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ESSAYS ON DEFAULT, ENTREPRENEURSHIP, AND INSTITUTIONAL ARRANGEMENTS

by

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Si no escalas la montaña,
jamás podrás disfrutar del paisaje. Neftalí Reyes B.

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ABSTRACT

This dissertation consists of three chapters on the implications of the personal default option on the economy. In the first two chapters, I analyze how credit constraints faced by entrepreneurs are shaped by the legal environment for default that they face. In the third chapter, I explore the welfare implications of allowing financial intermediaries to charge different interest rates according to perceived probabilities of consumer bankruptcy. In the first chapter, I build a model where agents can pick a career and decide whether to default on their mortgage. The purpose of this model is to analyze the interaction between these decisions and the existence of different legal environments, regarding the degree of recourse that lenders have over the borrowers' assets. The model yields three basic predictions. First, as lenders have more recourse, the cost of default for the borrower increases and default becomes less frequent. Second, as lenders have more recourse, the entrepreneurship threshold (i.e. the amount of home equity a homeowner requires to become an entrepreneur) also increases. Third, where lenders have relatively less recourse, the size of the entrepreneurship threshold reduction due to a house price increase is larger.

In the second chapter I test the validity of the third prediction of the model, which encompasses the other two. Using U.S. data, I find that the margins of creation for small young firms responded strongly to the increase in house prices between 2000 and 2007. This effect was driven by those areas where mortgage default is relatively less costly (less recourse). This link between house prices and entrepreneurial activity becomes weaker

after the Great Recession.

The third chapter explores the effects of allowing financial intermediaries to charge different interest rates according to the debt profile of agents. It also studies the welfare implications of different bankruptcy schemes and those associated with removing the default option. My findings indicate that allowing for price discrimination and removing the bankruptcy option are both desirable. However, the welfare gain from a more stringent bankruptcy regulation is negligible compared to those of removing the bankruptcy option and allowing discrimination.

Contents

List of Tables

List of Figures

List of Abbreviations

BDS	.....	Business Dynamics Statistics
CBO	.....	Congressional Budget Office
CDF	.....	Cumulative Distribution Function
CRRA	.....	Constant Relative Risk Aversion
FMHPI	.....	Freddie Mac House Price Index
Fn.	.....	Function
LBD	.....	Longitudinal Business Database
NAICS	.....	North American Industry Classification System
PDF	.....	Probability Density Function
PUMS	.....	Public Use Microdata Sample
SBO	.....	Survey of Business Owners
SUSB	.....	Statistics of United States Businesses Survey
U.S.	.....	United States
USFN	.....	United States Foreclosure Network

List of Symbols

*	.....	$p - value < 0.1$
**	.....	$p - value < 0.05$
***	.....	$p - value < 0.01$

Chapter 1

House Prices, Entrepreneurship, and the Cost of Default: A Model

1.1 Introduction

This chapter provides evidence that new entrepreneurs face credit constraints, which are shaped by the legal environment where they operate. In particular, mortgage default regulation in the geographical area where an entrepreneur plans to start a new business, determines the amount of capital the entrant requires. This is due to the insurance role mortgage default regulation can play in case of financial distress. Using MSA-level data for the US, we find that both the intensive and extensive margins of creation for small young firms responded strongly to the increase in house prices between 2000 and 2007. This effect is driven by those areas where mortgage default is relatively less costly and by those industries where the amount of required start-up capital is low. This link between house prices and entrepreneurial activity is almost non-existent after the onset of the Great Recession. A stylized career choice model with housing, illustrates the insurance role that a lower cost of default plays for entrepreneurs and how it shapes their entry decision.

Several theories have suggested that the relaxation of credit constraints can have significant effects on economic growth. Among others, Bernanke and Gertler [1989] and Kiyotaki and Moore [1997] propose theories that build upon the basic idea that higher net worth reduces lower financing costs of real capital investments. In these economies, capital is both a production input and a collateral for loans. Kiyotaki and Moore [1997] emphasize the role of secured debt and enforcement. When lenders cannot force borrowers to repay, durable assets become crucial as collateral, therefore the price of collateralized assets turns

into a relevant quantity determining the tightness of credit constraints. The authors find that the dynamic interaction between credit limits and asset prices turns out to be a powerful transmission mechanism by which the effects of shocks persist, amplify, and spread out.

In particular, testing for the empirical relevance of the collateral channel enunciated in the theories above has proven to be a challenging task. For firms, Gertler and Gilchrist [1994] find a disproportionate response of small firms to monetary policy tightening compared to that of large firms. Oliner and Rudebusch [1992] conduct a similar test using investment data for firms of different sizes, their findings suggest that small firms' investment decisions are more responsive to changes in the monetary policy stance than their large counterparts. While there is unquestionable value in these early attempts to validate the relevance of the collateral channel, the usage of aggregate data leaves open the possibility for some other underlying mechanism being behind the results. According to Kashyap and Stein [1994], it could be the case that for technological reasons, small firms are more sensitive to recessions than larger firms.

1.2 Literature Review

Our work is related to three strands of literature. First, mortgage default. Second, financial constraints. Third, institutional arrangements. Our main contribution is to the literature on credit constraints and entrepreneurship. We also contribute to the study on the link between homeownership and labor market outcomes. Finally, our work is related to the literature studying the effect of mortgage default regulation on the decision taking process of agents. We build upon the work of Evans and Jovanovic [1989] and Hatchondo et al. [2015] when setting up our structural model, and upon the work of Adelino et al. [2015] and Ghent and Kudlyak [2011] for our empirical verification exercises.

1.3 Background

1.3.1 Mortgage Market in the US

Mortgage lending is a major sector in the United States with many institutions and individuals taking part in it. This market is broken down into two connected entities: the primary and secondary mortgage markets. The primary market is where new mortgages are originated, i.e. the process by which a new mortgage is secured by a borrower. The secondary mortgage market is where existing mortgages are bought and sold between lenders and investors. Historically, the secondary mortgage market was relatively small and inactive. Two Government Sponsored Enterprises (GSEs) created by the United States Congress, the Federal National Mortgage Association (Fannie Mae) and the Federal Home Loan Mortgage Corporation (Freddie Mac), have changed that. When a consumer obtains a conforming home loan[1], that loan is underwritten[2], funded and serviced by a bank or lending institution. This financial institution will often sell the loan to a GSE (or a fully private agency), which in turn will package several similar loans into a mortgage-backed security (MBS). These securities are then sold to investors in the secondary market.

The GSEs are privately owned but publicly chartered companies. They are called government-sponsored enterprises because the government places looser restrictions on them relative to fully private companies. Also, GSE securities carry no explicit government guarantee of creditworthiness, however there exists an implicit guarantee that the government would not allow such important institutions to fail or default on debt. This implicit guarantee translates into lower funding costs for these institutions, Sherlund [2008] estimates the jumbo-conforming spread to be between 13 to 24 basis points using data from the Federal Housing Finance Board's Monthly Interest Rate Survey from January 1993 to

[1]The usual requirement for a loan to be considered conforming is its size, which as of 2016 should not exceed $417,000 for single family homes in the continental US. Other requirements include borrower's loan-to-value ratio, debt-to-income ratio, credit score and history, documentation requirements, etc. Above this amount limit, a mortgage is considered a jumbo loan, and typically has higher rates associated with it since a GSE cannot package it.

[2]Underwriting is the process a lender uses to determine if the risk of offering a mortgage loan to a particular borrower under certain parameters is acceptable.

June 2007. This difference is attributed to both the implicit guarantee and the scale of the GSE market. The implicit guarantee on GSEs became explicit when in September 2008 the Federal Housing Finance Agency (FHFA) placed Fannie Mae and Freddie Mac into conservatorship run by the FHFA. GSEs issue debt and use the proceeds from the sale of their debt to purchase mortgages. Because of changes in regulation affecting Fannie Mae and Freddie Mac[3] and the increased sophistication of U.S. financial markets, the secondary market in residential mortgages expanded rapidly in the 1990s. The growth of the secondary market has resulted in increased specialization in mortgage finance. It is now frequently the case that the originator of the loan does not hold it until maturity, but instead they sell it to investors through the secondary market.

The alternative secondary market for mortgages is known as the Non-agency or private mortgage-backed security market. In this market, loans that do not meet the standards of the GSEs are purchased, bundled, and sold to investors in the form of securities. This includes jumbo mortgages[4], subprime mortgages[5], and Alt-A mortgages[6]. Unlike investors in GSE securities, these agents do not receive any guarantees against losses of principal and interest on the loans underlying the securities. Therefore, they must accurately price both the risk of default and the risk of early prepayment.

Figure 1·1 shows the recent evolution of MBS issuance, separated by issuer (Fannie

[3]In 1992 the Housing and Community Development Act amended the charter of Fannie Mae and Freddie Mac. One major change in this new regulation was that the GSEs were required for the first time to meet mortgage purchase goals, these are set annually by the Department of Housing and Urban Development (HUD) and approved by Congress. The initial annual goal for low-income and moderate-income mortgage purchases for each GSE was 30% of the total number of dwelling units financed by mortgage purchases and increased to 55% by 2007. During the late 1990s, GSEs entered the subprime mortgage market by easing credit requirements on the mortgages they were willing to purchase.

[4]As of 2016, a loan is considered a jumbo loan if it exceeds $417,000 for a single family home in the continental US.

[5]Subprime borrowers typically have weakened credit histories that include payment delinquencies, and possibly more severe problems such as charge-offs, judgments, and bankruptcies. They may also display reduced repayment capacity as measured by credit scores, debt-to-income ratios, or other criteria that may encompass borrowers with incomplete credit histories. Subprime loans are loans to borrowers displaying one or more of these characteristics at the time of origination or purchase. Such loans have a higher risk of default than loans to prime borrowers

[6]Short for Alternative-A paper. These are loans for borrowers with a good credit score who provide less than full documentation, high loan to value ratio, or other loan characteristic that deems them as more risky than prime borrowers but less risky than subprime.

Mae and Freddie Mac combined, and Ginnie Mae[7]) and non-agency issuers. The former predominated through 2003, as those entities together comprised almost 80 percent of the MBS market. After 2003, coinciding with the rise in house prices (Figures 2·1 and 1·3), we can also see the surge in Non-agency MBS issuance. These agencies increased its market share up to 60 percent by 2006. The rise in private issuance, largely associated with subprime lending, was dependent upon secondary market appetite for higher yielding subprime mortgage debt. As house prices began to decline, also did the share of MBS issued with a private label. Since 2008, the demand for subprime MBS plummeted essentially to zero in the wake of the evidenced and severe nonperformance issues of subprime loans. As shown in Figure 1·1, as of 2014, the mortgage securitization market is largely limited to GSEs.

1.3.2 Default and Foreclosure Laws in the US

The literature generally views mortgage default as the exercise of a put option by the mortgagor, an early effort in this line is that of Asay [1978]. The author uses the Black-Scholes model to price mortgages, where prepayment is treated as an American call option and default as a put option. Whether this put option is in-the-money depends on a number of factors, including home equity and default costs among others. This option view of mortgage default suggests that borrowers may choose to exercise it the moment home equity turns negative[8], this is called "ruthless" or strategic default. The term was coined by Foster and Van Order [1984]. Two added elements to the pure option framework, needed to reconcile this type of model with the data, are the existence of transaction costs

[7]Ginnie Mae, formerly known as the Government National Mortgage Association, is different to Freddie Mac and Fannie Mae in at least two ways. First, the securities it issues are the only MBS that have an explicit government guarantee since it is not a GSE, but a wholly owned government corporation. Second, Ginnie Mae guarantees only securities backed by single-family and multifamily loans insured by government agencies, including the FHA, Department of Veterans Affairs, the Department of Housing and Urban Development's Office of Public and Indian Housing and the Department of Agriculture's Rural Development.

[8]Foster and Van Order [1984] originally suggested proxying the mortgage value as the discounted sum of the future payments using the current interest rate. Due to interest rate changes over time this could differ from computing home equity in the usual way, i.e. as the difference between the market value of a house and the outstanding debt associated to it.

and a trigger event such as an income shock (e.g. unemployment) or cost shock (e.g. health related expenditure). This approach has been called the "non-ruthless" default or default underexercise, where negative equity by itself is not a sufficient condition for default. The trigger event, along with the existence of negative equity, seem to better explain the occurrence of default in the data as Elul [2006] discusses. See Vandell [1995] for a survey on the different theoretical approaches to mortgage default. Our approach to modeling the default decision in Section 1.4 will be that of non-ruthless default, where negative equity by itself is not enough to trigger the default decision, this modeling choice is motivated by the findings of Gerardi et al. [2015] and Guiso et al. [2009] among others. Gerardi et al. [2015], using data from the Panel Study of Income Dynamics (PSID), find that over 80 percent of defaulting households experienced some form of shock to their cash flow prior to default. Guiso et al. [2009], using survey data find that less than a third of observed mortgage defaults are strategic or ruthless, and that borrowers would be willing to be at least 10 percent "underwater" and still would not default due to relocation costs and moral considerations.

When a borrower chooses to default on a mortgage loan, lenders typically will try to avoid a litigious and costly foreclosure. Usually when foreclosure is unavoidable, the lenders will have in their best interest expediting the process[9]. According to Ghent and Kudlyak [2011] there are several reasons for this preference. First, properties depreciate rapidly when the borrower is in default since there is no incentive for the mortgagor to maintain the property. Second, properties usually sell at a discount price in foreclosure sales. Third, there seems to be a negative spillover effect on the price of units located nearby a foreclosed house, as argued in Giglio et al. [2011].

Besides the foreclosure alternative, there are at least three lender-friendly ways for a borrower to default: a short sale, a voluntary conveyance, or a simple agreement not to contest the foreclosure. Under a conventional foreclosure process, the lender is allowed to recover fully or partially (depending on the degree of recourse over the borrower) the

[9]See Brueggeman and Fisher [2008].

amount owed on a defaulted loan by selling or taking ownership of the property securing the loan. The foreclosure process begins when a borrower defaults on loan payments and the lender files a public default notice. Properties repossessed by the lender are also known as bank-owned or REO properties (Real Estate Owned by the lender). In a short sale, the borrower finds a buyer for the property who pays a purchase price that is less than the full balance of the debt owed. The lender agrees to waive his right to a deficiency in exchange for the borrower selling the property and remitting the proceeds to the lender. In a voluntary conveyance, the borrower hands over the deed to the property to the lender. In the most common form of voluntary conveyancea deed in lieuthe lender forgives the debt owed in exchange for the deed. In addition to eliminating the risk of the lender pursuing a deficiency judgment, a deed in lieu may affect a borrowers future access to credit less severely than a forcible eviction. Finally, in a friendly foreclosure, the borrower agrees to not contest the foreclosure, and to submit to the jurisdiction of the court in terms of leaving the property and cooperating with the lender. This option takes more time than a voluntary conveyance but is less time-consuming than a standard foreclosure[10].

When a lender forecloses on a mortgage, the debt might exceed the amount that the lender recovers through the foreclosure sale. In states classified as non-recourse the creditor cannot seek a judgment against the debtor to recover this difference, also called deficiency. Recourse states allow lenders to seek a deficiency judgment against the debtor. The length of time it takes a lender to foreclose, and also how much recourse they have over the debtor varies by state. In those states where the lender has recourse over the debtor, the former can choose to take action during the foreclosure process to recover the mortgage debt. If the lender is unable to satisfy the balance of the loan by foreclosing on and selling the home, it can then sue the borrower to recover that balance. If the lender wins the lawsuit and obtains a deficiency judgment against the borrower, the lender will then be able to collect on that judgment by garnishing the borrower's wages or levying its bank accounts. If a borrower defaults on a non-recourse loan, the lender is limited to foreclosing on the

[10]See Brueggeman and Fisher [2008] for more details on the operation of each of these alternatives.

home to satisfy the debt. Even if the lender recovers just a small portion of the outstanding mortgage debt, the creditor has no further recourse and cannot obtain a personal judgment against the borrower. Also, the tax treatment in the case of short sales differs depending on the degree of recourse. The deficiency for which the mortgagor is not liable in a non-recourse state can be taxable, however the Mortgage Forgiveness Debt Relief Act of 2007 generally allows taxpayers to exclude income from the discharge of debt on their principal residence. Debt reduced through mortgage restructuring, as well as mortgage debt forgiven in connection with a foreclosure, qualify for this relief. In our work we will abstract from the tax dimension of default, however a quantitative model should consider the relevance of this element, for more details on taxation of capital gains on home sales see Shan [2011]. From the borrower's point of view, once a deficiency judgment is granted to the creditor, the only way to escape liability is to file for bankruptcy. In Chapter 7 bankruptcy the borrower can discharge the deficiency, while in Chapter 13 bankruptcy the borrower must usually pay a fraction of the owed amount. For a more in depth review on the legal aspects of default and its interaction with bankruptcy, see Li and Oswald [2014] and Ghent and Kudlyak [2011].

It is not direct to classify states as strictly recourse or non-recourse. Many of them allow deficiency judgments under certain conditions, for certain types of property or foreclosure proceedings. Moreover, many states restrict not only the conditions under which deficiency judgments are allowed but the maximum recovery for the creditors. An additional source of heterogeneity stems from the fact that, in states that permit deficiency judgments, usually the lender must credit the borrower's account for the fair market value of the property rather than the actual foreclosure sale price. This restriction usually increases legal costs and time spent pursuing a deficiency. The nature of the costs and timeline depend on state statutes governing the determination of fair market value. In some states, a single appraiser determines fair market value, while in others, such as Minnesota, fair market value must be determined by a jury. States also differ in how easy it is for the borrower to contest the fair market value assigned to the property. In other states, substantial personal

property or wages are exempt from collection on the deficiency. In practice, lenders have less recourse in states with long judicial foreclosure processes prior to obtaining a deficiency judgment than in those states characterized by a quicker, non-judicial foreclosure process.

It is also important to consider that the lender has the option to pursue a deficiency judgment. However, it may choose not no execute it due to factors enumerated above and the costs associated with the legal process. All of these elements generate a wide array of degrees of recourse among states, which are not easy to measure (most of these elements are summarized in Table 2.5), that ultimately shape the decisions of both creditors and borrowers. Through the rest of our work, we will focus on the recourse classification of states due to its intuitive appeal, its relevance in the mortgage default regulation, binary nature, and since it is straightforward to translate it into a non-linear budget constraint. The recourse status is a binary categorization where a state is classified as either recourse or non-recourse regarding mortgage loans. In future work we plan to further exploit this variation, by either defining more categories or using a continuous variable that captures the extent to which a lender has recourse in a given state.

All of the above refers to the original mortgage loan which financed the purchase of a real estate, also known as first mortgage. Borrowers can also use their home equity as collateral in order to get a new loan, or second mortgage. A second mortgage is a lien on a property which is subordinate to a more senior mortgage or loan. There are three types of financial instruments within the second mortgage category: home equity loans, Home Equity Lines of Credit (HELOCs) and cash-out refinances. With a home equity loan, the interest rate is usually fixed and monthly payments include both interest and principal. The loan is received as a lump sum one-time amount and no additional money can be drawn from the loan. A HELOC is structured as revolving credit, giving the borrower the option to make a payment lower than the interest charged each month (as with a credit card). HELOCs differ from conventional home equity loans in that the borrower is not advanced the entire sum up front, but uses a line of credit to borrow sums that total no more than the credit limit, similar to a credit card. The full principal amount is due at the end of the

draw period, either as a lump-sum balloon payment or according to a loan amortization schedule. Another important difference from a conventional home equity loan is that the interest rate on a HELOC is variable (usually the interest rate is based on the prime rate plus a spread set by the lender), and there is a window of time or borrowing period during which the debtor can make use of the line of credit. In the previous two cases, the second mortgage coexists with the first one, instead of replacing it as in the following. A cash refinance is one of two types of mortgage refinancing strategies, as mentioned above this second mortgage replaces the previous loan instead of adding up to it. On the one hand, there is the standard rate-and-term refinance which allows a borrower to obtain a replacing mortgage with a lower interest rate or a shorter term, while keeping their existing balance unchanged. On the other hand, with a cash refinance the borrower signs a new mortgage (which may have different terms) with a balance that is larger than in the original loan, with this money the borrower pays off the existing debt and "cashes-out" the lump-sum difference between the new and old balance.

With a second mortgage, the loan amount is determined by the home equity the borrower has and by the loan to value (LTV) ratio set by the financial institution. It may be possible to borrow up to an amount equal or above that of the home, minus any liens. Second mortgages are usually, but not always, for a shorter term than first mortgages. Home equity loans can be used as a main mortgage in place of a traditional mortgage. However, it is not possible to purchase a home using a home equity loan, it can only be used to refinance an existing debt. Second mortgages became popular in the United States in the early 2000s, in part because interest paid is typically deductible under federal and many state income tax laws[11]. In 2008, due to the change in outlook for house prices, major home equity lenders began informing borrowers that their home equity lines of credit had been frozen, reduced, suspended, rescinded or restricted in some other manner.

[11]The U.S. federal government, through the IRS, allows the deduction of mortgage interest. Although other requirements exist, only the interest paid during the year is eligible for a deduction. The law limits the deduction to the interest that is paid on up to $1 million in total mortgage balances (coming from up to two mortgages). Regarding HELOCs, the tax deduction can also be obtained. It applies to loans originated after October 1987 and it must be secured by the home.

Regarding second mortgages in general, they are subordinate to primary home loans. This means that the second mortgage lender, which does not necessarily coincide with the first mortgage lender, has claim to any money generated by a foreclosure only after the primary mortgage lender recoups their full loss. Therefore, if there is a deficiency, the lender will not receive payment coming from the foreclosure process. Another fundamental aspect of second mortgages is that they are generally considered recourse loans in almost all cases across most states[12], regardless of the recourse statutes of the state regarding first mortgages. We will take this feature into account in Section 1.4 when writing the budget constraint of defaulting agents. Hence, when the second mortgage lender is not fully paid with the proceeds coming from the foreclosure, they can sue the borrower for the outstanding loan balance. The lender may be able to recoup its loss by garnishing the borrower's wages or assets, or even placing a lien on a future property. We are interested in this kind of situation, where a homeowner uses its home equity as collateral to obtain a second mortgage, which in turn will be utilized as start-up capital for the creation of a business.

1.4 Model

We study a two-period career choice model that builds upon the work of Evans and Jovanovic [1989] and Hatchondo et al. [2015]. In contrast to Evans and Jovanovic [1989], we assume that (i) in addition to idiosyncratic entrepreneurial ability shocks, the household faces aggregate house price shocks; (ii) households have an option to default on their mortgage; and (iii) our approach is of partial instead of general equilibrium. Our model is similar to that of Hatchondo et al. [2015] in the existence of a default option and the study of its interaction with the recourse dimension. The two main differences with respect to their work are, (i) they have a general equilibrium life cycle model; (ii) households do not pick a career in their model. The main focus of Hatchondo et al. [2015] is evaluating

[12] A purchase money loan is one where the money went from the lender, to the escrow, and then to the seller or to pay purchase closing costs. In many states, non-purchase money second mortgages (such as HELOCS) are recourse loans. Which means that if the second mortgage was not directly used to finance the purchase of a real estate along with the first mortgage, then the loan becomes recourse.

default-prevention prudential regulations.

In our setup the economy consists of a unit mass of households who can either become entrepreneurs or rent their labor services to a large producer. This large firm produces the consumption good by operating a technology requiring labor and capital. There is also a financial intermediary which provides start-up financing to entrepreneurs. We model the career, housing and consumption decisions of a continuum of risk-averse heterogeneous households that live for two periods. However, we will abstract from modeling the decisions of the large producer and financial intermediary, instead will assume that those households who decide to become workers will supply their labor inelastically to this producer and receive a fixed wage in return. Also, those households who become entrepreneurs can borrow working capital from the financial intermediary at a constant interest rate determined exogenously.

At the beginning of the first period, the household observes the realization of its initial home equity. After this, the household makes its career decision for next period (become either a worker or an entrepreneur). In the second period, after observing aggregate house prices and entrepreneurial ability, the housing decision is made. Production and consumption take place at the end of period two.

1.4.1 Housing

We assume that the household must live in a house, the household may own up to one house, and that all houses are identical of size 1 and price P_t, where $t = 1, 2$ denotes time. Households may either own or rent the house where they live in period two. Housing provides utility to all agents and can serve as collateral when entrepreneurs finance start-up loans. At the beginning of the first period each household receives a random realization of home ownership share, h_i, where i denotes a household. This originates a mortgage debt equal to the portion of the house that is not owned by the household, $1 - h_i$. In period two the household can either pay the mortgage debt plus interest, $(1 - h_i)(1 + r)$, or default and

pay the pecuniary default cost Φ[13], the part of the debt for which the household is liable (which is determined by the corresponding default regulation), and the cost of renting a house (given by a fraction γ of the price of a house in the corresponding period). We assume that foreclosure takes place the moment the household defaults on its mortgage, therefore the household becomes a renter immediately.

Households that are homeowners and those that are renters, derive the same utility from housing services since houses are identical. However they differ on the payment they must make in period two, this will ultimately affect the amount of they consumption good they can purchase and consume at the end of the period. In particular, in order to maintain the model tractable, we assume that the utility derived from consumption c and housing services is specified by

$$U(c) = \log c$$

where the flow of housing services are normalized to equal 1 since it is assumed all households live in a house, either owned or rented.

1.4.2 House Prices and Earnings

Both house prices and earnings follow exogenous processes. House prices are observed by households at the beginning of each period. In period 1 house price P_1 is normalized to equal 1. Therefore, home equity in period 1 for household i is defined as

$$\begin{aligned} E_{1,i}(P_1, h_i) &= P_1 - (1 - h_i) \\ &= 1 - (1 - h_i) \\ &= h_i, \end{aligned} \tag{1.1}$$

where the home ownership share drawn at the beginning of time coincides with the home equity definition for period 1. Similarly, home equity in period 2 for household i is defined

[13]This term summarizes administrative and stigma costs of default. Other studies, such as Athreya [2002], in addition to this type of cost also consider exclusion from financial markets after default. This is not feasible in this version of our model since this decision is implemented in the last period.

as

$$E_{2,i}(P_2, h_i) = P_2 - (1 - h_i)(1 + r). \tag{1.2}$$

In order to keep the model tractable, we assume that house prices follow a two-point distribution specified by

$$P_t = \begin{cases} P_t^H & \text{with prob. } \lambda \\ P_t^L & \text{with prob. } 1 - \lambda \end{cases}, \text{ t=1,2}$$

where $P_t^H > P_t^L$. Since P_1 is observed at the beginning of period 1, uncertainty about house prices is only relevant regarding P_2.

Entrepreneurial ability is observed at the beginning of period 2. We assume entrepreneurial ability for household i (θ_i) also follows a two-point distribution

$$\theta_i = \begin{cases} \theta_H & \text{with prob. } \omega \\ \theta_L & \text{with prob. } 1 - \omega \end{cases},$$

where $\theta_H > \theta_L$.

Households who choose to become workers receive a fixed wage w. Those who become entrepreneurs have earnings that are a function of their own entrepreneurial ability θ_i, and house prices in period 2. With information available up to period 1, this income is stochastic.

1.4.3 Mortgage Contract, Default and Recourse

At the beginning of period 1, each household draws an ownership share over a house h_i. Since each house is identical and normalized to be of size 1, the part of the house that is not owned by the household is equal to $1 - h_i$ at this point in time. We assume that a bank owns this share of the house. This originates a mortgage contract between the household and the bank, where the former must repay the principal plus interest $(1 - h_i)(1 + r)$ in the next period, or default and pay a share d of the outstanding mortgage debt, a pecuniary cost Φ, and become a renter (paying the rental rate γP_2).

When the household repays its mortgage debt, it becomes the owner of the entire house

and must not make any further housing related payments. The decision regarding housing arrangements is made in period 2 after the uncertainty about entrepreneurial ability and current house prices has been unfolded.

In case of default, the foreclosure process begins immediately. The bank seizes the house, and sells it at its market price (P_2). This might or might not be enough to cover the mortgage debt. Whenever $P_2 < (1 - h_i)(1 + r)$ i.e. the market value of the property is less than the outstanding debt, the homeowner has negative equity. This is also known as an underwater mortgage. In these cases, the homeowner is liable for a fraction of the difference $(1 - h_i)(1 + r) - P_2$. We will denote this fraction as $d \in [0, 1]$, it summarizes how much recourse the lender has over the assets of the borrower (Talk more here about recourse). As d increases, the lender is more likely to recover the entirety of the mortgage loan in case of default (link to table with list of states and say how this is not black or white, and that is also an option the lender may or may not exercise). As d decreases, default becomes cheaper for the borrower. This difference regarding the legal framework among states should be priced in the mortgage market, however this does not seem to be the case according to Hurst et al. [2015]. The authors study the degree to which households can smooth regional shocks in the U.S., given their relevance they focus on borrowing from Government-Sponsored Enterprises (GSEs). Hurst et al. [2015] empirically establish that, despite large spatial variation in predictable default risk, there is no significant spatial variation in GSE mortgage rates, conditional on borrower observables. The authors show that the private market does set interest rates based in part on regional risk factors and provide evidence that the lack of regional variation in GSE mortgage rates is likely driven by political pressure.

In the unlikely case where a homeowner defaults while holding positive equity (also known as being above water), we assume the mechanism is as follows. Foreclosure takes place immediately, the banks seizes the property and sells it at its market value (P_2), we assume the bank keeps the excess value over the outstanding debt ($P_2 - (1 - h_i)(1 + r)$). After this, the borrower pays the default cost Φ and the rental cost γP_2.

Given this legal framework and the lack of interest rate discrimination across geographical areas by the GSEs, a natural prediction arises. Mortgage default should be more frequently observed in those areas where lenders have relatively less recourse (low values of d). Ghent and Kudlyak [2011], using loan-level monthly data on mortgage loans, quantify the effect of recourse laws on default in the US. The authors argue that recourse decreases borrowers sensitivity to negative equity, i.e., recourse deters some borrowers with negative equity from defaulting. Ceteris paribus, it takes 8.6% more negative equity to make the probability of default in a recourse situation the same as the probability of default in a non-recourse situation. Ghent and Kudlyak [2011] find that at the mean value of the default option for defaulted loans, borrowers are 30% more likely to default in non-recourse states. For homes with higher value (appraised at $500,000 to $700,000) borrowers are twice as likely to default in non-recourse states. The authors, just as in Hurst et al. [2015], find no evidence of interest rates being lower in recourse states. In the following we will discuss more in depth the implications between legal frameworks and default, as well as other aspects related to the heterogeneity observed in the degree of recourse among states.

1.4.4 Timing

At the beginning of period 1 households receive a random realization of home ownership share h_i from an exogenous cumulative distribution $J(h)$, with support in $[0, 1]$. Then, they observe aggregate house prices for the period (P_1). Later in period 1, households must decide which career they will have in period 2 (either workers or entrepreneurs), and in case of opting for entrepreneurship they must also choose the scale of their operation (how much capital to raise to start their business) which will be conditioned by a borrowing constraint based on their expected home equity in period 2.[14]

Early in period 2, both house price (P_2) and own entrepreneurial ability (θ_i) are ob-

[14]In the Appendix there are results for a similar model where the timing is slightly changed at this point. The change involves deciding about the scale of the business in period 2 instead, once all uncertainty has been resolved. Results are similar to those from the benchmark model, however expressions are more involved.

served. At this point all uncertainty has been resolved.[15] Households decide about their housing arrangements for the rest of the period (they can either pay their mortgage debt and stay homeowners, or default and become renters)

1.4.5 Workers

Those households who become workers will receive a fixed wage w in period 2, as a payment for supplying their labor towards the production of the consumption good by the large firm. Workers do not face uncertainty about their income at any point in this model, the assumption that workers face relatively less risk than entrepreneurs is common in this literature (quote some papers here). However when picking a career, households do face uncertainty regarding the value of becoming a worker or an entrepreneur. In the particular case of workers this uncertainty arises from the fact that house prices (P_2) are unknown during period 1, and they appear in the budget constraint of defaulting workers.

Workers have to decide about housing during period 2, they can either pay their mortgage loan and remain in homeowner status, or default and become renters. The value in period 2 of a worker with ownership share h who decides to pay her mortgage loan is denoted by $V^{WP}(h)$, and is defined as

$$V^{WP}(h) = \max_{c>0} U(c) \tag{1.3}$$
$$\text{s.t. } c + (1-h)(1+r) = w,$$

where c denotes consumption of the numeraire good, r is the mortgage loan interest rate, and w is the worker's wage.

A worker who defaults in period 2, with ownership share h, facing house prices P_2, under a degree of recourse summarized by d, solves the following problem

$$V^{WD}(h; P_2, d) = \max_{c>0} U(c) \tag{1.4}$$
$$\text{s.t. } c + d\max\{(1-h)(1+r) - P_2, 0\} + \gamma P_2 + \Phi = w,$$

[15] In the alternative timing model, entrepreneurs would decide here about the scale of their operation.

where d is the degree of recourse (higher values represent more recourse for the lender), γP_2 is the rental rate in period 2, and Φ is the administrative default cost. The max function in the budget constraint is a representation of the fact that the homeowner loses any positive home equity when default takes place.

