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HOUSE PRICES, HOME EQUITY AND ENTREPRENEURSHIPS

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In 2013 all ECB publications feature a motif taken from the €5 banknote.

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Abstract

How does home ownership affect new business creation? We develop a model of career choice in the presence of liquidity constraints in which shocks to the value of real estate affect the propensity of potential entrepreneurs to borrow against the value of their property. Using a large US individual-level survey dataset over the 1996-2006 period, we show that a 10% increase in home equity raises the probability of transition into entrepreneurship by up to 14%. Our results persist when we use the topological elasticity of housing supply to generate variation in home equity that is orthogonal to entrepreneurial choice.

JEL classification: G21, L26
Keywords: Home ownership, collateral channel, entrepreneurship

1 Non-technical Summary

What is the effect of homeownership on entrepreneurship? While both researchers and policy-makers have debated intensely the determinants of new business creation, the effect of housing has been almost entirely neglected. This paper presents the first systematic attempt to incorporate the dynamics of homeownership and of house prices in a model of entrepreneurial choice. We then test the implications of the model using household level data on property values, housing leverage, and labor choices. In theory, housing can affect entrepreneurship through several channels. The first is related to liquidity constraints. A number of influential papers have argued that would-be entrepreneurs may be discouraged from switching into entrepreneurship if low levels of own wealth and/or borrowing constraints prevent them from raising sufficient capital (Evans and Jovanovic, 1989; Evans and Leighton, 1989; Holtz-Eakin, Joulfain, and Rosen, 1994; Blanchflower and Oswald, 1998; Paulson and Townsend, 2004). Increasing home equity may alleviate such liquidity constraints by enabling would-be entrepreneurs to borrow against the value of their property. Alternatively, declining home equity can effectively raise households' borrowing constraints and depress entrepreneurship. These are important consideration given that one's home is the main asset for most Americans and that residential property represent 60% of all personal wealth in the US (US Census 2010). The second channel is related to entrepreneurship having a luxury good component. Hurst and Lusardi (2004) show that personal wealth affects entrepreneurial choice only for the richest households, implying that liquidity constraints do not matter a lot for entrepreneurship. Instead, as households become wealthier, they are more likely to purchase the benefits associated with owning a business, like prestige, power over decision-making, a flexible time schedule, etc. If this is the case, then more households will be more likely to switch to self-employment during housing booms when personal wealth is increasing. We motivate our empirical analysis with a simple but novel model of career choice. The novelty is the collateral channel of homeownership. In our model, agents start out as fixed-wage workers and can choose to become entrepreneurs in each following period.

Their value function in each period depends on own wealth (as in Quadrini, 2000; Caggetti and De Nardi, 2006; and Bruera, 2009), but also on housing prices through two channels. The first one is that the current level of housing prices affects the equity value they can extract from their home. The housing stock has a collateral value component, beyond the value derived from the direct consumption of housing services, due to prospects of limits on the amount of borrowing. The second channel is predictability in housing returns. We follow Corradin, Fillat, and Vergara (2012) assuming that the housing market can be in a "hot" regime (when house prices are expected to keep increasing) or in a "cold" regime (when house prices are expected to stay flat). The key implications of the model are threefold. First, higher home equity induces households to transition from fixed income to entrepreneurship through the collateral channel. Second, for high enough values of home equity, agents switch into entrepreneurship with less equity in a period of high house price appreciation because expected future rises in the housing prices increase the equity they can extract from their home allowing them to finance the capital investment necessary to start a business. Third, once agents become entrepreneurs, they extract the full amount of equity from their home in order to finance their business. The model thus predicts a positive correlation between current home equity and future transition into entrepreneurship, and a positive correlation between past home equity and current (especially mortgage) debt for new entrepreneurs. We test our model using microdata on housing and business ownership from the Survey of Income and Program Participation (SIPP) of the US Census Bureau from 1997 to 2006. In every survey year, the respondents are asked about whether they run and/or operate a business, about the value of their business equity, and about the value of their house and the size of the mortgage (if any). The survey also contains household-level data on a variety of relevant household characteristics, like the household's liquid wealth and labor income and the head's age, race, education, and marital status. We use information on $44,141$ unique households that were interviewed during the years $1996-2000$, $2001-2003$, and $2004-2006$, for a total of $108,970$ possible observations. We find that the probability

