to an increase of conditional baseline spreads of 17.5%. In principle, the introduction of a reorganization procedure gives rise to two opposite effects. The first effect is to lower interest payments because of efficiency gains from greater creditor coordination. At the same time, reorganization might exacerbate the debtor's incentives to behave in an opportunistic way, and thus increase the ex-ante cost of financing. Our results therefore show that worse repayment incentives outweigh efficiency gains from greater creditor coordination.

The liquidation reform decreased interest rate differences. This result has an intuitive rationale, since the reform of the liquidation procedure made the distribution of liquidation proceeds faster and more orderly, and creditors expected improved recovery rates in bankruptcy. The magnitude of the coefficient is close to the estimates of the reorganization reform and suggests that these effects could empirically wash out when assessing simultaneous reforms. Finally, estimates of the differences in the interim period hint at the presence of anticipation effects in the cross section.[23]

The analysis in Table 5.5-3 comprises a number of controls at the firm and contractual level. Although we do not make causal statements on their interpretation, we can still discuss their impact and possible interpretation. The existence of either real, personal, or other guarantees as opposed to no guarantees increases loan rates. This is consistent with Strahan [1999], Davydenko / Franks [2008] and Santos [2011]. Maturity decreases interest rates: this idea was presented in the discussion of descriptive statistics. Our evidence suggests that the size of a loan decreases interest rates. The larger size of a loan may generate more credit risk, but it can also allow a decrease in rates due to economies of scale in processing and monitoring. Turning to firm characteristics, we find that firms with higher leverage face higher interest rates. Sales significantly decrease rates as in Santos [2011], whilst age and group affiliation have no significant impact.[24]

Creditor Coordination Gains To further link our empirical evidence to the theoretical framework, we exploit heterogeneity in the benefits of both reforms. While the scope for opportunistic behaviour is in principle common across firms, benefits from coordination are

[23] We find that treatment effects are relatively higher for short-term as opposed to medium- and long-term loans. We also find weak evidence that secured credit is relatively worse off than unsecured credit after the introduction of reorganization. Results are available on request.

[24] In robustness checks we address feedback effects on covariates by leaving out loan and financing characteristics from the specification. The reason is that, unlike balance sheet characteristics, these financing variables are likely to respond quickly to the costs and benefits of legal changes. Results remain qualitatively similar. Results are available on request.

not. We construct two indicators of creditor-coordination problems. The first is the number of bank relations of a firm, and the second is a Herfindahl index of loan concentration. The use of a Herfindahl index allows us to take into account that certain bank links are negligible in terms of amounts granted. The indicators are computed in 2004, since afterwards they might have changed as a consequence of the reforms. Table 5.5-4 re-estimates our DID specification for subsamples split on the basis of median of these two indicators.

The first two columns of table 5.5-4 report coefficient estimates when the sample is split according to the number of banks indicator. The costs of the reform were mainly borne by firms with a small number of bank relations. For firms with less than four bank relations, interest rates significantly increased following the introduction of reorganization, while not decreasing significantly following the reform of the liquidation procedures. In the subsample of firms with a high number of bank relations, reorganization had a significantly smaller and statistically non-significant impact. This contrasts with a decrease of seven basis points in loan rates after the second reform. The assumption that the coefficients of both reforms were equal across samples is rejected, lending support to the idea that the benefits of both reforms mainly accrued to firms with high gains from coordination. This conclusion is confirmed if loan concentration is used to split the sample.

Credit Lines We extend our analysis to the cost of finance of credit lines. A credit line contract involves the bank providing the firm with a sum of money at a certain interest rate. In turn, the firm can use the money when needed. Although credit lines represent a significantly smaller fraction of total bank financing, they present two advantages in our empirical analysis. First of all, the interest rate on a credit line is observed across time, whereas a loan interest rate is only observed at loan origination. Second, for credit lines, banks can typically retain the right to modify the pricing terms of the relationship at the occurrence of contract-specified events.

The left panel of figure 5.6 plots average credit-line interest rates for control (black line, square) and treatment (red line, triangle) firms. The right panel plots the difference in average interest rates on credit lines for each quarter.

The patterns in credit-line rates are consistent with those on loan interest rates. We again find a stable level difference in the pre-reform period of approximately 80 basis points followed by an increase in the difference following Decree 35. Interestingly, the drop in interest rates for credit lines occurs precisely at the moment of the Law 5 reform. This is consistent with automatic renegotiation mechanisms being in place for credit lines, which are therefore less subject to anticipation effects.

We next exploit the fact that credit lines are easier to track empirically by plotting changes in average quarterly interest rates on credit lines within each Score category in the quarter preceding and following the reforms. The left panel of figure 5.7 focuses on the announcement of Decree 35 and plots changes in interest rates between 2004.Q4-2004.Q3 (black line, square)

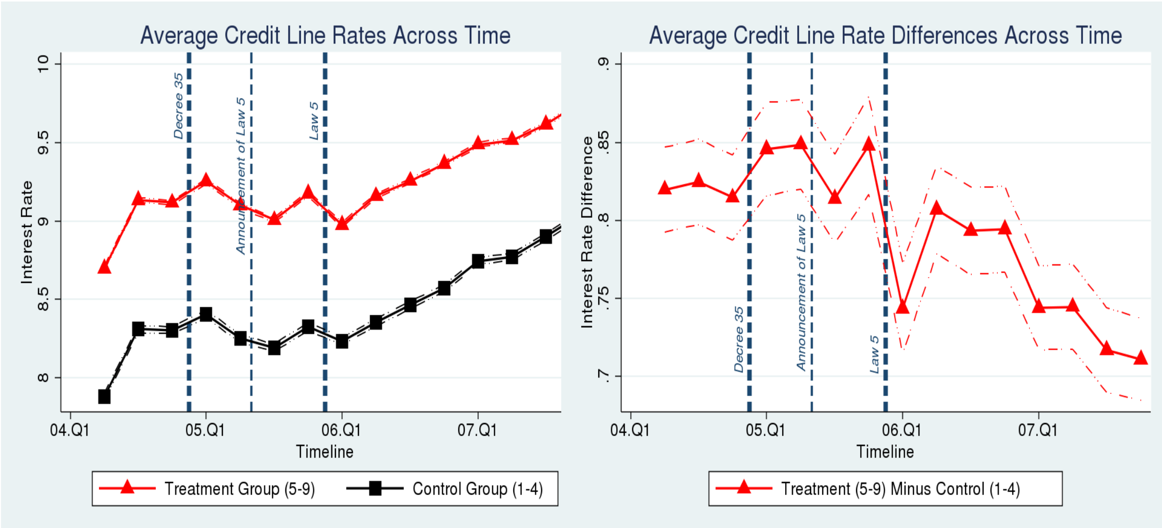
Table 5.5-4: Impact of Reforms on Loan Interest Rates

Dependent Variable: Interest Rates on Loans

	# of Bank Relations		Loan Concentration	
	Low	High	Low	High
After Reorganization*Treatment	0.079***	0.022	0.024	0.075**
	(0.029)	(0.020)	(0.019)	(0.030)
Interim Period*Treatment	-0.008	0.015	0.024	-0.021
	(0.024)	(0.016)	(0.016)	(0.025)
After Liquidation*Treatment	-0.011	-0.073***	-0.073***	-0.006
	(0.022)	(0.018)	(0.018)	(0.023)
Loan Controls: Guarantee, Maturity, Size, Financing Composition				
Firm Controls: Value Added, Leverage, Assets, Sales, Age, Ownership				
Firm*Bank FE	Yes	Yes	Yes	Yes
Quarterly FE	Yes	Yes	Yes	Yes
R-squared	0.522	0.590	0.587	0.525
N	72477	106402	106682	72197
	F-Test for Homogeneus Treatment Effect Across Splits			
	0.0227		0.0210	

The table reports split OLS estimation of the impact of the bankruptcy reforms on loan interest rates. Columns 1 and 2 splits the sample into *Low* versus *High* on the basis of the median *# of Bank Relations*. *# of Bank Relations* is computed in 2004 as the number of distinct bank relations with positive granted term loans. Columns 1 and 2 splits the sample into *Low* versus *High* on the basis of the median *Loan Concentration*. *Loan Concentration* is computed in 2004 as sum of the squares of bank shares in terms of granted loans. Note that *High Loan Concentration* is therefore associated with a single bank representing most of the loan financing. *After Reorganization* is a binary variable equal to 1 beginning in January 2005 (2005.Q1). *Interim Period* is a binary variable equal to 1 beginning in June 2005 (2005.Q3). *After Liquidation* is a binary variable equal to 1 beginning in January 2006 (2006.Q1). *Treatment* is a binary variable indicating whether the loan was made by a firm which had a Score above 4 in 2004. See Table 5.3-1 and 5.3-2 for the definition of the remaining variables. Omitted categories are "Unsecured" in the case of *Guarantees* and "Backed Loans/Tot.Fin." in the case of financing structure variables. F-Test is a partial F(2,32406) test on equality of coefficients *After Reorganization*Treatment* and *After Liquidation*Treatment* across splits. Robust, firm clustered standard errors are reported in parentheses. ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

Figure 5.6: Differences-in-Differences Plot of Credit Line Interest Rates



Note: The left panel of the figure separately plots average interest rates on credit lines for control firms (black line) and average interest rates on credit lines for treated firm categories (red line). The right panel plots the difference in average interest rates on credit lines between the two groups of firms for each quarter. Vertical lines represent legislative reforms that occurred in the first quarter of 2005 for Decree 35, and in the first quarter of 2006 for Law 5.

and 2005.Q1-2004.Q4 (green line, triangle). The right panel focuses on the announcement of Law 5 and plots changes in interest rates between 2005.Q4-2005.Q3 (black line, square) and 2006.Q1-2005.Q4 (green line, triangle).