In period 2, workers must decide about their housing arrangements by choosing between paying their mortgage debt, or defaulting on it. This decision is made under complete information, and is summarized by the following expression

$$V^W(h; P_2, d) = \max\{V^{WP}(h), V^{WD}(h; P_2, d)\}. \tag{1.5}$$

1.4.6 Entrepreneurs

Entrepreneurs operate a constant returns to scale technology in order to produce the consumption good. Those homeowners who, in period 1, decided to become entrepreneurs in period 2 must raise capital prior to production. They can get working capital k from the financial intermediary by pledging their home equity as collateral in exchange for a one period loan. This loan is not defaultable and must be repaid at the end of period 2, plus interest rate r. The decision about how much capital to raise determines the scale of production, and must be made under uncertainty in period 1. The optimal scale is a function of future house prices (P_2) and own entrepreneurial ability (θ), both unknown at the moment of the decision. This uncertainty generates discrepancies between actual and optimal scale, and therefore translates into uncertain income for entrepreneurs, which will in turn affect the likelihood of exercising the mortgage default option during period 2. For instance, entrants with high productivity (θ) might decide to operate at a sub-optimal scale smaller than that corresponding to complete information, this combined with unexpected low house prices will increase the value of default during period 2.

Just like workers, entrepreneurs must decide about housing during period 2. They can either pay their mortgage loan and remain in homeowner status, or default and become renters. The value in period 2 of an entrepreneur with ownership share h, own entrepreneurial ability θ, and house prices P_2, who decides to pay his mortgage loan is

denoted by $V^{EP}(h, \theta; P_2)$, and is defined as

$$V^{EP}(h, \theta; P_2) = \max_{c>0, k\geq 0} U(c) \tag{1.6}$$
$$\text{s.t. } c + (1-h)(1+r) = \theta k - rk$$
$$k \leq \tau \mathcal{E}_1[E_2(P_2, h)],$$

where k is working capital, τ is a loan-to-value ratio based on home equity, $\mathcal{E}_1$ denotes the expectation operator with information up to period 1, and $E_2(P_2, h)$ is home equity in period 2 as defined in (1.2). Notice that since the scale decision is made under uncertainty in period 1 (prior to the housing decision), expected house prices show up in the borrowing constraint, as opposed to actual house prices even though the housing problem is solved during period 2. Also notice that no entry into entrepreneurship costs appear in the budget constraint, this assumption is made only to keep the policy functions simple. It would be straightforward adding a one time entry payment, without any significant effect on the results.

An entrepreneur who decides to default on his mortgage in period 2, with ownership share h, own entrepreneurial ability θ, facing house prices P_2, under a degree of recourse summarized by d, solves the following problem

$$V^{ED}(h, \theta; P_2, d) = \max_{c>0, k\geq 0} U(c) \tag{1.7}$$
$$\text{s.t. } c + d\max\{(1-h)(1+r) - P_2, 0\} + \gamma P_2 + \Phi = \theta k - rk$$
$$k \leq \tau \mathcal{E}_1[E_2(P_2, h)],$$

where d is the degree of recourse (higher values represent more recourse for the lender), γP_2 is the rental rate in period 2, Φ is the administrative default cost, k is working capital, τ is a loan-to-value ratio based on home equity, $\mathcal{E}_1$ denotes the expectation operator with information up to period 1, and $E_2(P_2, h)$ is home equity in period 2 as defined in (1.2). The max function in the budget constraint is a representation of the fact that the homeowner loses any positive home equity when default takes place.

In period 2 entrepreneurs must decide about their housing arrangements by choosing between paying their mortgage debt, or defaulting on it. This decision is made under complete information, and is summarized by the following expression

$$V^E(h, \theta; P_2, d) = \max\{V^{EP}(h, \theta; P_2), V^{ED}(h, \theta; P_2, d)\}. \tag{1.8}$$

1.5 Recursive Formulation

The first decision agents have to make in period 1 is about their future career. They can either become workers or entrepreneurs in period 2, if they opt for the latter they must also pick their scale of operation. This decision is made under uncertainty about the future value of their home equity and also about their own entrepreneurial ability, both of which are determinants of their entrepreneurial outcome. Then, in period 2 and under complete information, they must decide about housing and consumption. As usual with this kind of setup we will tackle the problem using backward induction, i.e. we will solve the second period problem first and then we will solve for period 1 under uncertainty.

1.5.1 Housing Decision

All households, regardless of their career, must decide about their housing situation in the second period. They can either fully repay their mortgage debt, or they can default on it and pay the corresponding costs. This decision is made under complete information and can be characterized with thresholds based on ownership share (h), house prices in period 2 (P_2) and the degree of recourse (d). Alternatively the thresholds can be re-written as functions of home equity in period 2 ($E_2(P_2, h)$), and the degree of recourse.

Home equity in period 2 $E_2(P_2, h)$ is negative whenever the market value of a house is below the outstanding mortgage debt. Formally, home equity is negative, or the mortgage is underwater in period 2 whenever

$$P_2 < (1 - h)(1 + r) = P_2^U(h), \tag{1.9}$$

where P_2^U is the price threshold for underwater mortgages. Or equivalently, when

$$h < 1 - \frac{P_2}{1+r} = h^U(P_2), \tag{1.10}$$

where h^U is the period 1 home equity threshold for underwater mortgages. Intuitively, when house prices P_2 are below P_2^U, more homeowners will hold debt that exceeds the market value of their houses. Put in other terms, more mortgages will be underwater. Equivalently, those households with initial home equity h below h^U will have negative home equity during the second period.

The default threshold is defined as the combination of state variables (h, P_2, d) that make an agent indifferent between paying and defaulting on their mortgage debt. Formally, in terms of initial home equity, it is defined as the level $h^D(P_2, d)$ such that

$$V^{WP}(h^D(P_2, d)) = V^{WD}(h^D(P_2, d); P_2, d),$$

or, since the income level does not depend on the housing decision, we can alternatively solve for

$$V^{EP}(h^D(P_2, d), \theta; P_2) = V^{ED}(h^D(P_2, d), \theta; P_2, d).$$

Then, the solution for a worker or an entrepreneur is given by

$$h^D(P_2, d) = 1 - \frac{P_2(\gamma + d) + \Phi}{(1+d)(1+r)}. \tag{1.11}$$

Whenever $h < h^D(P_2, d)$ the household is better off defaulting on their mortgage debt, hence becoming a renter. When $h \geq h^D(P_2, d)$, the household pays the mortgage debt and stays a homeowner. This is due to the option value of paying the mortgage debt being increasing on h, since the mortgage debt is decreasing on it. The expression in (1.11) can be re-written as a price threshold instead,

$$P_2^D(h; d) = \frac{(1+d)(1+r)(1-h) - \Phi}{\gamma + d}. \tag{1.12}$$

In an analogous way to (1.11), this threshold indicates that whenever $P_2 < P_2^D(h;d)$ the household chooses the default option. Then, if $P_2 \geq P_2^D(h;d)$, the agent is better off repaying the mortgage loan.

It is important noting that the default threshold in (1.11) or (1.12), is decreasing on d. Provided that $d \in (0,1]$, $h \in [0,1]$ and $\Phi > 0$. In those areas where the lenders have more recourse (higher d) on the borrowers assets, i.e. it is more costly for borrowers to default on their mortgage debt, borrowers require a larger drop in house prices (or must hold smaller amounts of initial equity) in order to exercise the default option. The reason behind this result is simply the higher relative cost of the default option compared to the paying option. This gives us the first testable implication of the model, namely that everything else constant, we should see less default in those areas where lenders have more recourse (areas with higher values of d). This prediction is in line with the findings in Ghent and Kudlyak [2011], as mentioned earlier they find that on average borrowers are 30 percent more likely to default in non-recourse areas. For homes appraised at $500k to $750k, borrowers are twice as likely to default in non-recourse states.

The same rationale that applies to the degree of recourse is behind the fact that the threshold is also decreasing on the other two costs associated with the default option. Namely the administrative cost Φ, and the rental rate γ. Similarly, those households who hold large amounts of initial home equity h, require a significant drop in house prices in order to default on their mortgage, since their mortgage debt is relatively small. The previous results lead to the following proposition.

Proposition 1 *Negative equity in period 2 ($E_2(P_2,h) < 0$) is a necessary condition for default, since*

$$P_2^D(h;d) < P_2^U(h)$$

$\forall h$ in the default range. Provided that $\Phi > 0$, and $\gamma > 0$.

From Proposition 1 we can see that some households with negative equity are better off

repaying their mortgage loans. Even when they owe more than what their house is worth, the multiple costs associated to default deter them from exercising this option. It is also straightforward seeing why households with positive equity do not default, this is simply because the financial intermediary would keep all of the excess value over the outstanding debt, as formulated in the budget constraints in (1.4) and (1.7).

Figure 1·4 shows the policy function corresponding to the housing problem, in terms of initial home equity h and second period house prices P_2. The underwater threshold in (1.9) and the default threshold in (1.12) are depicted. The dashed downward sloping line corresponds to the former, separating the regions where agents hold positive (above the line) and negative (under the line) home equity in period 2. The slope of this schedule is determined by the interest rate r, more agents will hold underwater mortgages as r increases. Households will default on their mortgage loans whenever they face a combination of low initial home equity and low period 2 house prices, these pairs are represented by the red region. The schedule delimiting this region is $P_2^D(h;d)$, its slope is determined by several parameters, most notably by the degree of recourse d. When lenders have more recourse over the assets of the borrowers (high values of d), the default option is relatively more costly and only those agents deep underwater will exercise it. For high values of d the schedule shifts to the left and becomes more negatively sloped, reducing the area of the default region.

1.5.2 Scale Decision

In period 1, right after the career decision is made, those households who chose to become entrepreneurs must also decide about the scale of their operation. Entrepreneurs face a borrowing constraint given by

$$k \leq \tau \mathcal{E}_1 \left[E_2(P_2, h) \right], \tag{1.13}$$

where k is the amount of capital they can raise for operating their production technology, τ is the loan-to-value ratio for their home equity, $\mathcal{E}_1$ is the expectation operator computed

with information up to period 1, and E_2 is home equity in period 2. Given their constant returns to scale technology, entrepreneurs will raise as much capital as possible (making (1.13) bind) provided that $\mathcal{E}_1(\theta) > r$. They will operate at the minimum feasible scale ($k = 0$) when $\mathcal{E}_1(\theta) \leq r$. The borrowing constraint is relaxed when the loan to value ratio τ increases, when the initial home ownership share is higher, and when expected house prices in period 2 rise.

In summary, the optimal scale is determined by the entrepreneurs own expected ability $\mathcal{E}_1(\theta)$, expected future house prices $\mathcal{E}_1(P_2)$, initial home equity h and loan-to-value ratio τ.

1.5.3 Career Choice

After observing their home equity in period 1, agents pick a career for period 2. They can either become employees or entrepreneurs. This is the first decision they must make, and it takes place under uncertainty about their own entrepreneurial ability (θ) and future house prices (P_2). When making this decision they compare the expected value of being a worker with the expected value of being an entrepreneur, using all the information available up to period 1. The expected value of being a worker is given by

$$V^W(h;d) = \int_{P_2 \in \mathcal{P}} \max\left\{V^{WP}(h), V^{WD}(h;P_2,d)\right\} dF(P_2) \tag{1.14}$$

where $\mathcal{P}$ is the support set for house prices. Under uncertainty about future house prices (P_2), workers must decide between the two available housing alternatives (paying or defaulting on their mortgage). Similarly, the expected value of being an entrepreneur is given by

$$V^E(h;d) = \int_{\theta \in \Theta} \int_{P_2 \in \mathcal{P}} \max\left\{V^{EP}(h,\theta;P_2), V^{ED}(h,\theta;P_2,d)\right\} dF(P_2) dG(\theta) \tag{1.15}$$

where Θ is the support set for entrepreneurial ability. The same two housing alternatives are available. Relative to workers, entrepreneurs face an additional source of uncertainty

since they do not know their own entrepreneurial ability (θ) at the moment they make their career decision.

As can be seen in (1.14) and (1.15), the only state variables observed by agents before picking a career are their own home ownership share (h) and the degree of recourse they face (d). Therefore, the career policy function can be written as a threshold over either of these two states. We will write this policy function as a threshold for the home ownership share, which in turn will be a function of the degree of recourse, the different feasible realizations for the unknowns (future house prices and entrepreneurial ability) and some parameters.

1.6 Career Choice Policy Function

The home ownership share threshold that determines the career choice the agents make during period 1 is the value of h that solves

$$V^W(h;d) = V^E(h;d), \tag{1.16}$$

let us define h^* as the value of h for which the equality in (1.16) holds. Besides our distributional assumptions for house prices and entrepreneurial ability, the choice of a functional form for the utility function of the agents will shape the properties of the threshold h^*. In order to gain insight about this object, we will start with the most simple set of assumptions regarding functional form and timing of events, and progressively we will move towards the preferred setup.

In order to characterize (1.14) and (1.15), and find the career choice policy function, it is necessary to make assumptions regarding the probability distributions for P_2 and θ. In order to preserve tractability we will assume that both future house prices and entrepreneurial ability can each take on only two possible values. More precisely, for future house prices we will assume that

$$P_2 = \begin{cases} P_2^H & \text{with probability } \lambda \\ P_2^L & \text{with probability } 1-\lambda \end{cases},$$

where $P_2^H > P_2^L$, and $\lambda \in [0,1]$. Furthermore, we will assume that $P_2^H - P_2^L$ is sufficiently large so that some agents with low initial home equity find it optimal to default when P_2^L is realized, and decide to pay their mortgage when P_2^H is observed. To be more precise, we require P_2^L to be below $P_2^D(h;d)$ and P_2^H to be above $P_2^D(h;d)$, for some h.

Regarding entrepreneurial ability, the distribution is given by

$$\theta = \begin{cases} \theta^H & \text{with probability } \omega \\ \theta^L & \text{with probability } 1-\omega \end{cases},$$

where $\theta^H > \theta^L$, and $\omega \in [0,1]$.

In order to simplify the results even further, we will assume that these two-point distributions are symmetric, i.e. $\lambda = 1-\lambda$ and $\omega = 1-\omega$. The results, and most importantly their interpretation, are not significantly changed if we relax this assumption. However, the expressions characterizing the different thresholds are more involved.

1.6.1 Risk neutral agents and known θ

In this sub-section we will assume agents have linear utility, and know with certainty their own entrepreneurial ability when picking a career. Under these assumptions, the problem in (1.16) becomes a linear equation on h.

Under this simplified setup, we can re-write (1.14) as

$$\begin{aligned} V^W(h;d) &= \lambda V^{WP}(h) + (1-\lambda)V^{WD}(h;P_2^L,d) \\ &= \lambda\left\{w-(1-h)(1+r)\right\} \\ &\quad + (1-\lambda)\left\{w - d\left[(1-h)(1+r) - P_2^L\right] - \gamma P_2^L - \Phi\right\}, \end{aligned}$$

after plugging in (1.3) and (1.4), and using Proposition 1 to simplify the max function in (1.4), since no agent with positive home equity find it optimal to default. In the first term, corresponding to a worker who pays his mortgage, consumption is the difference between his fixed wage w and the payment he must make in order to keep his house. In the second term, for a defaulting worker, consumption equal the difference between the fixed income

w, the share of his mortgage payment for which he is liable (determined by d), the rental rate γP_2^L, and the administrative cost of default Φ.

Similarly, for entrepreneurs we can re-write (1.15) in order to get

$$\begin{aligned} V^E(h;d) &= \lambda V^{EP}(h,\theta;P_2^H) + (1-\lambda)V^{ED}(h,\theta;P_2^L,d) \\ &= \lambda\left\{(\theta-r)\tau\mathcal{E}_1\left[E_2(P_2,h)\right] - (1-h)(1+r)\right\} \\ &+ (1-\lambda)\left\{(\theta-r)\tau\mathcal{E}_1\left[E_2(P_2,h)\right] - d\left[(1-h)(1+r) - P_2^L\right]\right. \\ &\left.-\gamma P_2^L - \Phi\right\} \end{aligned}$$

after plugging in (1.6) and (1.7), and using Proposition 1 to simplify the max function in (1.7). The general form is analog to the value of being a worker. The only difference is in the income term, which is now a function of expected home equity in period 2. The housing decision is made during period 2 (after having observed house prices), therefore the rental rate paid is a certain amount. The scale of operation is picked during period 1, under uncertainty. Hence, the expectation operator shows up in the income term.

Now we need to find the level of h that solves (1.16). As mentioned above, given our assumptions, this is a simple linear equation on h. Both schedules are linear, and have different positive slopes on h, therefore we have a single crossing. It is direct to see that,

$$\frac{\partial V^E(h;d)}{\partial h} = (1+r)\left[1+d+2\tau(\theta-r)\right] > \frac{\partial V^W(h;d)}{\partial h} = (1+r)(1+d) > 0$$

where, we assume that $\theta > r$, otherwise entrepreneurs would not produce a positive amount of the consumption good, or equivalently would not become entrepreneurs. The value of being an entrepreneur has a higher slope on h since an increase in initial home ownership share, besides decreasing the amount of mortgage debt just like it does for workers, also relaxes the borrowing constraint for entrepreneurs. Increasing the size of their operation, and their level of consumption.

The crossing point h^* is given by

$$h^*(\theta) = 1 - \frac{\tau(\theta - r)\mathcal{E}_1(P_2) - w}{\tau(\theta - r)(1 + r)}, \tag{1.17}$$

re-arranging terms we get,

$$w = \tau(\theta - r)\mathcal{E}_1\left[E_2(P_2, h^*)\right],$$

where $\mathcal{E}_1\left[E_2(P_2, h^*)\right]$ is expected home equity in period 2, constructed with information up to period 1. This is the usual result under risk neutrality, where agents with initial home ownership share h^* are indifferent between becoming a worker or an entrepreneur as long as the expected utility among the two options is the same. Since the slope with respect to h is positive, and higher for $V^E(h; d)$ than for $V^W(h; d)$, those agents holding initial home ownership shares higher than h^* will become entrepreneurs. And those with $h < h^*$ will be better off becoming workers next period. Notice that the degree of recourse d does not show up in (1.17), this is because the default costs appear linearly with the same probability in both value functions, therefore they cancel out. The threshold h^* is increasing on w, which means the reservation home equity share is higher whenever becoming a worker becomes more attractive. The threshold is decreasing on expected house prices, whenever agents (and more importantly, financial intermediaries) perceive future house prices to be higher, they will be able to raise more initial capital today. They will operate at a higher scale, and therefore make a larger expected profit as entrepreneurs next period. More agents will become entrepreneurs holding lower levels of initial home ownership share. It is also decreasing on the loan to value ratio τ, whenever the borrowing constraint is relaxed and more capital can be raised, less initial home ownership is required in order to become an entrepreneur. Finally it is decreasing on θ as well, those agents with a higher entrepreneurial ability require less capital to produce the same as those agents with lower ability, then the more able agents will require less initial home equity in order to enter entrepreneurship.

1.6.2 Risk neutral agents and unknown θ

In this sub-section we will still assume that agents have linear utility over consumption. But instead of observing their own entrepreneurial ability prior to picking a career, they will realize it after the choice. Therefore, will have an additional source of uncertainty at the moment of choosing in period 1.

Similar to that we did in the previous section, we can re-write (1.14) as

$$\begin{aligned} V^W(h;d) &= \lambda V^{WP}(h) + (1-\lambda)V^{WD}(h;P_2^L,d) \\ &= \lambda\left\{w-(1-h)(1+r)\right\} \\ &+ (1-\lambda)\left\{w-d\left[(1-h)(1+r)-P_2^L\right]-\gamma P_2^L-\Phi\right\}, \end{aligned}$$

after plugging in (1.3) and (1.4), and using Proposition 1 to simplify the max function in (1.4). This expression is equal to that in the previous sub-section since θ does not enter the value function of workers.

Then, for entrepreneurs we can re-write (1.15) in order to get

$$\begin{aligned} V^E(h;d) &= \omega\left[\lambda V^{EP}(h,\theta^H;P_2^H)+(1-\lambda)V^{ED}(h,\theta^H;P_2^L,d)\right] \\ &+ (1-\omega)\left[\lambda V^{EP}(h,\theta^L;P_2^H)+(1-\lambda)V^{ED}(h,\theta^L;P_2^L,d)\right] \\ &= \omega\left[\lambda\left\{(\theta^H-r)\tau\mathcal{E}_1\left[E_2(P_2,h)\right]-(1-h)(1+r)\right\}\right. \\ &+ (1-\lambda)\left\{(\theta^H-r)\tau\mathcal{E}_1\left[E_2(P_2,h)\right]-d\left[(1-h)(1+r)-P_2^L\right]\right. \\ &\left.\left.-\gamma P_2^L-\Phi\right\}\right] \\ &+ (1-\omega)\left[\lambda\left\{(\theta^L-r)\tau\mathcal{E}_1\left[E_2(P_2,h)\right]-(1-h)(1+r)\right\}\right. \\ &+ (1-\lambda)\left\{(\theta^L-r)\tau\mathcal{E}_1\left[E_2(P_2,h)\right]-d\left[(1-h)(1+r)-P_2^L\right]\right. \\ &\left.\left.-\gamma P_2^L-\Phi\right\}\right], \end{aligned}$$

after plugging in (1.6) and (1.7), and using Proposition 1 to simplify the max function in (1.7).

Just as in the previous sub-section, we need to find the level of h that solves (1.16). As

mentioned above, given our assumptions, this is still a linear equation on h. Both sides of the equality are linear, and have different positive slopes on h, therefore we have a single crossing. It is direct to see that,

$$\frac{\partial V^E(h;d)}{\partial h} = 2(1+r)\left[1+d+2\tau(\mathcal{E}_1[\theta]-r)\right] > \frac{\partial V^W(h;d)}{\partial h} = 2(1+r)(1+d) > 0$$

where, we assume that $\mathcal{E}_1[\theta] > r$, otherwise entrepreneurs would not produce a positive amount of the consumption good, or equivalently would not become entrepreneurs. Then for the same reasons as before, the value of an entrepreneur has a higher slope on h than that of a worker.

The crossing point h^* in this case is given by

$$h^* = 1 - \frac{\tau\left[\mathcal{E}_1(\theta)-r\right]\mathcal{E}_1(P_2) - w}{\tau\left[\mathcal{E}_1(\theta)-r\right](1+r)}, \tag{1.18}$$

which resembles the previous result in (1.17), the only difference is that instead of being a function θ it is determined by the expected own entrepreneurial ability. This threshold shares its properties with the one previously found, it is increasing on w, decreasing on $\mathcal{E}_1(P_2)$, decreasing on τ, and decreasing on $\mathcal{E}_1(\theta)$. The interpretation is analog to the one we made of the previous result. Since the slope with respect to h is positive, and higher for $V^E(h;d)$ than for $V^W(h;d)$, those agents holding initial home ownership shares higher than h^* will become entrepreneurs. And those with $h < h^*$ will be better off becoming workers next period.

1.6.3 Risk averse agents and known θ

In this sub-section we will assume agents have log utility, and know with certainty their own entrepreneurial ability before picking a career. Under these assumptions, the problem in (1.16) is no longer linear on h. What is interesting about this setup is that the degree of recourse d shows up in the career choice threshold as part of the risk premium agents require in order to become entrepreneurs.

With this set of assumptions we can re-write (1.14) as

$$\begin{aligned} V^W(h;d) &= \lambda V^{WP}(h) + (1-\lambda)V^{WD}(h;P_2^L,d) \\ &= \lambda \log\left[w-(1-h)(1+r)\right] \\ &+ (1-\lambda)\log\left[w - d\left((1-h)(1+r)-P_2^L\right) - \gamma P_2^L - \Phi\right], \end{aligned}$$

after plugging in (1.3) and (1.4), and using Proposition 1 to simplify the max function in (1.4).

Similarly, for entrepreneurs we can re-write (1.15) in order to get

$$\begin{aligned} V^E(h;d) &= \lambda V^{EP}(h,\theta;P_2^H) + (1-\lambda)V^{ED}(h,\theta;P_2^L,d) \\ &= \lambda \log\left[(\theta-r)\tau\mathcal{E}_1\left(E_2(P_2,h)\right) - (1-h)(1+r)\right] \\ &+ (1-\lambda)\log\left[(\theta-r)\tau\mathcal{E}_1\left(E_2(P_2,h)\right) - d\left((1-h)(1+r)-P_2^L\right)\right. \\ &\left. -\gamma P_2^L - \Phi\right], \end{aligned}$$

after plugging in (1.6) and (1.7), and using Proposition 1 to simplify the max function in (1.7). We need to find the level of h that solves (1.16). Once again we have that the slopes on h are different for both schedules, in particular

$$\frac{\partial V^E(h;d)}{\partial h} > \frac{\partial V^W(h;d)}{\partial h} > 0,$$

where the slope of each value function is not shown due to space constraints. However, just like in the risk neutral case, for this ordering we require $\theta > r$. Otherwise entrepreneurs would not produce a positive amount of the consumption good, or equivalently would not enter into entrepreneurship. Then for the same reasons as before, the value of an entrepreneur has a higher slope on h than that of a worker. The crossing point h^* in this case is given by

$$h^*(\theta;d) = 1 - \frac{\tau(\theta-r)\mathcal{E}_1(P_2) - (w+\Phi) - P_2^L(\gamma-d)}{\left[\tau(\theta-r)+1+d\right](1+r)}, \tag{1.19}$$

which is similar to our previous results. In particular, if we compare it to that in (1.17) we can see how they share most of their properties. The main difference being that the threshold obtained under risk aversion in (1.19), unlike that in (1.17), is a function of the degree of recourse lenders have d and the pecuniary cost of default Φ. Both thresholds are decreasing on future house prices, LTV ratio τ, and own entrepreneurial ability θ. Also, both are increasing on w. The threshold for risk averse agents is increasing on the different costs associated to default. In particular, the level of initial home equity required to become an entrepreneur increases with the rental rate γ. When becoming a renter in a potential future default scenario becomes more expensive, they require additional home equity today in order to face this potential future cost. Regarding the administrative or stigma cost of default Φ, the threshold increases when this term goes up, this is expected since agents will require more entrepreneurial income in the future to be able to pay for higher default costs, should this scenario materialize. With respect to the degree of recourse d, when the lenders have more recourse over the borrowers assets (higher d) the prospect of default becomes more expensive in expected value. Therefore, just like with the other costs associated to default, agents will require an additional amount of initial home equity in order to become entrepreneurs.

It is also interesting to look at the cross derivative of the initial home equity threshold with respect to expected house prices and degree of recourse. This cross derivative tells us about the response of the career choice threshold to changes in expected house prices, under different regimes of mortgage default recourse. The cross derivative being positive means that the negative slope of the initial home equity threshold, with respect to expected house prices, is increasing on d. Alternatively, for a given increase in expected house prices, the decrease in the initial home equity threshold will be of smaller magnitude the higher d is. When there is an increase in expected house prices, the borrowing constraint for prospective entrepreneurs is relaxed, therefore agents require less initial home equity to enter into entrepreneurship. However, there is a tension since the additional value of being an entrepreneur in the future is reduced by the degree of recourse lenders might have in

case of default. Intuitively, the additional value of becoming entrepreneur grows less when there is more recourse for lenders (higher d) since the downside risk of mortgage default is not as insured as it would be with a lower level of recourse. Adding to the latter effect, when future house prices are expected to be higher, defaulting becomes more expensive because the expected cost of becoming a renter goes up as well.

All proofs for the above statements, regarding the derivatives of this threshold with respect to the mentioned variables, are available in Appendix A.1.

1.6.4 Risk averse agents and unknown θ

In this sub-section we will assume agents have log utility, and do not observe their own entrepreneurial ability prior to picking a career. Therefore, will have an additional source of uncertainty at the moment of choosing in period 1. Under these assumptions, the problem in (1.16) is no longer linear on h.

Similar to that we did in the previous sub-section, we can re-write (1.14) as

$$\begin{aligned} V^W(h;d) &= \lambda V^{WP}(h) + (1-\lambda)V^{WD}(h;P_2^L,d) \\ &= \lambda \log\left[w-(1-h)(1+r)\right] \\ &+ (1-\lambda)\log\left[w - d\left[(1-h)(1+r) - P_2^L\right] - \gamma P_2^L - \Phi\right], \end{aligned}$$

after plugging in (1.3) and (1.4), and using Proposition 1 to simplify the max function in (1.4). This expression is equal to that in the previous sub-section since θ does not enter the value function of workers.

Then, for entrepreneurs we can re-write (1.15) in order to get

$$\begin{aligned}
V^E(h;d) &= \omega\left\{\lambda V^{EP}(h,\theta^H;P_2^H)+(1-\lambda)V^{ED}(h,\theta^H;P_2^L,d)\right\}\\
&+(1-\omega)\left[\lambda V^{EP}(h,\theta^L;P_2^H)+(1-\lambda)V^{ED}(h,\theta^L;P_2^L,d)\right]\\
&=\omega\left\{\lambda\log\left[(\theta^H-r)\tau\mathcal{E}_1\left[E_2(P_2,h)\right]-(1-h)(1+r)\right]\right.\\
&+(1-\lambda)\log\left[(\theta^H-r)\tau\mathcal{E}_1\left[E_2(P_2,h)\right]-d\left[(1-h)(1+r)-P_2^L\right]\right.\\
&\left.\left.-\gamma P_2^L-\Phi\right]\right\}\\
&+(1-\omega)\left\{\lambda\log\left[(\theta^L-r)\tau\mathcal{E}_1\left[E_2(P_2,h)\right]-(1-h)(1+r)\right]\right.\\
&+(1-\lambda)\log\left[(\theta^L-r)\tau\mathcal{E}_1\left[E_2(P_2,h)\right]-d\left[(1-h)(1+r)-P_2^L\right]\right.\\
&\left.\left.-\gamma P_2^L-\Phi\right]\right\},
\end{aligned}$$

after plugging in (1.6) and (1.7), and using Proposition 1 to simplify the max function in (1.7). We need to find the level of h that solves (1.16). Once again we have that the slopes on h are different for both value functions, in particular

$$\frac{\partial V^E(h;d)}{\partial h}>\frac{\partial V^W(h;d)}{\partial h}>0,$$

where the slope of each value function is not shown due to space constraints. However, just like in the risk neutral case, for this ordering we require $\mathcal{E}_1(\theta)>r$. Otherwise entrepreneurs would not produce a positive amount of the consumption good, or equivalently would not enter into entrepreneurship. Then for the same reasons as before, the value of an entrepreneur has a higher slope on h than that of a worker. The threshold is shown in the Appendix **??** since it is a very long and involved expression, however it shares the general properties of the one found in (1.19). Both are decreasing on future house prices, LTV ratio τ, and own entrepreneurial ability θ. Also, both are increasing on w. The threshold for risk averse agents is also increasing on the different costs associated to default (rental rate γ and default cost Φ) and on the degree of recourse d.

1.6.5 Distributive Properties

Given the findings reported in section 1.6.3, we can propose the following.

Corollary 1 *Consider two different levels of recourse $d' < d''$ in two different regions. First, we know from the properties of (1.19) that*

$$h^*(\theta; \mathcal{E}_1(P_2), d') < h^*(\theta; \mathcal{E}_1(P_2), d''),$$

this expression tells us that the level of initial home equity required by agents to become entrepreneurs is lower where d is relatively smaller. As mentioned above, this is due to the downside risk of default being somewhat better insured when d is low, since defaulting agents are liable up to a smaller amount of their resources.

Second, if the probability density function of initial home equity, $j(h)$, is non-increasing around the corresponding threshold, i.e.

$$\left.\frac{\partial j(h)}{\partial h}\right|_{h=h^*(\theta;\mathcal{E}_1(P_2),d)} \leq 0$$

for $d \in \{d', d''\}$.

Then everything else constant, given an increase in expected house prices, we have that

$$\left.\frac{\partial^2 h^*(\theta; \mathcal{E}_1(P_2), d)}{\partial \mathcal{E}_1(P_2)}\right|_{d=d'} > \left.\frac{\partial^2 h^*(\theta; \mathcal{E}_1(P_2), d)}{\partial \mathcal{E}_1(P_2)}\right|_{d=d''}. \tag{1.20}$$

Corollary 1 tells us that, due to an increase in expected house prices, the mass of additional agents becoming entrepreneurs will be larger in the region with a lower degree of recourse. This prediction of the model is testable in the data, therefore will be studied in the empirical part of this work.

1.6.6 Summary and Testable Predictions

There are several predictions of the model that have been presented in the previous sections. They are summarized in the following list

1 As d increases, the default interval on period 2 prices becomes smaller. Then, we should see relatively less agents defaulting in areas where lenders have more recourse.

2 As d increases, the career threshold h^* increases as well. Everything else constant, in

those areas with a higher degree of recourse, we should see new entrepreneurs entering with relatively larger amounts of home equity.

3 As period 2 house prices increase, h^* decreases. Also, the mass of new entrepreneurs is decreasing on d. In areas where lenders have relatively less recourse over the borrowers' assets, the size of the entrepreneurship threshold reduction due to a house price increase is larger. This comes from Corollary 1.

In the following chapter of this dissertation we will test the empirical validity of these predictions. Focusing on the third one, which builds upon the previous two, due to data availability restrictions. As mentioned before, the first prediction has already been explored and validated in the literature (See Chan et al. [2015], Ghent and Kudlyak [2011], Jones [1993], Demiroglu et al. [2014], Li and Oswald [2014], Desai et al. [2013], and Mitman [2012]). Regarding the second prediction, we do not have home equity data available that is disaggregated enough in order to test it in an accurate way[16].

