CIREQ

Centre interuniversitaire de
recherche en économie quantitative

Cahier 03-2019

The Housing Boom and Selection into Entrepreneurship

João Alfredo Galindo da Fonseca and Pierluca Pannella

Cahier 03-2019

The Housing Boom and Selection into Entrepreneurship

João Alfredo Galindo da Fonseca and Pierluca Pannella

CIREQ, Université de Montréal
C.P. 6128, succursale Centre-ville
Montréal (Québec) H3C 3J7 Canada
☎ (514) 343-6557 / 🖷 (514) 343-7221
cireq@umontreal.ca
http://www.cireqmontreal.com
@CIREQMTL
https://www.facebook.com/CIREQ/

Ce cahier a également été publié par le Département de sciences économiques de l'Université de Montréal sous le numéro (2019-03).

This working paper was also published by the Department of Economics of the University of Montreal under number (2019-03).

Dépôt légal - Bibliothèque nationale du Canada, 2019, ISSN 0821-4441
Dépôt légal - Bibliothèque et Archives nationales du Québec, 2019
ISBN-13 : 978-2-89382-743-8

The Housing Boom and Selection into Entrepreneurship

João Alfredo Galindo da Fonseca* Pierluca Pannella†

May 2, 2019

Abstract

We provide evidence that the boom in housing prices occurred in the early 2000 distorted the selection of individuals that opened a business. A simple model of collateral financing predicts an increase in entry into entrepreneurship for house-owners and, particularly, for individuals with lower entrepreneurial ability and higher probability of failure. We support the predictions of the model using panel data at the individual level including restricted access information on the MSA of residence of an individual. We combine this data with geographic information about house prices at the MSA level. We confirm that the increase in house prices had a larger impact on the decision of becoming an entrepreneur for lower ability house-owners.

*University of Montreal and CIREQ, Email : ja.galindo.da.fonseca@gmail.com

†Sao Paulo School of Economics - FGV, Email : pierluca.pannella@fgv.br

1 Introduction

How did the housing price boom impact the selection of individuals into entrepreneurship? There exists a large literature on the importance of credit constraints at the household level for the creation of new firms (Evans and Jovanovic (1989), Holtz-Eakin et al. (1994), Quadrini (2000), Gentry and Hubbard (2004), Cagetti et al. (2006)). Furthermore, we know that young firms are important for job creation (Haltiwanger et al. (2013)). However, despite this literature, little is known about how the selection of individuals into entrepreneurship changes once we relax credit constraints and how it affects firm outcomes. The answer to this question is crucial for our understanding of the impact of the collateral channel on job creation. In this paper, we fill in this gap by investigating whether the housing price boom in the US during the early 2000 had a differential impact on the entry into entrepreneurship among individuals of different ability.

Our main finding is that the increase in house prices relatively favored the entry of individuals with lower ability. We show that this result can be easily rationalized in a simple model of collateral financing. An increase in the collateral value is more beneficial for those entrepreneurs that have a higher probability of failure. The delinquency probability is higher for these individuals: for this reason, the possibility of seizing their collateral and the value of it is more relevant. To support our predictions, we provide evidence at both the city level and the individual level, exploiting the variation in house prices across years and cities.

We start our investigation by looking at how the housing price boom of the 2000s affected firm and job creation and the survival of the new firms created. We follow Mian and Sufi (2011) and Adelino et al. (2015) in using the land supply elasticity measures constructed by Saiz (2010) as an instrument for the house price growth for the 2002-2007 period. Consistent with previous literature (Adelino et al. (2015), Schmalz et al. (2017)) we find that the house price boom induced the creation of more firms and jobs. However, we also find that the housing price boom is associated to a larger exit rate among the new generation of startups.

We investigate the economic mechanism behind these facts by using a tractable model of entrepreneurial financing. In our model, entrepreneurs are heterogeneous in their ability which translates in heterogeneity in their firm survival probability. All entrepreneurs require financing to start a firm. The representative banking sector decides to lend or not to an entrepreneur based on the expected repayment, which depends on the survival of the firm, and on what it can confiscate from the entrepreneur in case of failure. Individuals can either be house owners or renters. House owners can offer their housing stock in the case of failure of their firm. The Bank is assumed to always have the outside option of investing in a safe asset with return r_t. In equilibrium, the Bank charges different interest rate payments from different entrepreneurs so as to always be indifferent between lending to an entrepreneur and investing in the safe asset. Since renters are unable to offer a compensation for the Bank in the eventuality of their firm failing, they face a higher interest rate payment on average relative to home owners. Individuals make their decision to enter or not entrepreneurship by taking into account their individual-specific outside option, entrepreneurial ability and interest rate they would have to pay to the Bank.

We then consider an increase in house prices. The shock increases the housing stock available to home owners. As a result, they can pledge a higher amount to the Bank in case of failure. The result is a decrease in the average interest payment required by the Bank for home owners. This implies an increase in the entry rate into entrepreneurship among home owners. More specifically, the model predicts this effect is differentially stronger for low ability home owners, since these are facing a higher probability of failure.

Next, we proceed to testing these implications of the model in the data. We use publicly available data from the Panel Study of Income Dynamics (PSID) and restricted access information on the Metropolitan Statistical Area of residence of an individual. Our main testable implication is that house prices increases should differentially favour low ability home owners. Following Chaney et al. (2012), Adelino et al. (2015) and Himmelberg et al. (2005) we use the interaction of land supply elasticities by MSA (constructed in Saiz (2010)) interacted with long term interest rates as our instrument for house price growth in a particular MSA.

We start by verifying that home owners respond to MSA house price increases in their decision to open a firm while renters do not. These results are consistent with the finding of Schmalz et al. (2017). The key difference is that Schmalz et al. (2017) use house price increases interacted with home ownership status without the use of any instrument. Here, on the other hand, we consider separate specifications for each group and have an instrument for house prices. This implies Schmalz et al. (2017) require an assumption that the differences between home owners and renters in the absence of house price increases are fixed over time.[1]

In order to test our key implication, we construct a measure of entrepreneurial ability. We proceed to using the residual individual fixed effect component of a standard wage regression as our measure of worker ability. We then show that this is correlated to exit out of entrepreneurship, indicating that worker ability is positively correlated to entrepreneurial ability. To further investigate what our ability measure is capturing we also verify it is correlated to non-cognitive skills. Finally, making use of our instruments for

[1]The availability of an instrument for us is due to our use of American data for which housing supply elasticities have been constructed. This is in contrast to Schmalz et al. (2017) that use French data.

house price growth and this measure of ability, we verify that the positive effect of house price growth for entry into entrepreneurship is higher for low ability home owners. Our results are consistent with the housing boom inducing a rise in the exit rate among startups via a worsening of the selection of individuals into entrepreneurship.

A related paper to ours is Davis and Haltiwanger (2019). They key difference is that while Davis and Haltiwanger (2019) studies the effect of house price increases on young firm outcomes we investigate their implications for the selection of individuals into entrepreneurship. In fact, this the first paper to investigate the implications of the collateral channel for the selection of individuals into entrepreneurship.

One concern is that our results might be driven by the housing price boom inducing higher demand in the non-tradeable sector. This could induce higher entry into entrepreneurship among low ability individuals if these tend to operate firms in the non-tradeable sector. We verify this is not the case by excluding non-tradeable industries from all our main specifications.