of switching into entrepreneurship is strongly positively correlated with the value of the home equity. A 10% increase in home equity increases the probability that a non-business owning household will switch to entrepreneurship in the future by up to 14%. This effect is statistically significant regardless of whether we define business ownership in terms of owning and operating a business, in terms of holding non-zero business equity, or in terms of either. We also find that when agents expect the value of their property to increase in the future, they switch to entrepreneurship at lower current levels of home equity. Finally, we find a strong positive correlation between home equity and the change in (especially mortgage) debt for new entrepreneurs, implying that new business owners draw down their home equity in order to finance their business investment. In order to distinguish the effect of housing through the collateral channel from its effect through the wealth channel, we control for property values. While we find evidence of the "luxury good" component of entrepreneurship, our main results remain unchanged. Finally, we account for the fact that both entrepreneurial activity and homeownership may be driven by an unobservable component, like the household's degree of risk aversion. To that end, we use changes in average state-level and national house prices, interacted with the local topological elasticity of housing supply from Saiz (2010). Our results remain robust to this alternative empirical approach. Our reduced form estimates imply potentially important linkages between housing and real economic activity. For example, our results imply that the housing boom before the Great Recession may have driven up the rates of new business creation, while high levels of mortgage debt after 2006 may have depressed self-employment, denting the positive effect on new business creation of higher unemployment rates. Because such analysis ignores the effect of housing market shocks on asset prices, quantifying the effect of housing on entrepreneurship would require a general equilibrium model of financial, real estate, and asset markets. Our estimates should serve to inform such an analysis.

2 Introduction

The US housing boom of the 2000s and the subsequent deep recession revived the interest of both academics and policy makers in the real economic consequences of home ownership. One theme that has so far been left neglected is the link between housing and entrepreneurship. In this paper, we present the first systematic attempt to incorporate the dynamics of homeownership and of house prices in a model of entrepreneurial choice. We then test the implications of the model using household level data on property values, home equity, and labor market choices. As an illustration of our results, Figure 1 plots the change in establishments births between 2003 and 2006 (the peak of the housing boom) against the change in the state-level Federal Housing Finance Agency house price indexes over the same period, inflation adjusted, for the 50 US states plus the District of Columbia. A positive relationship is readily available, suggesting higher entrepreneurial activity in states with a house price boom.

Insert Figure 1 **here**

In theory, home ownership can affect entrepreneurship through several channels. The first is related to liquidity constraints. A number of influential papers have argued that would-be entrepreneurs may be discouraged from switching into entrepreneurship if low levels of own wealth and/or borrowing constraints prevent them from raising sufficient capital (e.g., Evans and Jovanovic, 1989; Evans and Leighton, 1989; Holtz-Eakin, Joulfain, and Rosen, 1994; Blanchflower and Oswald, 1998; and Paulson and Townsend, 2004). Increasing home equity may alleviate such liquidity constraints by enabling would-be entrepreneurs to borrow against the value of their property. Alternatively, declining home equity can effectively raise households' borrowing constraints and depress entrepreneurship. These are important consideration given that one's home is the main asset for most Americans and that residential property represent 60% of all personal wealth in the US (US Census, 2010). Hurst and Stafford (2004) highlight the use of home equity as a mechanism by which households

smooth their consumption over time. When faced with a negative income shock, a household can sustain their consumption by tapping into their home equity when more liquid assets are not available. Mian and Sufi (2011) empirically investigate how existing homeowners responded to the rising value of their home equity between 2002 and 2006. They provide evidence that this home equity-based borrowing channel, which may have been fueled by easy availability of mortgage credit, was an important cause of the rapid rise in household leverage before the downturn. Their findings lend support to the view that the home equity-based channel was used for real outlays but their data do not allow them to empirically identify the final use.