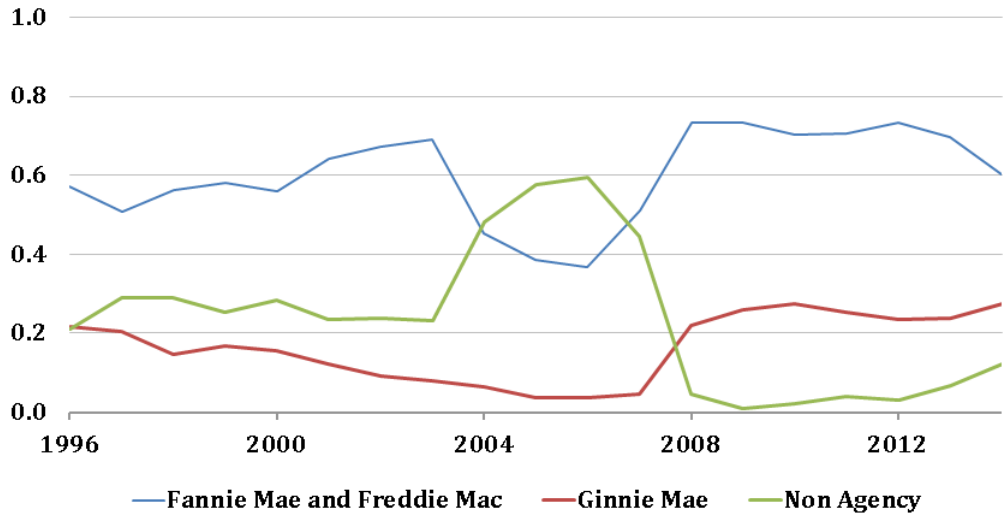
1.7 Conclusion

We have built an heterogeneous agents model with a career and housing choice with house price uncertainty. In this model, agents can pick a career and decide whether to default on their mortgage or not. The purpose of this model is to analyze the interaction between these two decisions, and how it is shaped by different legal environments regarding the degree of recourse lenders have over the borrowers' assets. The model emphasizes the insurance role mortgage default regulation can play during financial distress. This setup yields three testable predictions. First, as lenders have more recourse, the cost of default faced by the borrower increases, therefore default becomes less frequent. Second, as lenders have more recourse, the entrepreneurship threshold (i.e. the amount of home equity a homeowner requires in order to become an entrepreneur, as opposed to being a worker) also increases.

[16] Data from the Panel Study of Income Dynamics (PSID) suggests that new entrepreneurs hold relatively more home equity before starting a new business in recourse states compared to non-recourse states. However, the sample size is not large enough to accurately test for the statistical significance of the difference in home equity among different states.

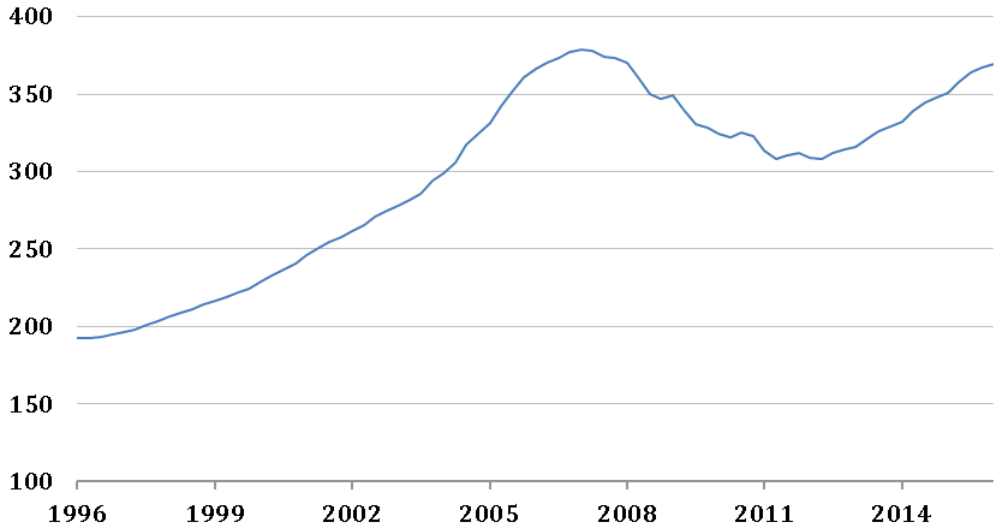
Third, where lenders have relatively less recourse, the size of the entrepreneurship threshold reduction due to a house price increase is larger.

Figure 1·1: MBS Issuance by Issuer



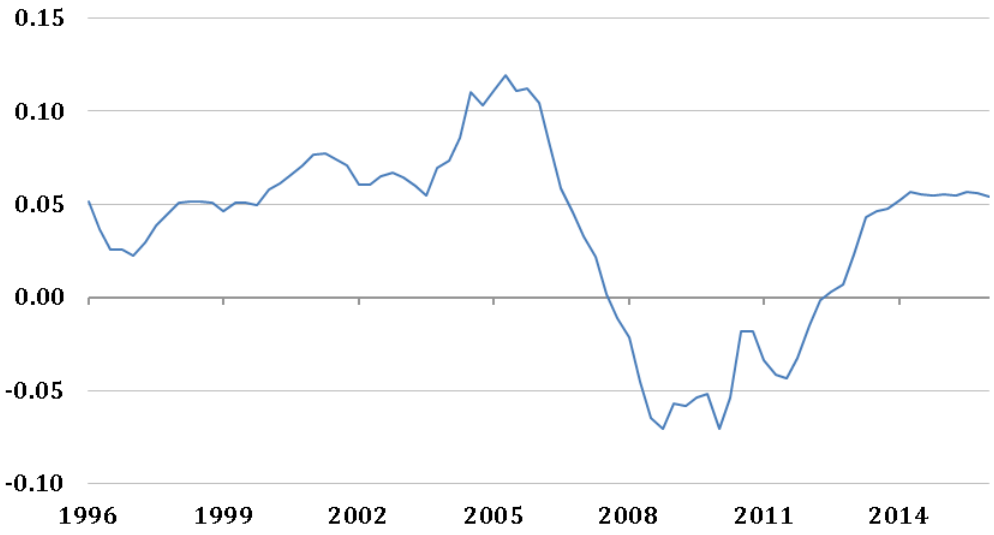
Source: Congressional Budget Office.

Figure 1·2: All-Transactions House Price Index (1980:Q1=100)



Source: US. Federal Housing Finance Agency.

Figure 1·3: All-Transactions House Price Index (YoY variation, percentage points)



Source: US. Federal Housing Finance Agency.

Figure 1·4: Housing Policy Function

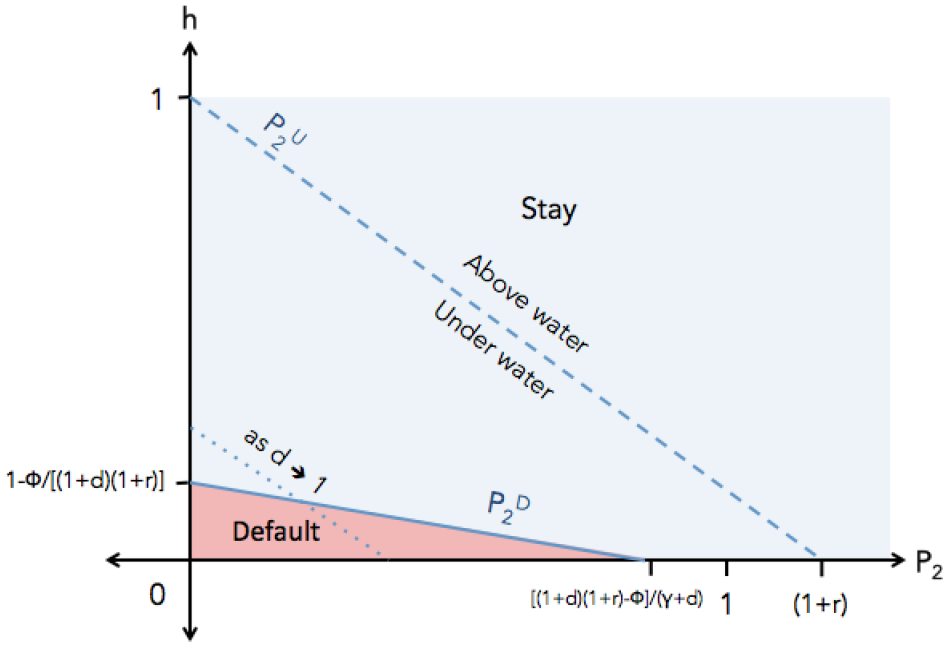


Table 1.1: Start-Up Capital Requirements as of 2007

Industry	NAICS2	Average Start-Up Amount (USD)	Above/Below Median
Construction	23	78,372	0
Professional, Scientific, and Technical Services	54	87,879	0
Admin. and Supp., Waste Mgmt. and Rem. Serv.	56	91,278	0
Transportation and Warehousing	48	131,893	0
Agriculture, Forestry, Fishing and Hunting	11	146,033	0
Educational Services	61	156,893	0
Other Services (except Public Administration)	81	161,995	0
Wholesale Trade	42	188,085	0
Finance and Insurance	52	203,799	0
Health Care and Social Assistance	62	214,889	0
Retail Trade	44	216,302	1
Arts, Entertainment, and Recreation	71	218,061	1
Real Estate, and Rental and Leasing	53	220,691	1
Information	51	236,126	1
Accommodation and Food Services	72	273,186	1
Manufacturing	31	363,166	1
Management of Companies and Enterprises	55	488,681	1
Utilities	22	601,149	1
Mining, Quarrying, and Oil and Gas Extraction	21	673,609	1

Sources: Adelino et al. [2015] and Hurst and Lusardi [2004].

Table 1.2: State Recourse and Foreclosure Laws

State	Judicial or Non -Judicial Foreclosure	Optimum Timeline (1)	Recourse Classification
Alabama	NJ	49-74	Recourse
Alaska	NJ	108-111	Non-Recourse
Arizona	NJ	115	Non-Recourse
Arkansas	NJ	90	Recourse
California	NJ	120	Non-Recourse
Colorado	NJ	173	Recourse
Connecticut	J, strict	160	Recourse
Connecticut	J, by decree of sale	235	
DC	NJ	48	Recourse
Delaware	J	200-300	Recourse
Florida	J	150	Recourse
Georgia	NJ	48	Recourse
Hawaii	NJ	195	Recourse
Hawaii	J	320	
Idaho	NJ	150	Recourse
Illinois	J	345	Recourse
Indiana	J	266	Recourse
Iowa	J	180	Non-Recourse
Kansas	J	230	Recourse
Kentucky	J	198	Recourse
Louisiana	J, executory process	209	Recourse
Louisiana	J, non-executory process	269	
Maine	J	270	Recourse
Maryland	J	46	Recourse
Massachusetts	J	75	Recourse
Michigan	NJ	360 (2)	Recourse
Minnesota	NJ	270-280 (3)	Non-Recourse
Missouri	NJ	61-65	Recourse
Montana	NJ	163	Non-Recourse
Mississippi	NJ	90	Recourse

(1) These are optimum timelines from the USFN [2004]. The optimum timelines assume no delays and are based on uncontested foreclosure actions.

(2)The non-judicial foreclosure optimally takes 60 days. However, after that, the redemption period begins to run, typically for six months. Estimated time for completion for uncontested foreclosure without eviction action is 12 months.

(3) The sale in non-judicial foreclosure can generally be held within 90 days. However, there are substantial redemption rights in Minnesota. Thus, including the redemption period, the optimum timeframe for non-judicial foreclosure is 270 to 280 days.

Table 1.3: State Recourse and Foreclosure Laws (continuation)

State	Judicial or Non -Judicial Foreclosure	Optimum Timeline (1)	Recourse Classification
Nebraska	NJ	121	Recourse
Nebraska	J	176	
Nevada (2)	NJ	116	Recourse
New Hampshire	NJ	75	Recourse
New Jersey	J	295	Recourse
New Mexico	J	225	Recourse
New York (NYC)	J	445	Recourse
New York (Outside NYC)	J	299	
New York (Outside NYC)	NJ	355	
North Carolina (Purchase Mortgages)	NJ	120	Non-Recourse
North Carolina (Other Mortgages)	NJ	120	Recourse
North Dakota	J	150	Non-Recourse
Ohio	J	217	Recourse
Oklahoma (3)	NJ	201	Recourse
Oregon	NJ	160	Non-Recourse
Pennsylvania	J	300	Recourse
Rhode Island	NJ	74	Recourse
South Carolina	J	180	Recourse
South Dakota	J	340	Recourse
Tennessee	NJ	50-55	Recourse
Texas	NJ	35-60	Recourse
Texas	J	80-180	
Utah	NJ	139	Recourse
Vermont	J	275	Recourse
Virginia	NJ	60	Recourse
Washington	NJ	140-150	Non-Recourse
West Virginia	NJ	120	Recourse
Wisconsin	J	315	Non-Recourse
Wyoming	NJ	180	Recourse

(1) These are optimum timelines from the USFN [2004]. The optimum timelines assume no delays and are based on uncontested foreclosure actions.

(2) Recent legislation also makes Nevada non-recourse in most cases for residential purchasers for mortgages obtained on or after October 1, 2009.

(3) Hawaii and Oklahoma are classified as Non-Recourse in Orlando [2010]. An alternative definition including these two states in the Non-Recourse group will be considered when estimating our specifications.

Chapter 2

House Prices, Entrepreneurship, and the Cost of Default: An Empirical Exploration

2.1 Introduction

This chapter provides evidence that new entrepreneurs face credit constraints, which are shaped by the legal environment where they operate. In particular, mortgage default regulation in the geographical area where an entrepreneur plans to start a new business, determines the amount of capital the entrant requires. This is due to the insurance role mortgage default regulation can play in case of financial distress. Using MSA-level data for the US, we find that both the intensive and extensive margins of creation for small young firms responded strongly to the increase in house prices between 2000 and 2007. This effect is driven by those areas where mortgage default is relatively less costly and by those industries where the amount of required start-up capital is low. This link between house prices and entrepreneurial activity is almost non-existent after the onset of the Great Recession. A stylized career choice model with housing, illustrates the insurance role that a lower cost of default plays for entrepreneurs and how it shapes their entry decision.

Several theories have suggested that the relaxation of credit constraints can have significant effects on economic growth. Among others, Bernanke and Gertler [1989] and Kiyotaki and Moore [1997] propose theories that build upon the basic idea that higher net worth reduces lower financing costs of real capital investments. In these economies, capital is both a production input and a collateral for loans. Kiyotaki and Moore [1997] emphasize the role of secured debt and enforcement. When lenders cannot force borrowers to repay, durable assets become crucial as collateral, therefore the price of collateralized assets turns

into a relevant quantity determining the tightness of credit constraints. The authors find that the dynamic interaction between credit limits and asset prices turns out to be a powerful transmission mechanism by which the effects of shocks persist, amplify, and spread out.

In particular, testing for the empirical relevance of the collateral channel enunciated in the theories above has proven to be a challenging task. For firms, Gertler and Gilchrist [1994] find a disproportionate response of small firms to monetary policy tightening compared to that of large firms. Oliner and Rudebusch [1992] conduct a similar test using investment data for firms of different sizes, their findings suggest that small firms' investment decisions are more responsive to changes in the monetary policy stance than their large counterparts. While there is unquestionable value in these early attempts to validate the relevance of the collateral channel, the usage of aggregate data leaves open the possibility for some other underlying mechanism being behind the results. According to Kashyap and Stein [1994], it could be the case that for technological reasons, small firms are more sensitive to recessions than larger firms.

2.2 Literature Review

Our work is related to three strands of literature. First, mortgage default. Second, financial constraints. Third, institutional arrangements. Our main contribution is to the literature on credit constraints and entrepreneurship. We also contribute to the study on the link between homeownership and labor market outcomes. Finally, our work is related to the literature studying the effect of mortgage default regulation on the decision taking process of agents. We build upon the work of Evans and Jovanovic [1989] and Hatchondo et al. [2015] when setting up our structural model, and upon the work of Adelino et al. [2015] and Ghent and Kudlyak [2011] for our empirical verification exercises.

2.3 Summary and Testable Predictions

There are several predictions of the model that have been presented in the previous sections. They are summarized in the following list

1 As d increases, the default interval on period 2 prices becomes smaller. Then, we should see relatively less agents defaulting in areas where lenders have more recourse.

2 As d increases, the career threshold h^* increases as well. Everything else constant, in those areas with a higher degree of recourse, we should see new entrepreneurs entering with relatively larger amounts of home equity.

3 As period 2 house prices increase, h^* decreases. Also, the mass of new entrepreneurs is decreasing on d. In areas where lenders have relatively less recourse over the borrowers' assets, the size of the entrepreneurship threshold reduction due to a house price increase is larger. This comes from Corollary 1.

In the remaining sections of this chapter we will test the empirical validity of the predictions implied by the model build in the previous chapter. Focusing on the third one, which builds upon the previous two, due to data availability restrictions. As mentioned before, the first prediction has already been explored and validated in the literature (See Chan et al. [2015], Ghent and Kudlyak [2011], Jones [1993], Demiroglu et al. [2014], Li and Oswald [2014], Desai et al. [2013], and Mitman [2012]). Regarding the second prediction, we do not have home equity data available that is disaggregated enough in order to test it in an accurate way[1].

2.4 Data and Empirical Methodology

In this section of the chapter, our main goal will be validating the predictions of the model presented in Section 1.4. In particular, given the data availability, we will focus on the

[1]Data from the Panel Study of Income Dynamics (PSID) suggests that new entrepreneurs hold relatively more home equity before starting a new business in recourse states compared to non-recourse states. However, the sample size is not large enough to accurately test for the statistical significance of the difference in home equity among different states.

implications of Corollary 1. We want to test whether in those areas where lenders have relatively less recourse over the borrowers' assets (low d), the size of the entrepreneurship threshold reduction due to a house price increase is relatively larger than in areas with higher recourse.

2.4.1 Data Description

There are two main sources of data for the entrepreneurial outcome which will be used in the remaining sections of this work. The first source is the Statistics of U.S. Businesses Survey (SUSB) published by the United States Census Bureau, it includes number of firms, number of establishments, employment, and annual payroll for most U.S. business establishments. The Statistics of U.S. Businesses (SUSB) program started in 1988 and has data through 2013. SUSB produces both annual (static) tabulations and employment change (dynamic, establishment birth and death) tabulations. The data are tabulated by geographic area (Metropolitan Statistical Area level), industry, and enterprise employment size. Industry classification is based on 2012 North American Industry Classification System (NAICS) codes. Size categories are 0-4 employees, 5-9, 10-19, 20-99, 100-499, and over 500. This constitutes our main dependent variable for the first estimation exercise. The breakdown of establishments by the number of employees allows us to differentially estimate the effect of house price growth in the net creation of establishments of different sizes.

The second source of entrepreneurial outcome data is the Business Dynamics Statistics (BDS), also published by the United States Census Bureau. This dataset provides annual measures of business dynamics (such as job creation and destruction, establishment births and deaths, and firm startups and shutdowns) for the economy and aggregated by establishment and firm characteristics. The BDS is created from the Longitudinal Business Database (LBD), a larger confidential database. The BDS series provides annual statistics since 1976. The BDS data are tabulated by geographic area (Metropolitan Statistical Area level), employment size, and also by firm age. The availability of the latter classification constitutes the main difference with respect to the SUSB data, where age of firms is absent.

Having information on a firm's age will allow us to further refine our estimations, this becomes particularly relevant in view of the work of Haltiwanger et al. [2010] and Haltiwanger et al. [2012]. The authors use the BDS and LBD to find that the relationship between firm size and employment growth breaks once they control for firm age. Establishment size is defined as the average of year $t-1$ and year t employment. Size categories for the BDS are 1-4 employees, 5-9, 10-19, 20-49, 50-99, 100-249, 250-499, 500-999, 1000-2499, 2500-4999, 5000-9999, and over 10000. Establishment age is computed by taking the difference between the current year of operation and the birth year. Since the LBD series (source to the BDS) starts in 1976, observed age is by construction left censored at 1975. Age 0 establishments are new establishments in the economy. Age categories are 0 years, 1, 2, 3, 4, 5, 6-10, 11-15, 16-20, 21-25, over 26, and left censored.

For the estimations using the SUSB data we use five size categories, establishments of 1 to 4 employees, 5 to 9 employees, 10 to 19 employees, 20 to 99 employees, and more than 100 employees. All these categories are given by the SUSB except for the last one, where we aggregate all establishments of more than 100 employees. The SUSB has two categories above 100 employees, but using each one individually would only add noise to our estimation, as they become rare at the MSA level, and even more so at the MSA and industry level.

When using the BDS data, besides considering the size dimension we will include the age of establishments. However, we no longer have available the industry classification with this dataset. Regarding age, we will follow Haltiwanger et al. [2012] in defining young units as those aged five years or less. Regarding size, we will use the same categories defined above for the SUSB data, following Adelino et al. [2015] we define small firms as those with less than 10 employees.

The house prices used are those summarized in the Freddie Mac House Price Index (FMHPI) at the MSA level. The FMHPI is calculated using a repeat-transactions methodology for conforming loans only. Repeat transactions indexes measure price appreciation while holding constant property type and location, by comparing the price of the same

property over two or more transactions. Freddie Mac uses a dataset that includes valuation and location data for the combined portfolio of loans that were purchased by either Freddie Mac or Fannie Mae since January 1975. This dataset is updated monthly with new purchases from the two firms and, as of January, 2011, contains over 25 million transaction pairs. Repeat transactions in this dataset are identified as two first-lien mortgages originated on different dates for the same property address, that are financed by loans purchased by either Freddie Mac or Fannie Mae. We use annual data on the MSA-level index between 1999 and 2011.

In order to identify the causal effect of house prices on small business creation we instrument house price growth with the measure of land unavailability of Saiz [2010], which varies at the MSA level. This measure focuses on geographic constraints by defining undevelopable land for construction as terrain with a slope of 15 degrees or more and areas close to bodies of water including seas, lakes, and wetlands. This measure provides an exogenous measure of supply elasticity, with a higher value if an area is more geographically restricted. Low elasticity areas correlate strongly with steeper house price growth in the period of 2002 to 2007. The Saiz [2010] measures are available only for 269 MSAs. The availability of this measure will condition the size of our sample when performing our estimations. Authors have alternatively used the supply elasticity or the share of land unavailability measures provided by Saiz [2010]. However, some argue in favor of using the latter due to endogeneity concerns with the former one. We will also use the share of land unavailability, and discuss about the relevance of this measure as an instrument in the Empirical Strategy sub-section below.

Following Adelino et al. [2015], we use the Survey of Business Owners (SBO) Public Use Microdata Sample (PUMS) to construct a measure of capital needed to start a firm. This provides an additional dimension though which we can categorize new firms, according to their start up capital requirements. The PUMS surveys a random sample of businesses selected from a list of all firms operating during 2007 with receipts of $1,000 or more provided by the IRS. The SBO PUMS file includes national and state-level data and

detailed characteristics of businesses and their owners such as access to capital, firm size, employer-paid benefits, minority- and women-ownership, and firm age. The SBO is part of the Economic Census conducted every five years in years ending in 2 and 7. We focus on the "Amount of start-up or acquisition capital" for each firm and we group the answers to this question at the 2-digit NAICS industry level (the finest level available in the data) for firms established in 2007. The average capital requirements by industry are summarized in Table 2.4. As Adelino et al. [2015] report, the classification obtained is nearly the same when using all the years in the data, or when using only firms with 1-4 employees. The median amount of capital needed to start a business in the data is 215 thousand dollars. We also follow Hurst and Lusardi [2004] and create two groups of firms according to their initial capital requirements, those below and those above the median requirement. The groups are clearly identified in the last column of Table 2.4 with a 0 or 1, respectively.

We follow the same recourse/non-recourse binary classification used by Ghent and Kudlyak [2011]. This is made at the state level since state laws are the ones determining the degree of recourse of lenders and the foreclosure procedures. Their classification is based on USFN [2004]. These categories are summarized in Table 2.5. The way Ghent and Kudlyak [2011] categorize states largely coincides with the classification in Orlando [2010]. We will perform our estimations based on Ghent and Kudlyak [2011], however we will also consider Orlando [2010] in a robustness exercise.

Total population, home ownership rate, percentage of college educated individuals, employment as a share of total population 16 years old or older, and labor force defined as the total population in the civilian labor force over 16 year old divided by the total population 16 years old or older at the MSA level, are used as controls to better identify the effect of prices on our different entrepreneurial outcome variables. These series are obtained from the Census Bureau Summary Files for 2000. Finally, we use the number of households at the MSA level as weights when estimating our different specifications.

2.4.2 Summary Statistics

Table 2.1 provides summary statistics for key variables included in our specifications, for the whole sample and also sub-samples of recourse and non-recourse areas. For our three entrepreneurial outcomes (employment, number of firms and number of establishments) we show levels as of 2000 and growth rates between years 2000 and 2007 (we also display the standard deviation for this figure). We also include house price growth for the same time period, share of land unavailability computed by Saiz [2010], number of households as of 2000 (which we use as weights in our estimations) and number of MSAs. The data shown is conditioned by the availability of the instrument (share of land unavailability), re-coding of some MSAs over time[2], and existence of non-missing values for the entrepreneurial outcome variable. Given these elements, our sample includes 236 Metropolitan Statistical Areas, out of a total of 388. 131 MSAs are considered non-recourse, and the remaining 105 are labeled as recourse according to the classification in Table 2.5. In terms of households, about 57 percent are located in non-recourse states. Employment in all MSAs in our data grew by 7.97 percent between years 2000 and 2007, with this variation being slightly larger among non-recourse areas. The number of firms and establishments grew by 8.54 and 10.48 percent respectively in the same time period, showing once again somewhat larger variations in non-recourse areas. Average house price growth was 34.94 percent for all MSAs in our sample, slightly larger among non-recourse areas. The share of land unavailability is not statistically different between our two groups of MSA, on average it is 23.63 percent. For the period between 2007 and 2011 all of our key variables showed negative variation and less volatility than during the 2000-07 period. Employment decreased 6.09 percent on average, with recourse areas falling slightly more than average. Number of firms and number of establishments dropped by 6.24 and 5.21 percent respectively, with non-recourse areas decreasing in somewhat larger amounts. House prices also fell slightly more in non-recourse areas during the period after 2007.

[2]Changes in the geographical definition of MSAs were implemented by the Census Bureau in 2004. We will only work with those areas where no changes were implemented, in order to keep the groups consistent.

In Tables 2.2 and 2.3 we show size and age distributions for employment, number of firms and number of establishments. In general we do not observe important differences in the distributions of size or age among recourse and non-recourse areas. This suggests that besides the institutional arrangement regarding mortgage default, there does not seem to be a significant difference in terms of distributions or changes in house prices as shown above, therefore these elements do not seem to introduce a composition or treatment bias in our results. Small firms (with less than 10 employees) account for almost 12 percent of total employment, but about 70 percent of the total number of firms. Young firms (aged 5 years or less) account for about 15 percent of employees (out of a universe of 132 million nonfarm workers in the U.S. as of 2000), over 40 percent of the total number of firms (out of a universe of 5.6 million firms in the U.S. as of 2000), and over 35 percent of the total number of establishments (out of a universe of over 7 million establishments in the U.S. as of 2000). This is an economically relevant group, therefore understanding the determinants behind its evolution and interaction with other sectors is a crucial endeavor.

2.4.3 Empirical Strategy

In this part of the chapter, our main goal is testing the validity of the predictions of the model presented in Section 1.4. In particular, given the available data, we will focus on the implications of Corollary 1. In particular, we want to test whether in those areas where lenders have relatively less recourse over the borrowers' assets (low d), the size of the entrepreneurial activity response due to a house price increase is relatively larger than in areas with higher recourse.

The two main challenges we face when estimating the relevance of the claims implicit in Corollary 1 are the following. First, being able to distinguish the collateral channel (more home equity due to increased real estate prices relaxing the borrowing constraint for potential entrepreneurs) from the aggregate demand channel (increased aggregate demand fostering the creation and growth of firms). Second, establishing a causal relationship between house prices and the creation of firms. House prices are a good proxy for housing

market shocks because key mechanisms by which housing sector shocks affect local labor market outcomes, such as increased construction activity or the provision of other goods and services because of an increase in household wealth, likely operate through house prices. However, establishing this link is not direct due to potential endogeneity, where unobserved elements can affect both variables (house prices and firm creation) at the same time. More specifically, house price variation at the MSA level may be due to unobserved shocks that may also affect firm creation, introducing bias to estimates that do not take this into account.

In order to deal with the first issue, the identification strategy is based on the idea that higher house prices will increase home equity for all homeowners, however it will only be crucial for those agents in need of capital up to a certain threshold. Homeowners in need of large amounts of capital, above the aforementioned threshold, cannot solely rely on their home equity in order to become entrepreneurs. Instead they must resort to alternative funding sources. As for the second issue, we will instrument the variation of MSA level housing prices using the elasticity of housing supply measure constructed by Saiz [2010]. Saiz [2010] uses highly detailed data to measure geographical constraints on local land supply, as well as factors that account for endogenous restrictions on land use through zoning, he estimates housing supply elasticities at the MSA level which, in turn, allow us to capture the effect of the housing boom on access to capital. Saiz [2010] finds that most areas in which housing supply is regarded as inelastic are severely land-constrained by their geography (due proximity to large bodies of water and/or steep terrain) or zoning laws. The sensitivity of house prices to an aggregate demand shock will be determined by the land availability of each area. The usefulness of this measure as an instrument stems from land availability being a pre/existing characteristic of the area. Then, we can assume that any variation in the aggregate demand shock captured by the instrument is probably uncorrelated with unobserved labor supply shifts during the housing boom. The exclusion restriction will be violated if the housing supply elasticity is correlated with employment or business creation for reasons other than house price growth. The housing supply elasticity

has been utilized as instrument in this context by many others in the literature, some of them are Adelino et al. [2015], Chaney et al. [2012], Charles et al. [2015], Cvijanovic [2012], Haltiwanger et al. [2010], Kumar [2014], Mian and Sufi [2012], Mian and Sufi [2009], and Robb and Robinson [2014] among others.

We will use two very similar specifications in order to test the validity of the claims in Corollary 1. These two specifications will differ on the data they will use but will be analogous in all other aspects. One of them will be written for the SUSB data, while the other will be tailored for the BDS data.

First, when using the SUSB data (which is available at the MSA $\times$ industry level), the specification will have the following form,

$$\begin{aligned}\Delta^{00-07} HP_i =& \phi_{0,1} + \phi_{1,1} SLU_i + \psi_1 X_i + \eta_{i,2} \\ \Delta^{00-07} HP_i \times REC_i =& \phi_{0,2} + \phi_{1,2} SLU_i + \psi_2 X_i + \eta_{i,2}\end{aligned} \tag{2.1}$$

$$\begin{aligned}\Delta^{00-07} Y_{iz} =& \beta_0 + \beta_1 REC_i + \beta_2 \Delta^{00-07} \widehat{HP}_i + \beta_3 \Delta^{00-07} \widehat{HP_i \times REC_i} \\ &+ \gamma X_i + \delta \mathbf{1}_z + \epsilon_{iz},\end{aligned} \tag{2.2}$$

where (2.1) is the first stage and (2.2) is the second stage. For the first stage, there are two equations since there are two interaction terms involving house prices in the second stage. The coefficients estimated in the first stage have subscripts that take this into account, the first subscript denotes the coefficient within the equation, while the second subscript denotes the equation within the first stage estimation system. MSAs are indexed by i, and industries by z. HP_i is the log of house price in i, SLU_i is the share of land unavailability in i, X_i is a set of controls (population, % college educated, % employed, workforce as % of population, % of homes owner-occupied and import share). $REC_i = 1$ if debt is recourse in i and equal to 0 otherwise. $\mathbf{1}_z$ is a set of dummy variables for each industry in the 2-digit NAICS 2012 classification. Y_{iz} is the entrepreneurial outcome for

small businesses (<10 employees), which could either be employment, number of firms, or number of establishments. In all the estimations below, we will use the growth of these variables between years 2000 and 2007 in order focus on a period of increasing house prices where borrowing constraints were being relaxed. Later on we will re-estimate all of our specifications for the 2007-2011 period, when house prices were decreasing, in order to assess whether the bursting of the price bubble somehow changed the way these variables interact. Tighter lending standards, record high foreclosure rates which reduced the number of homeowners with a usable collateral, and lower house prices tightened the borrowing constraint of potential entrepreneurs during the Great Recession. In (2.1) we instrument for the growth in house prices ($\Delta^{00-07}HP_i$) and its interaction ($\Delta^{00-07}HP_i \times REC_i$) using the share of land unavailability measure of Saiz [2010] (SLU_i), we also add a set of controls. Then, we estimate (2.2) using the instrumented house price growth ($\Delta^{00-07}\widehat{HP_i}$), its interaction $\Delta^{00-07}\widehat{HP_i \times REC_i}$), and our recourse dummy (REC_i), where β_3 is our coefficient of interest. In particular, this coefficient tells us about the different response of the entrepreneurship outcome to a house price increase in areas with different degrees of recourse. We are interested in testing the statistical significance of β_3. Following Mian and Sufi [2012], standard errors in this specification are heteroskedasticity robust and clustered at the MSA level (since the Saiz [2010] measure varies at that level) and all the regressions are weighted by the number of households in an MSA as of 2000. Following Mian and Sufi [2012], the inclusion of the industry level fixed effects allows us to test for the importance of the alternative demand channel. This channel proposes that higher house prices translate into higher home equity, which in turn increases the purchasing power of homeowners. Alternatively, higher house prices will boost demand for certain industries more closely related to construction or home improvement. The industry fixed effects allow us to test for differential effects to the same price increase for different NAICS codes. Also, if the demand channel is relevant it should affect firms of different sizes, while the collateral effect of house prices should mainly affect small firms. As Adelino et al. [2015] argue, there is a possibility that small firms are more sensitive to local demand shocks, therefore they

propose removing from the sample those industries more related to the construction sector and those in the non-tradable sector as classified in Mian and Sufi [2012].