Finally, we might worry that our measure of ability is actually capturing wealth of an individual. If this is the case, those we call of low ability are actually individuals of low wealth. Then house prices would have a stronger effect on these individuals not because of our main mechanism but rather because they are less wealthy before the housing boom. To guarantee our results are robust to this criticism, we show that our main specification continues to hold once we control for either housing wealth.

The remainder of the paper is organized as follows, Section 2 describes the data being used. Section 3 proceeds to our city level analysis describing our instrument. Section 4 presents the model. Section 5 discusses our measure of ability and our instrumental variable strategy. Section 6 presents our results for the individual level entrepreneur regressions. Section 7 concludes.

2 Data Description

We make use of different data sources to proceed to our analysis. In the next section, we use number of firms and number of jobs by firm age and category from the Business Dynamics Statistics (BDS). Then, we use data on the House Price Index by MSA from the Federal Housing Finance Agency and Housing Supply Elasticities by MSA constructed by Saiz as our instrument for house price growth.

For our individual level analysis, we combine the publicly available variables of the Panel Study of Income Dynamics (PSID) with restricted access information on the MSA of residence of individuals across time. We also use the Housing Supply Elasticities by MSA constructed by Albert Saiz and the 30 year fixed mortgage rate available at the Federal Reserve St. Louis website to construct our instrument. We restrict our attention to individuals 16 to 65 years old. We include both men and women.

In our individual level analysis we consider separate specifications for home owners and renters. Home ownership is assigned based on the ownership of the individual in the beginning of the housing boom (year 2001). In our sample 64% of individuals are home owners in 2001.[2] Among all individuals that are not entrepreneurs in the previous period, 5% enter entrepreneurship.

3 Empirical Patterns for Firms

In this section we analyze how house price increases affected the survival of startups. The strategy used here is to compare outcomes of startups in cities with different housing price increases. Our geographical measure of cities will be MSAs. From hereafter, the terms cities and MSAs will be used interchangeably.

Let $y_{c,j}$ represent outcome j for startups at the city c in year 2006. Let $\Delta HPI_c^{2002-2006}$ represent the growth in house prices of city c from 2002 to 2006. Then, ideally we would like to estimate for each outcome j of interest an equation of the type

$$y_{c,j} = \gamma_{0,j} + \gamma_{1,j} \Delta HPI_c^{2002-2006} + \epsilon_{c,j} \tag{1}$$

where $\epsilon_{c,j}$ are innovations to $y_{c,j}$ such as city specific productivity or demand shocks.

However, city specific shocks that increase the entry of more firms in all sectors should have an impact on house price increases. As a result, we suspect that

$$CORR(\Delta HPI_c^{2002-2006}, \epsilon_{c,j}) > 0. \tag{2}$$

This implies that Equation 1 suffers from an endogeneity problem. To resolve this issue we turn to an instrument for ΔHPI_c. The instrument is similar to that used by Mian and Sufi (2011) and Adelino et al. (2015). It is given by the housing supply elasticities e_c of each city.[3]The intuition is that for a same increase in housing demand, if the supply of land

[2]This is close to Adelino et al. (2015), who find that 71% of individuals are home owners in their sample.

[3]These elasticities were constructed in Saiz (2010) and are generously provided by the author in his website.

is very inelastic most of this shock will translate to higher house prices. On the other hand, if the supply of land is very elastic most of the increased demand for housing is translated into new housing construction instead of price increases. To summarize our instrument IV_c can be expressed by

$$IV_c = e_c. \tag{3}$$

The validity of this instrument is guaranteed as long as

$$CORR(e_c, \epsilon_{c,j}) = 0 \tag{4}$$

In other words for validity of the instrument we need that

1. Cities are small enough so that they cannot influence prices at the national level.
2. City specific demand or productivity shocks are uncorrelated to their land supply elasticity.

Now that we have established our identification strategy, we turn to the differences in outcomes of startups in cities that experienced different house price increases. Let $log(\#\text{ startups})^{2006}$ be the number of startups in city c in 2006 and $log(\text{jobs by startups})^{2006}$ be the total employment accounted for by startups in city c in 2006 then our first two specifications are

$$log(\#\text{ startups})^{2006} = \gamma_{0,1} + \gamma_{1,1}\Delta HPI_c^{2002-2006} + \epsilon_{c,1} \tag{5}$$

and

$$log(\text{jobs by startups})^{2006} = \gamma_{0,2} + \gamma_{1,2}\Delta HPI_c^{2002-2006} + \epsilon_{c,2} \tag{6}$$

where $\Delta HPI_c^{2002-2006}$ is instrumented by IV_c.

The results from these regressions tell us whether or not there has been an increase of importance of startups in cities with higher price increases. The idea is that if individuals can use houses as a collateral to obtain credit to start a firm, we expect to find a positive relationship between house price increases and the share of young firms that are young as well as the amount of jobs created by them.

However, even if there are more startups in cities with higher house prices this does not inform us whether or not these startups are in anyway different than startups in cities that experienced no house price increases. To get a sense if the composition of startups has changed, our next specifications consider as outcome variable the exit rate of young firms in city c in 2006. The idea is to check the exit rate in 2006 of firms that were started during the housing boom. We first consider firms that were born in 2004 and their exit in 2006.[4] The exit rate in 2006 of firms born in 2004 in city c is denoted by $ER^{2006}_{c,2004}$. Since we are interested in the effect of the housing boom on the composition of startups. We consider only the housing price growth prior to the birth of the firms in question. Our estimating equation in this case is

$$ER^{2006}_{c,2004} = \gamma_{0,3} + \gamma_{1,3}\Delta HPI^{2002-2004}_{c} + \epsilon_{c,3}. \quad (7)$$

where $\Delta HPI^{2002-2004}$ is the change in house prices from 2002 to 2004. $\Delta HPI^{2002-2004}_{c}$ is instrumented by IV_c. We also consider firms that were born in 2003 and their exit in 2006. The exit rate in 2006 of firms born in 2003 in city c is denoted by $ER^{2006}_{c,2003}$. [5] Our estimating equation in this case is

$$ER^{2006}_{c,2003} = \gamma_{0,4} + \gamma_{1,4}\Delta HPI^{2002-2003}_{c} + \epsilon_{c,4}. \quad (8)$$

where $\Delta HPI^{2002-2003}_{c}$ is the change in house prices from 2002 to 2003. $\Delta HPI^{2002-2003}_{c}$ is instrumented by IV_c. The intuition for this specification is that we are interested in whether the housing price increases prior to the birth of a firm can affect the quality of these firms and then affect their subsequent exit probability.

Finally, we might be concerned that there are already differences across cities in the levels of exit rates of firms. If this is the case we might be worried that these differences in levels are correlated to their land supply elasticities. To verify our results are robust to this concern, we modify our dependant variable and look at the difference in exit rate in 2006 in city c to the corresponding exit rate in 2002 in city c. The intuition is that by looking at the change in exit rates in city c from 2002 to 2006 we are taking out city specific level differences in exit rates. Hence, for the exit rate in 2006 of firms born in 2004 we can define $\Delta ER^{2006}_{c,2004} = ER^{2006}_{c,2004} - ER^{2002}_{c,2000}$. Similarly, for the exit rate in 2006 of firms born in 2003 we can define $\Delta ER^{2006}_{c,2003} = ER^{2006}_{c,2003} - ER^{2002}_{c,1999}$. Our estimating equations in this case become

$$\Delta ER^{2006}_{c,2004} = \gamma_{0,4} + \gamma_{1,4}\Delta HPI^{2002-2004}_{c} + \epsilon_{c,4}. \quad (9)$$

[4]This is a two year frequency exit rate. In other words, the exit rate is calculated using the number of firms born in 2004 that by 2006 no longer existed.