The second channel is related to entrepreneurship being a superior good. Hamilton (2000) shows that most entrepreneurs enter and persist in business although they have both lower initial earnings and lower income growth than paid employees. Moskowitz and Vissing-Jorgensen (2002) show that the returns on private equity are no higher than the returns on public equity, even though entrepreneurial investment is poorly diversified. Both papers thus suggest that there are important non-pecuniary benefits of entrepreneurship. Building on that work, Hurst and Lusardi (2004) argue that personal wealth is important only for the richest households, and that once these are excluded from the sample, there is no statistical relationship between wealth and entrepreneurial choices. The authors thus challenge the established view that liquidity constraints matter a lot for entrepreneurship. Instead, they argue that entrepreneurship may contain a "luxury good" component. Namely, as households become wealthier, they are more likely to purchase the benefits associated with owning a business, like prestige, power over decision-making, a flexible time schedule, etc. If this is the case, then more households will be more likely to switch to self-employment during housing booms when personal wealth is increasing.

We use both OLS and an Instrumental Variables analysis of the effect of home equity on the transition to entrepreneurship. We motivate our empirical analysis with a simple but novel model of career choice. The novelty is the collateral channel of homeownership. In

our model, agents start out as fixed-wage workers and can choose to become entrepreneurs in each following period. Their value function in each period depends on own wealth (as in Quadrini, 2000; Caggetti and De Nardi, 2006; and Buera, 2009), but also on house prices through three channels. The first one is that the current level of house prices affects the equity value they can extract from their home. The housing stock has a collateral value component, beyond the value derived from the direct consumption of housing services, due to prospects of limits on the amount of borrowing. The second channel is predictability in housing returns. We follow Corradin, Fillat, and Vergara (2012) assuming that the housing market can be in a "hot" regime (when house prices are expected to keep increasing) or in a "cold" regime (when house prices are expected to stay flat or decline). The last channel results from the interaction between the first two channels and the cost of external financing available to the potential entrepreneur. As in Quadrini (2000), the entrepreneur can take external financing up to an amount that corresponds to the difference between the maximum permitted level of capital investment and total net wealth. But external debt is costly and the cost depends on the cost of intermediation that lenders charge and the ratio of debt to capital. As a result, leverage depends on the proportional cost charged by lenders, the home equity, and the current housing return regime.

The key implications of the model are threefold. First, higher home equity induces households to transition from fixed income to entrepreneurship through the collateral channel. Second, for high enough values of home equity, agents switch into entrepreneurship with less equity in a period of high house price appreciation because expected future rises in house prices increase the equity they can extract from their home allowing them to finance the capital investment necessary to start a business. Third, once agents become entrepreneurs, they extract the full amount of equity from their home in order to finance their business. The model thus predicts a positive correlation between current home equity and future transition into entrepreneurship, and a positive correlation between past home equity and current (especially mortgage) debt for new entrepreneurs.

We test our model using microdata on housing and business ownership from the Survey of Income and Program Participation (SIPP) of the US Census Bureau from 1997 to 2006. In every survey year, the respondents are asked about whether they run and/or operate a business, about the value of their business equity, and about the value of their house and the size of the mortgage (if any). The survey also contains household-level data on a variety of relevant household characteristics, such as the household's non-housing wealth and labor income and the head's age, race, education, and marital status. We use information on $44,141$ unique households that were interviewed during the years $1996-2000$, $2001-2003$, and $2004-2006$, for a total of $108,970$ observations. As proxies for house price boom-bust periods, we use the topological elasticity of local housing supply from Saiz (2010). The intuition is that when there is a positive shock to demand for durables, house prices are likely to increase more in areas where the supply of housing cannot adjust quickly for reasons related to the characteristics of the local terrain.