The black line (square) on the left panel of Figure 5.7 shows that credit-line interest rates in the two quarters preceding Decree 35 remained stable across the entire Score range. Even after the announcement of the reorganization procedure credit-line rates remained unchanged for lower Score categories. Only firms in higher Score categories experienced an increase in their average interest rates. Whereas the interest rate for a firm in Score category eight did not change before Decree 35, interest rates immediately increased by approximately 20 basis points at the announcement of Decree 35. The right panel of Figure 5.7 shows that Law 5 reversed interest rate movements. In the two quarters preceding the reform (black line, square), the average cost of credit lines increased across categories. This suggests that for credit lines the increase in interest rates due to Decree 35 had not yet vanished. Immediately after Law 5 was passed, within Score interest rates decreased most significantly for higher default risks.

Finally, we estimate our cost of finance specification for credit lines in table 5.5-5. Since credit lines are a more homogeneous financing instrument we only have amounts used and granted in our data in terms of specific information about credit lines.

Table 5.5-5 confirms our previous findings on loan interest rates. Credit-line interest rates increased by eight to eleven basis points following Decree 35, but decreased by three to six basis points following the reform of liquidation procedures. One interesting difference between

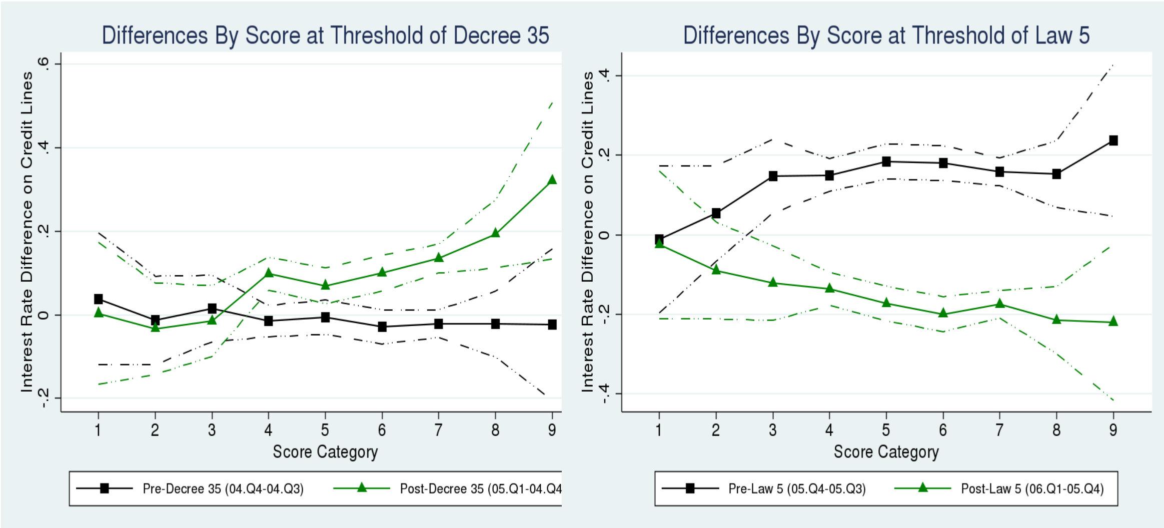
Table 5.5-5: Impact of Reforms on Credit Lines Interest Rates

Dependent Variable: Interest Rates on Credit Lines

	All Firms		1-4 vs 7-9	
	(1)	(2)	(3)	(4)
Treatment	0.346***		0.632***	
	(0.022)		(0.028)	
After Reorganization*Treatment	0.018	0.086***	0.014	0.112***
	(0.015)	(0.012)	(0.017)	(0.014)
Interim Period*Treatment	-0.003	0.019*	-0.020	0.021*
	(0.013)	(0.011)	(0.014)	(0.012)
After Liquidation*Treatment	-0.056***	-0.028**	-0.129***	-0.066***
	(0.015)	(0.012)	(0.018)	(0.015)
Log Use of Credit Lines	-0.027***	-0.084***	-0.037***	-0.081***
	(0.003)	(0.002)	(0.003)	(0.003)
Log Granted Credit Lines	-0.290***	-0.113***	-0.279***	-0.112***
	(0.002)	(0.002)	(0.003)	(0.003)
Credit Lines/Tot.Fin.	-2.679***	-0.981***	-2.582***	-0.887***
	(0.068)	(0.058)	(0.082)	(0.069)
Loans/Tot.Fin.	-0.551***	-0.285***	-0.528***	-0.248***
	(0.037)	(0.030)	(0.044)	(0.037)
Log Value Added	-0.011	-0.010	0.015	0.007
	(0.013)	(0.011)	(0.016)	(0.013)
Leverage	1.117***	0.891***	0.848***	0.811***
	(0.063)	(0.069)	(0.074)	(0.082)
Log Total Assets	0.336***	0.177***	0.278***	0.194***
	(0.017)	(0.022)	(0.021)	(0.027)
Log Total Sales	-0.467***	-0.213***	-0.428***	-0.216***
	(0.018)	(0.018)	(0.023)	(0.021)
Age of Firm	0.078***	0.320***	0.103***	0.375***
	(0.012)	(0.048)	(0.015)	(0.059)
Group Ownership	-0.356***	0.040	-0.341***	-0.004
	(0.066)	(0.079)	(0.084)	(0.115)
Firm*Bank FE	No	Yes	No	Yes
Industry FE	Yes	-	Yes	-
Quarterly FE	Yes	Yes	Yes	Yes
R-squared	0.273	0.096	0.284	0.093
N	1570167	1558095	974402	965632

The table reports OLS estimation of the impact of the bankruptcy reforms on credit line interest rates. Columns 1 and 2 use the entire range of Score observations. Columns 3 and 4 use the range of Score observations between 1-4 and 7-9. *After Reorganization* is a binary variable equal to 1 beginning in January 2005 (2005.Q1). *Interim Period* is a binary variable equal to 1 beginning in June 2005 (2005.Q3). *After Liquidation* is a binary variable equal to 1 beginning in January 2006 (2006.Q1). *Treatment* is a binary variable indicating whether the loan was made by a firm which had a Score above 4 in 2004. See Table 5.3-1 and 5.3-2 for the definition of the remaining variables. Omitted category is "Backed Loans/Tot.Fin." in the case of financing structure variables. Robust, firm clustered standard errors are reported in parentheses. ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

Figure 5.7: Within Score Variations At Threshold of Reforms



*Note:*The figure plots changes in average quarterly interest rates on credit lines within each Score category in the quarter preceding and following the reforms. The left panel focuses on the announcement of Decree 35 and plots changes in interest rates between 2004.Q4-2004.Q3 (black line) and 2005.Q1-2004.Q4 (green line). The right panel focuses on the announcement of Law 5 and plots changes in interest rates between 2005.Q4-2005.Q3 (black line) and 2006.Q1-2005.Q4 (green line).

the estimates on loans and credit lines is their magnitudes. Whereas the net effect of the sequential legal changes nearly washed out for loans, credit lines displayed a significantly larger increase in interest rates following Decree 35.

5.5.2 Alternative Interpretations

We now address concerns related to the causal interpretation of our DID estimates on the pricing of a loan contract. The first issue is related to unobserved demand shocks which differentially affect treatment and control groups. The second issue is related to the existence of a credit boom during the sample period, which again would differentially affect both groups of firms.

Demand Shocks We interpreted estimates from the DID estimation as being caused by successive reforms of bankruptcy procedures, which affected the expected recovery rates on the side of banks. At the same time, prices of loan contracts may also have changed due to demand shocks. These can be relevant in our empirical strategy, insofar as our treatment and control groups are not randomized. Addressing this issue is difficult, since the price of loan contracts depends on anticipated demand shocks.

To address this issue we rely on our Invind survey of manufacturing firms. Each year the survey asks the top management of each firm about their year-ahead forecasts of sales growth, prices, and productive capacity. In Figure 5.8 we provide a first graphical check of the effect of differential demand shocks to treatment and control firms. The left panels of the figure separately plot average forecasts for control firms (black line, square) and treated firm categories (red line, triangle). The right panels plot the difference in forecasts between the two groups of firms for each year.