[5]This is a three year frequency exit rate. In other words, the exit rate is calculated using the number of firms born in 2003 that by 2006 no longer existed.

Similarly, if we consider the effect of housing price growth preceding the birth of firms in 2003 on their corresponding exit probability we arrive at

$$\Delta ER^{2006}_{c,2003} = \gamma_{0,5} + \gamma_{1,5}\Delta HPI^{2002-2003}_{c} + \epsilon_{c,5}. \tag{10}$$

where $\Delta HPI^{2002-2004}_{c}$ and $\Delta HPI^{2002-2003}_{c}$ are instrumented by IV_c.

3.1 Results

In this section we go over the main results for our city-level regressions concerning the differences in startups across cities that experienced different house price growth. The analysis in this section makes use of the Business Dynamics Statistics. These moments are calculated from the universe of employers firms in the US.

Column 1 of Table 1 show the results of our first specification in which the outcome of interest is the total number of startups. The results indicate that a 1% increase in city level house prices is associated to a 6.44% increase in the number of startups. Column 2 of Table 1 show the results of our second specification in which the outcome of interest is the total number of jobs created by startups. The results indicate that a 1% increase in city level house prices is associated to a 6.30% increase in the number of jobs by startups.

Table 1: IV regressions of number of startups and jobs by startups on house price growth

Dependant Variable	$log(\#\text{ startups})^{2006}$	$log(\text{jobs by startups})^{2006}$
$\Delta HPI^{2002-2006}_{c}$	6.44^{***}	6.30^{***}
	(0.91)	(0.93)
p-value of 1st Stage	0.00	0.00
Observations	205	205

Notes: Notes: Regressions of total number of startups and total number of jobs created by startups in a MSA on the house price growth in that MSA. House price growth is instrumented by the elasticity of land supply of a given MSA. All standard errors are clustered at the MSA level. $\Delta HPI^{2002-2006}_{c}$ is the price growth in MSA c from 2002-2006. * represents 10% significance, ** represents 5% significance and *** represents 1% significance. Standard errors are clustered at the MSA level.

Next, we verify whether house prices had an impact on the survival rate of new firms. We verify this channel by considering how the exit rate of firms are affected by the housing price growth prior to the birth of these firms. Column 1 of Table 2 shows that firms born in 2004 were more likely to exit in 2006 in cities with higher housing price growth from 2002 to 2004. Given the average housing price growth of 12.28% during that period, the results indicate that on average exit rates increased by 10%.[6] Column 2 of Table 2 shows that results are similar once we look at firms born in 2003. In particular, given an average housing price growth of 5.14% for the 2002 to 2003 period, the results indicate that on average exit rates increased by 17%. It is important to note that our analysis only focuses on the years in which house prices were increasing and well before the burst of the financial crisis. Therefore, the increase in exit rates cannot be interpreted as the result of a collapse in house prices.

The results indicate that the composition of new firms may have played a role in this positive and significant effect on the exit probability of startups. In the next section of the paper we propose a tractable model to think about the effect of firms' composition and show how we test it further in the data.

Finally, we might be worried that our results are being driven by city-specific level differences in exit rates that are correlated to land supply elasticities. We verify our results are robust to this concern by considering changes in exit rates. In particular we look at the difference in exit rate in 2006 in city c to the corresponding exit rate in 2002 in city c. The intuition is that by looking at the change in exit rates from 2006 to 2002 in city c we are taking out city specific level differences in exit rates. Hence, we can define $\Delta ER^{2006}_{c,2004} = ER^{2006}_{c,2004} - ER^{2002}_{c,2000}$ and $\Delta ER^{2006}_{c,2003} = ER^{2006}_{c,2003} - ER^{2002}_{c,1999}$. Column 1 and 2 of Table 3 show our results are unchanged in both magnitude and significance.

Taken together, the results in this section point to an increase in the number of startups, number of jobs created by startups and a change in the composition of startups following the housing boom. In particular, cities with larger house price increases exhibited higher exit among startups born after these price increases. Importantly, these outcomes appeared 2 years before the burst of the financial crisis. This evidence is consistent with a change in the quality of startups during the housing boom. To further investigate this channel, we proceed by building a tractable model of selection into entrepreneurship that can deliver us testable predictions.

[6]Given the average housing price growth of 12.28% and our estimate of 0.302, on average the exit rate increased by 3.7 percentage points. For a benchmark exit rate of 37% this represents a 10% increase in the exit rate.

Table 2: IV regressions for exit rate of startups

Dependant Variable	$ER^{2006}_{c,2004}$	$ER^{2006}_{c,2003}$
$\Delta HPI^{2002-2004}_{c}$	0.302^{**}	-
	(0.131)	
$\Delta HPI^{2002-2003}_{c}$	-	1.535^{**}
		(0.621)
p-value of 1st Stage	0.00	0.00
Observations	205	205

Notes: Regressions of exit rate by startups in a MSA on the house price growth in that MSA prior to birth of the firms. House price growth is instrumented by the elasticity of land supply of a given MSA. All standard errors are clustered at the MSA level. $\Delta HPI^{2002-2004}_{c}$ is the price growth in MSA c from 2002-2004. $\Delta HPI^{2002-2003}_{c}$ is the price growth in MSA c from 2002-2003.* represents 10% significance, ** represents 5% significance and *** represents 1% significance. Standard errors are clustered at the MSA level.

Table 3: IV regressions for exit rate of startups

Dependant Variable	$\Delta ER^{2006}_{c,2004}$	$\Delta ER^{2006}_{c,2003}$
$\Delta HPI^{2002-2004}_c$	1.304^{**}	-
	(0.649)	
$\Delta HPI^{2002-2003}_c$	-	4.640^{**}
		(2.195)
p-value of 1st Stage	0.00	0.00
Observations	205	205

Notes: Regressions of exit rate by startups in a MSA on the house price growth in that MSA prior to birth of the firms. House price growth is instrumented by the elasticity of land supply of a given MSA. All standard errors are clustered at the MSA level. $\Delta HPI^{2002-2004}_c$ is the price growth in MSA c from 2002-2004. $\Delta HPI^{2002-2003}_c$ is the price growth in MSA c from 2002-2003.* represents 10% significance, ** represents 5% significance and *** represents 1% significance. Standard errors are clustered at the MSA level.

4 Model

In this section we present a model of selection into entrepreneurship with a housing collateral channel. In the economy there are several individuals i located in several cities c at time t. Each individual makes a binary decision between being a worker and opening a firm. In the first case, the individual earns w_i. In the second case, the individual needs to raise one unit of external funding in order to invest into his entrepreneurial project. In each city, a subset S_c of individuals is endowed with housing wealth $H_{c,t}$.[7] Individuals without housing wealth are called renters or non-owners. House-owners obtain no utility from owning the house.[8] However, housing can be used by the entrepreneur as a collateral

[7]Since in our empirical investigation we will only use house price variations across cities and time, we do not include heterogeneity in housing wealth among house-owners of a specific city c.

[8]However, the qualitative results of this section are unchanged when owning a house produces a fixed utility u.

to secure his borrowing. In accordance with the instrumental strategy that we will implement in the next sections, housing wealth is a function of a city-specific elasticity of land supply e_c and of the economy-wide interest rate r_t:

$$H_{c,t} = H\left(e_c, r_t\right) \, with \, H_r\left(e_c, r_t\right) < 0 \, and \, H_{er}\left(e_c, r_t\right) > 0.$$

Housing wealth decreases in the interest rate and the effect is amplified in cities with low elasticity of land supply.