We confirm the findings in previous studies that the probability of becoming an entrepreneur increases in education and is higher for agents who are white and married, as well as in local markets characterized by higher unemployment. Importantly, we find that the probability of switching into entrepreneurship is strongly positively correlated with the value of the home equity. A 10% increase in home equity increases the probability that a non-business owning household will switch to entrepreneurship in the future by up to 14%. The results are statistically significant regardless of whether we define business ownership in terms of owning and operating a business, in terms of holding non-zero business equity, or in terms of either. This effect is robust to controlling for a wide range of demographic and income characteristics, for the local business cycle, and for the bankruptcy code. It also exists independently of a "luxury good" component of housing whereby individuals whose house is appreciating in value are more likely to purchase the non-pecuniary benefits associated with running a business. We also confirm the prediction of our model that during housing booms, agents switch to entreprneurship at lower levels of home equity, arguably because

they expect the value of their property to keep increasing in the future. Finally, we find a strong positive correlation between last period's home equity and this period's increase in (particularly mortgage) debt for new business owners, implying that once they switch away from fixed income to entrepreneurship, agents tend to draw down their home equity in order to finance their business investment. Arguably because one's house is efficient collateral, new entrepreneurs with access to higher home equity use less of other types of debt, cush as consumer debt. In this regard, our findings are similar to Chaney, Sraer, and Thesmar (2012) who examine listed US firms over the $1993 - 2007$ period and provide evidence that when the value of a firm's real estate appreciates by 1\$, its investment increases approximately by \$0.06.

In our tests we also account for the fact that both entrepreneurial activity and home-ownership may be driven by an unobservable component, such as the household's degree of risk aversion. We employ a version of the identification strategy suggested by Chetty and Szeidl (2012). In particular, we use two instruments to extract the exogenous element of home equity. The first instrument is the change in average *state-wide* house prices between the year when the house was bought and the current year. The second instrument is the change in average *US-wide* house prices between the year when the house was bought and the current year, in interaction with the MSA-level topological elasticity of housing supply from Saiz (2010). The idea behind these instruments is that a higher house price appreciation implies higher equity today, and this effect is stronger in MSAs with less elastic housing supply where adjustment in response to aggregate demand shocks takes place on the price margin. Our main results remain robust to this alternative empirical approach.

Our reduced form estimates imply potentially important linkages between housing and real economic activity. For example, our results suggest that the housing boom before the Great Recession may have resulted in higher rates of new business creation. This conjecture is corroberated in aggregate industry-level data by Adelino, Schoar, and Severino (2013) who document that areas with a bigger run up in house prices between 2002 and 2007 experienced

a strong increase in small business employment relative to large business employment. Our results also have important potential implications for economic activity during downturns, suggesting that high levels of mortgage debt after 2006 may have depressed self-employment, denting the positive effect on new business creation of higher unemployment rates. Our paper thus relates to the evidence in Philippon and Midrigan (2011) who find that both output and employment declined more after 2007 in regions where household leverage increased more between 2001 and 2007.

The rest of the paper is organized as follows. Section 2 develops a career choice model with homeownership and stochastic house prices. Section 3 presents a calibration exercise. Section 4 presents the data. Section 5 develops the empirical strategy and reports the empirical estimates. Section 6 concludes.

3 The Model

Consider an agent with wealth a. The agent lives for T periods and in each period t she chooses numeraire consumption c_t and the amount of one period risk free financial assets to bring the next period, $\tilde{a}_{t+1}$. Let h denote the size of the housing stock that provides a constant flow of housing services to the agent. We make the following assumptions: (i) the housing stock does not depreciate; and (ii) the flow of housing services is $g(h) = g \times h$, where $g > 0$. The housing size in the first period is given and the agent does not change the house regardless of the path of her income, housing price and wealth. Thus, we ignore the possibility that the agent can adjust the level of housing services and move to a larger or smaller house. The agent's utility from housing consumption and numeraire consumption is given by

$$u(c, g(h)) = \frac{\left(c^{\beta} g(h)^{1-\beta}\right)^{1-\gamma}}{1-\gamma}. \tag{1}$$

Let p_t denote the relative price of one unit of housing, in terms of the numeraire non-durable consumption good. We assume that house price follows a binomial process with

time-varying parameters u_i ("up") and d_i ("down") and probability π_i. The initial house price value is p_0 and the tree has N steps. In the continuous-time model, over a discrete time period $\Delta t = T/N$, we have

$$\Delta \log p = \left(\mu_i - \sigma^2/2\right) \Delta t + \sigma_p \Delta W, \tag{2}$$

where μ_i is the expected house price growth rate, σ determines the standard deviation of the growth process and W is a Brownian motion. We approximate this process assuming that

$$u_i = e^{\left(\sqrt{\sigma^2 \Delta t + (\mu_i - \sigma^2/2)^2 \Delta t^2}\right)}, \quad d_i = 1/u_i \quad \text{and} \quad \pi_i = 0.5 + \frac{(\mu_i - \sigma^2)\Delta t}{2\log(u_i)}. \tag{3}$$