The top panels in figure 5.8 plot forecasts of sales growth. Between 2001 and 2007, the average forecast of sales growth for treatment group firms was 6-7%, but only 5% for control group firms. As long as these level differences remain constant, they do not invalidate our DID framework. The left panel shows that during our sample period (2004-2007), differences in sales forecasts were stable at two percentage points. Since demand shocks can also be channeled through prices, we plot price forecasts for own-production in the middle panel. Differences in price forecasts seem small in magnitude and statistically not significantly different from zero. The bottom panel plots forecasts of productive capacity for treatment and control firms. If firms were to differ in their forecasted use of productive capacity we would expect such differences to materialize in higher investment and financing needs. However, in terms of their use of productive capacity, again, both groups of firms seem to display parallel trends.

To check the robustness of our main results to demand shocks we embed these forecasts into our multivariate DID specification. We proceed as follows: in each year we compute average firm forecasts by industry code (two- and three-digit level) and by size dummies (five categories), Score, or binary treatment group indicator. We assign these average forecasts by industry-size-year and industry-score-year to each firm in our population of firms in the economy. If we cannot construct an average forecast in a given cell, we assign the industry-year average forecast. We then re-estimate our baseline loan-interest rate specification. Results are presented in table 5.5-6.

Each set of columns is divided according to the assignment criterion: *Sic*Score*, *Sic*Size*, *Sic*TC*. Table 5.5-6 confirms graphical evidence suggesting that demand factors do not confound our estimates of the impact of the bankruptcy reform. All estimates of the impact of reorganization and liquidation remain similar in magnitude and precision. Only forecasts on productive capacity seem to impact the loan-financing conditions of firms: a higher capacity utilization implies higher investment needs, and results in increases in the price of the loan contract.

Credit Boom An alternative threat to the causal interpretation of our results is the behaviour of international credit markets during the sample period. The argument is that in the period leading up to the crash of Lehman Brothers, credit markets were booming, and riskier firms were able to obtain loans at better conditions. Although this is not consistent with our results on the introduction of the reorganization procedure, credit booms might explain the lower interest rates after the liquidation phase was reformed.

Table 5.5-6: Impact of Reforms and Demand Differences

Dependent Variable: Interest Rates on Loans

	SIC*TC			SIC*SCORE			SIC*SIZE		
	Sales	Price	Capacity	Sales	Price	Capacity	Sales	Price	Capacity
After Reorganization*Treatment	0.043**	0.045**	0.049**	0.043**	0.048**	0.047**	0.044**	0.046**	0.054***
	(0.017)	(0.020)	(0.019)	(0.017)	(0.020)	(0.020)	(0.017)	(0.020)	(0.021)
Interim Period*Treatment	0.010	0.005	0.005	0.009	0.005	0.012	0.009	0.004	0.003
	(0.014)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.014)	(0.016)	(0.017)
After Liquidation*Treatment	-0.046***	-0.038**	-0.045***	-0.047***	-0.039**	-0.046***	-0.046***	-0.039**	-0.047***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.017)
CEO Forecast	-0.001	-0.002	0.001**	-0.001*	-0.000	0.000	-0.000	-0.001	0.001**
	(0.001)	(0.002)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
Loan Controls: Guarantee, Maturity, Size, Financing Composition									
Firm Controls: Value Added, Leverage, Assets, Sales, Age, Ownership									
Firm*Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarterly FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.538	0.547	0.540	0.538	0.545	0.543	0.538	0.547	0.541
N	155646	146036	145529	155442	140220	138354	155330	145047	126396

The table reports OLS estimation of the impact of the bankruptcy reforms on loan interest rates. Each column controls for average one year ahead CEO forecasts *CEO Forecast* on *Sales*, *Prices* and *Capacity*. Each variable is constructed in the subsample as the average of the forecast by *SIC*YEAR*TC*, *SIC*YEAR*SCORE* and *SIC*YEAR*SIZE*. If for a given industry in a year *SIC*YEAR** there were no observations to compute differences by **TC*, **SCORE*, **SIZE* we attributed the *SIC*YEAR* average to these observations. *SIC* refers to 2 digit SIC codes, *SCORE* to the Score variable and *TC* to the treatment definition. *Size* is a categorical variable distinguishing five employment brackets: $X \leq 20$, $20 \prec X \geq 50$, $50 \prec X \geq 100$, $100 \prec X \geq 250$, $250 \prec X$. *After Reorganization* is a binary variable equal to 1 beginning in January 2005 (2005.Q1). *Interim Period* is a binary variable equal to 1 beginning in June 2005 (2005.Q3). *After Liquidation* is a binary variable equal to 1 beginning in January 2006 (2006.Q1). *Treatment* is a binary variable indicating whether the loan was made by a firm which had a Score above 4 in 2004. See Table 5.3-1 and 5.3-2 for the definition of the remaining variables. Omitted categories are "Unsecured" in the case of *Guarantees* and "Backed Loans/Tot.Fin." in the case of financing structure variables. Robust, firm clustered standard errors are reported in parentheses. ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

Table 5.5-7: Impact of Reforms and Credit Cycles

Dependent Variable: Interest Rates on Loans

	All Firms		1-4 vs 7-9	
	(1)	(2)	(3)	(4)
After Reorganization*Treatment	0.034*	0.045***	0.080***	0.070***
	(0.019)	(0.017)	(0.024)	(0.021)
Interim Period*Treatment	-0.040**	0.010	-0.062***	0.004
	(0.017)	(0.014)	(0.021)	(0.017)
After Liquidation*Treatment	-0.034**	-0.045***	-0.070***	-0.048***
	(0.015)	(0.014)	(0.019)	(0.018)
US BAA/AAA*Treatment	-0.133***	-0.031	-0.274***	-0.058
	(0.042)	(0.036)	(0.052)	(0.045)
Loan Controls: Guarantee, Maturity, Size, Financing Composition				
Firm Controls: Value Added, Leverage, Assets, Sales, Age, Ownership				
Firm*Bank FE	Yes	Yes	Yes	Yes
Quarterly FE	Yes	Yes	Yes	Yes
R-squared	0.501	0.559	0.518	0.552
N	226422	183498	132436	104782

The table reports OLS estimation of the impact of the bankruptcy reforms on loan interest rates. Columns 1 and 2 use the entire range of Score observations. Columns 3 and 4 use the range of Score observations between 1-4 and 7-9. *After Reorganization* is a binary variable equal to 1 beginning in January 2005 (2005.Q1). *Interim Period* is a binary variable equal to 1 beginning in June 2005 (2005.Q3). *After Liquidation* is a binary variable equal to 1 beginning in January 2006 (2006.Q1). *Treatment* is a binary variable indicating whether the loan was made by a firm which had a Score above 4 in 2004. *US BAA/AAA* is the difference between yields on US corporate AAA rated bonds and Baa rated bonds. Information on corpororate bond yields comes from http://www.federalreserve.gov/releases/h15/current/. See Table 5.3-1 and 5.3-2 for the definition of the remaining variables. Omitted categories are "Unsecured" in the case of *Guarantees* and "Backed Loans/Tot.Fin." in the case of financing structure variables. Robust, firm clustered standard errors are reported in parentheses. ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

To address this issue we construct a proxy for international credit markets cycles. We collect information on Moody's corporate bond yields from the Federal Reserve Board (http://www.federalreserve.gov/releases/h15/current/) and we compute *US BAA/AAA* as the difference between yields on US corporate triple A-rated bonds and Baa-rated bonds. The use of US measures of credit-market cycles has two advantages. First, the US corporate bond market provides a very good first approximation for such credit cycles. Since it is the most liquid bond market, European issuers would often raise capital there, and swap the proceeds immediately into Euros. Second, we need a measure of interest rates which is not affected by the Italian bankruptcy reform. Table 5.5-7 augments our DID specification by interacting the treatment group dummy with *US BAA/AAA*.

The magnitude and statistical significance of our estimates are unchanged. International credit market conditions are significant only in the cross-sectional estimates, but not in the fixed-effects estimates. The sign on the coefficient on US spreads would suggest that Italian

Table 5.5-8: Alternative Specifications

Dependent Variable: Interest Rates on Loans

	Score	No Switchers	No Switchers No Attrition
After Reorganization*Treatment	0.018***	0.053**	0.055***
	(0.006)	(0.021)	(0.021)
Interim Period*Treatment	-0.000	0.013	0.008
	(0.005)	(0.017)	(0.017)
After Liquidation*Treatment	-0.015***	-0.050***	-0.045***
	(0.005)	(0.017)	(0.017)
Loan Controls: Guarantee, Maturity, Size, Financing Composition			
Firm Controls: Value Added, Leverage, Assets, Sales, Age, Ownership			
Firm*Bank FE	Yes	Yes	Yes
Quarterly FE	Yes	Yes	Yes
R-squared	0.559	0.553	0.551
N	183498	137392	142913

The table reports OLS estimation of the impact of the bankruptcy reforms on loan interest rates. Column 1 defines *Treatment* as the Score variable in 2004. Column 2 defines *Treatment* again as a binary variable but excludes observations that changed *Treatment* category on the basis of post-2004 Score. Column 3 defines *Treatment* on the basis of each years' Score but excluding switchers. *After Reorganization* is a binary variable equal to 1 beginning in January 2005 (2005.Q1). *Interim Period* is a binary variable equal to 1 beginning in June 2005 (2005.Q3). *After Liquidation* is a binary variable equal to 1 beginning in January 2006 (2006.Q1). See Table 5.3-1 and 5.3-2 for the definition of the remaining variables. Omitted categories are "Unsecured" in the case of *Guarantees* and "Backed Loans/Tot.Fin." in the case of financing structure variables. Robust, firm clustered standard errors are reported in parentheses. ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

loan spreads behave counter-cyclically. This result is not surprising when considering not only the sluggish growth of the Italian economy during the sample period, but also the fact that Italian banks have not been greatly affected by the 2009 financial crisis.[25]

5.5.3 Other Robustness Checks

Specifications We used the Score variable in 2004 in order to divide firms into treatment and control groups. This specification not only allowed us to construct more equally sized treatment and control groups, but also mirrored the split of Score categories at which bankruptcy rates and interest-rate spreads start significantly to increase. Table 5.5-8 provides robustness checks of our treatment-effect specification.