The expected profits from opening the firm depend on a uniform final return R, on an individual-specific probability of success p_i, and on an interest rate $r_{i,t}$ that the entrepreneur must pay:

$$\pi_i = p_i\left(R - r_{i,t}\right). \tag{11}$$

Therefore, an individual i chooses to create a firm if

$$p_i\left(R - r_{i,t}\right) > w_i. \tag{12}$$

A necessary condition for an individual i choosing to enter is that $r_t + w_i < R$, given that it must be $0 \leq p_i \leq 1$. While w_i represents the working ability, p_i is a measure of entrepreneurial ability. In this section the wage and the working ability of the individual are interchangable concepts. In the next section, we will analyze how to link the two concepts in the data and we will discuss the relation between working and entrepreneurial ability.

A risk-neutral financial sector provides external funding at an exogenous risk-free interest rate r_t. Entrepreneurs with no housing wealth have limited liability: they repay back the loan only if the project succeeds. The financial sector must be indifferent between the interest rate r_t and each expected return from lending to entrepreneurs. This implies the following equilibrium condition:

$$p_i r_{i,t} = r_t \; \forall i, c \mid i \notin S_c\,. \tag{13}$$

When lending to house-owners, the external investors can partially recollect their investment by seizing a fraction ϕ of the housing wealth in case of failure. Therefore, the equilibrium interest rate, $r_{i,t}$, faced by an entrepreneur with housing wealth must be such that

$$p_i r_{i,t} + \left(1 - p_i\right)\phi H_{c,t} = r_t \; \forall i, c \mid i \in S_c\,. \tag{14}$$

The presence of housing wealth, reduces the interest rate, $r_{i,t}$, that the entrepreneur must pay in case of success. This is a source of distortion in the selection of entrepreneurs. By combining Equations (12), and (13) with (14), we obtain the equilibrium entry condition for renters and owners:

$$p_i R - r_t - w_i \geq 0 \; \forall i, c \mid i \notin S_c \tag{15}$$

$$p_i R - r_t - w_i + (1 - p_i)\, \phi H_{c,t} \geq 0 \; \forall i, c \mid i \in S_c \,. \tag{16}$$

Equations (15) and (16) describe the different behavior of the two classes of individuals. Throughout the paper, we will keep the assumption that $R > \phi H_{c,t}$, $\forall c, t$.[9] The exogenous shock we consider in the model is a reduction in r_t. A lower interest rate induces a positive effect on the decision of opening a firm for both owners and non-owners. However, the relative increase in housing wealth is present only for house-owners. In particular, the positive effect of a higher $H_{c,t}$ is stronger for individuals with lower entrepreneurial ability. These individuals have a higher probability of failure. Therefore, an increase in housing prices has a larger impact on reducing their specific interest rate $r_{i,t}$ and their incentive to become entrepreneurs.

In order to get more insights about the change in entry decision after an increase in $H_{c,t}$, let us analyze the entry threshold for house-owners. From Equation (16), a house-owner opens a firm if

$$p_i \geq \frac{r_t + w_i - \phi H_{c,t}}{R - \phi H_{c,t}} = \underline{p}\left(r_t, H_{c,t}, w_i\right). \tag{17}$$

An increase in $H_{c,t}$ would reduce the right-hand side and relax the entry condition. The aggregate increase in entry is in line with the empirical results from the previous section and existing literature on the role of the collateral channel.

The average characteristics of the additional individuals that will enter depend on the relation between w_i and p_i. On one hand, the possibility of pledging a higher valuable house may encourage individuals with a marginally higher outside option w_i. On the other hand, individuals with lower entrepreneurial ability p_i may also obtain the possibility to enter. The two variables are likely correlated: high ability workers are also likely to be better entrepreneurs. A housing boom may improve the selection of entrepreneurs if the variation in outside options dominates the one in entrepreneurial ability. On the contrary, a higher $H_{c,t}$ worsens the selection of entrepreneurs when variations in p_i are larger with respect to w_i.

For a given w_i, the increase in $H_{c,t}$ clearly reduces the threshold ability of house-owners to open a firm. Importantly, our model predicts that this effect is relatively amplified for lower ability individuals. To fully comprehend this aspect, let us consider a situation in which the collateral of the entrepreneur could be seized in both good and bad

[9] If this was not the case, we would get a corner solution in which all individuals would enter.

states. In this environment, the equilibrium condition for the house-owner would be

$$p_i R - r_t - w_i + \phi H_{c,t} \geq 0 \; \forall i, c \mid i \in S_c \; . \tag{18}$$

A housing boom would benefit the house-owners and encourage the entry into entrepreneurship. This effect would be homogeneous across individuals, although it would only change the decision of those individuals that were not entrepreneurs but were close to the threshold before the boom.

However, in a mortgage loan contract the collateral is seized only in the bad state. This aspect distorts the selection of entrepreneurs. Specifically, the increase in house prices is more relevant for low ability individuals: this is because they face a higher probability of failure and they are more likely to repay their debt with their collateral. The relevance of this channel can easily be tested by studying the differential effect of a house price increase across different levels of ability. In our empirical analysis, we will show that this interacted effect is negative as predicted in 16.

5 Empirical Measurement and Testable Implications

In this section we describe how we will bring the theory to the data. Recall that our model delivered two separate testable implications. The first

$$Prob(\text{entry}|\text{renter}) = Prob(p_i R - r_t - w_i > 0) \tag{19}$$

tells us that entry into entrepreneurship of a renter is an increasing function of entrepreneurial ability p_i and a decreasing function of worker ability w_i. The second prediction

$$Prob(\text{entry}|\text{home owner}) = Prob(p_i R - r_t - w_i + \phi H_{c,t} - p_i \phi H_{c,t} > 0) \tag{20}$$

tells us that, besides entrepreneurial ability p_i and worker ability w_i, entry into entrepreneurship of a home owner also depends on the value of the housing stock in the economy. In particular, a higher housing stock increases the probability of entry into entrepreneurship for a home owner. Furthermore, this effect is stronger for lower entrepreneurial ability home owners.

To proceed to the analysis we need a measure of entrepreneurial ability, a proxy for p_i and a proxy for worker ability, w_i. To retrieve a measure of worker ability we will use the fact that wages contain information on worker ability. Measuring entrepreneurial ability, on the other hand, is more empirically challenging. Even with information on ex-post performance of a firm, we would be unable to calculate the ability of individuals that never entered entrepreneurship. Instead, our strategy is to rely on the correlation between worker and entrepreneurial ability. This allows us to proxy both entrepreneurial and worker ability by a same object. In the next subsection we show evidence that this proxy for entrepreneurial ability is correlated with lower exit rate from entrepreneurship. In the main results section we show that entry is increasing in our measure of entrepreneurial ability. Both of these checks reassure us that our proxy is capturing entrepreneurial ability. In what follows, we describe in detail our proceedure for identifying our proxy for both ability measures and the corresponding main specifications we test in the data.