We also explore an aggregated version of (2.2) where we collapse the industry dimension, this alternative specification can be written as

$$\begin{aligned}\Delta^{00-07}HP_i =& \phi_{0,1} + \phi_{1,1}SLU_i + \psi_1 X_i + \eta_{i,1} \\ \Delta^{00-07}HP_i \times REC_i =& \phi_{0,2} + \phi_{1,2}SLU_i + \psi_2 X_i + \eta_{i,2}\end{aligned} \tag{2.3}$$

$$\begin{aligned}\Delta^{00-07}Y_i =& \beta_0 + \beta_1 REC_i + \beta_2 \Delta^{00-07}\widehat{HP}_i + \beta_3 \Delta^{00-07}\widehat{HP_i \times REC_i} \\ &+ \gamma X_i + \epsilon_i,\end{aligned} \tag{2.4}$$

where the variables included are defined in the same fashion as above. Notice that the industry level dummies are no longer part of the estimation due to the aggregation at that level. We estimate (2.4) in order to obtain the average effect of house price changes over the entrepreneurial outcome.

Second, when using the BDS data (which is available at the MSA $\times$ firm age level) our main specification will be,

$$
\begin{aligned}
\Delta^{00-07} HP_i &= \phi_{0,1} + \phi_{1,1} SLU_i + \psi_1 X_i + \eta_{i,1} \\
\Delta^{00-07} HP_i \times REC_i &= \phi_{0,2} + \phi_{1,2} SLU_i + \psi_2 X_i + \eta_{i,2} \\
\Delta^{00-07} \hat{HP}_i \times \mathbf{1}_j &= \phi_{0,3} + \phi_{1,3} SLU_i + \psi_3 X_i + \eta_{ij,3} \\
\Delta^{00-07} \hat{HP}_i \times REC_i \times \mathbf{1}_j &= \phi_{0,4} + \phi_{1,4} SLU_i + \psi_4 X_i + \eta_{ij,4} \\
\Delta^{00-07} \hat{HP}_i \times \mathbf{1}_k &= \phi_{0,5} + \phi_{1,5} SLU_i + \psi_5 X_i + \eta_{ik,5} \\
\Delta^{00-07} \hat{HP}_i \times REC_i \times \mathbf{1}_k &= \phi_{0,6} + \phi_{1,6} SLU_i + \psi_6 X_i + \eta_{ik,6}
\end{aligned} \tag{2.5}
$$

$$
\begin{aligned}
\Delta^{00-07} Y_{ijk} = &\beta_0 + \beta_1 REC_i + \beta_2 \Delta^{00-07} \widehat{HP}_i + \beta_3 \Delta^{00-07} \widehat{HP_i \times REC_i} \\
&+ \beta_4 \Delta^{00-07} \widehat{HP_i \times \mathbf{1}}_j + \beta_5 \Delta^{00-07} HP_i \times \widehat{REC_i} \times \mathbf{1}_j \\
&+ \beta_5 \Delta^{00-07} \widehat{HP_i \times \mathbf{1}}_k + \beta_6 \Delta^{00-07} HP_i \times \widehat{REC_i} \times \mathbf{1}_k \\
&+ \gamma X_i + \eta \mathbf{1}_j + \nu \mathbf{1}_k + \epsilon_{ijk},
\end{aligned} \tag{2.6}
$$

where (2.5) is the first stage system and (2.6) is the second stage equation. MSAs are indexed by i, age by j and size by k. We include dummy variables for age $\mathbf{1}_j$[3] and size $\mathbf{1}_k$[4]. The remaining variables are defined the same way as above. The main difference with respect to (2.1)-(2.4) is that the entrepreneurial outcome is no longer available at the industry level, instead we can analyze the interactive effect of house prices and degree of recourse across firms of different age and size. The inclusion of the age dimension into our analysis will allow us to take into account the findings of Haltiwanger et al. [2010, 2012]. They report that when firm age is not considered, there is an inverse relationship between net growth rates and firm size, confirming the view that small firms contribute disproportionately to net job growth. However, when including firm age as a control they find no systematic inverse relationship between net growth rates and firm size. Haltiwanger et al. [2010, 2012] also report that firm births are important contributors to both gross and

[3]Equal to one if the firm is aged five years or less, and zero otherwise.
[4]Equal to one if the firm has less than 10 employees, and zero otherwise.

net job creation. Since young firms tend to be small, is easy to understand why in the absence of age as a control in net firms growth regressions there was a systematic inverse relationship between the dependent variable and size. This simply was an omitted variable case, since most new firms are also classified as small. Also, conditional on survival, young firms grow more rapidly than older units. However, survival has a small likelihood among firms. The authors emphasize that many of the research done on the relationship between firm growth and size utilized public data such as the Statistics of U.S. Business (SUSB) we use for estimating (2.1) through (2.4). In view of this, they suggest exploring datasets such as the Business Dynamics Statistics (BDS) which include the age of firms and permit refining the results obtained. This new public-use product gives data users a much richer window on the interactions of size, age and growth that was previously only available to those with access to restricted-use data. We follow this approach and use this data when estimating our specifications in (2.5) and (2.6). As mentioned above, when defining our size categories we follow the approach taken by Haltiwanger et al. [2012], where firms up to 5 years old are considered young and those older than 5 years are labeled as mature.

2.5 Empirical Results

As mentioned above, the focus in this section is testing whether in those areas where lenders have relatively less recourse over the borrowers' assets (low d), the size of the entrepreneurial activity response due to a house price increase is relatively larger than in areas with higher recourse. The main hypothesis is that the increase in home equity provided individuals with easier access to startup capital, and that this increased access effect is larger in areas with lower recourse since this operates as insurance against low realizations of entrepreneurial ability. We expect this effect to be concentrated in small young firms that require less initial capital. However, considering the findings in Haltiwanger et al. [2010, 2012], we expect the size effect to disappear once we control for firm age using the BDS data.

2.5.1 House Prices, Recourse, Size and Industries: SUSB data

Using the SUSB data we estimate (2.1) and (2.2) for different entrepreneurial outcome variables (employment, number of firms, number of establishments), levels of aggregation (which gives us 2.3 and 2.4), industry sub-samples (according to the amount of startup capital required), and also different time periods (2000-2007, and 2007-2011). All of the results for the SUSB dataset are in Tables 2.7 through 2.15. We also perform placebo tests as in Shoag [2013] for all our estimations of key coefficients. In these placebo tests we compute the empirical CDF from one thousand Monte Carlo simulations for the state-level recourse categorization dummy variable and compare it to the point estimate obtained from the original definition of the recourse binary variable. All of the placebo test results for this dataset are shown in Figures 2·4 through 2·21.

We test our main hypothesis in Table 2.7 using employment growth between years 2000 and 2007 as entrepreneurial outcome. We run two-stage least squares regressions (2.1 and 2.2) at the MSA level for employment growth on house price growth, instrumented with the Saiz [2010] measure of land unavailability, and on the interaction of house price growth with the recourse dummy at the state level. In column (1) we show the first stage estimation of house price growth on the land unavailability measure, the obtained coefficient of 0.22 means that a 1 percentage point in the share of land unavailability is associated with a 22 percentage point increase in house prices (for an average house price growth of 36 percent)[5]. The F-statistic for the first stage is 18.21 (above the rule of thumb threshold for weak instruments equal to 10). This confirms previous findings in the literature indicating that areas with relatively less land available for construction experienced larger price increases during the period prior to the recent financial crisis. In column (2) we run a regression of employment growth on house price growth and its interaction with the recourse dummy (besides other controls), without instrumenting house prices in order to show the raw correlation and possible bias due to endogeneity. The smallest size category is excluded. The effect of house prices on employment of small

[5]Descriptive Statistics in the Appendix.

firms is positive and statistically significant. A one standard deviation increase in house prices in a non-recourse MSA is associated with an increase in total employment of 12.75 percent over this period, for an average growth in employment of 16 percent. The effect in a recourse area is smaller, only 5 percent over the period, for an average employment growth of 11 percent. As documented by Adelino et al. [2015], there is no differential effect among sizes when not instrumenting house prices. Therefore, we proceed to re-estimate using the share of land unavailability as instrument, the results are shown in columns (3) and (4) with and without industry level fixed effects respectively. The size of the effect of house prices on employment is not very different when using the instrumented version of our specification, however the effect in recourse areas is close to zero in column (4) (our preferred specification). Also notice how the effect diminishes monotonically as size (in terms of number of employees) increases, until it becomes statistically equal to zero for firms with more that 9 employees in recourse areas. These results confirm the prediction of the model in the previous chapter, namely that the effect of an increase in house prices on entrepreneurial activity is larger in areas with less recourse. Also, these results suggest that the causal effect of house prices on employment is not due to generalized increased demand, since the effect is focused in small firms only and not present in the entire firm size distribution. We also test whether the effect is constant across different levels of required initial capital. In order to do so we re-estimate our preferred specification splitting the sample at the industry level according to required startup capital (below and above the median requirement, more details in Table 2.4). The results in columns (5) and (6) show a larger effect of house prices on employment among those industries with lower capital requirements, the monotonically decreasing pattern is also present in these sub-samples.

In Table 2.13 we show the results of testing whether the effect found above is driven by those industries more closely related to a local demand boom. This would be a consequence of increased demand rather than an effect through the collateral channel. We sequentially remove construction and non-tradables sectors (according to the classification in Mian and Sufi [2012]) and the results are practically unchanged. We also run our regressions for the

manufacturing sector only, given that these are the firms that should be least affected by local demand, given their production of tradable goods. The effect on the manufacturing sector is somewhat smaller, but still present. This confirms the relevance of the collateral and recourse channels, beyond just an aggregate demand effect.

In Figures 2·4, 2·5, and 2·6 we perform placebo tests to assess the specificity of our previous results. We want to confirm that the differential effect between recourse and non-recourse areas is associated to the way these are classified. We conducted one thousand Monte Carlo simulations where we randomly re-arrange the states in the recourse classification and re-estimate for each simulation. We plot the CDF of these simulated coefficients and compare it to the point estimate obtained with the actual classification of states. The results suggest in all cases that the original point estimate is obtained by less than 1 percent of the simulations, lying well outside the range of placebo estimates.

When we change the entrepreneurial outcome variable and use the growth of the number of firms and establishments, instead of employment growth, our results are basically unchanged. We also find the differential effect between recourse and non-recourse areas to be significant, and the monotonically decreasing pattern of the house price effect across the size distribution of firms and establishments. Once again the effect is larger among industries with lower capital requirements, and is robust to the exclusion of industries more closely related to a local demand boom. Also, the placebo tests indicate that the point estimates for the interaction of house prices and recourse dummy lie well outside the range of placebo estimates.

2.5.2 House Prices, Recourse, Size and Age: BDS data

Using the BDS data we estimate (2.5) and (2.6) for different entrepreneurial outcome variables (employment, number of firms, number of establishments), and also different time periods (2000-2007, and 2007-2011). All of the results for the BDS dataset are in Tables 2.16 through 2.21. We also perform placebo tests as in Shoag [2013] for all our estimations of key coefficients. All of the placebo test results for this dataset are shown in

Figures 2·22 through 2·27.

The BDS data permits including the age of firms into our specifications. In Table 2.16 we show the results from estimating (2.5) and (2.6) using employment growth as entrepreneurial outcome. We will test our main hypothesis once again, regarding the differential effect house prices have on employment depending on the level of recourse in the state. This time we will also check for the presence of the findings documented in Haltiwanger et al. [2010, 2012], the authors claim that the size effects found above tend to lose statistical significance when age is included in the specification (as a dummy variable equal to one for firms aged 5 years or less). In column (1) we show the first stage estimation of house price growth on the land unavailability measure, the obtained coefficient of 0.29 is similar to the one reported before and has the same interpretation. The F-statistic is above the usual threshold for weak instruments. In column (2) we run a regression of employment growth on house price growth and its interaction with the recourse dummy (besides other controls), without instrumenting house prices in order to show the raw correlation and possible bias due to endogeneity. The effect of house prices on employment of young firms is positive and statistically significant, we also find a negative and significant effect of recourse on this relationship. Notice how the size of firms is no longer a relevant regressor, just as reported in Haltiwanger et al. [2010, 2012]. In columns (3) and (4) we use the instrumented version of house price growth to confirm our previous finding is not influenced by endogeneity, considering the numerous factors that are likely to drive both employment creation and house prices (income growth, investment opportunities, etc.). In column (3) we include the size of firms (as a dummy variable equal to one for firms with less than 10 employees) instead of age. Once again, as with the SUSB data, the effect is relevant only among small firms, and significantly larger when those small firms are located in non-recourse areas. Then, in column (4) after adding age to the specification in column (3) we confirm the fidings in Haltiwanger et al. [2010, 2012]. The interaction of size and house price growth is no longer relevant, however house prices have a sizable effect on young firms employment. This effect is statistically equal to zero in recourse

areas. These results suggest that the causal effect of house prices on employment is not due to generalized increased demand, since the effect is focused in young firms only and not present in the entire firm age distribution.

Given the availability of data we cannot perform all the robustness tests we computed with the SUSB data since we do not have the industry level data. However, with our dataset we can compute the placebo tests we described before. Our results are shown in Figure 2·22 for employment in the 2000-07 period, they indicate that the point estimate is outside the placebo estimates range at the 99 percent.

Using the alternative measures of entrepreneurial outcome (number of firms and number of establishments) we find similar results to those reported for employment. The estimations for the growth of the number of firms are in Table 2.18 and the corresponding placebo test results are shown in Figure 2·24. For the change in number of establishments, the estimations are summarized in Table 2.20 and the corresponding placebo test results are shown in Figure 2·26.

2.5.3 Crisis Period (2007-2011)

All the estimations carried out above consider a period of time where prices were increasing in most MSAs (Figure 2·1), average homeownership rate reached a historical high of 69.2 percent in 2004:Q2 (Figure 2·2), and lending standards were being steadily loosened (Figure 2·3). One natural question is how were the recourse and collateral channels affected by the abrupt change in all of the above market conditions that started in 2007. Given the available data the only way to answer this question (at least partially) is by re-estimating our specifications for the financial crisis period, with decreasing house prices, declining homeownership rate, and tighter lending standards.

In Table 2.8 we estimate all of our specifications for the period of time spanning from 2007 through 2011 using the SUSB data for the employment growth as entrepreneurial outcome. In column (1) we show the first stage estimation of house price growth on the land unavailability measure, the coefficient is no longer statistically significant. Some of the

control variables are still significant, the R^2 is less than half compared to the one obtained for the 2000-07 period, and the F-statistic is barely above 10. In general, the instrument loses statistical significance and other factors seem to be the driving force during this period of financial turmoil. However, when estimating the second stage in columns (3) and (4) there is still evidence of a positive and significant effect of house price growth on employment growth, concentrated among small firms located in recourse areas. In our preferred specification (column (4)) the monotonically decreasing pattern of this effect is no longer present. However it is still significant in column (3) when we pool all the industries together. The effect also seems to be stronger among those industries with relatively lower startup capital requirements (columns (5) and (6)). The placebo test for the interaction between house price growth and the recourse dummy, in Figure 2·7, no longer displays the point estimate outside the interval of placebo coefficients. In fact, about 35 percent of the simulations yield an estimate below the original coefficient. This suggests that the evidence of structural change is widespread across geographical areas.

Once again, the results are largely the same when using our alternative measures of entrepreneurial outcome (number of firms and number of establishments).

Using the BDS data we find similar results. In Table 2.8 we summarize our estimations using this dataset for the crisis period, with employment growth as entrepreneurial outcome. In column (1) we show the first stage estimation of house price growth on the land unavailability measure, the obtained coefficient is statistically significant and positive, however ten times smaller than the one obtained for the 2000-07 period. The results in columns (3) and (4) once again show how the size effect disappears once we control for age. Also, again we find evidence of both the recourse and collateral channels being present in the data, however with smaller magnitudes than in the previous period (about 40 percent smaller). Similar as with the SUSB data, the placebo test for the interaction between house price growth and the recourse dummy, in Figure 2·23, no longer displays the point estimate outside the interval of placebo coefficients. Around 75 percent of the simulations yield an estimate below the original coefficient. This suggests that the evidence of structural change

is widespread across geographical areas in this dataset as well.

Finally, the results are basically the same when using our alternative measures of entrepreneurial outcome (number of firms and number of establishments).

2.6 Conclusion

In summary, we present evidence that validates some of the predictions made in the previous section. We identify the presence of both the recourse and collateral channels in the extensive and intensive margins of creation of young firms, being the latter channel stronger in non-recourse areas. Our results indicate that access to collateral in areas were agents are insured by low recourse has a strong effect in facilitating the creation of small businesses. This link seems to had been weakened during the financial crisis, most likely due to the profound changes that took place during this period, particularly in terms of lower home equity and tighter lending standards.

We show that the causal effect identified is concentrated among young firms, and that the size effect disappears once we control for age. Our results are stronger in those areas where lenders have relatively less recourse, and among industries with relatively lower initial capital requirements. The results are robust to the exclusion of certain industries closely related to local booms, and also robust to re-ordering along the recourse dimension.

Table 2.1: Summary Statistics

	All MSA	Non-Recourse	Recourse
Total Employment (2000)	70,732,472	40,767,461	29,965,011
Total Employment Growth (2000-07, percent)	7.97	10.44	4.79
	(24.50)	(22.51)	(26.61)
Total Employment Growth (2007-11, percent)	-6.09	-5.91	-6.34
	(4.71)	(4.83)	(4.56)
Total Number of Firms (2000)	3,520,180	2,038,634	1,481,546
Total Number of Firms Growth (2000-07, percent)	8.54	9.95	6.74
	(24.78)	(22.50)	(27.44)
Total Number of Firms Growth (2007-11, percent)	-6.24	-6.33	-6.13
	(3.38)	(3.57)	(3.13)
Total Number of Establishments (2000)	4,161,535	2,413,157	1,748,378
Total Number of Establishments Growth (2000-07, percent)	10.48	11.92	8.61
	(25.48)	(23.12)	(28.22)
Total Number of Establishments Growth (2007-11, percent)	-5.21	-5.25	-5.16
	(3.23)	(3.44)	(2.94)
House Prices Growth (2000-07, percent)	34.94	35.70	33.97
	(23.92)	(24.18)	(23.67)
House Prices Growth (2007-11, percent)	-16.40	-18.21	-14.08
	(15.39)	(15.73)	(14.69)
Share of Land Unavailability (percent)	23.63	24.28	22.78
	(20.11)	(20.38)	(19.83)
Number of Households (2000)	37,040,321	21,093,631	15,946,690
Number of MSAs	236	131	105

Note 1: Standard deviations in parenthesis below each corresponding quantity.
Note 2: As of December of 2000, there are 132 million nonfarm employees in the U.S. This is a measure of the number of U.S. workers in the economy that excludes proprietors, private household employees, unpaid volunteers, farm employees, and the unincorporated self-employed. This measure accounts for approximately 80 percent of the workers who contribute to Gross Domestic Product (GDP).
Note 3: As of 2000, there are 105 million households in the U.S. out of which 84 million are located in MSAs. There is a total of 388 MSAs, 381 in the U.S. and 7 in Puerto Rico.
Note 4: The sample size is conditioned by the availability in the cross section of the share of unavailable land computed by Saiz [2010].
Source: United States Census Bureau.

Table 2.2: Summary Statistics by Number of Employees in Establishment (as of 2000) - SUSB Data (participation shares by size group, percent)

Variable	Sample	0 to 4	5 to 9	10 to 19	20 to 99	+100
Employment	All MSA	5.76	5.94	7.41	17.81	63.09
	Non-Recourse	6.30	6.42	8.08	19.16	60.04
	Recourse	5.62	5.82	7.24	17.46	63.86
Firms	All MSA	51.02	18.10	11.18	10.28	9.41
	Non-Recourse	52.01	18.08	11.31	10.27	8.33
	Recourse	50.75	18.11	11.15	10.28	9.71
Establishments	All MSA	43.15	15.44	9.84	10.41	21.15
	Non-Recourse	44.44	15.60	10.09	10.61	19.26
	Recourse	42.80	15.40	9.77	10.36	21.67

Note 1: As of December of 2000, there are 132 million nonfarm employees in the U.S. This is a measure of the number of workers in the economy that excludes proprietors, private household employees, unpaid volunteers, farm employees, and the unincorporated self-employed. This measure accounts for approximately 80 percent of the workers who contribute to Gross Domestic Product (GDP).
Note 2: As of 2000, there are 105 million households in the U.S. out of which 84 million are located in MSAs. There is a total of 388 MSAs, 381 in the U.S. and 7 in Puerto Rico.
Source: United States Census Bureau.

Table 2.3: Summary Statistics by Age of Establishments (as of 2000) - BDS Data (participation shares by age group in years, percent)

Variable	Sample	0 to 5	6 to 10	11 to 15	16 to 20	21 to 25	Left Censored (*)
Employment	All MSA	14.47	8.77	9.78	7.63	6.18	53.18
	Non-Recourse	16.42	9.91	10.40	8.97	6.78	47.51
	Recourse	13.97	8.47	9.62	7.29	6.02	54.63
Firms	All MSA	42.61	15.60	11.84	8.56	4.66	16.72
	Non-Recourse	44.24	15.83	12.16	8.90	4.78	14.09
	Recourse	42.16	15.54	11.75	8.47	4.63	17.45
Establishments	All MSA	36.59	13.82	11.12	8.30	5.31	24.85
	Non-Recourse	38.42	14.25	11.48	8.82	5.47	21.57
	Recourse	36.09	13.71	11.02	8.16	5.26	25.76

(*): These are firms born before 1976 and for which the exact age is unknown.
Note 2: As of December of 2000, there are 132 million nonfarm employees in the U.S. This is a measure of the number of workers in the economy that excludes proprietors, private household employees, unpaid volunteers, farm employees, and the unincorporated self-employed. This measure accounts for approximately 80 percent of the workers who contribute to Gross Domestic Product (GDP).
Note 3: Regarding households, as of 2000 there are 105 million households in the U.S. out of which 84 million are located in MSAs. There is a total of 388 MSAs, 381 in the U.S. and 7 in Puerto Rico.
Source: United States Census Bureau.

Table 2.4: Start-Up Capital Requirements as of 2007

Industry	NAICS2	Average Start-Up Amount (USD)	Above/Below Median
Construction	23	78,372	0
Professional, Scientific, and Technical Services	54	87,879	0
Admin. and Supp., Waste Mgmt. and Rem. Serv.	56	91,278	0
Transportation and Warehousing	48	131,893	0
Agriculture, Forestry, Fishing and Hunting	11	146,033	0
Educational Services	61	156,893	0
Other Services (except Public Administration)	81	161,995	0
Wholesale Trade	42	188,085	0
Finance and Insurance	52	203,799	0
Health Care and Social Assistance	62	214,889	0
Retail Trade	44	216,302	1
Arts, Entertainment, and Recreation	71	218,061	1
Real Estate, and Rental and Leasing	53	220,691	1
Information	51	236,126	1
Accommodation and Food Services	72	273,186	1
Manufacturing	31	363,166	1
Management of Companies and Enterprises	55	488,681	1
Utilities	22	601,149	1
Mining, Quarrying, and Oil and Gas Extraction	21	673,609	1

Note: According to the Survey of Business Owners (SBO) Public Use Microdata Sample (PUMS). As of 2007, the median start-up capital requirement is $215,000.
Source: United States Census Bureau.

Table 2.5: State Recourse and Foreclosure Laws

State	Judicial or Non -Judicial Foreclosure	Optimum Timeline (1)	Recourse Classification
Alabama	NJ	49-74	Recourse
Alaska	NJ	108-111	Non-Recourse
Arizona	NJ	115	Non-Recourse
Arkansas	NJ	90	Recourse
California	NJ	120	Non-Recourse
Colorado	NJ	173	Recourse
Connecticut	J, strict	160	Recourse
Connecticut	J, by decree of sale	235	
DC	NJ	48	Recourse
Delaware	J	200-300	Recourse
Florida	J	150	Recourse
Georgia	NJ	48	Recourse
Hawaii	NJ	195	Recourse
Hawaii	J	320	
Idaho	NJ	150	Recourse
Illinois	J	345	Recourse
Indiana	J	266	Recourse
Iowa	J	180	Non-Recourse
Kansas	J	230	Recourse
Kentucky	J	198	Recourse
Louisiana	J, executory process	209	Recourse
Louisiana	J, non-executory process	269	
Maine	J	270	Recourse
Maryland	J	46	Recourse
Massachusetts	J	75	Recourse
Michigan	NJ	360 (2)	Recourse
Minnesota	NJ	270-280 (3)	Non-Recourse
Missouri	NJ	61-65	Recourse
Montana	NJ	163	Non-Recourse
Mississippi	NJ	90	Recourse

(1) These are optimum timelines from the USFN [2004]. The optimum timelines assume no delays and are based on uncontested foreclosure actions.

(2)The non-judicial foreclosure optimally takes 60 days. However, after that, the redemption period begins to run, typically for six months. Estimated time for completion for uncontested foreclosure without eviction action is 12 months.

(3) The sale in non-judicial foreclosure can generally be held within 90 days. However, there are substantial redemption rights in Minnesota. Thus, including the redemption period, the optimum timeframe for non-judicial foreclosure is 270 to 280 days.

Table 2.6: State Recourse and Foreclosure Laws (continuation)

State	Judicial or Non -Judicial Foreclosure	Optimum Timeline (1)	Recourse Classification
Nebraska	NJ	121	Recourse
Nebraska	J	176	
Nevada (2)	NJ	116	Recourse
New Hampshire	NJ	75	Recourse
New Jersey	J	295	Recourse
New Mexico	J	225	Recourse
New York (NYC)	J	445	Recourse
New York (Outside NYC)	J	299	
New York (Outside NYC)	NJ	355	
North Carolina (Purchase Mortgages)	NJ	120	Non-Recourse
North Carolina (Other Mortgages)	NJ	120	Recourse
North Dakota	J	150	Non-Recourse
Ohio	J	217	Recourse
Oklahoma (3)	NJ	201	Recourse
Oregon	NJ	160	Non-Recourse
Pennsylvania	J	300	Recourse
Rhode Island	NJ	74	Recourse
South Carolina	J	180	Recourse
South Dakota	J	340	Recourse
Tennessee	NJ	50-55	Recourse
Texas	NJ	35-60	Recourse
Texas	J	80-180	
Utah	NJ	139	Recourse
Vermont	J	275	Recourse
Virginia	NJ	60	Recourse
Washington	NJ	140-150	Non-Recourse
West Virginia	NJ	120	Recourse
Wisconsin	J	315	Non-Recourse
Wyoming	NJ	180	Recourse

(1) These are optimum timelines from the USFN [2004]. The optimum timelines assume no delays and are based on uncontested foreclosure actions.

(2) Recent legislation also makes Nevada non-recourse in most cases for residential purchasers for mortgages obtained on or after October 1, 2009.

(3) Hawaii and Oklahoma are classified as Non-Recourse in Orlando [2010]. Estimations with this classification do not modify our results in a statistically significant magnitude.

Table 2.7: Employment Growth (2000-2007) - SUSB Data

	All Industries				Start-up Capital < P50	Start-up Capital > P50
	House Price Growth	Employment Growth			Employment Growth	
	WLS	WLS	IV	IV	IV	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Share of Land Unavailability	0.22***					
	(0.10)					
Growth in House Prices		0.51***	0.55***	0.52***	0.55***	0.26*
		(0.11)	(0.12)	(0.13)	(0.15)	(0.15)
Recourse Debt		-0.05	-0.05	-0.12*	-0.09	-0.15**
		(0.06)	(0.06)	(0.06)	(0.07)	(0.08)
Growth in House Prices x Recourse		-0.28***	-0.21*	-0.43***	-0.52***	-0.12*
		(0.03)	(0.11)	(0.11)	(0.13)	(0.06)
Growth in House Prices x 10-19 Employees		-0.00*	-0.01*	-0.05*	-0.10*	-0.31**
		(0.00)	(0.00)	(0.04)	(0.04)	(0.15)
Growth in House Prices x 20-99 Employees		-0.07	-0.20**	-0.15**	-0.16**	-0.38***
		(0.08)	(0.08)	(0.08)	(0.08)	(0.16)
Growth in House Prices x >99 Employees		-0.01	-0.23**	-0.28**	-0.21**	-0.37***
		(0.01)	(0.10)	(0.12)	(0.08)	(0.10)
Log of the Population	0.11*	0.03	0.04	0.11***	0.10**	0.07
	(0.07)	(0.02)	(0.02)	(0.03)	(0.03)	(0.05)
Percent College Educated	-1.72	1.18	0.47	1.70	0.79	1.89
	(1.36)	(1.39)	(1.78)	(1.88)	(1.78)	(1.79)
Percent Employed (2000 Census)	9.79**	-6.06	0.78	2.14	-3.78	6.98
	(4.11)	(2.31)	(5.78)	(3.86)	(5.14)	(6.86)
Workforce as a Percentage of Population	-10.33**	6.55	0.73	-1.45	2.89	-6.77
	(4.56)	(4.12)	(3.60)	(5.11)	(5.12)	(6.18)
Percent of Homes Owner-occupied	-1.33***	0.58**	0.37	1.17**	0.81	1.88***
	(0.57)	(0.26)	(0.66)	(0.63)	(0.77)	(0.56)
Constant	1.18**	-1.87***	-1.37**	-3.11***	-2.74***	-3.01***
	(0.52)	(0.49)	(0.66)	(0.67)	(0.75)	(0.74)
2-Digit Industry Fixed Effects	N	N	N	Y	Y	Y
Number of Observations	974	1167	1167	10348	5111	5237
F-stat	17.11	356.11	246.88	1258.11	811.07	158.45
R2	0.47	0.28	0.32	0.35	0.36	0.26

Note: Robust Std. Err. adjusted for 236 clusters in MSA. *** p-value<0.01, ** p-value<0.05, * p-value<0.1. Controls are at the MSA level for the year 2000 and are obtained using Census Bureau Data Summary Files. Smallest size category is excluded. All regressions are weighted by the number of households in an MSA as of 2000. House price growth instrumented with the share of land unavailability from Saiz [2010] and same set of controls as in second stage. Dummy variables for each establishment size (not shown in the table) are included.

Table 2.8: Employment Growth (2007-2011) - SUSB Data

	All Industries				Start-up Capital < P50	Start-up Capital > P50
	House Price Growth	Employment Growth			Employment Growth	
	WLS	WLS	IV	IV	IV	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Share of Land Unavailability	-0.01					
	(0.09)					
House Price Growth		0.13***	0.13***	0.21***	0.16***	0.08***
		(0.04)	(0.04)	(0.04)	(0.05)	(0.03)
Recourse Debt		-0.01	-0.02	-0.02*	-0.02**	-0.02
		(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Growth in House Prices x Recourse		-0.12***	-0.11***	-0.12***	-0.17***	-0.09
		(0.05)	(0.02)	(0.03)	(0.04)	(0.07)
Growth in House Prices x 10-19 Employees		-0.02	-0.11**	-0.14*	-0.21***	-0.09
		(0.04)	(0.04)	(0.08)	(0.09)	(0.09)
Growth in House Prices x 20-99 Employees		-0.13***	-0.24***	-0.10	-0.21***	-0.03
		(0.03)	(0.05)	(0.07)	(0.04)	(0.09)
Growth in House Prices x >99 Employees		-0.16***	-0.16***	-0.06	-0.08*	-0.05
		(0.03)	(0.05)	(0.06)	(0.05)	(0.07)
Log of the Population	-0.12***	-0.01	-0.02	-0.02***	-0.01***	-0.02***
	(0.04)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Percent College Educated	0.87	0.64***	0.53***	-0.07	-0.06	-0.12
	(1.67)	(0.23)	(0.18)	(0.24)	(0.27)	(0.29)
Percent Employed (2000 Census)	-1.87	-0.93**	-0.86**	-0.76	-0.45	-0.54
	(1.46)	(0.39)	(0.47)	(0.65)	(0.77)	(0.44)
Workforce as a Percentage of Population	0.99	0.75*	0.68*	0.55	-0.04	0.49
	(1.37)	(0.45)	(0.33)	(0.59)	(0.72)	(0.63)
Percent of Homes Owner-occupied	0.09	0.05	0.02	-0.11**	-0.15**	-0.15**
	(0.12)	(0.04)	(0.04)	(0.06)	(0.07)	(0.07)
Constant	0.95**	-0.02*	-0.05	-0.29***	-0.33***	-0.42***
	(0.49)	(0.01)	(0.04)	(0.08)	(0.04)	(0.05)
2-Digit Industry Fixed Effects	N	N	N	Y	Y	Y
Number of Observations	974	1167	1167	10439	5134	5305
F-stat	10.51	70.10	24.11	156.14	55.43	76.18
R2	0.23	0.51	0.44	0.34	0.42	0.24

Note: Robust Std. Err. adjusted for 236 clusters in MSA. *** p-value<0.01, ** p-value<0.05, * p-value<0.1. Controls are at the MSA level for the year 2000 and are obtained using Census Bureau Data Summary Files. Smallest size category is excluded. All regressions are weighted by the number of households in an MSA as of 2000. House price growth instrumented with the share of land unavailability from Saiz [2010] and same set of controls as in second stage. Dummy variables for each establishment size (not shown in the table) are included.