The first column interacts the reforms with the 2004 Score instead of the binary treatment and control-group definition. Our results suggest that the relative interest-rate difference between the 1st and the 9th category increased by 16 basis points after Decree 35, and

[25] More precisely, no bank needed the intervention of the Italian government during the recent financial crisis.

decreased by 13.5 basis points after the liquidation reform. The second column excludes firms that changed treatment group afterwards, on the basis of their 2004 Score variable. One should note that, as long as the switching behaviour into these groups occurs on the basis of lagged balance-sheet variables, our identification strategy should not be affected. Results in column 2 are similar in magnitudes and precision to our previous results. The last column classifies firms into treatment and control group on the basis of their yearly Score indicator. This addresses the concern that the decrease in interest rates following Law 5 might be driven by attrition in the treatment-group sample.

Bank Composition A final robustness check relates to composition effects of a firm's banking relationships. If firms mitigate the consequences of reforms by matching with different banks then it would be necessary to account for such changes, as well. Table 5.5-9 re-estimates our baseline regression, including two measures of a firm's banking relationships. The first is an indicator of change in the number of bank relationships, the second is an indicator of change in the identity of a firm's banks.

Our main results remain very similar with respect to our baseline regression. Column 3 includes both of our indicators for a firm's banking relationships. Our estimates suggest that changes in the identity of banks in the portfolio are associated with lower interest rates, but that these changes do not confound our estimates on the bankruptcy reforms.

Anticipation Effects In Decree 35 Graphical analysis of the DID plots suggested that the level differences between treatment and control-group firms were stable before Decree 35. But these differences in interest rates might be misleading, as the aggregate effect can veil anticipation effects for parts of the interest rate distribution. For instance, anticipation effects may have existed for the top quantiles of the interest-rate distribution.

To address this concern, we plot the distribution of interest-rate differences between treatment and control-group firms for the two quarters preceding Decree 35. The left panel of figure 5.9 plots interest rate differences in the second quarter of 2004 (blue line) and the third quarter of 2004 (red line). The right panel these differences in the third quarter of 2004 (blue line) and the fourth quarter of 2004 (red line).[26] The right panel clearly shows that the distribution of interest rate differences were stable in the last and second to last quarter before the reform. The interest rate difference between a firm at the 20th percentile of the treatment distribution and a firm at the 20th percentile of the control distribution was approximately 50 basis points in the third and fourth quarter of 2004. The left panel shows that there is again no clear pattern of interest rate differences between the second and third quarter of 2004.[27]

[26] We bootstrap the sample so as to estimate confidence intervals on the differences in interest rates.
[27] In unreported regressions we implement placebo experiments to show in a regression framework that interest rates did not change prior to the first reform.

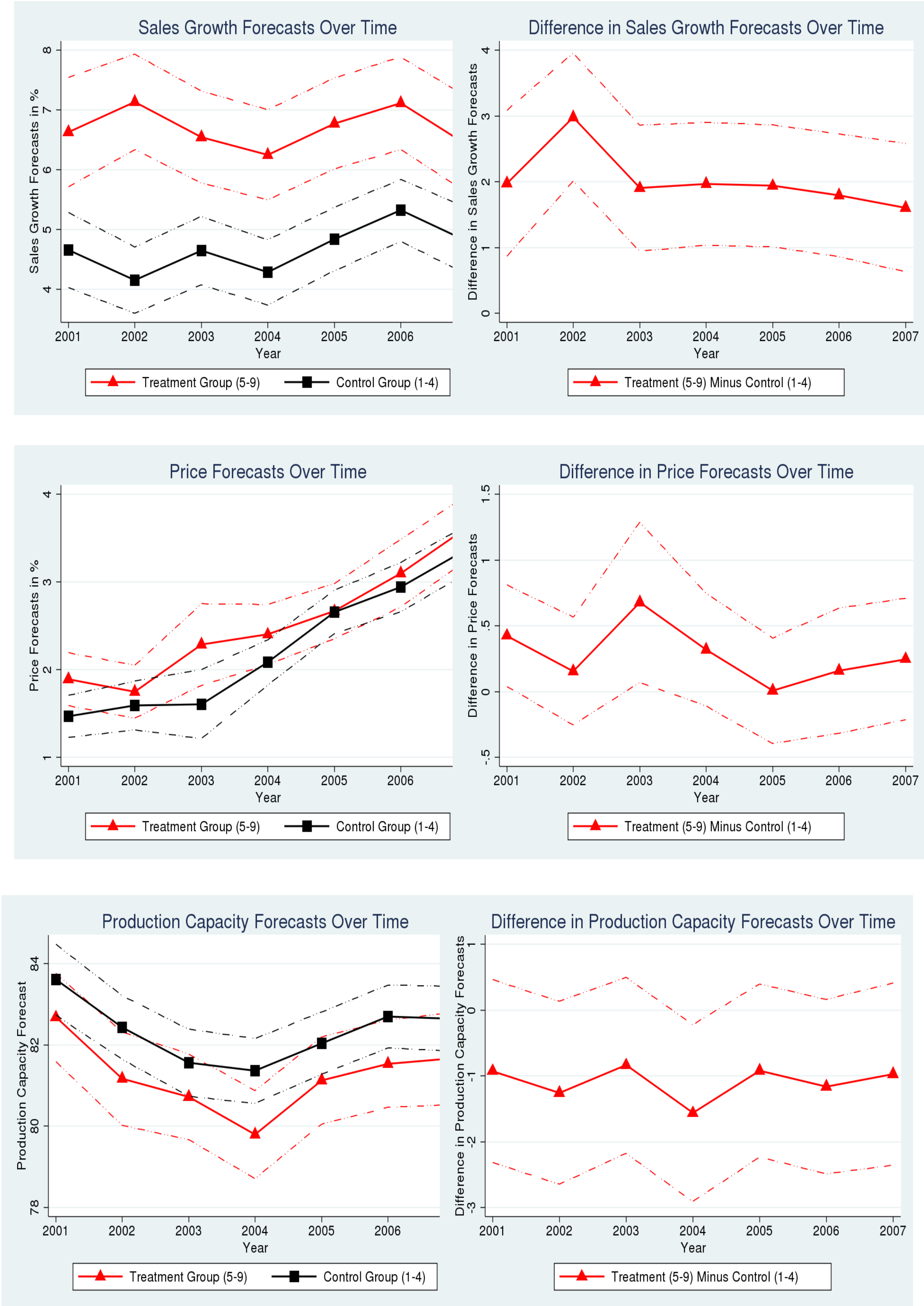
Table 5.5-9: Bank Composition

Dependent Variable: Interest Rates on Loans

	(1)	(2)	(3)
After Reorganization*Treatment	0.044***	0.044***	0.044***
	(0.016)	(0.016)	(0.016)
Interim Period*Treatment	0.004	0.004	0.004
	(0.014)	(0.014)	(0.014)
After Liquidation*Treatment	-0.045***	-0.045***	-0.045***
	(0.014)	(0.014)	(0.014)
Bank Composition	-0.016*		0.012
	(0.009)		(0.011)
# of Banks		-0.005	-0.026**
		(0.008)	(0.013)
Loan Controls: Guarantee, Maturity, Size, Financing Composition			
Firm Controls: Value Added, Leverage, Assets, Sales, Age, Ownership			
Firm*Bank FE	Yes	Yes	Yes
Quarterly FE	Yes	Yes	Yes
R-squared	0.559	0.559	0.559
N	183336	183336	183336