5.1 Empirical Measurement of Ability

In our stylized model wages w_i and worker ability were interchangeable. However, in reality we recognize that observable characteristics $X_{i,t}$ (composed of dummies in industry, gender, year and quadratics in school and age) also affect log wages $w_{i,t}$ of an individual i at year t. From hereafter, $w_{i,t}$ denotes individual log wages and μ_i denotes unobserved worker ability. Let $\varepsilon_{i,t}$ be measurement error in $w_{i,t}$. Then the expression for log wages, $w_{i,t}$, is given by

$$w_{i,t} = X_{i,t}\beta + \mu_i + \varepsilon_{i,t} \tag{21}$$

The two separate testable implications now become

$$Prob(\text{entry}|\text{renter}) = Prob(p_i R - r_t - w_{i,t} > 0) \tag{22}$$

and

$$Prob(\text{entry}|\text{home owner}) = Prob(p_i R - r_t - w_{i,t} + \phi H_{c,t} - p_i \phi H_{c,t} > 0) \tag{23}$$

From this specification for $w_{i,t}$ we can interpret worker ability as the individual fixed component of wages of each individual. Next, we consider that worker and entrepreneurial ability are correlated[10]

$$p_i = \alpha \mu_i + \eta_i \quad \text{with} \quad E[\eta_i | X_{i,t}, \mu_i, H_{c,t}] = 0 \tag{24}$$

where α tells us how p_i changes for a change in μ_i and η_i is measurement error. Given this relationship, we can recover a proxy for entrepreneurial ability $\hat{\mu}_i$ by estimating Equation 21. To make sure we are not confounding the effect of the housing boom on wage deter-

[10]The particular case where both variables are uncorrelated is captured by $\alpha = 0$.

mination we use only years prior to 2000 to calculate μ_i.

However, if we want to use $\hat{\mu}_i$ in a estimation of entry probability on entrepreneurial ability we need to know whether α is positive or negative.[11] To verify the sign of this correlation we consider the relationship between the exit probability of an entrepreneur and our proxy for ability $\hat{\mu}_i$. In our model, entrepreneurial ability p_i is equal to $1 - Prob(\text{exit out of entrepreneurship})$. However, in reality we think that failure of a firm is a negative function of an individual ability component p_i and a luck component $\zeta_{i,t}$. Hence we have

$$Prob(\text{exit out of entrepreneurship})_{i,t} = Prob(\gamma_p p_i + \zeta_{i,t} > 0) \qquad (25)$$

where the negative relationship between ability p_i and the exit probability is captured by $\gamma_p < 0$.

Now once we replace p_i by its expression we get

$$Prob(\text{exit out of entrepreneurship})_{i,t} = Prob(\alpha\gamma_p\hat{\mu}_i + \gamma_p\eta_i + \zeta_{i,t} > 0) \qquad (26)$$

Note that the above equation 26 can be estimated via OLS due to our assumption that $E[\eta_i|X_{i,t}, \mu_i, H_{c,t}] = 0$. If $\alpha > 0$, then we should get a negative coefficient for $\hat{\mu}_i$. In other words, if worker and entrepreneurial ability are positively correlated, we should expect worker ability to be correlated to a lower exit rate out of entrepreneurship.

Column 1 of Table 4 shows that the exit rate out of entrepreneurship is negatively correlated to our proxy μ_i. The coefficient in Column 1 implies a drop in 13% in the probability of exit for a one standard deviation increase in our ability measure. Column 2, 3 and 4 show that these results are unchanged in both significance and magnitude once we include industry dummies, year dummies and a quadratic in age. Unfortunately, we run into small sample problem when considering these exit regressions. As such, these results are interpreted as correlations and conditional correlations between our measure of ability μ_i and exit out of entrepreneurship. We interpret this as evidence that entrepreneurial ability and worker ability are positive correlated.

[11] Otherwise, we would be unable to identify the direction of the effect of entrepreneurial ability p_i on entry.

Table 4: Probability of Exit as a function of ability $\hat{\mu}_i$

$\hat{\mu}_i$	-0.155^{**}	-0.172^{***}
	(0.067)	(0.061)
Industry dummies	No	Yes
Year dummies	No	Yes
Observations	756	735

Notes: Probit regressions of the exit rate out of entrepreneurship on our proxy for entrepreneurial ability μ_i. The proxy is obtained as the fixed effect component of individuals wages for all years prior to the years used in exit rate regressions. Standard errors are bootstrapped. * represents 10% significance, ** represents 5% significance and *** represents 1% significance. Standard errors are bootstrapped.

Another alternative to measure μ_i would be to have a direct measure of individual ability in the PSID. Indeed the PSID does offer cognitive test scores as well as self-reported characteristics often associated to non-cognitive skills (belief in control of own life, taste for challenges and motivation index). However, these variables are only available for early years of the PSID, which imposes data size limitations. [12] Nonetheless, we can use these measure to verify if they predict our constructed $\hat{\mu}_i$. This is a useful exercise both as a validation of our proxy for $\hat{\mu}_i$ and also to get a sense of what it represents. In Table 5 below we show that $\hat{\mu}_i$ is positively correlated to a high congitive test score, a belief that life is under one's control, a taste for challenges and a high motivation index. These results are consistent with $\hat{\mu}_i$ representing a combination of cognitive and non-cognitive skills.

[12] These measure are only available at latest for 1975. If we consider these measures make sense only for individuals that were at least 16 years old when they took them. This means these are individuals that will be at least 41 years old in 2000. This significantly decreases our sample which makes such analysis unfeasible.

Table 5: Ability $\hat{\mu}_i$ as a function of cognitive and non-cognitive measures

Locus of Control	0.136^{**}	-	-	-
	(0.062)	-		
Values challenge	-	0.137^{**}	-	-
	-	(0.059)		
Achievement-Motivation Index	-	-	0.022^{**}	-
	-	-	(0.010)	-
Fill phrase cognitive test	-	-	-	0.041^{***}
	-	-	-	(0.012)
Observations	822	737	755	755

Notes: Linear regressions of our ability measure as a function of cognitive and non cognitive measures available at the PSID. Locus of control is a dummy taking value 1 if the individual reports believing they have control over their own life. Values challenge is a dummy taking value 1 if the individual reports liking challenges in life. Achievement-Motivation Index is an index measuring if the individual is highely motivated/high achiever in life. Fill phrase cognitive test is a test score to a series of questions in which individuals are asked to fill the missing word in the phrase based on the phrase's context. Standard errors are bootstrapped.* represents 10% significance, ** represents 5% significance and *** represents 1% significance. Standard errors are bootstrapped.