Table 2.9: Growth of Number of Firms (2000-2007) - SUSB Data

	All Industries				Start-up Capital < P50	Start-up Capital > P50
	House Price Growth	Firm Growth			Firm Growth	
	WLS	WLS	IV	IV	IV	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Share of Land Unavailability	0.22***					
	(0.10)					
House Price Growth		0.43**	0.89**	0.75***	1.33***	0.23
		(0.18)	(0.22)	(0.13)	(0.54)	(0.17)
Recourse Debt		-0.06	-0.05	-0.16***	-0.17***	-0.16***
		(0.04)	(0.05)	(0.05)	(0.06)	(0.07)
Growth in House Prices x Recourse		-0.29*	-0.38**	-0.33***	-0.35**	-0.34*
		(0.16)	(0.12)	(0.15)	(0.17)	(0.16)
Growth in House Prices x 10-19 Employees		-0.19	-0.43**	-0.47***	-0.65***	-0.43
		(0.27)	(0.17)	(0.18)	(0.27)	(0.23)
Growth in House Prices x 20-99 Employees		-0.34	-0.46**	-0.53***	-0.62***	-0.14
		(0.25)	(0.22)	(0.17)	(0.21)	(0.17)
Growth in House Prices x >99 Employees		-0.26	-0.44**	-0.58***	-0.84***	-0.11
		(0.22)	(0.19)	(0.16)	(0.20)	(0.15)
Log of the Population	0.10*	-0.05	-0.02	-0.07**	-0.05**	-0.07***
	(0.06)	(0.04)	(0.03)	(0.03)	(0.02)	(0.03)
Percent College Educated	-1.75	1.56	2.12*	2.11*	2.74*	1.58
	(1.37)	(1.21)	(1.14)	(1.13)	(1.32)	(1.31)
Percent Employed (2000 Census)	8.79*	3.32	2.30	2.09	6.09	-1.70
	(5.09)	(6.04)	(3.43)	(6.24)	(3.16)	(5.75)
Workforce as a Percentage of Population	-10.31**	-4.35	-3.32	-3.22	-7.55	1.22
	(4.97)	(6.78)	(5.66)	(5.22)	(5.16)	(5.62)
Percent of Homes Owner-occupied	-1.31**	0.23	-0.01	0.23	0.27	0.29
	(0.66)	(0.46)	(0.37)	(0.41)	(0.44)	(0.48)
Constant	1.19**	2.56***	2.52***	3.14***	3.32***	2.59***
	(0.50)	(0.51)	(0.60)	(0.55)	(0.58)	(0.57)
2-Digit Industry Fixed Effects	N	N	N	Y	Y	Y
Number of Observations	974	1167	1167	10348	5111	5237
F-stat	18.21	1253.65	1532.14	2644.26	664.39	519.02
R2	0.51	0.79	0.69	0.55	0.69	0.58

Note: Robust Std. Err. adjusted for 236 clusters in MSA. *** p-value<0.01, ** p-value<0.05, * p-value<0.1. Controls are at the MSA level for the year 2000 and are obtained using Census Bureau Data Summary Files. Smallest size category is excluded. All regressions are weighted by the number of households in an MSA as of 2000. House price growth instrumented with the share of land unavailability from Saiz [2010] and same set of controls as in second stage. Dummy variables for each establishment size (not shown in the table) are included.

Table 2.10: Growth of Number of Firms (2007-2011) - SUSB Data

	All Industries				Start-up Capital < P50	Start-up Capital > P50
	House Price Growth	Firm Growth			Firm Growth	
	WLS	WLS	IV	IV	IV	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Share of Land Unavailability	-0.01					
	(0.09)					
House Price Growth		0.15***	0.13***	0.12***	0.13***	0.11***
		(0.05)	(0.03)	(0.04)	(0.03)	(0.03)
Recourse Debt		-0.03	-0.03	-0.02	-0.01	-0.02
		(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Growth in House Prices x Recourse		-0.06*	-0.09***	-0.06	-0.05	-0.03
		(0.04)	(0.03)	(0.05)	(0.05)	(0.05)
Growth in House Prices x 10-19 Employees		-0.05	-0.10**	-0.02	-0.04	-0.04
		(0.06)	(0.04)	(0.05)	(0.06)	(0.05)
Growth in House Prices x 20-99 Employees		-0.11*	-0.14***	-0.10	-0.06	-0.12**
		(0.06)	(0.03)	(0.06)	(0.05)	(0.05)
Growth in House Prices x >99 Employees		-0.09	-0.12***	-0.07	-0.05	-0.06*
		(0.06)	(0.03)	(0.03)	(0.04)	(0.04)
Log of the Population	-0.11***	-0.02	-0.02	-0.01	-0.01	-0.01**
	(0.04)	(0.02)	(0.00)	(0.00)	(0.01)	(0.00)
Percent College Educated	1.56	0.29	0.22	0.18	0.17	0.14
	(1.18)	(0.17)	(0.16)	(0.18)	(0.19)	(0.21)
Percent Employed (2000 Census)	-1.90	-0.67	-0.82*	-0.15	-0.43*	0.33*
	(3.46)	(0.58)	(0.42)	(0.73)	(0.20)	(0.17)
Workforce as a Percentage of Population	1.83	0.89	0.75*	0.48	0.33	-0.21
	(3.40)	(0.56)	(0.38)	(0.67)	(0.48)	(1.11)
Percent of Homes Owner-occupied	0.13	0.00	0.00	0.01	0.02	-0.00
	(0.53)	(0.06)	(0.05)	(0.06)	(0.06)	(0.08)
Constant	0.98**	0.08	0.07	0.10	0.04	0.32***
	(0.45)	(0.07)	(0.07)	(0.09)	(0.08)	(0.14)
2-Digit Industry Fixed Effects	N	N	N	Y	Y	Y
Number of Observations	974	1167	1167	10439	5134	5305
F-stat	10.51	94.89	122.33	512.11	134.11	144.19
R2	0.23	0.61	0.47	0.32	0.42	0.29

Note: Robust Std. Err. adjusted for 236 clusters in MSA. *** p-value<0.01, ** p-value<0.05, * p-value<0.1. Controls are at the MSA level for the year 2000 and are obtained using Census Bureau Data Summary Files. Smallest size category is excluded. All regressions are weighted by the number of households in an MSA as of 2000. House price growth instrumented with the share of land unavailability from Saiz [2010] and same set of controls as in second stage. Dummy variables for each establishment size (not shown in the table) are included.

Table 2.11: Growth of Number of Establishments (2000-2007) - SUSB Data

	All Industries				Start-up Capital < P50	Start-up Capital > P50
	House Price Growth	Establishment Growth			Establishment Growth	
	WLS	WLS	IV	IV	IV	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Share of Land Unavailability	0.22***					
	(0.10)					
House Price Growth		0.69***	0.56**	0.71***	1.24***	0.25
		(0.24)	(0.21)	(0.18)	(0.25)	(0.22)
Recourse Debt		-0.11	-0.11*	-0.18***	-0.17***	-0.18**
		(0.08)	(0.05)	(0.05)	(0.06)	(0.06)
Growth in House Prices x Recourse		-0.19**	-0.34**	-0.36**	-0.39**	-0.36**
		(0.14)	(0.15)	(0.18)	(0.17)	(0.17)
Growth in House Prices x 10-19 Employees		-0.27	-0.44*	-0.48**	-0.82***	-0.23
		(0.24)	(0.23)	(0.19)	(0.28)	(0.33)
Growth in House Prices x 20-99 Employees		-0.33	-0.63***	-0.56***	-0.72***	-0.18
		(0.21)	(0.19)	(0.16)	(0.18)	(0.16)
Growth in House Prices x >99 Employees		-0.37	-0.42*	-0.57***	-0.71***	-0.16
		(0.32)	(0.19)	(0.17)	(0.27)	(0.21)
Log of the Population	0.10*	-0.03*	-0.05*	-0.06**	-0.06*	-0.06**
	(0.06)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Percent College Educated	-1.75	1.67	2.05	2.32*	2.66*	1.91
	(1.37)	(1.48)	(1.13)	(1.22)	(1.51)	(1.32)
Percent Employed (2000 Census)	8.79*	3.76	2.27	1.84	2.93	-3.14
	(5.09)	(5.41)	(4.89)	(5.37)	(6.12)	(4.22)
Workforce as a Percentage of Population	-10.31**	-4.59	-3.42	-2.45	-4.29	-1.14
	(4.97)	(6.38)	(6.17)	(5.53)	(5.34)	(3.45)
Percent of Homes Owner-occupied	-1.31**	0.13	0.22	0.43	0.31	0.42
	(0.66)	(0.37)	(0.59)	(0.42)	(0.40)	(0.52)
Constant	1.19**	1.48	2.21***	2.72***	3.12***	1.52**
	(0.50)	(0.57)	(0.56)	(0.57)	(0.59)	(0.59)
2-Digit Industry Fixed Effects	N	N	N	Y	Y	Y
Number of Observations	974	1167	1167	10348	5111	5237
F-stat	18.21	2153.69	1871.33	2340.12	1333.12	366.14
R2	0.51	0.69	0.66	0.45	0.53	0.41

Note: Robust Std. Err. adjusted for 236 clusters in MSA. *** p-value<0.01, ** p-value<0.05, * p-value<0.1. Controls are at the MSA level for the year 2000 and are obtained using Census Bureau Data Summary Files. Smallest size category is excluded. All regressions are weighted by the number of households in an MSA as of 2000. House price growth instrumented with the share of land unavailability from Saiz [2010] and same set of controls as in second stage. Dummy variables for each establishment size (not shown in the table) are included.

Table 2.12: Growth of Number of Establishments (2007-2011) - SUSB Data

	All Industries				Start-up Capital < P50	Start-up Capital > P50
	House Price Growth	Establishment Growth			Establishment Growth	
	WLS	WLS	IV	IV	IV	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Share of Land Unavailability	-0.01					
	(0.09)					
House Price Growth		0.07**	0.12***	0.11***	0.13***	0.09
		(0.04)	(0.03)	(0.03)	(0.03)	(0.06)
Recourse Debt		-0.03	-0.00	-0.02	-0.03	-0.02
		(0.04)	(0.01)	(0.02)	(0.02)	(0.02)
Growth in House Prices x Recourse		-0.06**	-0.08**	-0.04	-0.05**	-0.01
		(0.03)	(0.03)	(0.03)	(0.03)	(0.06)
Growth in House Prices x 10-19 Employees		-0.03	-0.09**	-0.01	-0.03	-0.03
		(0.06)	(0.04)	(0.06)	(0.06)	(0.07)
Growth in House Prices x 20-99 Employees		-0.05	-0.15***	-0.07	-0.06	-0.05
		(0.06)	(0.04)	(0.08)	(0.06)	(0.07)
Growth in House Prices x >99 Employees		-0.05	-0.06*	-0.02	-0.05*	-0.02
		(0.05)	(0.03)	(0.02)	(0.03)	(0.03)
Log of the Population	-0.11***	-0.03	-0.01	-0.01*	0.00	-0.02**
	(0.04)	(0.02)	(0.00)	(0.00)	(0.00)	(0.01)
Percent College Educated	1.56	0.19	0.15	0.13	0.15	0.12
	(1.18)	(0.17)	(0.12)	(0.11)	(0.09)	(0.18)
Percent Employed (2000 Census)	-1.90	-0.57*	-0.85*	-0.55*	-0.66**	0.32
	(3.46)	(0.29)	(0.46)	(0.26)	(0.31)	(0.95)
Workforce as a Percentage of Population	1.83	0.55	0.81*	0.13	0.58*	-0.41
	(3.40)	(0.49)	(0.43)	(0.54)	(0.33)	(1.13)
Percent of Homes Owner-occupied	0.13	-0.01	0.00	-0.01	-0.00	0.03
	(0.53)	(0.03)	(0.04)	(0.07)	(0.11)	(0.09)
Constant	0.98**	0.05	-0.05	-0.01	-0.02	0.27*
	(0.45)	(0.06)	(0.07)	(0.11)	(0.06)	(0.14)
2-Digit Industry Fixed Effects	N	N	N	Y	Y	Y
Number of Observations	974	1167	1167	10439	5134	5305
F-stat	10.51	93.86	49.28	243.11	109.52	97.56
R2	0.23	0.64	0.42	0.35	0.43	0.27

Note: Robust Std. Err. adjusted for 236 clusters in MSA. *** p-value<0.01, ** p-value<0.05, * p-value<0.1. Controls are at the MSA level for the year 2000 and are obtained using Census Bureau Data Summary Files. Smallest size category is excluded. All regressions are weighted by the number of households in an MSA as of 2000. House price growth instrumented with the share of land unavailability from Saiz [2010] and same set of controls as in second stage. Dummy variables for each establishment size (not shown in the table) are included.

Table 2.13: Employment Growth Excluding Sectors (2000-2007) - SUSB Data

	Ex. Construction	Ex. Construction and NT	All Manufacturing
	Employment Growth		
	IV	IV	IV
	(1)	(2)	(3)
House Price Growth	0.45***	0.41***	0.22*
	(0.20)	(0.19)	(0.15)
Recourse Debt	-0.03	-0.04	-0.11
	(0.07)	(0.08)	(0.11)
Growth in House Prices x Recourse	-0.36***	-0.35***	-0.19*
	(0.13)	(0.12)	(0.12)
Growth in House Prices x 10-19 Employees	-0.05**	-0.13**	-0.12
	(0.02)	(0.06)	(0.32)
Growth in House Prices x 20-99 Employees	-0.15	-0.03	-0.24
	(0.19)	(0.17)	(0.22)
Growth in House Prices x >99 Employees	-0.12**	-0.06**	-0.01**
	(0.07)	(0.03)	(0.00)
Log of the Population	0.06	0.04	0.00
	(0.04)	(0.03)	(0.08)
Percent College Educated	0.91	0.73	-0.58
	(1.82)	(1.72)	(2.42)
Percent Employed (2000 Census)	-1.34	-1.66	9.06
	(5.89)	(5.96)	(12.47)
Workforce as a Percentage of Population	1.39	1.72	-5.72
	(6.33)	(6.25)	(6.14)
Percent of Homes Owner-occupied	0.51	0.47	-0.22
	(0.77)	(0.66)	(1.37)
Constant	-1.33**	-1.35*	1.67
	(0.82)	(0.79)	(2.33)
2-Digit Industry Fixed Effects	Y	Y	Y
Number of Observations	9628	7917	824
R2	0.43	0.31	0.52

Note: Robust Std. Err. adjusted for 236 clusters in MSA. *** p-value<0.01, ** p-value<0.05, * p-value<0.1. Controls are at the MSA level for the year 2000 and are obtained using Census Bureau Data Summary Files. Smallest size category is excluded. All regressions are weighted by the number of households in an MSA as of 2000. House price growth instrumented with the share of land unavailability from Saiz [2010] and same set of controls as in second stage. Dummy variables for each establishment size (not shown in the table) are included. Classification as in Mian and Sufi [2012], Non Tradables are those industries with NAICS 2-digit codes 44-45 (retail) and 72 (accommodation and food services).

Table 2.14: Growth of Number of Firms Excluding Sectors (2000-2007) - SUSB Data

	Ex. Construction	Ex. Construction and NT	All Manufacturing
		Firm Growth	
	IV	IV	IV
	(1)	(2)	(3)
House Price Growth	0.33***	0.27***	0.08***
	(0.11)	(0.07)	(0.03)
Recourse Debt	-0.01	-0.01	-0.02
	(0.03)	(0.02)	(0.03)
Growth in House Prices x Recourse	-0.21**	-0.14***	-0.02*
	(0.12)	(0.07)	(0.07)
Growth in House Prices x 10-19 Employees	-0.01	-0.04*	-0.03
	(0.07)	(0.06)	(0.09)
Growth in House Prices x 20-99 Employees	-0.05**	-0.01*	-0.00
	(0.02)	(0.01)	(0.09)
Growth in House Prices x >99 Employees	-0.01**	-0.05**	-0.03**
	(0.00)	(0.01)	(0.01)
Log of the Population	-0.02**	0.01	0.02
	(0.01)	(0.01)	(0.02)
Percent College Educated	0.13	-0.01	-0.64
	(0.59)	(0.58)	(0.73)
Percent Employed (2000 Census)	0.22	0.44	2.86
	(2.03)	(2.02)	(3.51)
Workforce as a Percentage of Population	-0.30	-0.57	-3.22
	(2.13)	(2.12)	(3.71)
Percent of Homes Owner-occupied	-0.08	-0.16	-0.29
	(0.25)	(0.25)	(0.39)
Constant	-0.74***	-0.62**	-0.35
	(0.27)	(0.27)	(0.43)
2-Digit Industry Fixed Effects	Y	Y	Y
Number of Observations	9268	7917	824
R2	0.55	0.54	0.79

Note: Robust Std. Err. adjusted for 236 clusters in MSA. *** p-value<0.01, ** p-value<0.05, * p-value<0.1. Controls are at the MSA level for the year 2000 and are obtained using Census Bureau Data Summary Files. Smallest size category is excluded. All regressions are weighted by the number of households in an MSA as of 2000. House price growth instrumented with the share of land unavailability from Saiz [2010] and same set of controls as in second stage. Dummy variables for each establishment size (not shown in the table) are included. Classification as in Mian and Sufi [2012], Non Tradables are those industries with NAICS 2-digit codes 44-45 (retail) and 72 (accommodation and food services).

Table 2.15: Growth of Number of Establishments Excluding Sectors (2000-2007) - SUSB Data

	Ex. Construction	Ex. Construction and NT	All Manufacturing
	Establishments Growth		
	IV	IV	IV
	(1)	(2)	(3)
House Price Growth	0.68***	0.55***	0.29*
	(0.16)	(0.14)	(0.16)
Recourse Debt	-0.01	-0.01	-0.02
	(0.03)	(0.03)	(0.04)
Growth in House Prices x Recourse	-0.33***	-0.24***	-0.18**
	(0.10)	(0.09)	(0.08)
Growth in House Prices x 10-19 Employees	-0.01*	-0.05*	-0.02
	(0.00)	(0.03)	(0.07)
Growth in House Prices x 20-99 Employees	-0.05**	-0.02**	-0.04
	(0.02)	(0.00)	(0.09)
Growth in House Prices x >99 Employees	-0.04**	-0.05**	-0.07
	(0.02)	(0.02)	(0.08)
Log of the Population	0.01	0.02*	0.02
	(0.01)	(0.01)	(0.02)
Percent College Educated	0.12	-0.01	-0.66
	(0.71)	(0.67)	(0.77)
Percent Employed (2000 Census)	0.08	0.21	2.79
	(2.44)	(2.41)	(3.70)
Workforce as a Percentage of Population	-0.17	-0.36	-3.15
	(2.56)	(2.54)	(3.92)
Percent of Homes Owner-occupied	-0.08	-0.18	-0.28
	(0.30)	(2.96)	(0.41)
Constant	-0.74**	-0.57*	-0.38
	(0.33)	(0.32)	(0.44)
2-Digit Industry Fixed Effects	Y	Y	Y
Number of Observations	9628	7917	824
R2	0.41	0.41	0.67

Note: Robust Std. Err. adjusted for 236 clusters in MSA. *** p-value<0.01, ** p-value<0.05, * p-value<0.1. Controls are at the MSA level for the year 2000 and are obtained using Census Bureau Data Summary Files. Smallest size category is excluded. All regressions are weighted by the number of households in an MSA as of 2000. House price growth instrumented with the share of land unavailability from Saiz [2010] and same set of controls as in second stage. Dummy variables for each establishment size (not shown in the table) are included. Classification as in Mian and Sufi [2012], Non Tradables are those industries with NAICS 2-digit codes 44-45 (retail) and 72 (accommodation and food services).

Table 2.16: Employment Growth - BDS Data (2000-2007)

	House Price Growth	Employment Growth		
	WLS	WLS	IV	IV
	(1)	(2)	(3)	(4)
Share of Land Unavailability	0.29***			
	(0.01)			
House Price Growth		-0.29	-0.29	-0.29
		(0.37)	(0.65)	(0.65)
Recourse Debt		-0.05	-0.08	-0.08
		(0.05)	(0.05)	(0.05)
House Price Growth x Recourse		0.55	1.64	1.64
		(0.93)	(1.46)	(1.46)
House Price Growth x Young Firm		0.33*		0.44***
		(0.17)		(0.06)
House Price Growth x Young Firm x Recourse		-0.34***		-0.42***
		(0.23)		(0.04)
House Price Growth x Small Firm		0.41	0.22**	0.16
		(0.37)	(0.12)	(0.28)
House Price Growth x Small Firm x Recourse		-0.10	-0.16**	-0.10
		(1.13)	(0.08)	(0.19)
Log of the Population	0.05***	0.03	0.02*	0.02**
	(0.00)	(0.02)	(0.01)	(0.00)
Percent College Educated	0.60***	1.74*	1.85	1.87
	(0.04)	(0.99)	(1.15)	(1.15)
Percent Employed (2000 Census)	-2.10***	-4.48	-3.05	-3.03
	(0.14)	(2.82)	(3.00)	(3.00)
Workforce as a Percentage of Population	0.15	3.61	1.41	1.39
	(0.15)	(2.74)	(3.07)	(3.08)
Percent of Homes Owner-occupied	0.28***	0.36	0.13	0.13
	(0.01)	(0.52)	(0.64)	(0.65)
Constant	0.31***	-0.14	0.08	0.08
	(0.03)	(0.26)	(0.28)	(0.29)
Number of Observations	22,973	14,079	12,346	12,346
F-Statistic	2972	69.92	50.31	49.37
R2	0.44	0.11	0.12	0.15

Note: Robust Std. Err. adjusted for 236 clusters in MSA. *** p-value<0.01, ** p-value<0.05, * p-value<0.1. Controls are at the MSA level for the year 2000 and are obtained using Census Bureau Data Summary Files. All regressions are weighted by the number of households in an MSA as of 2000. House price growth instrumented with the share of land unavailability from Saiz [2010] and same set of controls as in second stage. Dummy variables for each establishment size (not shown in the table) are included.

Table 2.17: Employment Growth - BDS Data (2007-2011)

	House Price Growth	Employment Growth		
	WLS	WLS	IV	IV
	(1)	(2)	(3)	(4)
Share of Land Unavailability	0.03***			
	(0.00)			
House Price Growth		-0.27	-1.33	-1.35
		(0.59)	(3.08)	(3.07)
Recourse Debt		-0.07	-0.04	-0.04
		(0.06)	(0.05)	(0.05)
House Price Growth x Recourse		0.51	0.15	0.11
		(2.27)	(4.91)	(4.91)
House Price Growth x Young Firm		0.28*		0.27***
		(0.15)		(0.10)
House Price Growth x Young Firm x Recourse		-0.11*		-0.12**
		(0.06)		(0.05)
House Price Growth x Small Firm		0.19	0.89***	0.89
		(0.59)	(0.22)	(2.05)
House Price Growth x Small Firm x Recourse		-0.50	-0.35*	-0.05
		(0.48)	(0.18)	(0.24)
Log of the Population	0.03***	-0.06***	0.05	0.06
	(0.00)	(0.02)	(0.06)	(0.06)
Percent College Educated	0.10***	0.22	1.11	1.18
	(0.02)	(0.75)	(0.85)	(0.84)
Percent Employed (2000 Census)	-1.50***	-0.25	-6.62*	-6.66*
	(0.05)	(1.96)	(3.97)	(3.91)
Workforce as a Percentage of Population	1.35***	0.11	5.15	5.15
	(0.06)	(1.94)	(3.36)	(3.31)
Percent of Homes Owner-occupied	0.02***	0.05	0.23	0.23
	(0.00)	(0.27)	(0.26)	(0.26)
Constant	-0.37***	-0.30	-0.13	-0.11
	(0.01)	(0.18)	(0.23)	(0.23)
Number of Observations	22,973	15,671	13,709	13,709
F-Statistic	1078	30.52	13.16	27.85
R2	0.22	0.12	0.11	0.12

Note: Robust Std. Err. adjusted for 236 clusters in MSA. *** p-value<0.01, ** p-value<0.05, * p-value<0.1. Controls are at the MSA level for the year 2000 and are obtained using Census Bureau Data Summary Files. All regressions are weighted by the number of households in an MSA as of 2000. House price growth instrumented with the share of land unavailability from Saiz [2010] and same set of controls as in second stage. Dummy variables for each establishment size (not shown in the table) are included.

Table 2.18: Growth of Number of Firms - BDS Data (2000-2007)

	House Price Growth	Growth of Number of Firms		
	WLS	WLS	IV	IV
	(1)	(2)	(3)	(4)
Share of Land Unavailability	0.29***			
	(0.01)			
House Price Growth		-0.24	-0.54	-0.64
		(0.21)	(0.29)	(0.40)
Recourse Debt		-0.04**	-0.06***	-0.06***
		(0.02)	(0.02)	(0.02)
House Price Growth x Recourse		0.12	0.19	0.29
		(0.18)	(0.22)	(0.23)
House Price Growth x Young Firm		0.47***		0.68***
		(0.12)		(0.14)
House Price Growth x Young Firm x Recourse		-0.41**		-0.75***
		(0.18)		(0.16)
House Price Growth x Small Firm		0.42	0.79***	0.55
		(0.31)	(0.38)	(0.36)
House Price Growth x Small Firm x Recourse		-0.10	-0.51**	-0.24
		(0.20)	(0.24)	(0.24)
Log of the Population	0.05***	-0.05***	-0.03**	-0.03***
	(0.00)	(0.01)	(0.01)	(0.01)
Percent College Educated	0.60***	0.28	0.05	0.08
	(0.04)	(0.30)	(0.38)	(0.38)
Percent Employed (2000 Census)	-2.10***	-0.98	-0.05	-0.37
	(0.14)	(1.10)	(1.33)	(1.35)
Workforce as a Percentage of Population	0.15	0.95	-0.41	-0.09
	(0.15)	(1.07)	(1.44)	(1.46)
Percent of Homes Owner-occupied	0.28***	0.11	-0.02	0.01
	(0.01)	(0.19)	(0.26)	(0.27)
Constant	0.31***	0.05	0.05	0.06
	(0.03)	(0.12)	(0.15)	(0.15)
Number of Observations	22,973	19,294	16,749	16,749
F-Statistic	2972	26.83	17.96	15.45
R2	0.44	0.13	0.11	0.12

Note: Robust Std. Err. adjusted for 236 clusters in MSA. *** p-value<0.01, ** p-value<0.05, * p-value<0.1. Controls are at the MSA level for the year 2000 and are obtained using Census Bureau Data Summary Files. All regressions are weighted by the number of households in an MSA as of 2000. House price growth instrumented with the share of land unavailability from Saiz [2010] and same set of controls as in second stage. Dummy variables for each establishment size (not shown in the table) are included.

Table 2.19: Growth of Number of Firms - BDS Data (2007-2011)

	House Price Growth	Growth of Number of Firms		
	WLS	WLS	IV	IV
	(1)	(2)	(3)	(4)
Share of Land Unavailability	0.03***			
	(0.00)			
House Price Growth		-0.23	-1.21	-0.99
		(0.15)	(0.89)	(0.85)
Recourse Debt		-0.01	0.01	0.01
		(0.01)	(0.02)	(0.01)
House Price Growth x Recourse		-0.89	-1.35	-1.36
		(1.54)	(1.57)	(1.56)
House Price Growth x Young Firm		0.13**		0.28**
		(0.06)		(0.13)
House Price Growth x Young Firm x Recourse		-0.10*		-0.28**
		(0.06)		(0.13)
House Price Growth x Small Firm		0.01	0.31*	0.33
		(0.07)	(0.17)	(0.20)
House Price Growth x Small Firm x Recourse		-0.11	-0.18*	-0.17
		(0.14)	(0.10)	(0.14)
Log of the Population	0.03***	-0.04***	-0.01	-0.01
	(0.00)	(0.01)	(0.02)	(0.02)
Percent College Educated	0.10***	0.25	0.42**	0.49**
	(0.02)	(0.18)	(0.19)	(0.19)
Percent Employed (2000 Census)	-1.50***	-0.67	-2.60**	-2.42**
	(0.05)	(0.56)	(1.13)	(1.06)
Workforce as a Percentage of Population	1.35***	0.66	2.29**	2.10**
	(0.06)	(0.57)	(1.01)	(0.94)
Percent of Homes Owner-occupied	0.02***	-0.04	0.00	0.01
	(0.00)	(0.11)	(0.11)	(0.11)
Constant	-0.37***	-0.22***	-0.17***	-0.15***
	(0.01)	(0.05)	(0.06)	(0.06)
Number of Observations	22,973	21,255	18,410	18,410
F-Statistic	1078	91.46	21.86	77.17
R2	0.22	0.14	0.11	0.14

Note: Robust Std. Err. adjusted for 236 clusters in MSA. *** p-value<0.01, ** p-value<0.05, * p-value<0.1. Controls are at the MSA level for the year 2000 and are obtained using Census Bureau Data Summary Files. All regressions are weighted by the number of households in an MSA as of 2000. House price growth instrumented with the share of land unavailability from Saiz [2010] and same set of controls as in second stage. Dummy variables for each establishment size (not shown in the table) are included.

Table 2.20: Growth of Number of Establishments - BDS Data (2000-2007)

	House Price Growth	Growth of Number of Establishments		
	WLS	WLS	IV	IV
	(1)	(2)	(3)	(4)
Share of Land Unavailability	0.29***			
	(0.01)			
House Price Growth		-0.37	-0.26	-0.50
		(0.40)	(0.47)	(0.45)
Recourse Debt		-0.05**	-0.07***	-0.06***
		(0.03)	(0.02)	(0.02)
House Price Growth x Recourse		0.00	-0.41	-0.19
		(0.35)	(0.59)	(0.57)
House Price Growth x Young Firm		0.82***		0.77***
		(0.22)		(0.30)
House Price Growth x Young Firm x Recourse		-0.16*		-0.60***
		(0.08)		(0.21)
House Price Growth x Small Firm		0.43*	0.57*	0.05
		(0.22)	(0.29)	(0.57)
House Price Growth x Small Firm x Recourse		-0.14	-0.10*	0.35
		(0.16)	(0.07)	(0.37)
Log of the Population	0.05***	-0.03**	-0.01	-0.02
	(0.00)	(0.01)	(0.01)	(0.01)
Percent College Educated	0.60***	0.33	0.15	0.22
	(0.04)	(0.35)	(0.47)	(0.46)
Percent Employed (2000 Census)	-2.10***	2.72	3.97**	3.21*
	(0.14)	(1.67)	(1.82)	(1.82)
Workforce as a Percentage of Population	0.15	-3.45**	-5.18***	-4.41**
	(0.15)	(1.60)	(1.99)	(1.98)
Percent of Homes Owner-occupied	0.28***	-0.10	-0.18	-0.11
	(0.01)	(0.24)	(0.31)	(0.32)
Constant	0.31***	-0.01	-0.06	-0.05
	(0.03)	(0.17)	(0.21)	(0.21)
Number of Observations	22,973	19,294	16,749	16,749
F-Statistic	2972	10.38	8.080	10.68
R2	0.44	0.12	0.11	0.11

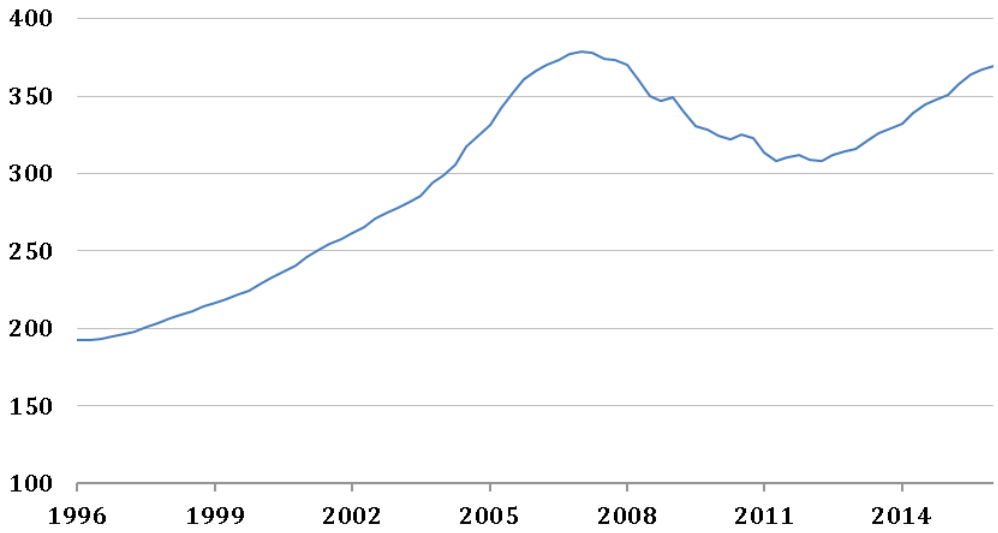
Note: Robust Std. Err. adjusted for 236 clusters in MSA. *** p-value<0.01, ** p-value<0.05, * p-value<0.1. Controls are at the MSA level for the year 2000 and are obtained using Census Bureau Data Summary Files. All regressions are weighted by the number of households in an MSA as of 2000. House price growth instrumented with the share of land unavailability from Saiz [2010] and same set of controls as in second stage. Dummy variables for each establishment size (not shown in the table) are included.