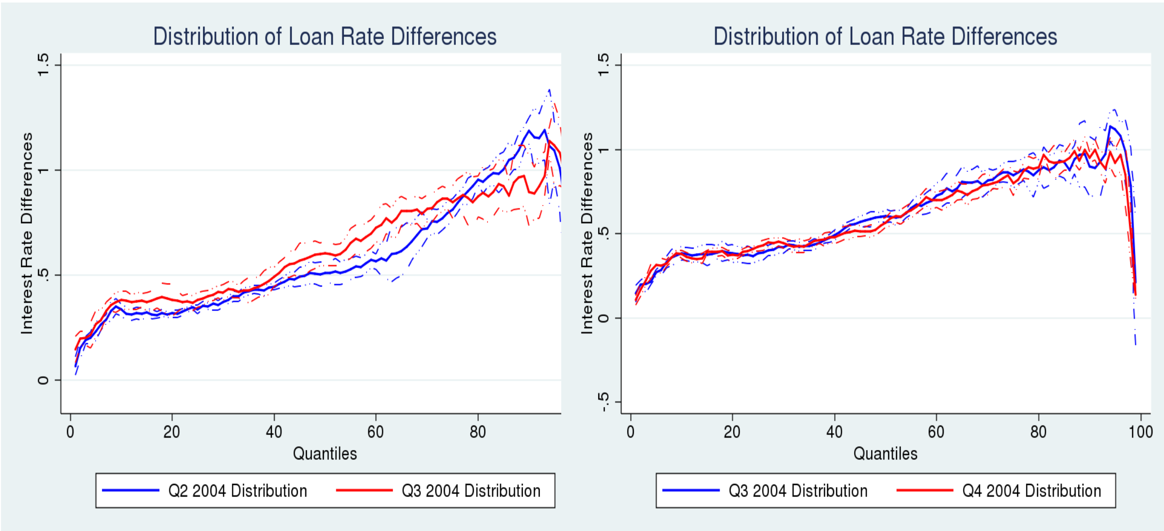
The table reports OLS estimation of the impact of the bankruptcy reforms on loan interest rates. All columns use the entire range of Score observations *After Reorganization* is a binary variable equal to 1 beginning in January 2005 (2005.Q1). *Interim Period* is a binary variable equal to 1 beginning in June 2005 (2005.Q3). *After Liquidation* is a binary variable equal to 1 beginning in January 2006 (2006.Q1). *Treatment* is a binary variable indicating whether the loan was made by a firm which had a Score above 4 in 2004. *Bank Composition* is a binary variable indicating whether the portfolio of bank relationships of the firm has changed. *# of Banks* is a binary variable indicating whether the number of bank relationships of the firm has changed. See Table 5.3-1 and 5.3-2 for the definition of the remaining variables. Omitted categories are "Unsecured" in the case of *Guarantees* and "Backed Loans/Tot.Fin." in the case of financing structure variables. Robust, firm clustered standard errors are reported in parentheses. ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

Figure 5.8: Differences-in-Differences Plot of CEO Forecasts



Note: The figure uses information from the Invind survey of manufacturing firms between 2001 and 2007. The left panels of the figure separately plot average forecasts for control firms (black line, square) and treated firm categories (red line, triangle). The right panels plot the difference in forecasts between the two groups of firms for each year. The top panels plot forecasts of sales growth, the middle panels forecasts of price changes, the bottom panels forecasts of productive capacity utilization.

Figure 5.9: Anticipation Effects in 2004?



Note: The figure plots interest rate differences at each percentile of the distribution of treatment and control groups. The left panel plots interest rate differences in the second quarter of 2004 (blue line) and the third quarter of 2004 (red line). The right panel these differences in the third quarter of 2004 (blue line) and the fourth quarter of 2004 (red line). We bootstrap the sample so as to estimate confidence intervals on the differences in interest rates.

5.6 Additional Evidence: Credit Constraints & Non-Price Effects

So far the focus of our analysis has been on the impact of the two bankruptcy procedures in terms of interest rates charged on a loan contract of an Italian small- or medium-sized enterprise. However, it is also possible that these procedures modified choices on non-price dimensions.

Credit Constraints The reform of the liquidation procedure is likely to have relaxed financing constraints and increased participation in the credit market. This was partly reflected in differences in magnitude and significance between our cross-sectional and fixed effects specifications. While within firm-bank, estimates identify the impact of the reforms using only observations of firms with continued access to banking finance, cross-sectional estimates allow for identification of firm observations observed only after the reforms. It is therefore not surprising that the increase in interest rates following the introduction of reorganization procedures was significantly smaller and statistically not significant in the cross section, while the decreases in interest rates after the liquidation were larger and statistically significant in the cross-sectional specification.

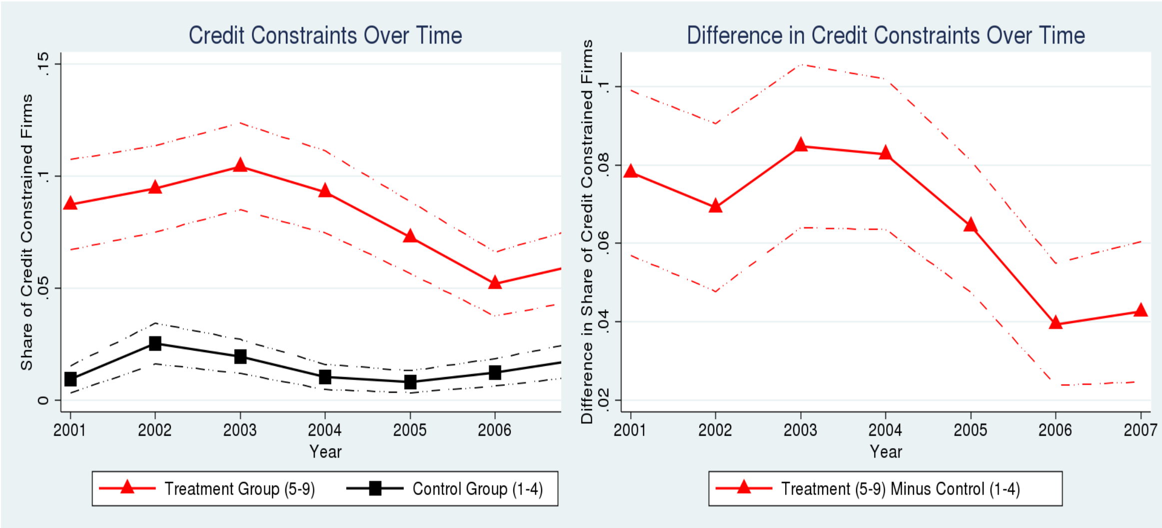
To further investigate the issue we use complementary information coming from Invind, the annual survey of manufacturing firms managed by the Bank of Italy. Although the survey is collected only for a subsample of approximately 1,500 firms it has the advantage of containing information about loan rejections, which is not provided in the Central Credit Register. More specifically, firms are asked whether they originally wanted more credit at current or higher interest rates, but were turned down. Following Guiso and Parigi (1999) we classify a firm as credit-constrained if it demanded more credit but was was rejected.[28]

Figure 5.10 plots the credit constraints of Italian manufacturing firms between 2001 and 2007. The left panel separately plots the share of credit-constrained control firms (black line, square) and the share of credit-constrained treatment firms (red line, triangle). The right panel plots the difference in the share of credit-constrained firms between the two groups of firms for each year.

Figure 5.10 shows that the share of credit-constrained firms significantly decreased after 2004 for the treatment group, but remained stable for the control group. Similar to Guiso and Parigi (1999), we find that before the bankruptcy reform, the share of credit-constrained firms in the treatment group was approximately 10%. This share decreased to around 5% in 2006 and 2007. The share of credit-constrained firms in the control group remained stable across time at around 1%. The left panel shows that the difference in the share of credit-constrained firms decreased by approximately four percentage points from 2001 to 2007, the bulk of

[28] Note that the concept of credit constraints is potentially broader. In principle it also includes those firms that were discouraged from applying in the first place. Since 2004, the Bank of Italy also includes a question on such implicit constraints. The results remain robust even with the inclusion of this more general definition of credit constraints.

Figure 5.10: Differences-in-Differences Plot of Credit Constraints



Note: The figure uses information from the Invind survey of manufacturing firms between 2001 and 2007. We classify a firm as credit-constrained if it demanded more credit but was was rejected. The left panel separately plots the share of credit-constrained control firms (black line, square) and the share of credit-constrained treatment firms (red line, triangle). The right panel plots the difference in the share of credit-constrained firms between the two groups of firms for each year.

the variation occurring in 2005/2006. In the Table 5.6-10 we show that the drop in credit constraints is statistically significant and not confounded by other factors. This result is particularly interesting because, by standard revealed preference argument, this change was welfare-enhancing.

Number of Bank Relations Our results, linking the benefits of both reforms to gains from creditor coordination, imply that the cost of multi-bank lending has decreased as a result of the reforms. We explore whether this implication is empirically verifiable.

The left panel of Figure 5.11 separately plots the average number of bank relations of control firms (black line, square), and the average number of bank relations of treated firms (red line, triangle). The right panel plots the difference in the average number of bank relations between the two groups of firms for each quarter.

Figure 5.11 shows that the number of bank relations of treated firms has increased significantly more than the bank relations of control firms. At the beginning of the sample period, the difference in the number of bank relations was around 0.25, but this difference increased to 0.4 at the end of the sample period. The increase in the relative number of bank relations occurs at the moment of the liquidation reform.