5.2 Main Empirical Specifications

We now have a proxy for both worker and entrepreneurial ability given by $\hat{\mu}_i$. Next, consider that beyond the variables in our model, individuals face shocks that may push them to enter or not into entrepreneurship. These shocks could represent the effect of city specific productivity or demand shocks. Let these be denoted by $\upsilon_{c,t}$. Secondly, consider there is some measurement error in individual entry decisions in the data. We allow for the possibility for this measurement error to be drawn from different distributions for renters and home owners. We denote them by $\upsilon^h_{i,t}$ and $\upsilon^r_{j,t}$ for home owners and renters in period t respectively for individuals i and j. We recognize that entry into entrepreneurship might be a function of individual observable characteristics $X_{i,t}$. Finally, we consider that entry into entrepreneurship might be affected by a time invariant city characteristics, denoted by λ_c. Once we use the expression for p_i and our ability measure $\hat{\mu}_i$ the expressions for probability of entry among renters and home owners can be written respectively as

$$Prob(\text{entry}|\text{renter})_{i,t} = Prob(\beta^r_{\mu,H}\hat{\mu}_i \cdot H_{c,t} + \beta^r_H H_{c,t} + \beta^r_\mu \hat{\mu}_i - r_t + X_{i,t}\beta_r + \lambda_c + \nu^r_{i,t})$$

and

$$Prob(\text{entry}|\text{home owner})_{i,t} = Prob(\beta^h_{\mu,H}\hat{\mu}_i \cdot H_{c,t} + \beta^h_H H_{c,t} + \beta^h_\mu \hat{\mu}_i - r_t + X_{i,t}\beta_h + \lambda_c + \nu^h_{i,t}).$$

where $\beta^r_{\mu,H} = 0$, $\beta^r_H = 0$, $\beta^h_{\mu,H} < 0$, $\beta^h_H > 0$, since the housing price change should have no impact for renters and should have a stronger effect for lower ability home owners. Note that we have no prediction for sign of β^r_μ and β^h_μ. The reason being that these coefficient capture both the negative effect on entry of a higher outside option (via a higher worker ability) and the positive effect on entry of higher entrepreneurial ability. Hence, whether or not these coefficients are positive or negative depends on which of these two effects dominates for renters and home owners, respectively. Given the equations above, it follows our main empirical specifications are given by

$$\begin{aligned} Prob(\text{entry}|\text{renter}) = Prob(&\beta^r_{\mu,H}\hat{\mu}_i \cdot HPI_{c,t} + \beta^r_H HPI_{c,t} + \beta^r_\mu \hat{\mu}_i \\ &+ \mathbb{1}\{\text{year}\}^r_t + \mathbb{1}\{\text{city}\}^r_c + X_{i,t}\beta_r + \nu^r_{i,t}) \end{aligned} \quad (27)$$

and

$$\begin{aligned} Prob(\text{entry}|\text{home owner}) = Prob(&\beta^h_{\mu,H}\hat{\mu}_i \cdot HPI_{c,t} + \beta^h_H HPI_{c,t} + \beta^h_{\mu,h} \hat{\mu}_i \\ &+ \mathbb{1}\{\text{year}\}^h_t + \mathbb{1}\{\text{city}\}^h_c + X_{i,t}\beta_h + \nu^h_{i,t}) \end{aligned} \quad (28)$$

where $\mathbb{1}\{\text{year}\}$ are year dummies, $\mathbb{1}\{\text{city}\}$ are MSA dummies and $HPI_{c,t}$ is the house price index for MSA c in year t.

The error terms can be written as

$$\nu^r_{i,t} = -\beta^r_H \eta_i H_{c,t} + \upsilon^r_{i,t} + \upsilon_{c,t} \quad (29)$$

and

$$\nu^h_{i,t} = -\beta^h_H \eta_i H_{c,t} + \upsilon^h_{i,t} + \upsilon_{c,t} \quad (30)$$

Firstly, note that under our assumption of $E[\eta_i|X_{i,t}, \mu_i, H_{c,t}] = 0$, the terms $-\beta_H^h \eta_i$ and $-\beta_H^r \eta_i$ do not bias our results.[13] Hence, in absence of $\upsilon_{c,t}$ we could estimate the equations above using a probit specification. However, the presence of $\upsilon_{c,t}$ in the error term creates a correlation between the error terms $\nu_{i,t}^h$ and $\nu_{i,t}^r$ with the explanatory variable $H_{c,t}$. To address this issue we use an instrument for $HPI_{c,t}$. We follow the strategy used by Chaney et al. (2012), Adelino et al. (2015) and Himmelberg et al. (2005). In order to exploit variation across metropolitan statistical areas and years, we instrument the growth in house prices with land supply elasticity (e_c) interacted with the 30 year fixed mortgage rate (r_t). While a reduction in interest rate increases the price of houses, this effect is stronger for cities in which the supply of land is less elastic. It follows a house price growth should be increasing in $e_c \cdot r_t$. Let $IV_{2,c,t}$ denote our second instrument, then it can be written as

$$IV_{2,c,t} = e_c \cdot r_t. \tag{31}$$

Hence, our main testable predictions are given by Equations 27 and 28 where we instrument $HPI_{c,t}$ by $IV_{2,c,t}$ and we instrument $HPI_{c,t} \cdot \hat{\mu}_i$ by $IV_{2,c,t} \cdot \hat{\mu}_i$.

6 Results

In this section we will present the results related to our main specifications from the previous section. In our regressions we only consider the sample of individuals that are head of a family, that have an age between 16 and 65 and that are not business owners. Then, our main dependant variable is a dummy that identifies the creation of a business. We analyze the effect of the increase in house prices in 2003, 2005 and 2007 with respect to 2001.[14] In addition, we also want to analyze the effect of our ability measure and its interaction with the housing boom. All our results are reported for two groups of individuals: individuals that were house-owners in 2001 and individuals that were renters in 2001. Importantly, we want to prove that our housing price variables induce significant effects only for the group of house-owner.

In all the regressions, house price, at the metropolitan statistical level, is always instrumented with the index of land supply elaticity interacted with the 30 year fixed mortgage

[13] The proof of this claim can be found in Section A of the Appendix.

[14] Data are not available for the years 2002, 2004 and 2006.

rate[15]. We also include as controls a quadratic polynomial in age, a quadratic in totals years of education, dummies for gender, year, metropolitan stastical area and industries. We exclude from our analysis entries into enrepreneurship in the non-tradeable sector. This is done to reassure our results are not being driven by local demand effects. In particular, we want to exclude the non-tradable sector since the creation of business in this sector may be driven by an increase in aggregate demand.[16] In all our regressions, standard errors are clustered at the MSA level and bootstrapped.

In Table 6, we start presenting our results for regressions (28) and (29), excluding the interaction term between ability and house prices growth. In line with the findings by Schmalz, Sraer, and Thesmar (2017) for France, housing prices induce a positive effect on the entry into entrepreneurship only for individuals that were house-owners before the boom. This finding has already been interpreted as an evidence of the role of collateral financing. Our ability measure is insignificant for both renters and home owners. Recall that our ability measure captures both the negative effect on entry of higher wages (via larger worker ability) and the positive effect on entry of higher entrepreneurial ability. Hence, our theory has no prediction for the sign of this coefficient.

In Table 7, we report our results for the full specification. Columns 1 and 3 refer to the samples of house-owners and renters as presented in the previous paragraphs. House price growth still produces a significant positive effect on the probability that a house owner opens a business. As before, there is no significant effect for renters. The effect of ability is now positive for home owners. Through the lenses of our model, this result indicates that the positive effect on entry of higher entrepreneurial ability is larger than the negative one coming from higher wages (due to higher worker ability). Finally, our results confirm the predictions of our simple model also regarding the interaction between ability and house price growth. While the coefficient is not significant for renters, the result is negative and signifcant for house-owners. Those individuals that live in a city experiencing a larger boom have a higher probability of opening a firm. However, the effect is larger for individuals with lower ability. As we showed in Section 4, this outcome is a natural consequence of the collateral channel. An increase in housing wealth is more important for those individuals that have lower abilities because of the higher chance of failure.

[15] Just as Chaney et al. (2012) and Adelino et al. (2015), this serves as our measure of long term interest rate

[16] Adelino, Schoar, and Severino (2015) follow the same strategy to prove the importance of the collateral channel.