Table 2.21: Growth of Number of Establishments - BDS Data (2007-2011)

	House Price Growth	Growth of Number of Establishments		
	WLS	WLS	IV	IV
	(1)	(2)	(3)	(4)
Share of Land Unavailability	0.03***			
	(0.00)			
House Price Growth		-0.34	-0.07	-0.09
		(0.22)	(2.04)	(1.97)
Recourse Debt		-0.11***	-0.14***	-0.14***
		(0.04)	(0.04)	(0.04)
House Price Growth x Recourse		-3.51	0.88	0.86
		(2.49)	(2.34)	(2.30)
House Price Growth x Young Firm		0.18**		0.20**
		(0.08)		(0.11)
House Price Growth x Young Firm x Recourse		-0.18*		-0.12**
		(0.10)		(0.07)
House Price Growth x Small Firm		-0.01	-2.98	-3.76
		(0.25)	(2.38)	(2.87)
House Price Growth x Small Firm x Recourse		0.56	1.17	0.72
		(2.06)	(2.29)	(2.77)
Log of the Population	0.03***	-0.03**	0.01	0.01
	(0.00)	(0.01)	(0.03)	(0.03)
Percent College Educated	0.10***	0.79**	1.00***	1.01***
	(0.02)	(0.33)	(0.38)	(0.38)
Percent Employed (2000 Census)	-1.50***	-1.67	-4.19**	-4.15*
	(0.05)	(1.14)	(2.12)	(2.11)
Workforce as a Percentage of Population	1.35***	1.47	3.57*	3.54*
	(0.06)	(1.18)	(1.94)	(1.94)
Percent of Homes Owner-occupied	0.02***	0.15	0.15	0.16
	(0.00)	(0.20)	(0.19)	(0.19)
Constant	-0.37***	-0.05	0.05	0.06
	(0.01)	(0.08)	(0.09)	(0.09)
Number of Observations	22,973	21,255	18,410	18,410
F-Statistic	1078	13.15	13.29	14.25
R2	0.22	0.11	0.11	0.11

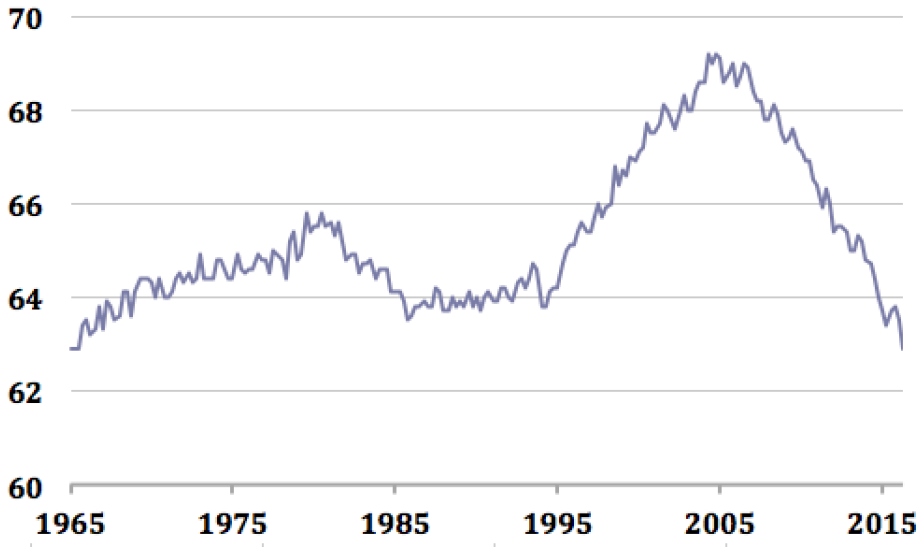
Note: Robust Std. Err. adjusted for 236 clusters in MSA. *** p-value<0.01, ** p-value<0.05, * p-value<0.1. Controls are at the MSA level for the year 2000 and are obtained using Census Bureau Data Summary Files. All regressions are weighted by the number of households in an MSA as of 2000. House price growth instrumented with the share of land unavailability from Saiz [2010] and same set of controls as in second stage. Dummy variables for each establishment size (not shown in the table) are included.

Figure 2·1: All-Transactions House Price Index (1980:Q1=100)



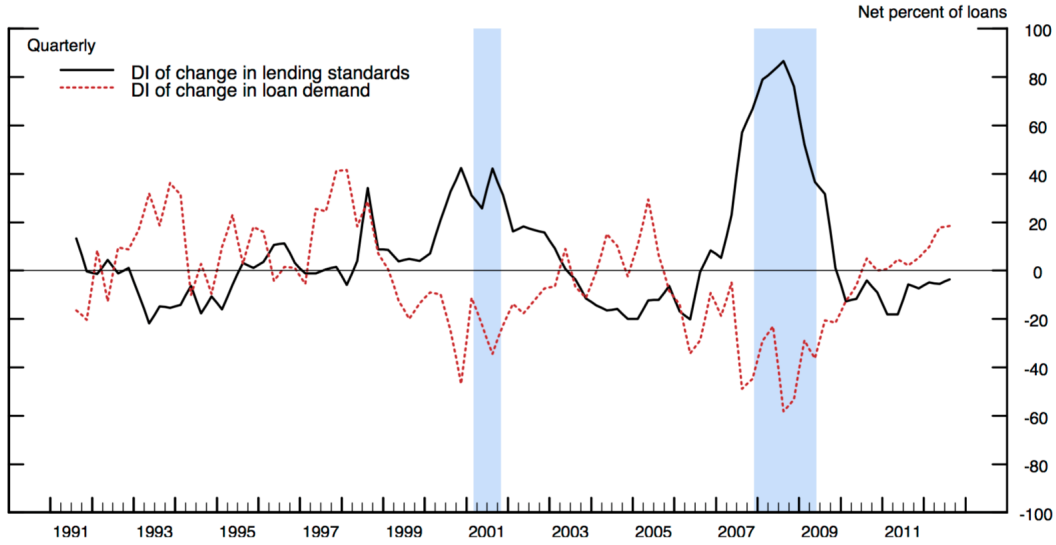
Source: US. Federal Housing Finance Agency.

Figure 2·2: Homeownership Rate for the United States (percent, not seasonally adjusted)



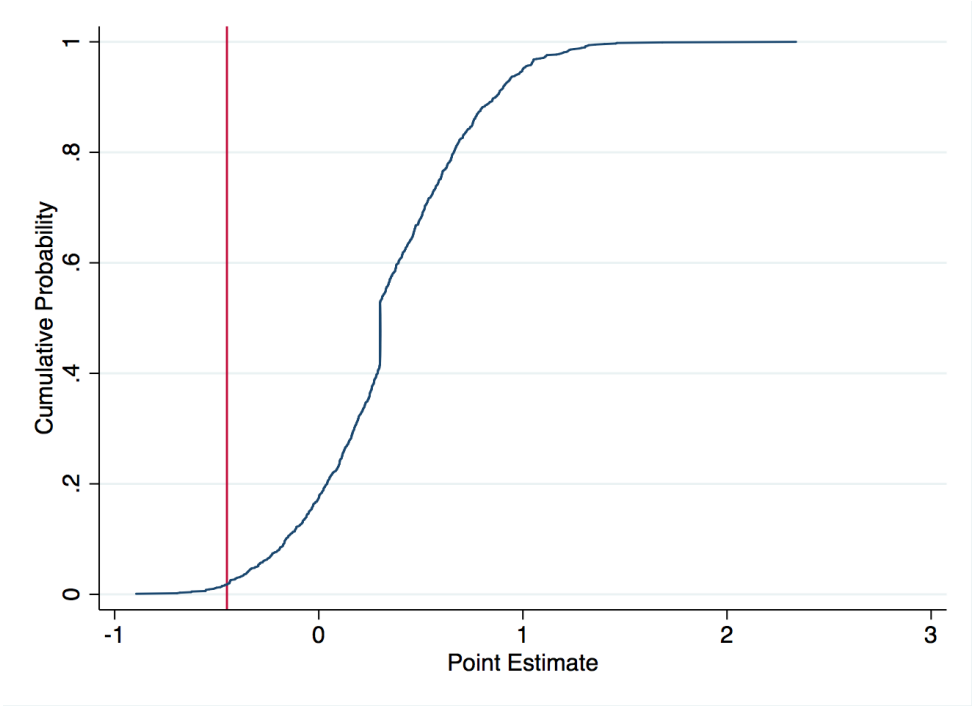
Source: US. Bureau of the Census.

Figure 2·3: Changes in Bank Lending Standards and Loan Demand



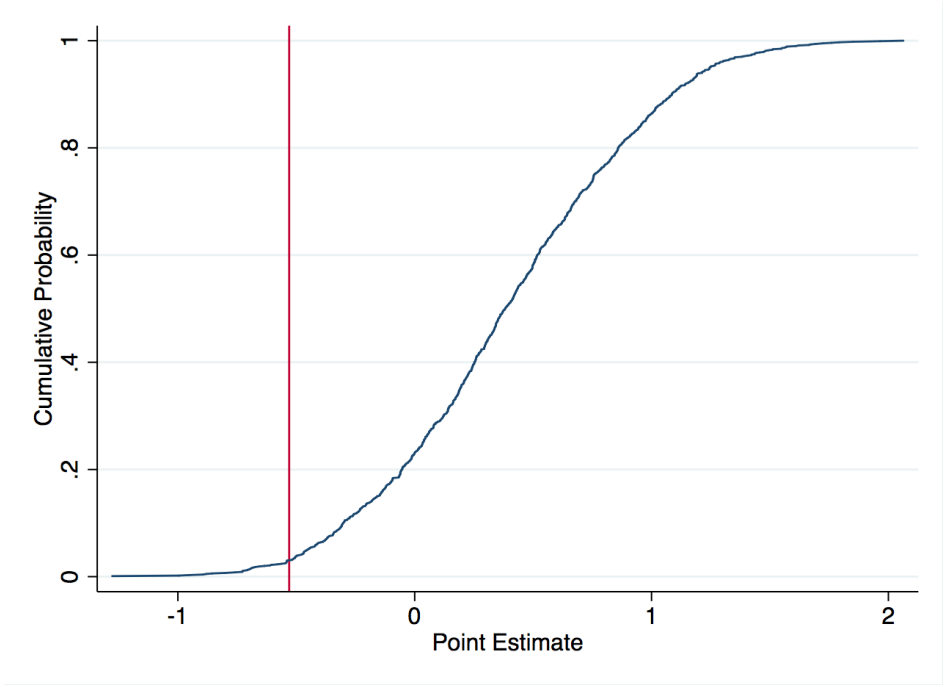
Note: Sample period: 1991:Q3-2012:Q3. The solid line depicts the DI of the change in overall bank lending standards; the dotted line depicts the DI of the change in overall loan demand. Positive values of the DIs indicate a net tightening/increase in standards/demand, while negative values indicate a net easing/decrease in standards/demand. The shaded vertical bars represent the NBER-dated recessions.
Source: Bassett et al. [2014].

Figure 2·4: Placebo Tests of the Second Stage (SUSB Data) - House Price Growth x Recourse Interaction Coefficient: Employment - All Industries (2000-2007)



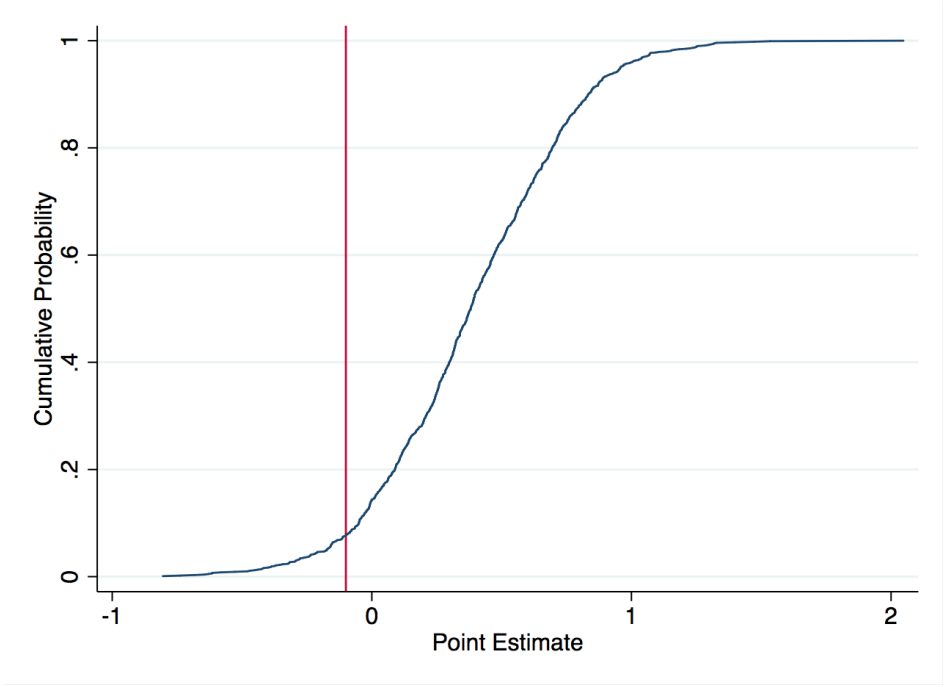
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·5: Placebo Tests of the Second Stage (SUSB Data) - House Price Growth x Recourse Interaction Coefficient: Employment - Startup Capital < P50 (2000-2007)



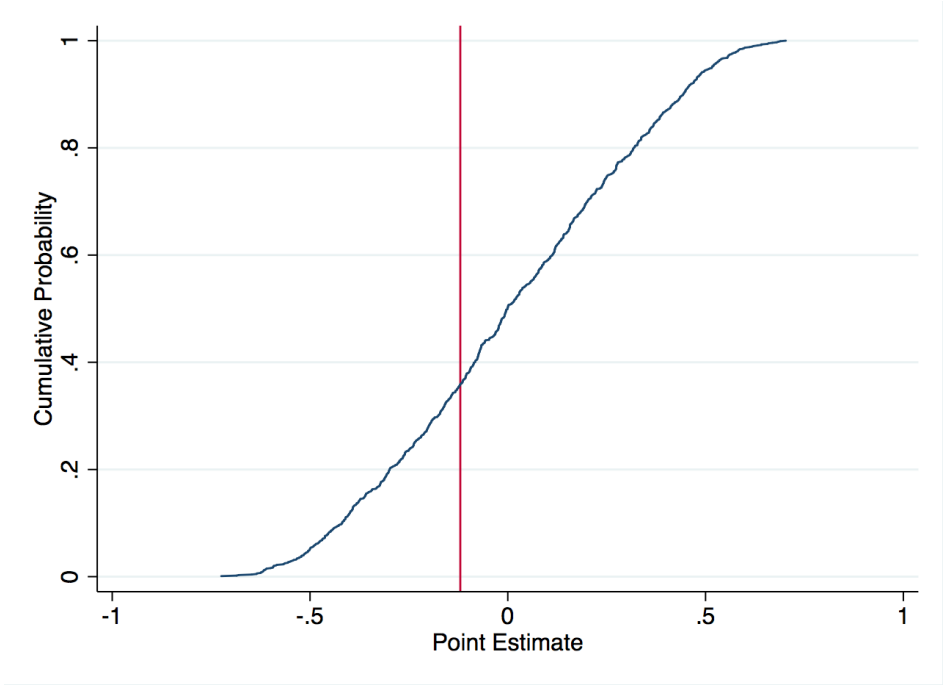
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·6: Placebo Tests of the Second Stage (SUSB Data) - House Price Growth x Recourse Interaction Coefficient: Employment - Startup Capital > P50 (2000-2007)



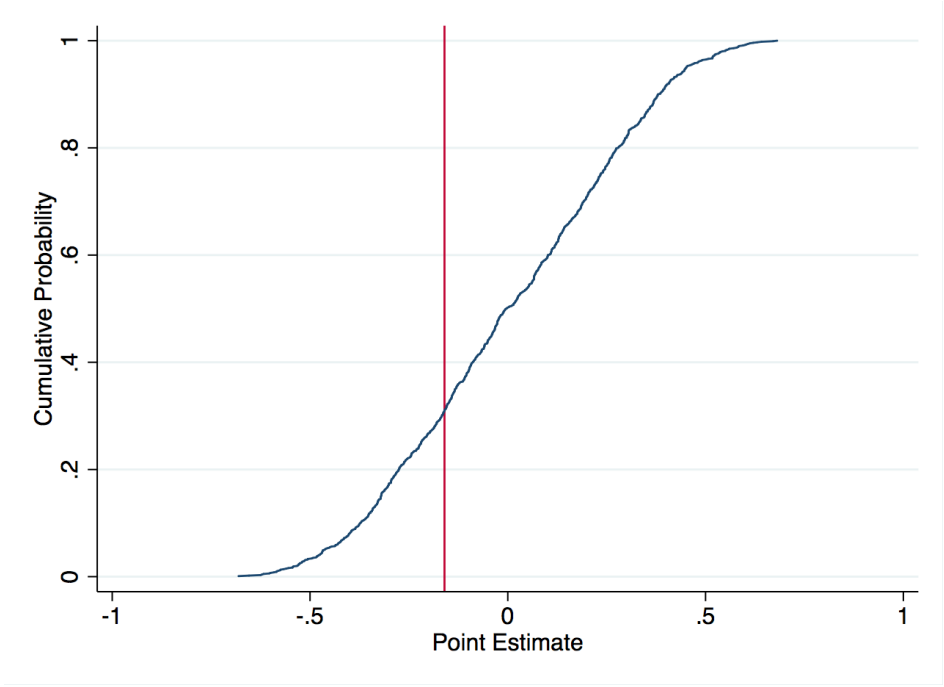
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·7: Placebo Tests of the Second Stage (SUSB Data) - House Price Growth x Recourse Interaction Coefficient: Employment - All Industries (2007-2011)



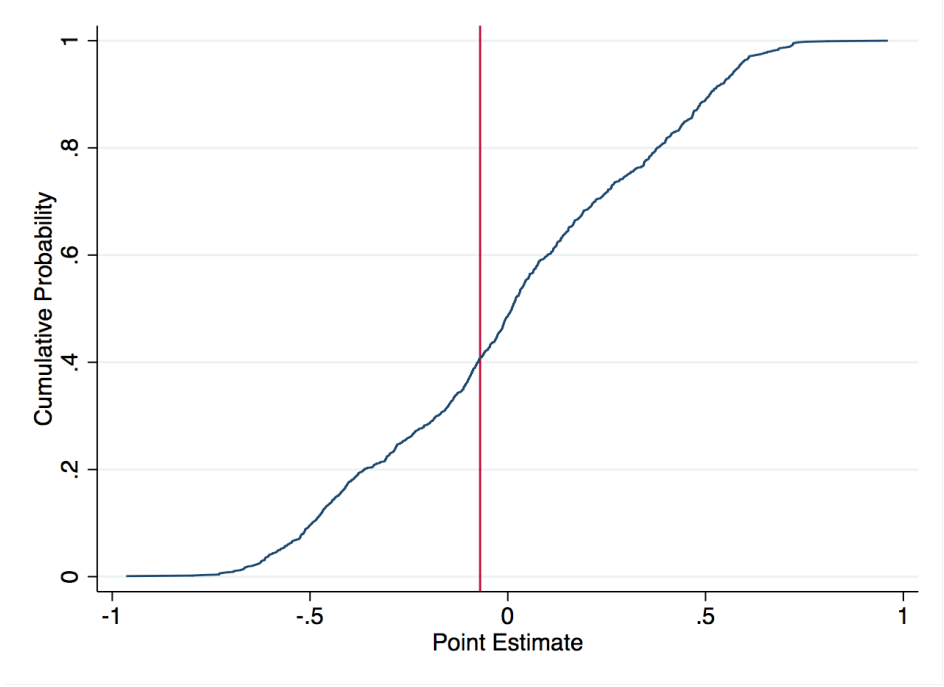
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·8: Placebo Tests of the Second Stage (SUSB Data) - House Price Growth x Recourse Interaction Coefficient: Employment - Startup Capital < P50 (2007-2011)



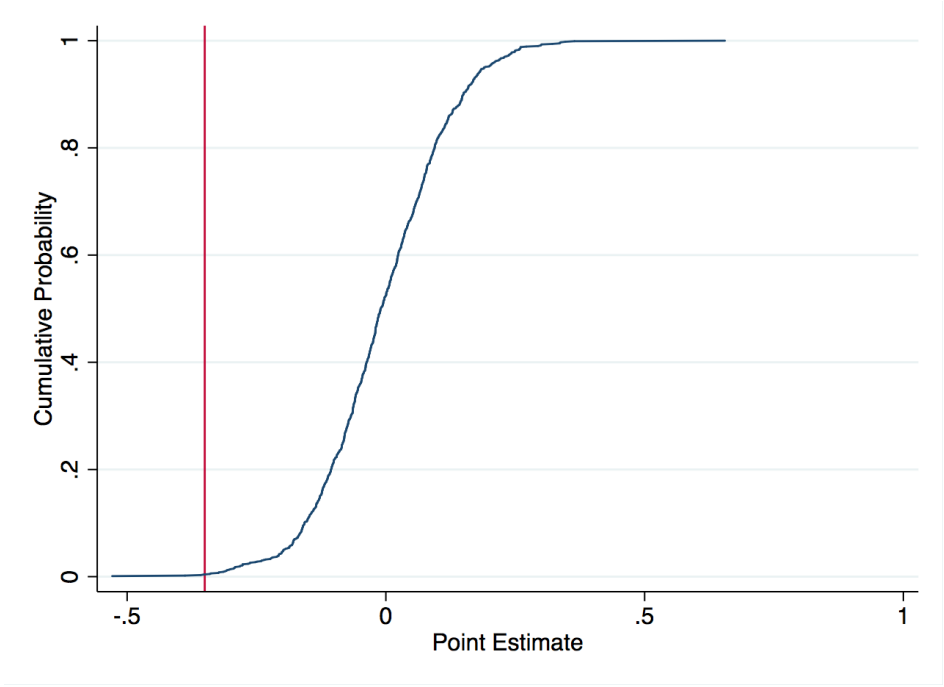
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·9: Placebo Tests of the Second Stage (SUSB Data) - House Price Growth x Recourse Interaction Coefficient: Employment - Startup Capital > P50 (2007-2011)



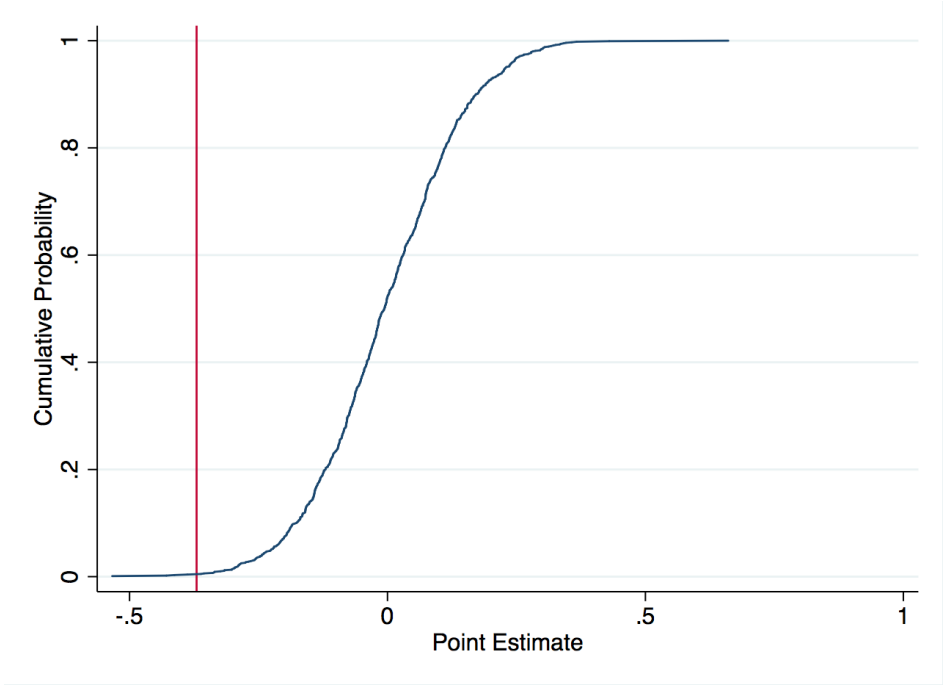
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·10: Placebo Tests of the Second Stage (SUSB Data) - House Price Growth x Recourse Interaction Coefficient: Firms - All Industries (2000-2007)



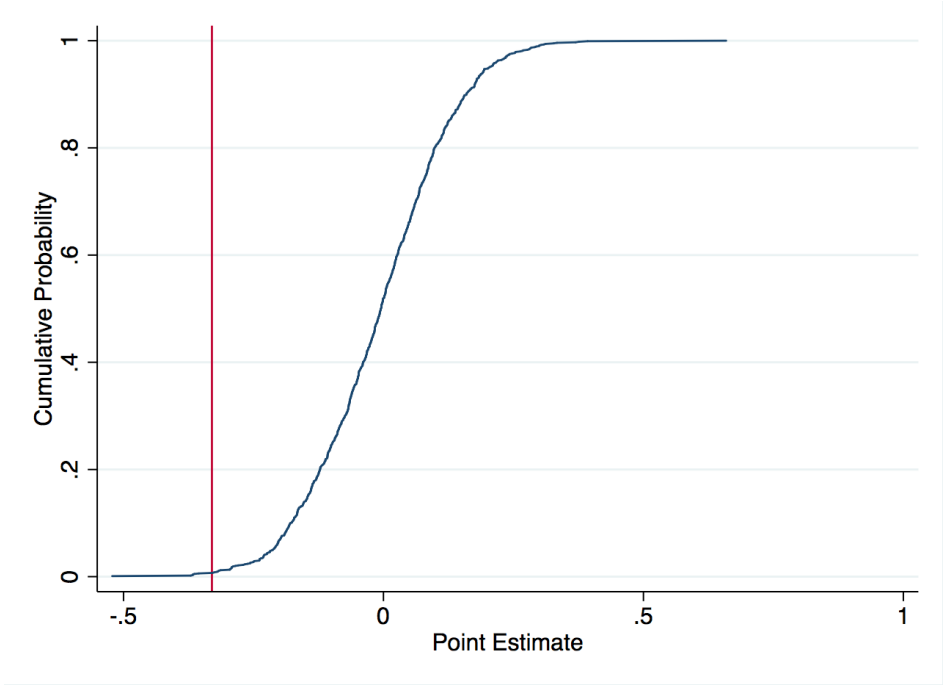
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·11: Placebo Tests of the Second Stage (SUSB Data) - House Price Growth x Recourse Interaction Coefficient: Firms - Startup Capital < P50 (2000-2007)



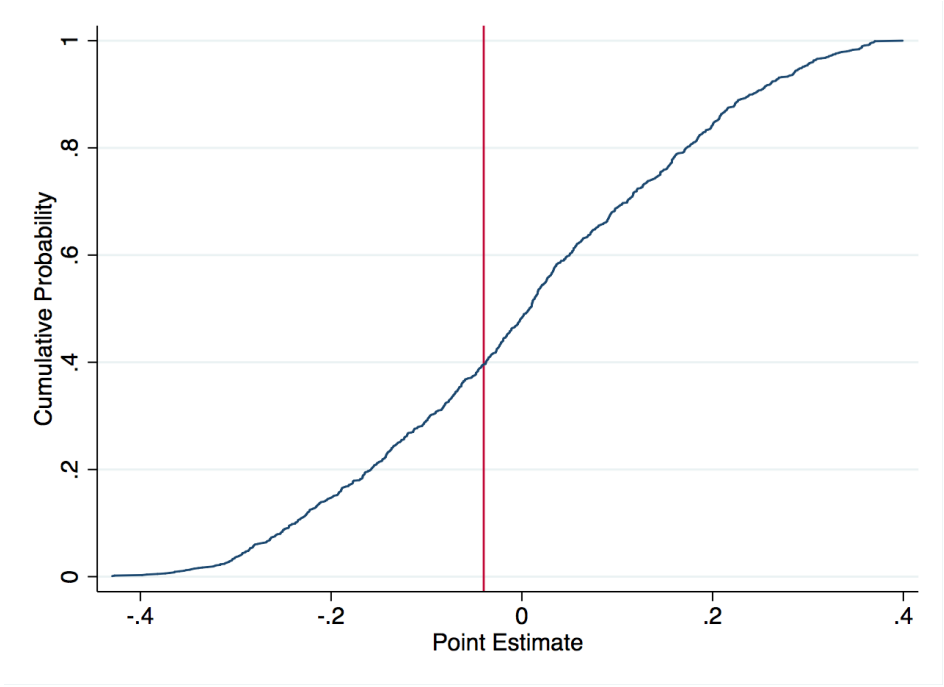
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·12: Placebo Tests of the Second Stage (SUSB Data) - House Price Growth x Recourse Interaction Coefficient: Firms - Startup Capital > P50 (2000-2007)



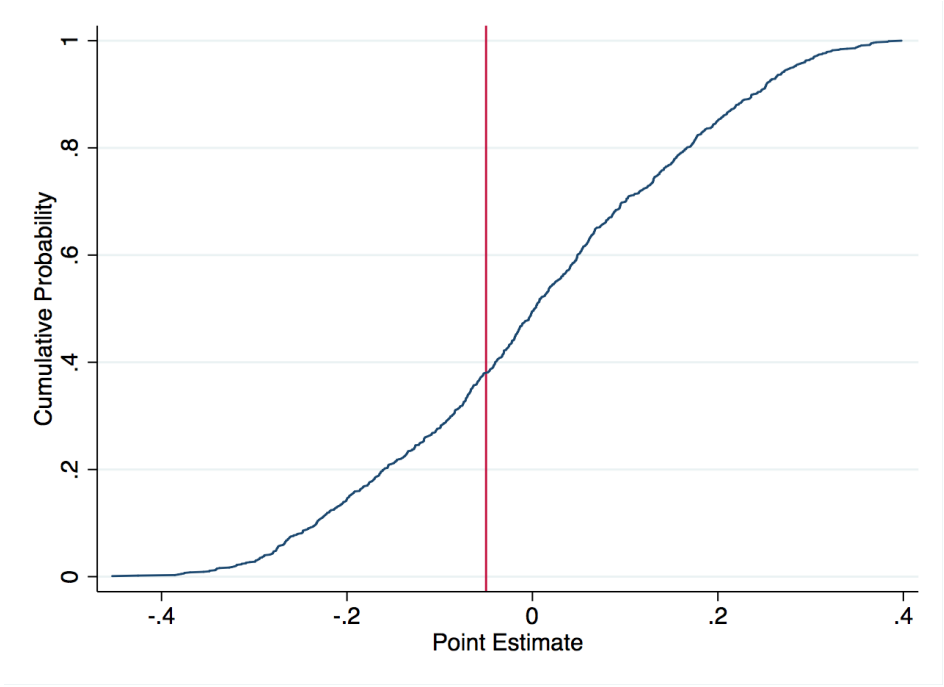
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·13: Placebo Tests of the Second Stage (SUSB Data) - House Price Growth x Recourse Interaction Coefficient: Firms - All Industries (2007-2011)



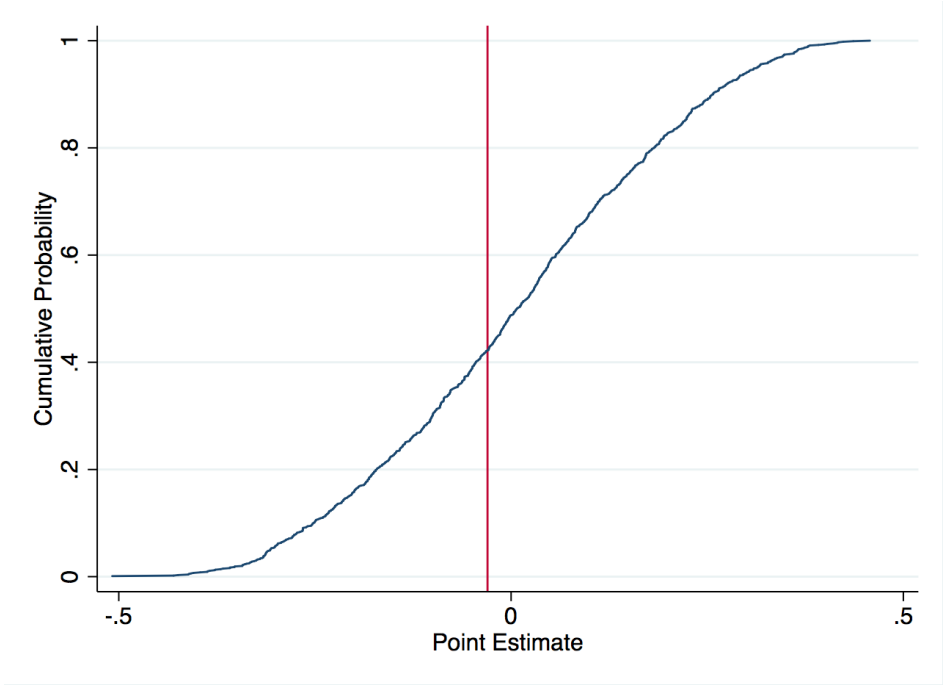
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·14: Placebo Tests of the Second Stage (SUSB Data) - House Price Growth x Recourse Interaction Coefficient: Firms - Startup Capital < P50 (2007-2011)