We follow Corradin, Fillat and Vergara (2012) in assuming that the house price mean growth rate, μ_i, depends on some $n-$regime process, where the expected value is modeled through a Markov chain tracking the particular regime at a given point in time. For example, in the case of two regimes, the expected growth in house prices, μ_i can only take two values: $\mu_i = \mu_h$, where h denotes the high growth regime, and $\mu_i = \mu_l$, where l denotes the low growth regime, and $\mu_h > \mu_l$. The transition probability matrix of the Markov chain is denoted by Λ. The diagonals of this matrix represent the unconditional probabilities of staying in the current regime while the off-diagonal terms represent the probability of a regime shift, either from high to low, λ_{hl}, or from low to high, λ_{lh}. Then, the probability of moving from regime j to regime k within time Δt is approximately $\lambda_{jk}\Delta t$. We assume that the agent knows with certainty the regime of the economy, hence μ_i is observable by the agent at time t.

The agent can choose to be an entrepreneur or to work for a fixed wage l. In the first case, the agent's wealth at time t is $a_t = b_t + h \times p_t$, where b_t is the risk free asset and represents the financial wealth $\tilde{a}_t$. Interestingly, a_t also corresponds to the home equity the agent holds when $b_t < 0$. Then, we follow prior research by Kiyotaki and Moore (1997) in

which a financing constraint is introduced

$$b_t \geq -\phi \frac{h \times E\left[p_{t+1}\right]}{1 + r_D}, \tag{4}$$

where r_D is the risk free rate. Prospects of limits to how much the agent can borrow introduce a collateral value to the housing stock. Increases in the value of a house enlarges the amount of permissible debt, and this adds to the value to home owning beyond the direct consumption of housing services. To ensure that that borrowing is risk-free, we impose a loan-to-value ratio and require that the agent is able to borrow up to ϕ fraction of the collateral value.

In the second case, she can generate output νk^{α}, where k is the input of capital and ν is the stochastic entrepreneurial ability of the agent, relative to her ability to earn a wage income. The optimal input of capital is determined by maximizing the profit net of the opportunity cost of capital that is $\Pi = \nu k^{\alpha} - (r_t + \delta)\kappa$, where r_t will be defined later and δ is the depreciation rate of capital. We assume that ν follows a 2-regime Markov chain, where $\overline{\nu} > \underline{\nu}$, and the transition probability matrix is denoted by Θ. The entrepreneur's wealth at time t is $a_t = b_t + k_t + h \times p_t$, where $\tilde{a}_t = b_t + k_t$ represents the financial wealth.

For an agent with a sufficiently high ν, $E\left[\Pi\right] > l$ so that she would generate higher income by choosing to become entrepreneur. In the absence of financial frictions, the model predicts that an agent with $E\left[\Pi\right]$ above a certain threshold becomes entrepreneur, otherwise she chooses to be a worker. With financial constraints, however, wealth a and in particular housing $h \times p_t$ also become important. We assume that the agent can use the house as collateral. As in Quadrini (2000), we introduce the variable r_t that is the cost of capital from internal and external source of finance. If $k_t \leq a_t$, the project is entirely financed with internal resources, $b_t + h \times p_t$, and the cost of capital is given by the opportunity cost r_D. If $k_t > a_t$, part of the capital that is invested in the business is financed with costly debt,

and the cost of capital is an increasing function of the ratio of debt to capital:

$$r_t = r_D + \epsilon \left(\frac{k_t - a_t}{k_t} \right) \quad if \quad k_t > a_t, \tag{5}$$