Table 6: Relationship between house ownership and entry

Sample considered	Home Owners	Renters
$HPI_{c,t}$	0.021^{**}	0.001
	(0.009)	(0.012)
$\hat{\mu}_i$	0.0296	0.1407
	(0.0611)	(0.1134)
Significance IV for $HPI_{c,t}$	Yes	Yes
Observations	$1,998$	$1,139$

Notes: Probit IV regressions of entry into entrepreneurship on ability ($\hat{\mu}_i$) and House price index in the city of residence of the individual ($HPI_{c,t}$). Other controls include dummies in MSA of residence of the individual, quadratic in age, quadratic in total years of schooling, dummies in industry, dummies in year and a dummy for gender. Regressions includes only housing boom years ($2001-2007$). Regressions are run separately for house owners and renters. Both regressions exclude entrepreneurship entry in the non-tradeable sector. House ownership status is based on house ownership status in 2001. * represents 10% significance, ** represents 5% significance and *** represents 1% significance. Standard errors are bootstrapped.

Table 7: Main specifications

Sample considered	Home Owners	Renters
$\hat{\mu}_i \cdot HPI_{c,t}$	-0.007^{**}	-0.005
	(0.003)	(0.006)
$\hat{\mu}_i$	1.199^{**}	1.128
	(0.548)	(1.066)
$HPI_{c,t}$	0.018^{*}	-0.002
	(0.010)	(0.013)
Significance IV for $HPI_{c,t}$	Yes	Yes
Significance IV for $\hat{\mu}_i \cdot HPI_{c,t}$	Yes	Yes
Observations	$1,998$	$1,319$

Notes: Probit IV regressions of entry into entrepreneurship on ability ($\hat{\mu}_i$), House price index in the city of residence of the individual ($HPI_{c,t}$) and the interaction of House price and ability ($\hat{\mu}_i \cdot HPI_{c,t}$). Other controls include dummies in MSA of residence of the individual, quadratic in age, quadratic in total years of schooling, dummies in industry, dummies in year and a dummy for gender. Regressions includes only housing boom years ($2001-2007$). Regressions are run separately for house owners and renters. House ownership status is based on house ownership status in 2001. Both regressions exclude entrepreneurship entry in the non-tradeable sector. * represents 10% significance, ** represents 5% significance and *** represents 1% significance. Standard errors are bootstrapped.

Finally, in Table 8, we show that our results are robust also when we control for the initial wealth of the individuals. In fact, one possible alternative hypothesis is that our ability measure is highly correlated with the wealth of the individuals. Then, we may interpret that the housing boom helped more those individuals that started with lower wealth. In Column 1 we control for the initial housing wealth of house-owners. In Column 2 we also include the interaction between initial housing wealth and house prices. Our main findings are validated also in these alternative specifications.

Previous empirical papers have proven the importance of the collateral financing on the decision of opening a business. Our analysis confirm the findings of these papers. In addition, we also highlight the distortions associated with this collateral channel. Specifically, a housing boom distorts the selection of individuals that open a business favoring people with lower ability. This is one of the possible factors behind the increase in firms' exit rates that started before the burst of the 2008 financial crises.

Table 8: Robustness : Controlling for initial wealth

$\hat{\mu}_i \cdot HPI_{c,t}$	-0.008^{**}	-0.007^{*}
	(0.004)	(0.004)
$\hat{\mu}_i$	1.331^{**}	1.166^{*}
	(0.588)	(0.616)
$HPI_{c,t}$	0.02^{*}	0.042
	(0.011)	(0.026)
Significance IV for $HPI_{c,t}$	Yes	Yes
Significance IV for $\hat{\mu}_i \cdot HPI_{c,t}$	Yes	Yes
Control for hw_{2001}	Yes	Yes
Control for hw_{2001} interacted with $HPI_{c,t}$	No	Yes
Observations	$1,835$	$1,835$

Notes: Probit IV regressions of entry into entrepreneurship on ability ($\hat{\mu}_i$), House price growth in the city of residence of the individual ($HPI_{c,t}$) and the interaction of House price growth and ability ($\hat{\mu}_i \cdot HPI_{c,t}$). hw_{2001} is 2001 level of real housing wealth. Other controls include dummies in MSA of residence of the individual, quadratic in age, quadratic in total years of schooling, dummies in industry, dummies in year and a dummy for gender. Regressions includes only housing boom years ($2001 - 2007$). Regressions are run only for house owners. Both regressions exclude entrepreneurship entry in the non-tradeable sector. House ownership status is based on house ownership status in 2001.* represents 10% significance, ** represents 5% significance and *** represents 1% significance. Standard errors are bootstrapped.

7 Conclusion

The role of financial frictions as a barrier to the opening of a business has been emphasized in both theoretical and empirical work. In particular, recent papers have revealed the positive effect of an increase in house prices on the creation of new firms. This has been widely interpreted as an evidence for the existence of a collateral channel. However, these papers have usually neglected the distorting effect that a change in the collateral value can produce on the selection of new entrepreneurs.

In this paper, we analyze the effect of the US housing boom of the early 2000 on the selection of individuals that entered entrepreneurship. In line with the existing evidence, we prove that house owners are positively affected by the change in prices in the decision of opening a firm. In order to explore how this effect differs across individuals, we measure abilities by computing the individual fixed effects of a wage regression. Therefore, we show that the positive incentive to create a firm was higher for individuals with lower ability.

This result can be easily explained in a model of collateral financing. An increase in the value of housing wealth is more important for individuals that have a lower probability of success. This is because these individuals face a higher probability of having to repay their debt with the collateral. Our analysis reveal one possible channel explaining the increase in exit rates that followed the boom in house prices.

References

Adelino, Manuel, Antoinette Schoar, and Felipe Severino, "House prices, collateral, and self-employment," *Journal of Financial Economics*, 2015, *117* (2), 288–306.

Cagetti, Marco, Mariacristina De Nardi et al., "Entrepreneurship, frictions, and wealth," *Journal of Political Economy*, 2006, *114* (5), 835–870.

Chaney, Thomas, David Sraer, and David Thesmar, "The collateral channel: How real estate shocks affect corporate investment," *American Economic Review*, 2012, *102* (6), 2381–2409.

Davis, Steven J and John C Haltiwanger, "Dynamism diminished: The role of housing markets and credit conditions," Technical Report, National Bureau of Economic Research 2019.

Evans, David S and Boyan Jovanovic, "An estimated model of entrepreneurial choice under liquidity constraints," *Journal of Political Economy*, 1989, pp. 808–827.

Gentry, William M and R Glenn Hubbard, "" Success Taxes," Entrepreneurial Entry, and Innovation," Technical Report, National Bureau of Economic Research 2004.

Haltiwanger, John, Ron S Jarmin, and Javier Miranda, "Who creates jobs? Small versus large versus young," *Review of Economics and Statistics*, 2013, *95* (2), 347–361.

Himmelberg, Charles, Christopher Mayer, and Todd Sinai, "Assessing high house prices: Bubbles, fundamentals and misperceptions," *Journal of Economic Perspectives*, 2005, *19* (4), 67–92.

Holtz-Eakin, Douglas, David Joulfaian, and Harvey S Rosen, "Sticking it Out: Entrepreneurial Survival and Liquidity Constraints," *Journal of Political Economy*, 1994, pp. 53–75.

Mian, Atif and Amir Sufi, "House prices, home equity-based borrowing, and the US household leverage crisis," *American Economic Review*, 2011, *101* (5), 2132–56.

Quadrini, Vincenzo, "Entrepreneurship, saving, and social mobility," *Review of Economic Dynamics*, 2000, *3* (1), 1–40.