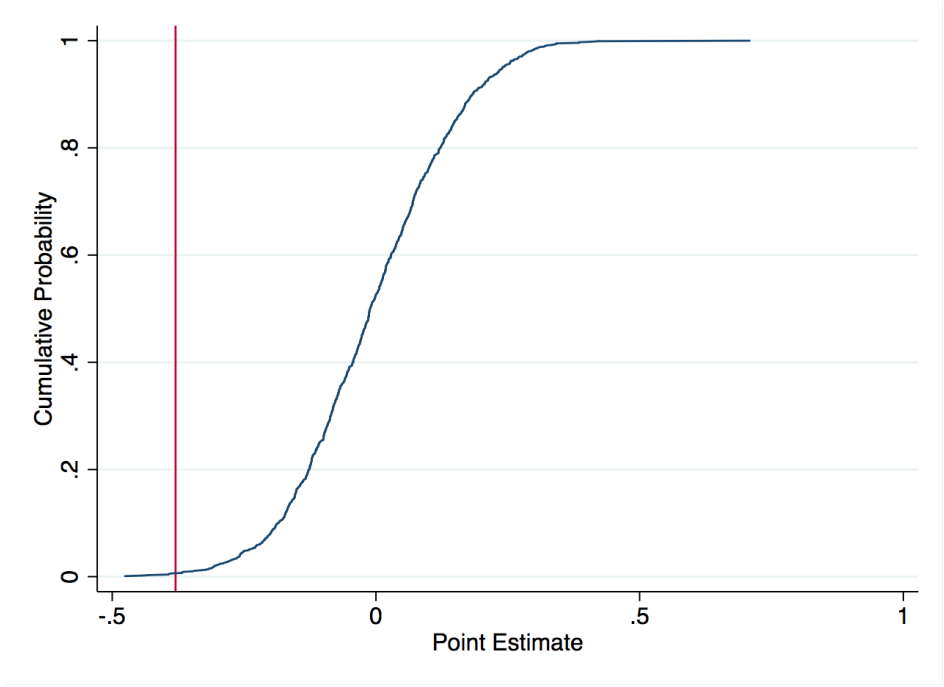
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·15: Placebo Tests of the Second Stage (SUSB Data) - House Price Growth x Recourse Interaction Coefficient: Firms - Startup Capital > P50 (2007-2011)



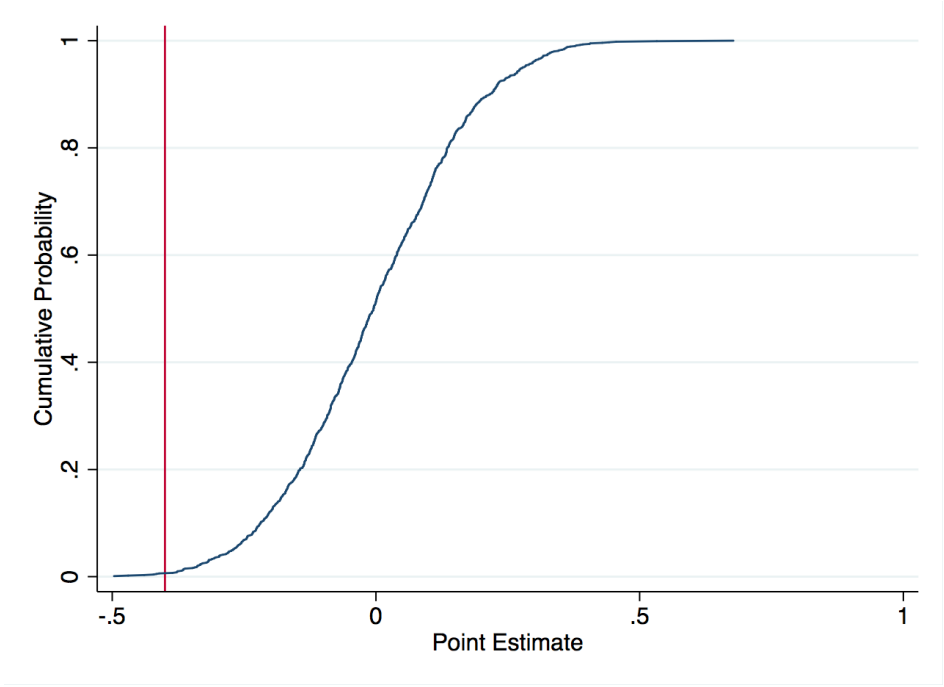
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·16: Placebo Tests of the Second Stage (SUSB Data) - House Price Growth x Recourse Interaction Coefficient: Establishments - All Industries (2000-2007)



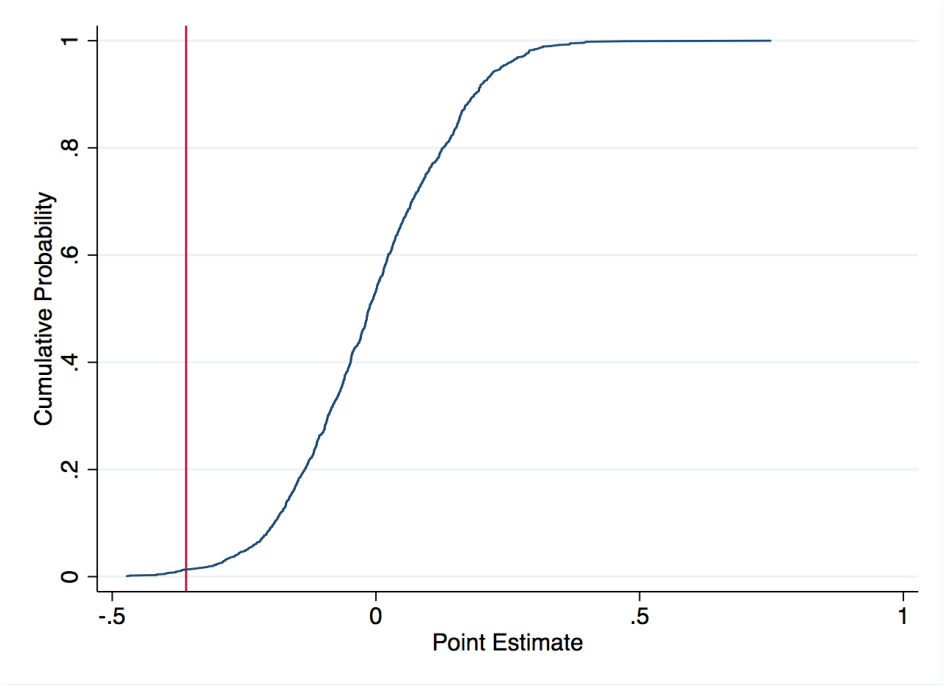
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·17: Placebo Tests of the Second Stage (SUSB Data) - House Price Growth x Recourse Interaction Coefficient: Establishments - Startup Capital < P50 (2000-2007)



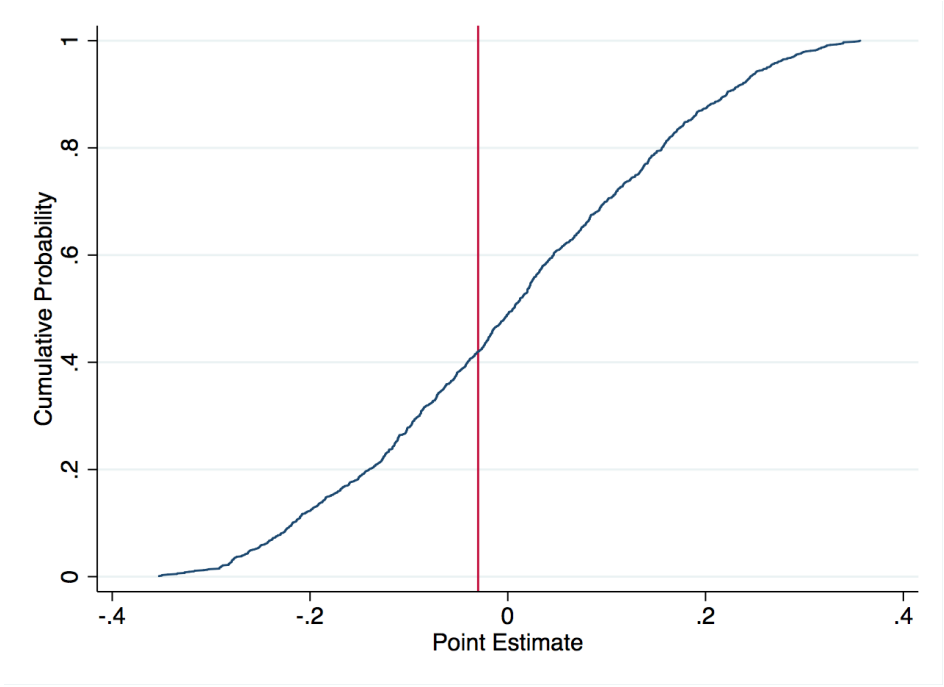
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·18: Placebo Tests of the Second Stage (SUSB Data) - House Price Growth x Recourse Interaction Coefficient: Establishments - Startup Capital > P50 (2000-2007)



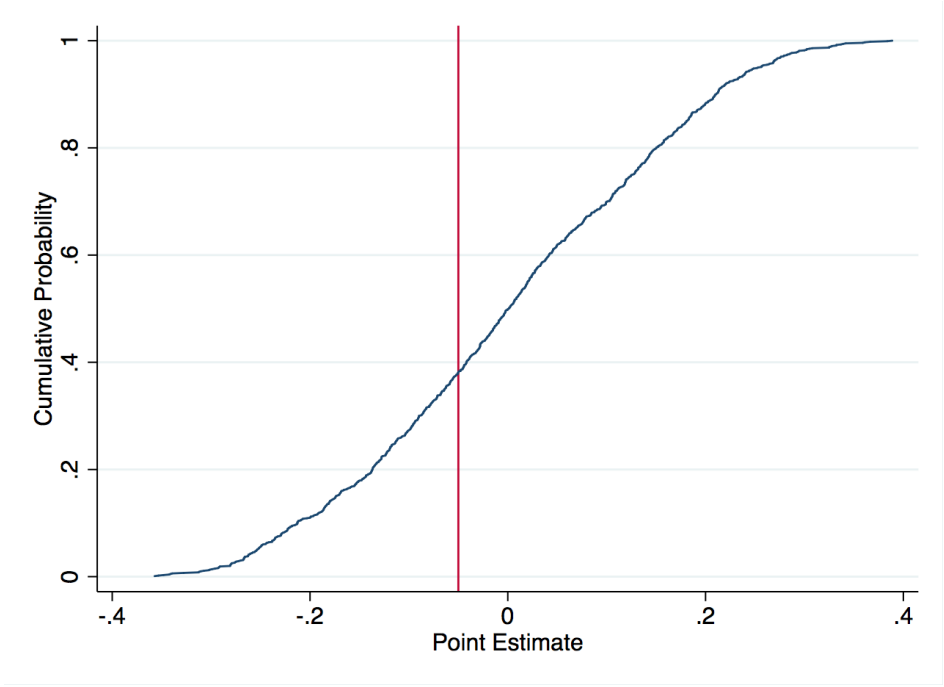
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·19: Placebo Tests of the Second Stage (SUSB Data) - House Price Growth x Recourse Interaction Coefficient: Establishments - All Industries (2007-2011)



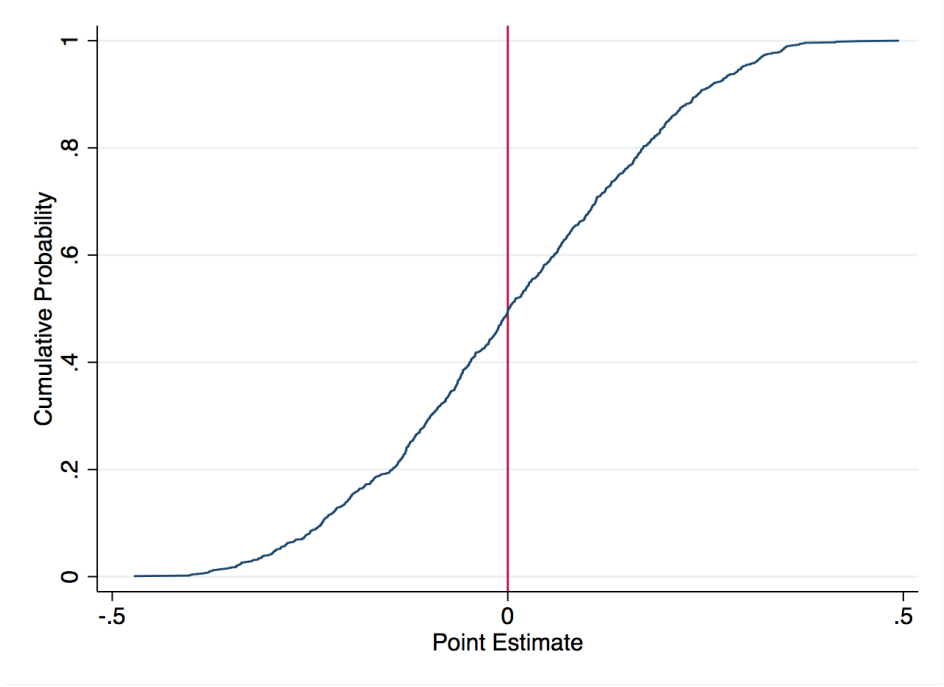
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·20: Placebo Tests of the Second Stage (SUSB Data) - House Price Growth x Recourse Interaction Coefficient: Establishments - Startup Capital < P50 (2007-2011)



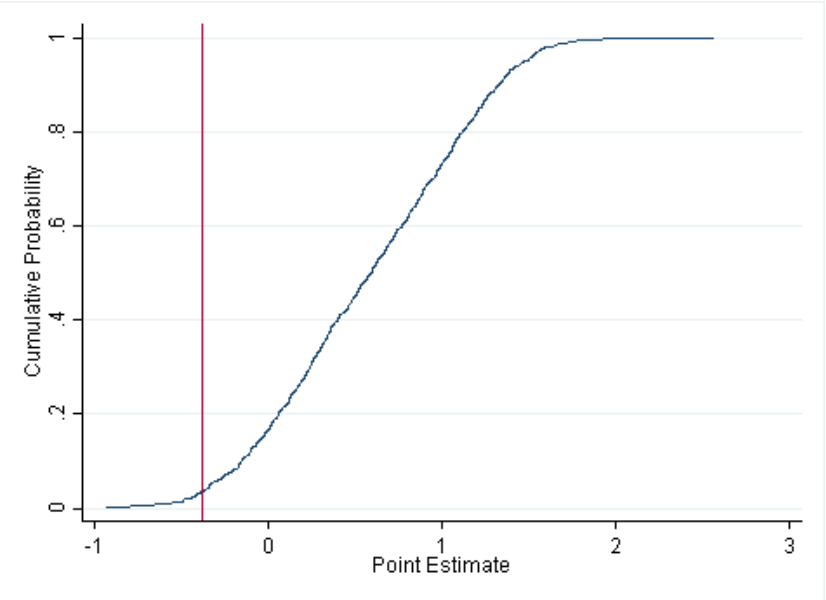
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·21: Placebo Tests of the Second Stage (SUSB Data) - House Price Growth x Recourse Interaction Coefficient: Establishments - Startup Capital > P50 (2007-2011)



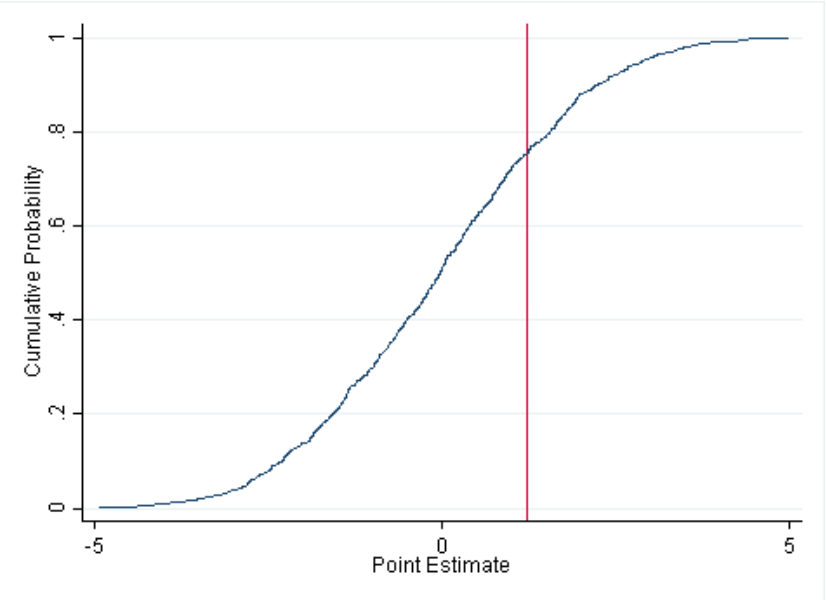
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·22: Placebo Tests of the Second Stage (BDS Data) - House Price Growth x Recourse Interaction Coefficient for Young Firms: Employment (2000-2007)



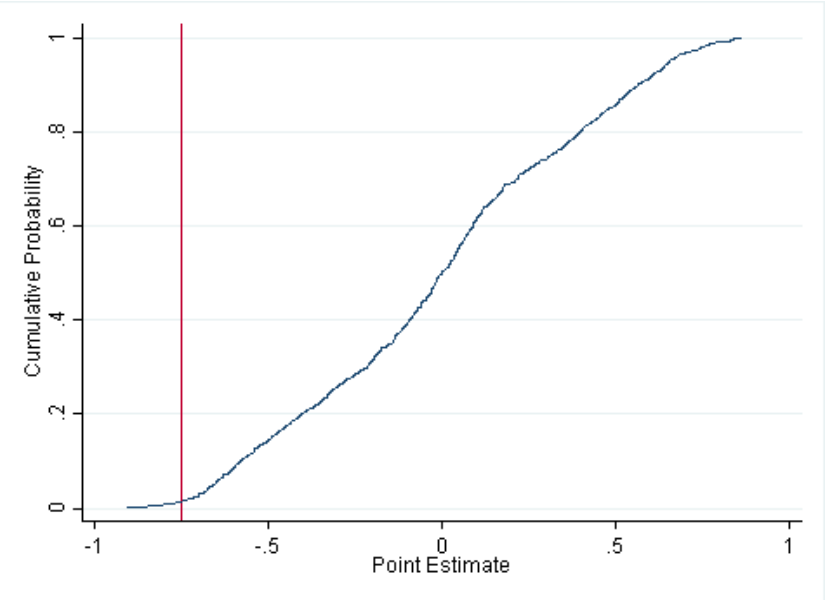
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·23: Placebo Tests of the Second Stage (BDS Data) - House Price Growth x Recourse Interaction Coefficient for Young Firms: Employment (2007-2011)



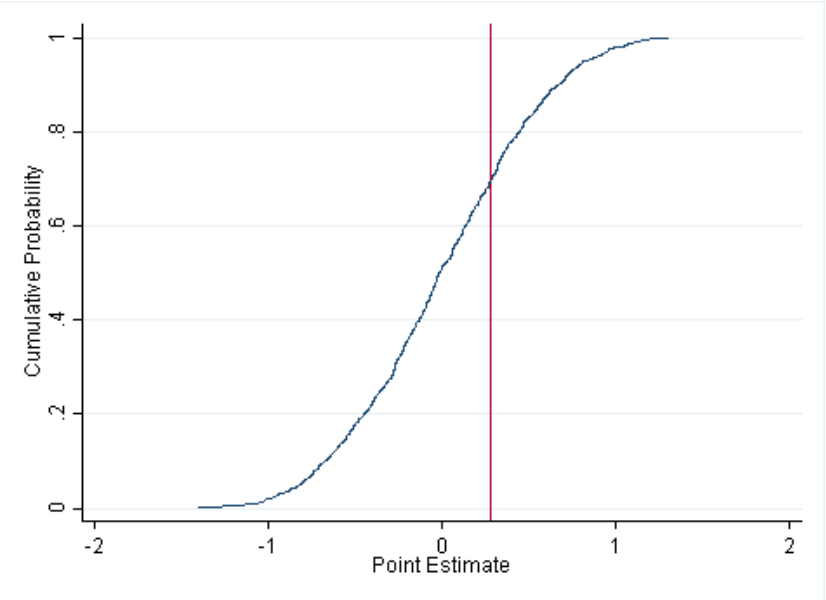
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·24: Placebo Tests of the Second Stage (BDS Data) - House Price Growth x Recourse Interaction Coefficient for Young Firms: Firms (2000-2007)



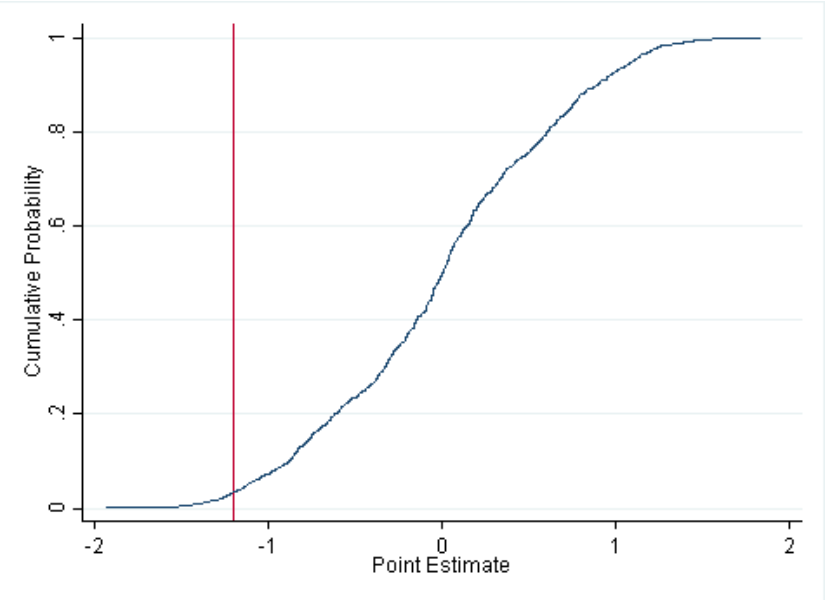
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·25: Placebo Tests of the Second Stage (BDS Data) - House Price Growth x Recourse Interaction Coefficient for Young Firms: Firms (2007-2011)



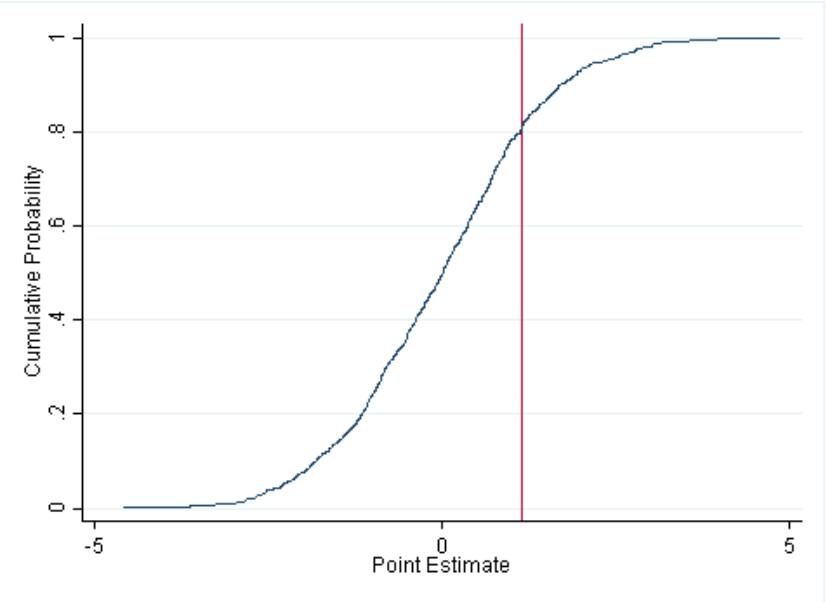
Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·26: Placebo Tests of the Second Stage (BDS Data) - House Price Growth x Recourse Interaction Coefficient for Young Firms: Establishments (2000-2007)



Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Figure 2·27: Placebo Tests of the Second Stage (BDS Data) - House Price Growth x Recourse Interaction Coefficient for Young Firms: Establishments (2007-2011)



Note: The blue line in the figure displays the empirical CDF from one-thousand Monte Carlo simulations for the state-level recourse categorization. The vertical red line displays the point estimate with the true recourse categorization for states.

Chapter 3

Interest Rate Discrimination and Consumer Default

3.1 Introduction

This chapter explores the effects of allowing financial intermediaries to charge different interest rates according to the debt profile of the agents, in contrast to most of previous work where debtors are pooled. It also studies the welfare effects of different bankruptcy schemes and the implications of removing the default option from the economy, exploring the trade-off between moral hazard and the consumption smoothing role of this mechanism.

In this chapter we extend the popular model developed by Athreya [2002] for studying the effect of implementing means-testing prior to allowing for bankruptcy. This framework allows the simultaneous study of bankruptcy law and consumer welfare in general equilibrium. The extension developed in our paper concerns price discrimination in the credit market, where financial intermediaries group agents according to the level of debt they hold and charge different loan rates which reflect their perceived default risk level. This work relates to that of Chatterjee et al. [2007], who take discrimination several steps further by allowing financial intermediaries offer a complete menu of prices and quantities according to each individual's characteristics.

This work explores the general equilibrium effect of giving more flexibility to intermediaries, and also the desirability of having a default option available. Allowing for consumer default raises the question about whether or not the role of bankruptcy as an insurance is outweighed by moral hazard issues. The main purpose of this work is studying these trade-offs and shedding some light about the welfare effects of these changes. The implica-

tions of different alternative policies are also studied. Regarding bankruptcy laws, several regimes are considered and compared, and finally with a scenario without a default option.

During the last two decades much academic effort has aimed to better understanding the consumer default decision. On the other hand, most of the literature on usury laws dates from the late 1970s and 1980s, without much development until late 2000s where empirical work on the topic kindled the academic interest once again.

By allowing households and firms to stop or delay the repayment of debt, the option to file for bankruptcy can be seen as a device for completing missing markets in bad states of nature. This option can be seen as an insurance that permits smoothing consumption across states. This insurance role is formalized in Dubey et al. [2005] and Zame [1993], both propose simple two-period models where uncertainty about the state of the world is resolved on the second period. They key assumption here is that of incomplete insurance markets. Their main result is that in this setting, allowing default subject to a finite penalty can improve allocations, by creating a state-contingency to debt that aids smoothing consumption.

There is a tension between the role of bankruptcy rules as an instrument for completing markets, and its role as a source of moral hazard. Opponents of default and bankruptcy have argued that limited liability may encourage some borrowers to not repaying, imposing significant costs on those willing to pay back. Kocherlakota [1996] takes a different approach to that described above, assuming the existence of a full set of securities to be traded before the revelation of the true state of nature, in this setting they study the extent to which allowing limited commitment for repayment shrinks the feasible set of available contracts. This produces incomplete insurance as an outcome, as opposed to an initial assumption as in Dubey et al. [2005] and Zame [1993]. In this ex-ante complete markets environment, the welfare consequences of introducing consumer bankruptcy are unambiguously negative.

According to Athreya [2005], who surveys theoretical and empirical work on personal bankruptcy, filers are similar to the overall U.S. population in terms of education and median age. However, they are more likely to be young, low net-wealth, sick, unemployed,

and self-employed.

Recent literature on personal bankruptcy has relied on dynamic general equilibrium models in order to better understand the consequences of the availability of the default option, and also trying to disentangle the factors behind the dramatic increase of consumers filing for bankruptcy in the U.S. between 1970s and early 2000s. This literature strand confined itself initially to both partial equilibrium analysis, and stylized bankruptcy mechanisms with a single option for filing. More recently, general equilibrium models with heterogeneous agents, and more accurate descriptions of the current U.S. bankruptcy laws have emerged[1]. This has improved the quality of quantitative evaluations on the relative strengths of the forces of incomplete insurance and limited commitment mentioned above. While there is a good deal of empirical work describing the salient facts on these two opposing forces (Congressional Budget Office [2000]), questions of welfare are not addressed in that literature.

In an early attempt using a dynamic general equilibrium model, Athreya [2002] sets up a single-asset economy with a unique bankruptcy option to study the effects of the Bankruptcy Reform Act of 1999 in the U.S., investigating the trade-off between the consumption smoothing role of bankruptcy and the interest rate and deadweight costs it imposes. The environment is basically an extension of Aiyagari [1994] and Huggett [1993]. There is a large number of risk-averse households facing uninsurable idiosyncratic risk. There is no aggregate uncertainty, and no production. Creditors are assumed to issue credit cards with fixed lines of credit, where the interest rate on loans is independent of the total debt level. This simplifying assumption allows writing financial contracts as simple fixed-rate instruments, however it restricts credit conditions to appear only through prices, whereby bankruptcy laws would have no effects on credit limits. The main result is that stringent means-tests embodied in the Bankruptcy Reform Act would reduce filing rates only slightly, and would have only modest welfare consequences. Intuitively, given the costs of bankruptcy implied by the data, most households would not file unless already poor. On

[1]Including the option to file for either Chapter 7 or Chapter 13 when it comes to personal bankruptcy.

the other hand, the elimination of bankruptcy altogether is found to have substantial benefits. This result is robust to income shock persistence, and to stringency in the application of means-tests.

Li and Sarte [2006] study the implications of U.S. personal bankruptcy rules for resource allocation and welfare. Their key insight is that general equilibrium considerations along with bankruptcy chapter choice and production matter crucially for the effects of policy reform. They find that completely eliminating the option for bankruptcy causes significant declines in output and welfare by reducing capital formation and labor input. The authors consider a continuum of households that choose consumption and how much to work, each household faces a stochastic stream of productivity shocks affecting their income on each period. One of the distinguishing aspects of this work is that it allows for aggregate production, which uses capital and labor as inputs. There is also an intermediation sector that takes all deposits and makes loans, the key simplifying assumption regarding this sector is that all credit contracts have fixed interest rates common for all borrowers. At each point in time, each household either has access to credit or is borrowing constrained as a result of having filed for bankruptcy. Unconstrained households have three options: they can either pay off their debt, file for bankruptcy under Chapter 7, or file for bankruptcy under Chapter 13. A household that pays off its debt in full in the current period necessarily gains unconstrained access to credit markets in the following period. When a household chooses to file for bankruptcy under Chapter 7, all of its debts are discharged, and is allowed to keep assets up to some exemption level. When a household files for bankruptcy under Chapter 13, it is allowed to keep all of its assets but must enter a partial debt repayment plan[2] financed from current and future income. Under both bankruptcy options, the filer must pay an exogenous fixed bankruptcy cost and becomes borrowing constrained in the following period. Borrowing constrained households, excluded from credit markets after having filed, are not individually tracked by the authors. Instead, the modeling strategy is that of a lottery, where the excluded households remain in the constrained state with some

[2]Usually three to five years long.

given probability compatible with a six years exclusion period. This contrasts with the work of Livshits et al. [2005], where a life-cycle approach is taken, time periods are defined to have a three-year length, exclusion is tracked for each household and lasts two periods. As opposed to the results of Athreya [2002], where no production and bankruptcy chapter choice is allowed, the authors find welfare gains from having a bankruptcy mechanism available. Eliminating the bankruptcy option in principle generates gains due to the elimination of the bankruptcy costs paid by filers, however this effect is more than offset by general equilibrium feedback effects into production (accumulation of capital augments production and also allows for an additional asset with which households may smooth consumption). Eliminating Chapter 7 altogether hinders risk sharing to an inefficient degree, as Chapter 13 does not provide the same allowance for contingent repayment (it discourages households to work, since the reorganization mechanism can be seen as a labor tax). Finally, Li and Sarte [2006] find that tightening Chapter 7 legislation by adding means testing at best leaves output and welfare unchanged. However, lower asset exemption levels can improve economic efficiency, since in general equilibrium they paradoxically induce more Chapter 7 but fewer Chapter 13 bankruptcies.

Recognizing the role of the borrower individual characteristics as a determinant of interest rates charged by lenders, Livshits et al. [2005, 2010] use a heterogeneous agent life cycle model to better understand the welfare implications of having a bankruptcy option available in the U.S. and also to account for the dramatic increase in filings between the early 1970s and 2002. One crucial difference with previous work is that, unlike Athreya [2002] and Li and Sarte [2006], Livshits et al. [2005] allows interest rates to depend on an agent's type (age and productivity) and its current level of debt. In this overlapping generations environment, households face both income shocks and expense uncertainty (e.g., uninsured medical bills, divorce costs, etc. The kind of shocks frequently cited by filers as the cause of their bankruptcy), and markets are incomplete since the only assets are person-specific, one-period non-contingent bonds. There are no markets for insurance, however the bankruptcy option introduces a partial contingency. The risk-free interest rate

is exogenously given. Intermediaries make loans, they observe the total level of borrowing, the productivity and the borrower's age. The definition of bankruptcy used incorporates two costs, one is temporary exclusion from credit markets which translates into inability to borrow and save during the bankruptcy period only. The second cost is a share of the consumer's income that may be seized when the bankruptcy is declared. The authors conduct a comparison between two economies, one in which a type of Chapter 7 bankruptcy option exists (FS for fresh start), and one resembling continental Europe where consumer bankruptcy works restructuring a borrower's debt payments and limits the amount of earnings that can be garnished (NFS for no fresh start). The authors find that, for reasonable parameter values, the FS system may achieve higher welfare than the NFS in the U.S. However, this result is sensitive to both the nature and extent of uncertainty, as well as the life-cycle profile of earnings and family size. Without expense uncertainty, a bankruptcy mechanism with severe limits on the discharge of debt is better than a FS system. In general, FS facilitates insurance across states, while NFS makes life-cycle smoothing easier. Then, under flatter income profiles, FS is preferred to NFS. Using an extension of this model, allowing three additional costs of bankruptcy[3], the authors try to account for the rise in bankruptcy filings in the U.S. between the 1970s and 2002. They find that increased uncertainty (income shocks and expense uncertainty) is not sufficient to fully understand this phenomenon. Instead, the rise in filings appears mainly to reflect changes in credit markets (lower transaction and bankruptcy costs). Finally, they argue that the abolition of usury laws and other legal changes were not relevant in this respect.