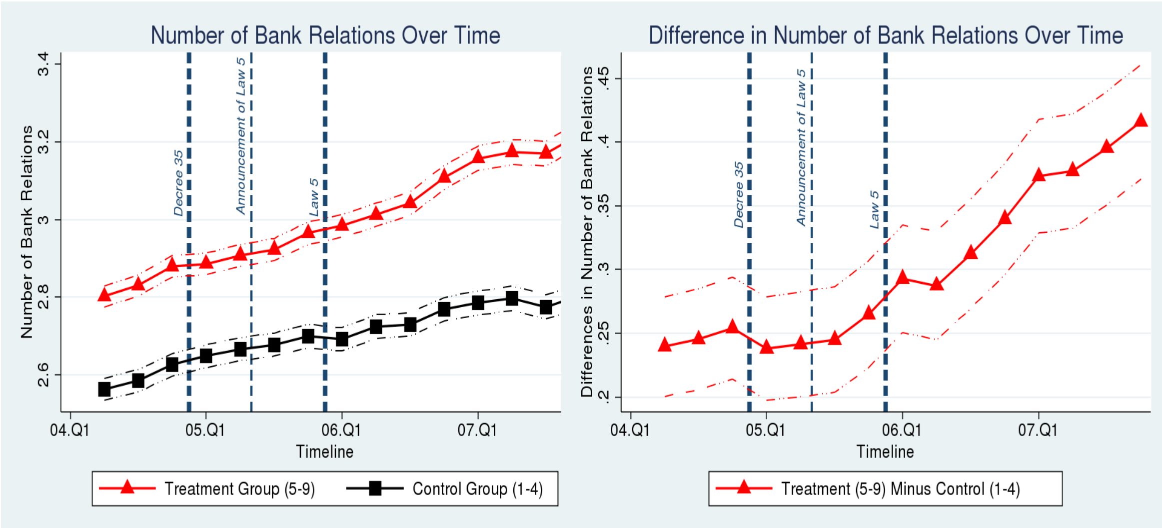
Table 5.6-10: Impact of Reforms on Credit Constraints

Dependent Variable: Is Credit Constrained

	No Covariates		Covariates	
	(1)	(2)	(3)	(4)
After 2004	-0.001	0.007	-0.004	0.007
	(0.005)	(0.006)	(0.008)	(0.010)
Treatment	0.079***		0.051***	
	(0.006)		(0.010)	
After*Treatment	-0.030***	-0.025***	-0.025**	-0.027**
	(0.008)	(0.008)	(0.010)	(0.011)
Leverage			0.066***	0.009
			(0.017)	(0.051)
Log Sales			-0.013***	-0.015
			(0.003)	(0.022)
Cash Stock			-0.034***	-0.041**
			(0.010)	(0.020)
Sales Forecast			0.001***	-0.000
			(0.000)	(0.000)
Firm*Bank FE	No	Yes	No	Yes
Quarterly FE	Yes	Yes	Yes	Yes
R-squared	0.029	0.003	0.034	0.005
N	14767	14767	7620	7620

The table reports OLS estimation of the impact of the bankruptcy reforms on the probability to credit constrained. *Credit Constrained* is defined as wanting more bank financing at current or slightly higher interest rates but having been rejected. *Treatment* is a binary variable indicating whether the loan was made by a firm which had a Score above 4 in 2004. *After 2004* is a binary variable equal to 1 beginning in January 2005. See Table 5.3-1 and 5.3-2 for the definition of the remaining variables. Robust, firm clustered standard errors are reported in parentheses. ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

Figure 5.11: Differences-in-Differences Plot of Number of Bank Relations



Note: The left panel separately plots the average number of bank relations of control firms (black line, square), and the average number of bank relations of treated firms (red line, triangle). The right panel plots the difference in the average number of bank relations between the two groups of firms for each quarter. Vertical lines represent legislative reforms that occurred in the first quarter of 2005 for Decree 35, and in the first quarter of 2006 for Law 5.

5.7 Conclusion

We contribute to the empirical analysis of bankruptcy by disentangling i) the impact of the introduction of a reorganization procedure from, ii) the impact of the liquidation design on the cost of debt finance borne by small- and medium-sized firms. We exploit the staggered nature of the Italian bankruptcy law reform of 2005 and 2006, and examine the impact of the legislation using a loan-level dataset covering the universe of firm funding contracts. We reach two major results. The first is that the introduction of reorganization in bankruptcy increases the cost of funding: this result is supported by the literature on incomplete contracts and renegotiation, which shows that granting a second chance to an entrepreneur in distress will translate into lower incentives for that entrepreneur to behave with care. The second result is that the reform of the liquidation procedure to reinforce banks' rights triggers a significant reduction of the cost of finance. Overall, we document that the reform of the Italian bankruptcy law has relaxed the share of credit-constrained entrepreneurs in the economy.

5.8 Appendix A: Data Organisation and Sample Selection

Our analysis focuses on manufacturing firms for the period 2004-2007. We organize our final sample in several steps.

The first step is to organize the information in the *Taxia* database. We take information on newly issued term loans (interest rates, loan size, and maturity) from the *Taxia* database and we match it with the guarantee information contained in the Central Credit Register to recover their guarantee status.[29] We drop all new loans with an amount smaller than 1,000 Euro and extreme percentiles of the term loan interest-rate distribution.[30] Then we associate the interest rates on credit lines (between a given bank and a given firm in a certain period) in the *Taxia* database with other characteristics of the firm-bank relationship, such as total amount of credit granted and utilized on the credit lines in the same period. We drop extreme percentiles of the credit lines interest-rate distribution. Finally, we drop the first quarter of 2004, since this is the first time data was collected on the credit-line level and is possibly subject to substantial measurement error.[31]

The second step is to harmonize the format of the Credit Register and the credit line data. We therefore organize the financial information on amounts, loan categories, and guarantees at the quarterly level. This leaves an unbalanced panel of firm-bank relations at the quarterly level observed over 15 periods, which are then matched with yearly balance sheet data. We then organize the balance-sheet data before merging them with the financial information of firms. We drop firms with incomplete balance sheets and profit and loss accounts, missing *Score*, with leverage above one or below 0. Since only small- and medium-sized firms were affected by the policy change we drop firm observations with more than 500 recorded employees.[32] Every year of balance-sheet data is matched with quarterly credit information. The final dataset is of quarterly frequency, and runs from the second quarter of 2004 to the last quarter of 2007, for a total of 202,964 firms and 1,097 banks.

5.9 Appendix B: Bankruptcy Codes in the United States and Europe

In the United States, Chapter 7 and Chapter 11 of the bankruptcy law provide the federal discipline that regulates corporate insolvency procedures. The objective of Chapter 11 is to protect a bankrupt firm from pressure from outsiders while it is coping with a process of rehabilitation. The entrepreneur can file unilaterally for Chapter 11 at the prospect of

[29] We do so by constructing an algorithm that tries to match a new loan from firm j with bank b in period t to the information on the same match in the same time period. The algorithm searches for a match to the exact amount of the new term loan in the Credit Register by comparing it to the total size of utilized and granted loans in a six-month window around period t. If the algorithm does not find an exact match then it searches for matches with first differences of utilized and granted loans in the same time window around the period t of the contract. Subsequently, we check the type of loan relationship between the bank and the firm in the Credit Register. Provided all the contracts between the bank and the firm have the same collateral status, we assume that the new term loan necessarily has the same collateral status (otherwise we would observe a distinct entry in the data). If we cannot find a match we create a residual "unmatched" category that should be interpreted as having a high probability of some type of collateral on the loan. Indeed, in the six-month window around the date of the new loan there is some kind of collateral agreement between the firm and the bank involved.

[30] For computational reasons, we focus on firms that have at most one loan per quarter with a given bank. In this way we drop 3% of all newly issued term loans.

[31] Results are robust to the inclusion of the first quarter.

[32] Firms above this threshold had access to a different set of procedures that were also reformed during the same period.

potential distress. Once in Chapter 11, the entrepreneur must devise a restructuring plan to be submitted to creditors.[33] Creditors can propose an alternative plan to the entrepreneur's and then vote on the restructuring project in a ballot described by a system of qualified majorities. By rejecting the plan, creditors can reverse the restructuring procedure into a Chapter 7 liquidation process.

The post-reform Italian reorganization procedure shares important features with Chapter 11. In both cases, the entrepreneur can open the reorganization phase unilaterally, conditional on court approval. Moreover, as in Chapter 11 the entrepreneur can stay in charge of the company while renegotiating with creditors. Finally, the decision over the restructuring plan is taken via a creditor vote. However, within Chapter 11 the judge has stronger supervision powers, for instance the firm can undertake new financial operations only under the approval of the judge. Moreover, the judge in Chapter 11 can decide whether to concede an extension to the period of time during which the entrepreneur can invoke the automatic stay and devise a restructuring plan, whereas in the Italian case the law does not impose any deadline.