Saiz, Albert, "The geographic determinants of housing supply," *The Quarterly Journal of Economics*, 2010, *125* (3), 1253–1296.

Schmalz, Martin C, David A Sraer, and David Thesmar, "Housing collateral and entrepreneurship," *The Journal of Finance*, 2017, *72* (1), 99–132.

A Proof

In this section we show that $E[\eta_i|H_{c,t}, \mu_i, X_{i,t}] = 0$ is a sufficient condition for the term $-\eta_i\beta_H H_{c,t}$ to not bias our results. To simplify the proof consider the case where $\upsilon_{c,t} = 0, \forall c, t$, so that the only potential source of bias is $-\eta_i\beta_H H_{c,t}$ in the error term. Let $y_{i,t}$ be a dummy taking value 1 if the individual enters entrepreneurship and zero otherwise. Then our main specifications for both renters and home owners can be written using the general form

$$y = F((X - \eta X)\beta) \tag{32}$$

where

$$y = \begin{bmatrix} y_1 \\ . \\ . \\ . \\ y_n \end{bmatrix}, \quad X = \begin{bmatrix} H_1 & H_1\mu_1 & \mu_1 & x_{1,1}... & x_{k,1} & \\ . & . & . & . & ... & . \\ . & . & . & . & ... & . \\ . & . & . & . & ... & . \\ H_n & H_n\mu_n & \mu_n & x_{1,n}... & x_{k,n} & \end{bmatrix} \tag{33}$$

$$\eta X = \begin{bmatrix} \eta_1 H_1 & 0 & ... & 0 \\ . & . & ... & . \\ . & . & ... & . \\ . & . & ... & . \\ \eta_n H_n & 0 & ... & 0 \end{bmatrix}, \quad \beta = \begin{bmatrix} \beta_H \\ \beta_{H,\mu} \\ \beta_\mu \\ \beta_{x_1} \\ . \\ . \\ . \\ \beta_{x_k} \end{bmatrix} \tag{34}$$

and $F(.)$ is the CDF of a Normal distribution for a Probit specification.

Now rewrite the regression equation as

$$F^{-1}(y) = (X - vX)\beta \tag{35}$$

where

$$F^{-1}(y) = \begin{bmatrix} F^{-1}(y_1) \\ . \\ . \\ . \\ F^{-1}(y_n) \end{bmatrix} \tag{36}$$

Then, the probit estimator without taking η into account is given by $(X'X)^{-1}X'F^{-1}(y)$.[17] It follows that

$$\hat{\beta}^{probit} = \beta - (X'X)^{-1}X'\eta X \tag{38}$$

Hence, we need $(X'X)^{-1}X'\eta X = 0$ to guarantee no bias in our estimator. After some algebra we can show

$$X'\eta X = \begin{bmatrix} E[\eta HH]N & 0 & ... & 0 \\ E[\eta HH\mu_i]N & 0 & ... & 0 \\ E[\eta H\mu_i]N & 0 & ... & 0 \\ E[\eta Hx_1]N & 0 & ... & 0 \\ . & . & ... & . \\ . & . & ... & . \\ . & . & ... & . \\ E[\eta Hx_k]N & 0 & ... & 0 \end{bmatrix} \tag{39}$$

Now if we impose $E[\eta|H\mu, x_1, ..., x_k] = 0$ we get

$$E[\eta HH] = E[E[\eta HH|H, \mu, x_1, ..., x_k] = E[HHE[\eta|H, \mu, x_1, ..., x_k]] = 0$$

$$E[\eta HH\mu] = E[E[\eta HH\mu|H, \mu, x_1, ..., x_k] = E[HH\mu E[\eta|H_i, \mu, x_1, ..., x_k]] = 0$$

$$E[\eta H\mu] = E[E[\eta H\mu|H, \mu, x_1, ..., x_k] = E[H\mu E[\eta|H, \mu, x_1, ..., x_k]] = 0$$

$$E[\eta Hx_j] = E[E[\eta Hx_j|H, \mu, x_1, ..., x_k] = E[Hx_jE[\eta|H_i, \mu, x_1, ..., x_k]] = 0 \quad \forall j \in \{1, .., k\}$$

which then implies

$$X'\eta X = \begin{bmatrix} 0 & 0 & ... & 0 \\ 0 & 0 & ... & 0 \\ 0 & 0 & ... & 0 \\ . & . & ... & . \\ . & . & ... & . \\ . & . & ... & . \\ 0 & 0 & ... & 0 \end{bmatrix} \tag{40}$$

[17]To see this note that if $\eta = 0$ then we would have

$$(X'X)^{-1}X'F^{-1}(y) = \beta \tag{37}$$

Hence, if

$$E[\eta|H, \mu, x_1, ...x_k] = 0 \tag{41}$$

then

$$(X'X)^{-1}X'\eta X = 0 \tag{42}$$

which implies

$$\hat{\beta}^{probit} = \beta \tag{43}$$

Récents cahiers de recherche du CIREQ
Recent CIREQ Working Papers

La liste complète des cahiers de recherche du CIREQ est disponible à l'adresse suivante : http://www.cireqmontreal.com/cahiers-de-recherche .

The complete list of CIREQ's working papers is available at the following address : http://www.cireqmontreal.com/cahiers-de-recherche .

14-2018 Godefroy, R., "The Birth of the Congressional Clinic", août 2018, 47 pages

15-2018 Godefroy, R., J. Lewis, "The Impact of Uncertainty in Agriculture", août 2018, 40 pages

16-2018 Horan, S., P. Manzini, M. Mariotti, "Precision May Harm : The Comparative Statics of Imprecise Judgement", août 2018, 32 pages

17-2018 Bouakez, H., O. Rachedi, E. Santoro, "Sectoral Heterogeneity, Production Networks, and the Effects of Government Spending", août 2018, 44 pages

18-2018 Benchekroun, H., M. Breton, A. Ray Chaudhuri, "Mergers in Nonrenewable Resource Oligopolies and Environmental Policies", septembre 2018, 40 pages

19-2018 Dudley, L., C. Rauh, "Innovation Growth Clusters : Lessons from the Industrial Revolution", août 2018, 32 pages

20-2018 Amodio, F., L. Baccini, M. DiMaio, "Security, Trade, and Political Violence", septembre 2018, 58 pages

21-2018 Sprumont, Y., "Belief-weighted Nash Aggregation of Savage Preferences", septembre 2018, 27 pages

22-2018 Andersson, T., L. Ehlers, A. Martinello, "Dynamic Refugee Matching", octobre 2018, 36 pages

23-2018 Dutta, R., "Gradual Pairwise Comparison and Stochastic Choice", novembre 2018, 46 pages

24-2018 Horan, S., "Threshold Luce Rules", novembre 2018, 35 pages

25-2018 Beauchêne, D., J. Li, M. Li, "Ambiguous Persuasion", octobre 2018, 74 pages

26-2018 Horan, S., "Random Consideration and Choice : A Case Study of "Default" Options", novembre 2018, 27 pages

27-2018 Marcoux, M., "Sharp Test for Equilibrium Uniqueness in Discrete Games with a Flexible Information Structure", décembre 2018, 38 pages

01-2019 Marcoux, M., "Games with Unobservable Heterogeneity and Multiple Equilibria : An Application to Mobile Telecommunications", février 2019, 45 pages

02-2019 Mueller, H. et C. Rauh, "The Hard Problem of Prediction for Conflict", avril 2019, 46 pages