Chatterjee et al. [2007] models an economy where financial intermediaries offer a complete menu of interest rates and loan amounts to agents according to their observed characteristics. Intermediaries break even, in expected value, with each different loan. This framework takes our simple framework with two credit segments to the extreme, allowing complete discrimination. The authors prove the existence of a steady-state equilibrium and characterize the circumstances under which a household defaults on its loans. They are

[3]Which show to be particularly difficult to identify when calibrating the model.

able to match most of the main statistics regarding bankruptcy and unsecured credit, also several macroeconomic aggregates, and the earnings and wealth distributions. Just like Athreya [2002], they are interested in the effects of more stringent bankruptcy regulation regarding means-testing of potential filers. They find much larger welfare gains from this policy change, compared to the ones reported below in our work.

Section 2 describes the model, characterizes the households, intermediaries, and defines an equilibrium for this economy. In Section 3, we present the main results and analysis of the proposed extensions. Section 4 concludes.

3.2 Model

The model presented below is an extension of that proposed by Athreya [2002]. As mentioned before, the main extension is allowing the financial intermediaries to charge different credit spreads according to the level of assets of the agents. Discrimination is not complete as in Chatterjee et al. [2007], instead they are able to pool agents into two different groups according to the amount of assets they hold.

The market for unsecured credit in the U.S. is characterized by a large, competitive marketplace where lenders are price-takers and issue credit through the purchase of securities backed by repayments from those who borrow. These transactions are intermediated principally by credit card issuers. According to Athreya [2002], these issuers can be viewed as technologies that pool risks, facilitate transactions, and provide delegated monitoring of borrowers. Credit card issuers have to assess the likelihood that any single borrower will default, however they hold large enough portfolios to allow fairly precise predictions regarding aggregate default rates, and expected profits in any given period.

3.2.1 Households

There is a continuum with unit mass of ex-ante identical households, which are infinitely lived. Time is discrete, each period corresponds to a year. Households have standard additively separable CRRA utility functions over stochastic processes for consumption.

The period utility function is given by

$$U(c_t) = \frac{c_t^{1-\sigma}}{1-\sigma},$$

where c_t is consumption of the only good in this economy in period t, and σ is the coefficient of relative risk aversion. Agents maximize

$$\mathcal{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-\sigma}}{1-\sigma}, \quad \beta \in (0,1).$$

At the beginning of each period, households receive a random endowment of the single, perishable good $\epsilon \in \{\epsilon_l, \epsilon_h\}$, with $\epsilon_l < \epsilon_h$. The endowment follows a first-order Markov process independent across individuals but serially correlated, in order to obtain anticipation effects, with cumulative distribution function $G(\epsilon'|\epsilon)$ and corresponding density function $g(\epsilon'|\epsilon)$. Then, the household's wealth at the beginning of each period is the sum of its endowment ϵ, and asset holdings a. Agents have access to a competitive, unsecured credit market where they may lend, borrow up to a certain limit, or default on previously acquired debt.

3.2.2 Intermediaries

The intermediation sector takes all deposits and makes loans. Credit contracts with fixed interest rates are signed with households, these must ensure zero profits given average repayment rates. Financial intermediaries have perfect information regarding the amount of assets/debt each agent holds. Considerations regarding rationing of credit are omitted, if it is the case that the supply side response to default risk is to tighten the credit limits then the welfare computations presented may be affected.

There is a single asset in this economy: private debt, with its price set in a competitive market. Three prices are quoted[4], two loan rates $r_{l,i}$ with $i = l, h$, and a deposit rate r_d, with $r_{l,i} > r_d$, $\forall i$. Where $r_{l,l}$ is the loan rate for debtors holding low assets or low debt, and $r_{l,h}$ is the loan rate for those holding high assets or high debt. The credit spread is

[4]Following the convention, r is used for denoting net interest, and R for gross rates.

defined as $r_{l,i} - r_d = \tau + \gamma_i$, with $i = l, h$, where $\tau > 0$ is a common transaction cost and $\gamma_i > 0$ is a risk premium for each group of agents.

The existence of this credit spread is necessary since some households will default in equilibrium, and in order to break even, financial intermediaries will have to charge higher interest rates on loans than they pay for deposits (intermediation cost spread). There is a costly intermediation technology where deposits are collected and loans are made to a large number of households, allowing complete diversification. This will permit avoiding the computation of the whole rate schedule as in Chatterjee et al. [2007]. Unlike most of the literature on this topic, where common rates are charged on all loans and deposits across all individuals, in this work some discrimination is allowed in the sense that intermediaries can charge two different risk premia on loans according to the amount of assets/debt an agent holds. Those agents holding a large amount of assets or debt face a certain loan rate, while those holding small amounts of assets or debt are charged a different one. They all face the same deposit rate. Basically, there are two kinds of intermediaries, those dealing with large transactions (deposits and loans) and those for smaller ones. In equilibrium, each type must break-even independently.

All debt is assumed to be unsecured, the focus is on households with little or no collateral who rely on unsecured debt to smooth consumption. According to Gropp et al. [1997], in many cases those considering filing use unsecured credit to transform secured debts into unsecured credit, and then discharge this debt in bankruptcy.

3.2.3 Bankruptcy

In this particular case we will focus on Chapter 7 bankruptcies to keep the analysis simple. Households may save while filing, not being in complete autarky. Before filing they must satisfy two conditions. First, a necessary minimum debt condition, if $a \leq -T^*$ then the household satisfies the necessary condition, henceforth this threshold will be denoted T^*. Second, the household must be in good standing, i.e. cannot have recently filed for bankruptcy (within the previous four years on average).

Bankruptcy is treated as a within-period event, households decide whether or not to file having previously observed their own period income. When a household decides to file, it pays the cost of filing, debt is discharged, and it becomes restricted from access to future borrowing. The cost of filing involves both a pecuniary and non-pecuniary component, the latter is defined as $\lambda > 0$. This term summarizes time costs arising from court dates, legal procedures, and also societal disapproval or "stigma" as discussed by Dubey et al. [2005], Gross and Souleles [2001], and Fay [2002]. This component of the cost of filing will be calibrated to match observed bankruptcy filing rates in the U.S., given the average length of credit market exclusion.

An important drawback of using bankruptcy to provide insurance against bad states of the world in an incomplete markets environment, is that the penalties associated typically do not involve any transfer of wealth from debtors to someone else, as opposed to conventional insurance. Bankruptcy penalties therefore impose deadweight losses on society.

As in Athreya [2002], and most of the literature, exclusion from credit is modeled as a lottery, in order to avoid keeping track of the length of exclusion for each household. In each period after bankruptcy, a household with bad credit is subject to a lottery, whereby it may regain full access to financial markets with probability $1 - \rho$, or stay excluded for another period (ρ). The average time a household is excluded from borrowing is given by $1/(1 - \rho)$.

3.2.4 Households' Problem

At each point in time, a household has either good credit (facing a budget set denoted $\mathcal{B}_{gc}$) or bad credit (with budget set $\mathcal{B}_{bc}$). There is also a within-period transition state for households who just filed for bankruptcy (with budget set $\mathcal{B}_b$), these are allowed to keep their beginning-of-period endowment.

Given the level of endowment drawn and beginning-of-period assets, households must choose each period whether or not to file[5], consumption level, and asset holdings for next

[5]If in good standing and satisfying the necessary condition, $z = 1$ if a household files, and $z = 0$ otherwise.

period a'. From the households' point of view all savings is risk-free and earns the same rate of return r_d, so total assets are denoted a. However, the loan rate faced depends on the amount of assets/debt they hold.

Good Credit Households

Let $V_{gc}(a, \epsilon)$ denote the value function of a household in good standing. The relevant states for this household include its asset level a and its endowment draw ϵ. This household has two options, it can either pay off its debt, or file for bankruptcy under the liquidation option (similar to Chapter 7 in the U.S.).

The value of paying off debts in the current period is defined recursively as follows

$$V_p(a, \epsilon) = \max_{c>0, a' \geq \underline{a}} \left\{ U(c) + \beta \int_{\epsilon} V_{gc}(a', \epsilon') dG(\epsilon'|\epsilon) \right\}$$
$$\text{s.t.} \qquad c + a' \leq R_i a + \epsilon,$$

with

$$R_i = \begin{cases} R_d & \text{, if } a \geq 0 \\ R_{l,l} = R_d + \tau + \gamma_l & \text{, if } a \in (-\phi, 0) \\ R_{l,h} = R_d + \tau + \gamma_h & \text{, if } a \leq -\phi, \end{cases}$$

where $\underline{a} \leq 0$ sets the borrowing limit, $\tau > 0$ is a common transaction cost, $\gamma_i > 0$ is a type-specific risk premium, and $\phi > 0$ is the threshold for agents being either in the high or low debt group.

The value of filing for bankruptcy in the current period is defined recursively as follows

$$V_b(a, \epsilon) = \max_{c>0, a' \geq 0} \left\{ U(c) - \lambda + \beta \int_{\epsilon} V_{bc}(a', \epsilon') dG(\epsilon'|\epsilon) \right\}$$
$$\text{s.t.} \qquad c + a' \leq \epsilon,$$

where $\lambda > 0$ denotes the utility cost of bankruptcy described above. When the household qualifies for bankruptcy, and chooses to file, it has its debt discharged, pays the non-pecuniary cost λ, and then is automatically sent to the "bad credit"state.

Then, the value of a good credit household who can choose whether to repay its debt or file for bankruptcy is given by

$$V_{gc}(a,\epsilon) = \begin{cases} \max\left\{V_p(a,\epsilon), V_b(a,\epsilon)\right\}, & \text{if } a \leq -T^* \\ V_p(a,\epsilon), & \text{otherwise,} \end{cases} \tag{3.1}$$

where T^* is the threshold parameter associated to the minimum debt necessary condition for filing.

Bad Credit Households

As mentioned before, exclusion is modeled as a lottery, where a borrowing-constrained household has a probability $1-\rho$ of regaining full access to credit next period. The value of a household in bad standing is defined recursively as

$$\begin{aligned} V_{bc}(a,\epsilon) = \max_{c>0, a'\geq 0} & \left\{ U(c) + \beta \int_{\epsilon} \left[\rho V_{bc}(a',\epsilon') + (1-\rho) V_{gc}(a',\epsilon')\right] dG(\epsilon'|\epsilon) \right\} \\ \text{s.t.} \quad & c + a' \leq R_d a + \epsilon. \end{aligned} \tag{3.2}$$

Notice that the non-pecuniary cost of bankruptcy λ is no longer being payed. This assumption can be changed by a continued smaller payment that goes beyond the bankrupt state into the bad credit state as in Li and Sarte [2006] and Livshits et al. [2005]. We follow the approach taken by Athreya [2002] with a one-time large payment instead. Results do not differ much between these two different approaches.

3.2.5 Stationary Equilibrium

An equilibrium for this economy is a set of prices (one deposit rate, two borrowing rates). Decision rules for agents with good credit $\{c, a, z\}_{gc}$, for agents with bad credit $\{c, a\}_{bc}$. Sets of value functions $\{V_{gc}, V_p, V_b, V_{bc}\}$, probability measures $\{\mu_{gc}, \mu_{bc}\}$. Such that, the household decision rules solve the problems in (3.1) and (3.2), capital markets clear, both types of intermediaries break-even, and probability measures are stationary.

Let $X = \mathcal{B} \times E \times S$ denote the state-space for households, with $\mathcal{B} = \cup_{i=gc,b,bc} \mathcal{B}_i$,

$E = \{\epsilon_l, \epsilon_h\}$, and $S = \{gc, bc\}$. Where χ_B is the Borel σ-algebra on X.

The household's asset decision rule is denoted $a(x)$, this rule together with the productivity uncertainty imply an stochastic process for consumption and asset holdings with transition function $Q(x, Z)$ $\forall Z \in \chi_B$ on the measurable space (X, χ_B). The transition function implies a stationary probability measure $\mu(Z)$ $\forall Z \in \chi_B$.

Regarding the financial intermediaries, their profits must be zero. Let $X_{+,l} = \{x \in X | 0 \leq a \leq \delta\}$ and $X_{+,h} = \{x \in X | \delta < a\}$, where $\delta > 0$ is the threshold parameter that divides the market between high and low asset holding agents. Analogously define $X_{-,l} = \{x \in X | -\phi \leq a \leq 0\}$, and $X_{-,h} = \{x \in X | a < -\phi\}$. In the stationary state, there is a time-invariant mass of households, which according to our classification have total borrowing given by $\int_{X_{-,l}} a(x) d\mu_{gc}$ and $\int_{X_{-,h}} a(x) d\mu_{gc}$ for low and high debt respectively. Given the per-unit cost of intermediation τ, and the risk premia, the zero profit condition for each type of intermediary can be written as

$$R_d \int_{X_{+,i}} a(x) d\mu - (R_d + \gamma_i) \left| \int_{X_{-,i}} a(x) \mathbf{1}_{[z=0]} d\mu_{gc} \right| = 0; \qquad i = l, h \tag{3.3}$$

where $\mathbf{1}_{[z=0]}$ is the indicator function equal to one for those households that choose not to file for bankruptcy. The first term on the left in (3.3) denotes payments intermediaries must make to their depositors, the second term represents payments from the good credit households that repay their debt in full. The zero profit condition must hold on both markets, h and l.

With respect to the probability measures, it must be true that

$$\mu(Z) = \int_X Q_j(x, Z) d\mu_j, \tag{3.4}$$

for all $Z \in \chi_B$, and for all $\mu_j \in \{\mu_{gc}, \mu_{bc}\}$. For the asset market, market clearing requires

that

$$\int_X a(x) d\mu_j = 0, \tag{3.5}$$

for all $\mu_j \in \{\mu_{gc}, \mu_{bc}\}$.

The computation of equilibrium is fairly standard[6]. We use successive approximations of the different value functions in order to solve for the stationary equilibrium. The whole algorithm consists of two main steps, first we iterate on the different value functions in order to find the policy functions with initial guesses for the prices and value functions. The state-space is discretized by choosing a grid of assets that includes both positive and negative values, with a total number of points of 400. Second, the invariant distribution corresponding to the policy functions is found by iterating on (3.4). Together with the household decision rules, the invariant distribution is used to check market-clearing condition in (3.5), and update prices if necessary.

3.2.6 Calibration

Practically all the calibrated parameters were taken from Athreya [2002], and are summarized in Table 3.1. Except the upper bound on the endowment process that was reduced to 1.00 from 1.25 used by Athreya [2002]. This modification also changes the value of $\underline{a}$, which corresponds to the unconditional mean of the endowment process. This slight change was necessary in order to match the bankruptcy frequency.

Regarding the asset grid, the borrowing limit is set equal to the unconditional mean of income in a year. The upper limit of savings is set high enough so no agent is constrained by it.

Not existent in Athreya's work are the threshold parameters for debt (ϕ) and assets (δ) that split the market in two, these two parameters were set arbitrarily in order to divide both loan and deposit markets exactly in half. Also not present, but similar in spirit, is T^*. This parameter governs the minimum debt condition necessary to file for bankruptcy.

[6]The complete procedure is described in the appendix C of Li and Sarte [2006].

Athreya [2002] uses the same notation for the means-testing regulation change performed in the U.S. in the early 2000's. In our baseline model, $T^* = 0.9$ means that an agent is only allowed to file if its total debt is at least equal to 90% of its average annual income[7].

3.2.7 Welfare

When comparing different outcomes, their desirability will be evaluated using an utilitarian approach, according to the following expression

$$\Delta W = \left(\frac{\Lambda^1 + 1/(1-\sigma)(1-\beta)}{\Lambda^0 + 1/(1-\sigma)(1-\beta)} \right)^{1/(1-\sigma)} - 1$$

where $\Lambda^i = \int_X V(x) d\mu$, with Λ^0 and Λ^1 denoting the baseline and alternative scenarios under comparison, respectively.

Under this criterion, $\Delta W > 0$ implies that households ex-ante are better off under a proposed alternative policy than in the benchmark economy.

3.3 Results

The results here reported involve three basic exercises. First, comparing economies with and without the availability of a default option in terms of prices, allocations and general welfare. Second, when bankruptcy is available, comparing different degrees of stringency on the requirements necessary to file for bankruptcy in terms of the minimum amount of debt required. Finally, contrasting economies where financial intermediaries are allowed to discriminate how much to charge on loans according to the agents' characteristics, and an economy in which this discrimination is not possible. All of the above will be analyzed by comparing steady states, no transitional dynamics are computed.

The model described above is calibrated to match the frequency of bankruptcy filings in the U.S. between 1990 and 1998 as in Athreya [2002]. We report the main properties of the benchmark model economy and their data counterparts in Table 3.2. The model does well matching interest rates and the debt-to-income ratio, even though it was not directly

[7]This is imposed to resemble closely the regulation proposed for Chile, however it serves a purpose similar to means-testing in practice.

tailored to do so. Since intermediaries charge two different interest rates, those shown in Table 3.2 for the model are not directly comparable to the data. However, in Table 3.4 the corresponding value for the Pooled model is directly comparable and turns out to be 1.8 points higher than the observed counterpart.

Regarding the non-pecuniary cost of bankruptcy, summarized by λ. Our calibration requires a value slightly lower than that in Athreya [2002], but much higher than that reported by Li and Sarte [2006]. Nevertheless the latter work sets up a bankruptcy cost that is paid for a longer period of time, then it is sensible that it is lower (0.89).

With respect to the first exercise, the results are summarized in Table 3.3. The comparison here is between an economies with and without a default option, without bankruptcy the deposit rate goes down 0.1 point. The effect is more noticeable on the loan rates, for the high debt segment it is reduced 6 points, and 2 points for the low debt agents, this places the rate charged on both types of agents almost at the same level. This is sensible since the default risk disappears and only the transaction cost remains. However, around 3 points of spread between loan and deposit rates remain unexplained, this might be due to the fact that agents hold more debt on average. Then a higher loan rate is needed in order to clear the market. Regarding total welfare, our findings indicate that removing the default option is welfare improving. In this endowment economy there are three elements to consider in order to understand this result. First, when bankruptcy is not allowed the use of ex-post deadweight costs stops, such as court costs, lawyer's fees, and others. Second, even though they do not imply transfer of resources, the absence of stigma and credit market restrictions are also part of the deadweight cost avoided. Third, clear in Table 3.3, is the general lowering of interest rates. This change is, ceteris paribus, unambiguously welfare improving since it makes easier moving resources from good to bad states where the marginal utility of consumption is higher.

The bankruptcy decision is depicted in Figure 3·1 by means of value functions. The solid line corresponds to the value of good credit which is increasing on the level of assets, and the dashed line to that of filing for bankruptcy. For high values of debt (close to the

unconditional mean income in a year) it is optimal defaulting. The crossing point is closer to zero in the high endowment state, making bankruptcy seldom observed. Regarding the distribution of agents, the cumulated distribution of assets is shown in Figure 3·3. The solid line corresponds to agents with good credit, and the dashed one to those with bad credit. Since the latter cannot acquire debt they are concentrated close to zero, which is binding, with the distribution rapidly gaining mass for low levels of assets. Unlike the group with good credit, which shows symmetry around zero and barely any agents with assets over the maximum level of the endowment. Their risk aversion and the high persistence of the endowment process is behind this behavior. It is also noticeable that only those agents with high debt are filing for bankruptcy, these are households that have received a string of low endowments and have nearly reached the borrowing constraint. This is seen by noting that in all cases, the minimum debt level discharged in a bankruptcy ranges between 93 and 96% of average annual income according to the baseline model.

For the second exercise, which compares different levels of minimum debt required to file, the results are summarized in Table 3.3. When the requirement is made more stringent, going from 90 to 95% of average annual income, there are no big changes on interest rates. There is an increment on debt held and a reduction on filings, which is sensible. This measure is desirable, however the welfare improvement is close to zero and almost 40 times smaller than that associated to removing the default option altogether. This finding is in line with the fact noted above, about the average amount of debt discharged when defaulting. Since discharged debt is usually higher than the new limit, the total effect is almost zero in equilibrium.

With respect to the third exercise, which compares an economy where financial intermediaries break-even charging a single loan rate, and one where lenders partially discriminate. Results are shown in Table 3.4. The frequency of default, and deposit rate remain almost unchanged, the single loan rate is slightly higher than that charged to high debt agents in the benchmark economy. Once again, this is related to the amount of debt discharged in equilibrium. Since "risky" agents that file hold large amounts of debt, they are the domi-

nant driver of loan rates and have a large weight when intermediaries set the default risk premium. Finally, given the higher loan rate, in this pooled economy the average welfare level is lower than in the benchmark economy. This welfare difference is higher than that associated to removing the bankruptcy option.

The incorporation of this discrimination feature opens the door for a policy experiment regarding interest rate ceilings in future research, where this limit is placed in between the two loan rates and generates exclusion as a side effect of market clearing.

3.4 Summary and Conclusions

In this paper we extended the popular model developed by Athreya [2002] for studying the effect of implementing means-testing prior to allowing for bankruptcy. This framework allows the simultaneous study of bankruptcy law and consumer welfare in general equilibrium. The extension developed in our paper concerns price discrimination in the credit market, where financial intermediaries group agents according to the level of debt they hold and charge different loan rates which reflect their perceived default risk level. This work relates to that of Chatterjee et al. [2007], who take discrimination several steps further by allowing financial intermediaries offer a complete menu of prices and quantities according to each individual's characteristics.

There are two main findings in our work. First, in this endowment environment allowing for bankruptcy is not a desirable policy since the deadweight costs associated outweigh the gains from the insurance role of default during bad states of the world. Second, price discrimination in the credit market is highly desirable, being those individuals holding low levels of debt the most benefited. The welfare gain from allowing financial intermediaries charge different interest rates to different profiles of debtors is higher than that associated to removing the default option from the economy altogether.

Future research should enrich the economy to include production, since the consumption/leisure decision seems to play an important role when accounting for the cost of bankruptcy according to Chatterjee et al. [2007]. In the same direction, including housing

property seems compelling since this kind of wealth is usually exempt of bankruptcy discharge and seems to play a role both with respect to the decision to file and through which Chapter.

Another possible extension is the inclusion of other types of insurance that actually involve transfers from one agent to another, unlike bankruptcy where most of the cost does not have a counterpart receiving resources, in line with the work of Attanasio and Rios-Rull [2000] where the existence of public insurance makes private insurance redundant. Finally, as mentioned above, this framework allows, and should be extended towards, studying the effect of setting interest rate ceilings in an economy where default is allowed and rate discrimination is observed.

Table 3.1: Calibrated Parameters

Parameter	Description	Value
Preferences		
β	Discount rate	0.947
σ	Coefficient of relative risk aversion	3
Income and assets		
ϵ	Endowments	[0.75; 1.00]
$g(\epsilon'\|\epsilon)$	Transition matrix for endowments	$\pi_{hh} = \pi_{ll} = 0.75$
τ	Loan transaction cost	0.034
$\underline{a}$	Upper bound on borrowing	-0.875
Bankruptcy		
s	Non-pecuniary filing cost	1.246
T^*	Minimum debt threshold	0.9
$1/(1-\lambda)$	Average length of exclusion	4
ϕ	Threshold parameter for debt	0.5
δ	Threshold parameter for assets	0.5

Note: π_{hh} denotes the probability of staying in the high (π_{ll} for low) endowment state next period.

Table 3.2: Benchmark Economy

Statistics	U.S. Data	Model
Deposit rate (%)	2.57	2.00
Loan rate (%)	13.0	
High debt		14.4
Low debt		10.4
Debt/income	-0.085	-0.073
Defaults (%)	1.18	1.18

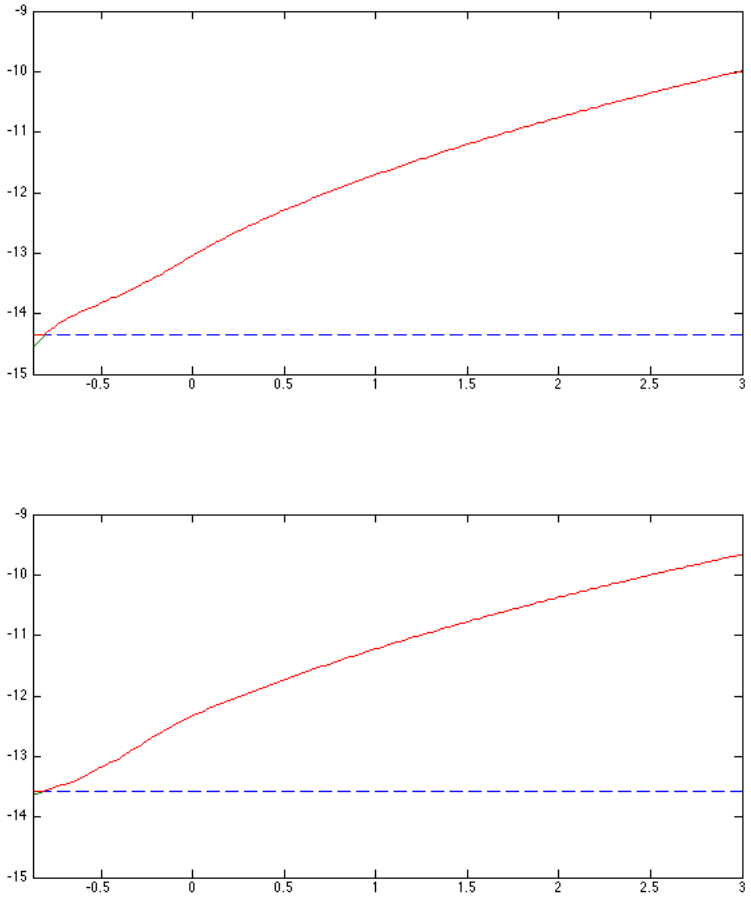
Table 3.3: Bankruptcy Regimes Comparison

	Benchmark $T^* = 0.9$	$T^* = 0$	$T^* = 0.95$	No BK
Deposit rate (%)	1.9	2.0	2.0	1.8
Loan rate (%)				
High debt	14.3	14.4	14.4	8.3
Low debt	10.3	10.4	10.4	8.3
Debt/income	-0.076	-0.073	-0.082	-0.095
Defaults (%)	1.18	2.14	1.05	0.00
ΔW	0	0	5.10 E^{-4}	0.002

Table 3.4: Price discrimination comparison

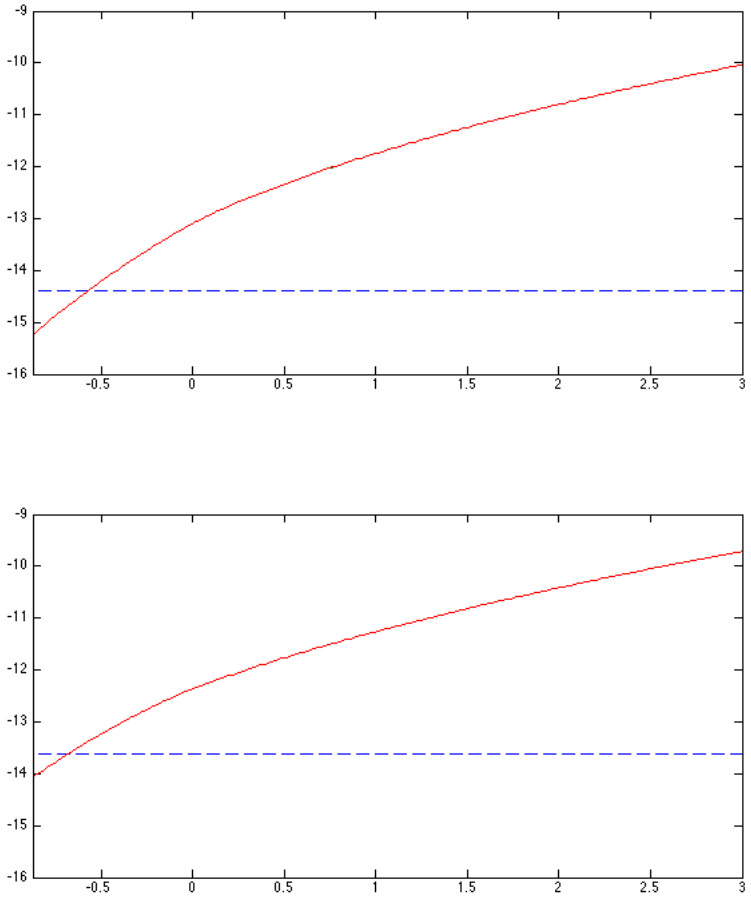
	Benchmark	Pooled
Deposit rate (%)	1.9	2.0
Loan rate (%)		14.8
High debt	14.3	
Low debt	10.3	
Debt/income	-0.076	-0.070
Defaults (%)	1.18	1.17
ΔW	0	-0.003

Figure 3·1: Bankruptcy Choice



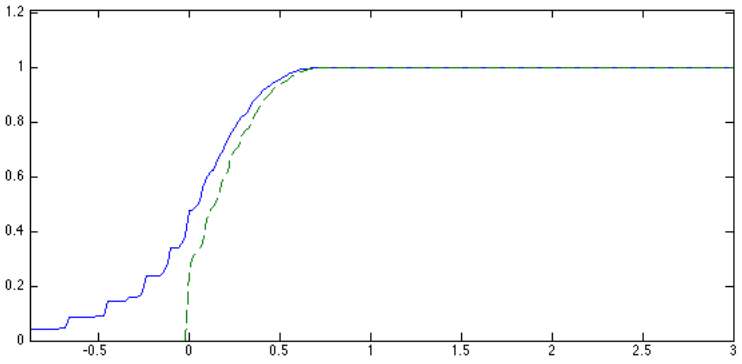
Note: Upper plot for low endowment, lower plot for high endowment. Asset level on horizontal axis, utility value on vertical axis.
Dashed line is the value of filing for bankruptcy. Solid line is the value of repaying debt. Upper envelope is the value of good credit. Starting on zero assets the value of bad credit coincides with that of good credit.

Figure 3·2: Economy Without Bankruptcy Option



Note: Upper plot for low endowment, lower plot for high endowment. Asset level on horizontal axis, utility value on vertical axis.
Dashed line is the value of filing for bankruptcy. Solid line is the value of repaying debt and that of good credit. Starting on zero assets the value of bad credit coincides with that of good credit.

Figure 3·3: Cumulative Distribution Fn. of Assets



Note: Level of assets on horizontal axis, cumulated probability on vertical axis. Dashed line for bad credit agents, solid line for good credit.

Appendices

Appendix A

House Prices, Entrepreneurship, and the Cost of Default

A.1 Properties of the threshold under risk aversion and known ability

For h^* in (1.19) to be decreasing on LTV ratio τ, and own entrepreneurial ability θ.

$$\frac{\partial h^*}{\partial \tau} = -\frac{(\theta - r)\left[(\gamma - d)P_2^L + (1+d)\mathcal{E}_1(P_2) + \Phi - w\right]}{(1+r)\left[1 + d + \tau(\theta - r)\right]^2} < 0,$$

$$\frac{\partial h^*}{\partial \theta} = -\frac{\tau\left[(\gamma - d)P_2^L + (1+d)\mathcal{E}_1(P_2) + \Phi - w\right]}{(1+r)\left[1 + d + \tau(\theta - r)\right]^2} < 0,$$

we need the term in brackets in the numerator to be positive, provided that we are assuming $\theta > r$.

$$\begin{aligned}(\gamma - d)P_2^L + (1+d)\mathcal{E}_1(P_2) + \Phi - w &> 0 \\ \mathcal{E}_1(P_2) &> \frac{w - \Phi + (d-\gamma)P_2^L}{1+d},\end{aligned} \tag{A.1}$$

this requirement reduces to a lower bound condition on expected prices for period 2. Intuitively, this means that a minimum level of expected future home equity is required by agents in order to become entrepreneurs, and be able to consume a positive amount. If expected house prices are too low, then not even those agents with high levels of initial home equity will become entrepreneurs.

For the initial home equity threshold to be increasing on d,

$$\frac{\partial h^*}{\partial d} = \frac{w - (1+\gamma)P_2^L + \tau(\theta - r)\left[\mathcal{E}_1(P_2) - P_2^L\right] - \Phi}{(1+r)\left[1 + d + \tau(\theta - r)\right]^2} > 0,$$

besides condition (A.1), we need the term in the numerator to be positive,

$$w - (1+\gamma)P_2^L + \tau(\theta - r)\left[\mathcal{E}_1(P_2) - P_2^L\right] - \Phi > 0, \tag{A.2}$$

conditions (A.1) and (A.2) are satisfied when

$$P_2^H > P_2^L,$$

which is one of our basic assumptions.

About the cross derivative of the threshold h^* with respect to the degree of recourse d and expected house prices $\mathcal{E}_1(P_2)$,

$$\frac{\partial^2 h^*}{\partial d \partial \mathcal{E}_1(P_2)} = \frac{\tau(\theta - r)}{(1+r)\left[1 + d + \tau(\theta - r)\right]^2} > 0,$$

it is positive provided that $\theta > r$.

The remaining slope properties of h^*, namely it being decreasing on period 2 house prices P_2^L and P_2^H, and wages w. Also being increasing on the rental rate γ, and administrative/stigma cost Φ. All hold provided that $\theta > r$.

$$\frac{\partial h^*}{\partial P_2^H} = -\frac{\tau(\theta - r)}{2(1+r)\left[1 + d + \tau(\theta - r)\right]} < 0$$

$$\frac{\partial h^*}{\partial P_2^L} = -\frac{\tau(\theta - r)/2 + d - \gamma}{(1+r)\left[1 + d + \tau(\theta - r)\right]} < 0$$

$$\frac{\partial h^*}{\partial w} = -\frac{1}{(1+r)\left[1 + d + \tau(\theta - r)\right]} < 0$$

$$\frac{\partial h^*}{\partial \gamma} = \frac{P_2^L}{(1+r)\left[1 + d + \tau(\theta - r)\right]} > 0$$

$$\frac{\partial h^*}{\partial \Phi} = \frac{1}{(1+r)\left[1 + d + \tau(\theta - r)\right]} > 0.$$

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