In the early 2000s the European Commission tried to stimulate European adoption of bankruptcy codes inspired by Chapter 11.[34] Accordingly several countries have reformed their bankruptcy codes. However, we were particularly interested by the fact that the Italian policy reform came in piecemeal, over 2005-2006. This has allowed us to disentangle the effect of the new reorganization procedure from that of the new liquidation procedure. For example, in July 2005 the French legislator reformed corporate bankruptcy law by simultaneously introducing a new procedure of reorganization and strengthening creditors' enforcement rights. The fact that the two changes were implemented at the same time makes it difficult to distinguish the effects of each reform. Moreover, in September 2004, the reform of Spanish bankruptcy law introduced a unified court-supervised procedure whereby parties may settle before the liquidation phase starts, whereas in the pre-reform regime there were two separate avenues to deal with insolvency.

5.10 Appendix C: Additional table

[33] More specifically, entry into Chapter 11 opens the debtor-in-possession phase, during which the entrepreneur has the right to stop payments to existing investors (automatic stay) and also search for new funds. To facilitate this, the law prescribes that investors willing to finance bankrupt firms are privileged in the reimbursement of their claims at the end of the restructuring process, i.e., they can be repaid before (even senior) existing investors.

[34] The belief of the Commission was that a harsh approach to financial distress would deter risk-taking, experimentation, and innovation. See the website *http : //ec.europa.eu/enterprise/entrepreneurship/sme2chance/*.

Table 5.10-11: Actively Used Credit Lines

Dependent Variable: Interest Rates on Credit Lines

	All Firms		1-4 vs 7-9	
	(1)	(2)	(3)	(4)
After Reorganization*Treatment	0.067***	0.134***	0.063***	0.155***
	(0.020)	(0.016)	(0.022)	(0.017)
Interim Period*Treatment	0.014	0.028**	0.006	0.033**
	(0.017)	(0.014)	(0.018)	(0.015)
After Liquidation*Treatment	-0.084***	-0.054***	-0.150***	-0.088***
	(0.020)	(0.016)	(0.023)	(0.018)
Credit Line Controls: Amount Granted and Used				
Firm Controls: Value Added, Leverage, Assets, Sales, Age, Ownership				
Firm*Bank FE	No	Yes	No	Yes
Industry FE	Yes	-	Yes	-
Quarterly FE	Yes	Yes	Yes	Yes
R-squared	0.304	0.118	0.314	0.113
N	1046600	1028693	652228	640208

The table reports OLS estimation of the impact of the bankruptcy reforms on credit line interest rates for the subsample of firm-bank observations with non-zero overdraft use. Columns 1 and 2 use the entire range of Score observations. Columns 3 and 4 use the range of Score observations between 1-4 and 7-9. *After Reorganization* is a binary variable equal to 1 beginning in January 2005 (2005.Q1). *Interim Period* is a binary variable equal to 1 beginning in June 2005 (2005.Q3). *After Liquidation* is a binary variable equal to 1 beginning in January 2006 (2006.Q1). *Treatment* is a binary variable indicating whether the loan was made by a firm which had a Score above 4 in 2004. See Table 5.3-1 and 5.3-2 for the definition of the remaining variables. Omitted category is "Backed Loans/Tot.Fin." in the case of financing structure variables. Robust, firm clustered standard errors are reported in parentheses. ***, **, * denote significance at the 1, 5 and 10 percent levels, respectively.

Chapter 6

Poverty traps in a world of perfect credit markets: an efficiency wage explanation

6.1 Introduction

Starting from the work of Loury [1981] a vast literature has developed on the functional effects of wealth inequality on the economic system.[1] One main result is that both non-convex technology *and* credit market imperfections are necessary conditions for the emergence of an individual poverty trap[2].

The main assumption of this paper is that individuals' productivity increases with consumption. This reflects the idea that certain types of consumption activities can be viewed as investment in productivity[3]. It is assumed that this relationship has the usual properties of a neoclassical production function. Under this assumption, it is shown that an individual poverty trap may emerge even in a world with perfect credit markets. Even without borrowing constraints, each agent is subject to a lifetime resources constraint that depends on inherited initial wealth, and therefore is more stringent for the poor. When human wealth is a concave function of consumption, incentives to leave bequest are higher for rich agents than for poor ones, because for them bequest is cheaper in terms of consumption. Thus poor agents leave less bequest, and in the long run may be trapped in a low wealth-low efficiency equilibrium. The main result of the paper is to show that credit market imperfections are not a necessary condition for an individual poverty trap to emerge.

It is also shown here that the steady-state wealth distribution is determined by the initial

[1] I would like to thank Alberto Dalmazzo, Maitreesh Ghatak, Alex Michaelides, Debraj Ray, Astrid Winkler, Giulio Zanella and participants at the MES-S401 seminar for helpful discussions and comments.

[2] See Dasgupta / Ray [1986], Galor / Zeira [1993], Banerjee / Newman [1993], Moav [2002] for different models of poverty traps, and Banerjee [2001] for a discussion.

[3] This idea is at the basis of the first efficiency wages models, like Leibenstein [1957]. This relation is not to be interpreted as only a nutrition story: "consumption" could also include health services. For a survey on empirical evidence on the issue, see Strauss / Thomas [1995, 1998].

distribution of wealth. Thus one-shot changes in wealth distribution will have persistent effects on aggregate labor productivity. This is a widely accepted result in the literature, but the main policy implication is strikingly different: while in the literature the focus is on credit markets enhancing policies[4], this paper argues that redistribution is the only way to improve the long term outcome of the economy.

This paper is most closely related to the work by Dasgupta / Ray [1986], where the assumption that productivity is affected by consumption is used to analyze the equilibrium in the labour market in a static model. The main difference from this paper is that, given the static framework, the issue of steady state wealth distribution is not addressed and there is no role for the credit market. Ray / Streufert [1993] instead introduce similar ideas in a dynamic setting, but they do not allow their agents to run into debt, thereby assuming credit market imperfections. Other related work is that of Funk / Vogel [2003], which uses a dynamic model with perfect capital markets and where investment requires a minimum amount of resources, to analyze the issue of persistent inequality. They do not, however, address the issue of poverty traps.

The setting of this paper is also similar to the work of Gersovitz [1983] and Moav [2002]. Gersovitz [1983] uses a two period model akin to the short run decision in this paper, to show that average propensity to save can increase with income; but he does not explore the long run implications. Moav [2002] generates a poverty trap by assuming that bequest is a luxury good in a world with credit market imperfections and convex technology. This work is different in that it assumes perfect credit market and non-convexities in technology.

6.2 The model

A small, open, one-good economy with non-overlapping generations is considered. Capital is perfectly mobile while labor can not move across countries. Time is discrete and there is perfect competition in all markets. There is no uncertainty.

6.2.1 Production

In this economy the good is produced by a representative firm that operates in perfect competitive factor and good markets and uses capital (K) and efficiency of labor (H) according to a standard neoclassical production function[5]:

$$Y = F(K, H) \tag{6.2-1}$$

[4] See Banerjee [2001] for a discussion.

[5] Following Galor / Zeira [1993] and Moav [2002] we assume that individuals' investment decisions are taken before production takes place. Thus firm takes H as given.

Given perfect capital mobility, perfect competition and constant returns to scale, the first-order conditions of the firm's optimization problem uniquely determines the capital-labor ratio (K/H) and the wage per unit of efficiency of labor, w[6].

6.2.2 Individuals

At any date (t) a generation of individuals is alive. Agents are identical with respect to preferences, investment opportunity, and access to credit. They differ according to inherited wealth, a_t. $G_t(\cdot)$ is the distribution of wealth in period t. Given perfect credit markets, agents can freely reallocate their resources across periods of life, thus to simplify the analysis we abstract from intertemporal consumption choice. Agents live for a single period, enjoy consumption at the beginning of the period and bequest at the end. Each agent has only one child, thus population is stable.

Preferences The agents derive utility from consumption c and from bequest b[7]. Individuals' preferences are represented by the following Cobb-Douglas utility function

$$U(c,b) = \log c + \beta \log b \tag{6.2-2}$$

Resources constraint Each generation is subject to the following resources constraint

$$c + \frac{b}{R} = a + HW \tag{6.2-3}$$

where a is financial wealth and HW is human wealth and $R = 1 + r$ is the interest factor. This formulation of the budget constraint, together with the preferences (6.2-2), implies that the assumption that agents do not leave debt to future generations. Below we discuss how the main results of the paper still hold under more general preferences and intergenerational borrowing.

Human wealth As in efficiency wage models, consumption determines how productive the agents are, and thus their human wealth. The simplest possible concave technology for the transformation of consumption in human wealth is assumed. Human wealth takes the following piece-wise linear formulation

$$HW = y(c) = \begin{cases} = y_0 + \gamma c & \text{if } c \leq c_1 \\ = y_0 + \gamma c_1 & \text{if } c \geq c_1 \end{cases} \tag{6.2-4}$$

[6] Given perfect capital mobility, capital adjusts to satisfy the FOC for the firm $F_1(K,H) = F_1(K/H,1) = r$. Thus r uniquely determines K/H, that uniquely determines w. We normalize $w = 1$.

[7] This is a common assumption in the literature. Below we discuss how the main results of the paper hold if this assumption is relaxed. See Banerjee [2001] for a discussion.

where $\gamma < 1$[8]. Our formulation can be interpreted as a reduced form of a complex investment decision that affects agent's productivity like in Galor / Zeira [1993] and Moav [2002]. At the beginning of every period all agents have access to an investment opportunity, by paying a fixed cost I, that determines their efficiency unit of labor with a return that depends on consumption[9].

6.2.3 The maximization problem

Substituting (6.2-4) into (6.2-3) we get the following resource constraint:

$$b = \begin{cases} = R\left[a + y_0 + (\gamma - 1)\, c\right] & \text{if } c \leq c_1 \\ = R\left[a + y_0 + \gamma c_1 - c\right] & \text{if } c \geq c_1 \end{cases} \tag{6.2-5}$$

Note that the relative price of consumption in terms of bequest is R if $c \geq c_1$, and $(1-\gamma)\, R$ if $c \leq c_1$.

Each generation maximizes utility (6.2-2) subject to (6.2-5). The optimal solution is

$$c^* = \begin{cases} \frac{1}{(1-\gamma)(1+\beta)} (a + y_0) & \text{if } a \leq a_1 \\ c_1 & \text{if } a_1 \leq a \leq a_2 \\ \frac{1}{1+\beta} \left[a + y_0 + \gamma c_1\right] & \text{if } a_2 \leq a \end{cases}$$

for consumption, and

$$b^* = \begin{cases} \frac{R\beta}{(1+\beta)} (a + y_0) & \text{if } a \leq a_1 \\ R\left[a + y_0 + (\gamma - 1)\, c_1\right] & \text{if } a_1 \leq a \leq a_2 \\ \frac{R\beta}{1+\beta} \left[a + y_0 + \gamma c_1\right] & \text{if } a_2 \leq a \end{cases}$$

for bequest, where $a_1 = c_1\left[(1-\gamma)(1+\beta)\right] - y_0$ and $a_2 = c_1\left[(1+\beta) - \gamma\right] - y_0$.

The result is due to the piece-wise linear formulation of $y(c)$. For a general function $y(c)$ with $y'(c) > 0$ and $y''(c) < 0$ the FOC for an interior solution is

$$MRS = \frac{b}{c\beta} = R\left[1 - y'(c)\right] \tag{6.2-6}$$

Equation (6.2-6) underlines the basic intuition behind the result: higher wealth implies higher consumption, and lower $y'(c)$. The cost of leaving bequests in terms of consumption, $-R\left[1 - y'(c)\right]$, is lower for rich than for poor agents. Thus rich agents will tend to leave relatively more bequest[10].

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[8] Linearity is assumed only for simplicity. Instead we restrict to $\gamma < 1$ because the consumer will only choose an allocation such as $y'(c) < 1$. The main results of the paper do not depend on either of these assumptions.

[9] If there were credit markets imperfections, poor agents would be prevented from the investment opportunity by the fixed cost I. This does not happen in this model.

[10] See Gersovitz [1983] for a formal proof. In this general setting a poverty trap can emerge if human wealth is

6.2.4 The steady-state equilibrium: the poverty trap

Given demographic assumptions, across generations $a_{t+1} = b_t$ holds. Thus the evolution of wealth can be represented by the following difference equation

$$a_{t+1} = b_t^* = \begin{cases} \frac{R\beta}{1+\beta}(a_t + y_0) & \text{if } a_t \leq a_1 \\ R\left[a_t + y_0 + (\gamma - 1) c_1\right] & \text{if } a_1 \leq a_t \leq a_2 \\ \frac{R\beta}{1+\beta}\left[a_t + y_0 + \gamma c_1\right] & \text{if } a_t \geq a_2 \end{cases} \tag{6.2-7}$$

In what follows we will assume that $R < 1 + 1/\beta$. If this does not hold, bequest is so cheap in terms of consumption that wealth level would never converge[11]. If Figure 6.1 represents the the evolution of wealth (6.2-7), then a poverty trap emerges:

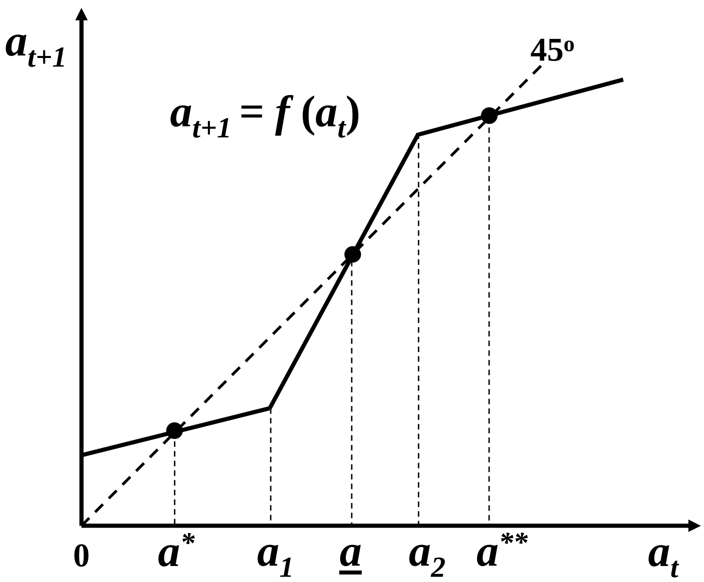

Figure 6.1: The evolution of individual wealth

the agents born poor, with initial wealth $a < \underline{a} = [(1-\gamma) c_1 - y_0] R/(R-1)$ will become poor in steady-state, with a wealth level $a^* = y_0 [1 + \beta (1 - R)] / (1 + \beta)$. Instead rich agents $(a > \underline{a})$ will end up in the high steady state wealth level $a^{**} = (y_0 + \gamma c_1) [1 + \beta (1 - R)] / (1 + \beta)$.

assumed (similarly to Dasgupta and Ray, 1986) to be a non-concave function of consumption like

$$y(c) = \begin{cases} 0 & if\ c < c_0 \\ \tilde{y}(c - c_0) & if\ c \geq c_0 \end{cases}$$

with $\tilde{y}(0) = 0$, $\tilde{y}'(c) > 0$ and $\tilde{y}''(c) < 0$.

[11] This is a common assumption in the literature, see Galor / Zeira [1993].

By examination of Figure 6.1, it is clear that the conditions for a poverty trap to emerge are:

- $a_1 < \underline{a}$: this implies $c_1/y_0 > 1/\left[(1-\gamma)(1+\beta-\beta R)\right]$. In words, this says that c_1 must be big with respect to y_0 otherwise no agent remains trapped;

- $a_2 > \underline{a}$: if γ is big enough, $\gamma > (1+\beta-\beta R)$, this condition reduces to $c_1/y_0 > 0$ which is always satisfied. If γ is small the condition implies $c_1/y_0 < 1/(1+\beta-\beta R-\gamma)$. In words, this means that bequests are not too costly in terms of consumption and thus some of the agents will manage to escape poverty.

Under these conditions the steady-state equilibrium depends on the initial distribution of wealth $G_0(\cdot)$. In steady-state the number of poor is $Poor = \int_0^{\underline{a}} dG_0(a)$, the number of agents initially below the threshold wealth level $\underline{a}$, while the rich are $Rich = \int_{\underline{a}}^{\infty} dG_0(a)$. Since $a^* < a_1$, poor agents consume less than c_1, so their efficiency of labor is less than the rich one. Efficiency of labor in the economy could be improved by a one-shot redistribution policy that allows some agents to overcome the threshold without allowing anybody to fall below[12].

6.3 Conclusions

In this note it is shown that, contrary to what is considered in the literature, an individual poverty trap may arise even in an economy without credit market imperfections. Under the assumption that the productivity of agents depends on their consumption, poor agents may be stuck in a low wealth-low productivity equilibrium. Moreover one-shot redistributing policies improve aggregate efficiency of labor in steady state. This result is common in the individual poverty trap literature, but in this case the policy implications are strikingly different. While a poverty trap generated by credit market imperfections calls both for improvements of credit markets (titling of assets, microfinance programs, reform of legal system, credit scores...) and for redistribution, the latter is usually considered to be socially too costly. Instead, in this model redistribution is indeed the only way to improve steady state efficiency of labor in the economy.

[12] These results are robust to a general specification that allows for both dynastic preferences and perfect credit markets between generations, that were implicitly ruled out by equations (6.2-2) and (6.2-3). In this setting the time allocation of income across generations is irrelevant for their decisions. Thus we can collapse the infinite horizon problem into a static problem of the form

$$\begin{aligned} &\max_c u(c) \\ &s.t. \quad c = a + y(c) \end{aligned}$$

which has a corner solution $c = a + y(c)$. This implicitly defines a concave relation between a and c. Thus an egalitarian redistribution of wealth increases average consumption and thus productivity.

Author Index

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