where ϵ is a proportional cost per each unit of funds intermediated charged by a competitive lending market. The agent can borrow only up to a maximum amount, the size of which depends on the lending policy. This policy consists of lending up to the amount that the borrower will be able to repay with certainty at the end of the following period. If the entrepreneur invests k units of capital in the business, then the minimum amount of resources that can be disposed of at the end of the period, and before repaying the debt, is given by $DR_{min} = \underline{\nu} k^{\alpha} - \delta\kappa$, where DR_{min} stands for disposable resources when the shock takes the minimum possible value. The amount of funds that the entrepreneur has to pay back to the bank is given by $(k_t - a_t)(1 + r_t)$ and this has to be smaller than DR_{min}. Therefore, bankruptcy is not allowed.

Our model suggests a link between the capital input and the value of housing stock. In the next section, we will present some figures that motivate our empirical analysis and suggest that housing value $h \times p_t$ affects (i) the occupational choice, because the agent chooses to become an entrepreneur only if the agent has a net worth or home equity bigger than a^*; and (ii) after becoming an entrepreneur, the input of capital and therefore the income generated by the entrepreneur himself depends on shocks to the values of the house.

At the beginning of each period, before any economic decisions are made, the current ability level ν is known with certainty, whereas next period's levels are uncertain. The agent chooses whether to be an entrepreneur or a fixed-wage worker during the current period. The agent's value function is

$$V(\tilde{a}, p, i, j, t) = \max \left(V_e(\tilde{a}, p, i, j, t), V_w(\tilde{a}, p, i, t) \right), \tag{6}$$

where $V_e(a, p, i, j, t)$ is the value function of the agent who manages an entrepreneurial ac-

tivity during the the current period. The value function depends on the current level of financial wealth $\tilde{a}_t$, the current level of house prices p_t, the current regime of house price appreciation i and the current ability level j. Formally,

$$V_e(\tilde{a}, p, i, j, t) = \max_{c_t, k_t} E_0 \left[\sum_{t=1}^{T} \rho^{t-1} u(c_t, g(h)) + \rho^T \frac{a_T^{1-\gamma}}{1-\gamma} \right], \tag{7}$$

where ρ is the standard time discount factor and expectations E_0 are taken with respect to the stochastic processes driving house prices and the entrepreneur's profits. The evolution of the financial wealth is

$$\tilde{a}_{t+1} = (1 + r_t)(\tilde{a}_t - k_t) + (1 - \delta)k_t - c_t + \nu k_t^{\alpha}, \tag{8}$$

subject to the following constraints:

$$a_t \geq 0, \quad k_t \geq 0 \quad \text{and} \quad k_t \leq \tilde{a}_t + \phi \frac{h \times E\left[p_{t+1}\right]}{1 + r_D} + \frac{DR_{min}}{1 + r_t}. \tag{9}$$

The function $V_w(\tilde{a}, p, i, t)$ is the value function of the agent who chooses to be a worker during the current period. We have

$$V_w(\tilde{a}, p, i, t) = \max_{c_t} E_0 \left[\sum_{t=1}^{T} \rho^{t-1} u(c_t, g(h)) + \rho^T \frac{a_T^{1-\gamma}}{1-\gamma} \right], \tag{10}$$

subject to $a_t \geq 0$ and $b_t \geq -\phi \left(h \times E\left[p_{t+1}\right]\right) / (1 + r_D)$, and the evolution of the financial wealth is

$$\tilde{a}_{t+1} = (1 + r_D)\tilde{a}_t + l - c_t. \tag{11}$$

We make the following assumption on the occupational choice. In the first period, the agent is a fixed-wage worker and she can choose to become an entrepreneur in any following period. Later, the agent, as an entrepreneur, has the option to liquidate the capital at any time and to become again a fixed-wage worker.

4 Numerical Simulations

It is not possible to find properties of our model in closed form, therefore a backward numerical procedure is developed and implemented in the context of a simple numerical example. Table 1 reports the model parameters. In order to parameterize the model we assume that each period corresponds to one year. We set the initial age to 30 and the terminal age to 50. Thus T is 20 years. We assume a curvature of the utility function of 2 and a rate of time preference of 3%. The parameter $1-\beta$ measures how much the agent values housing consumption relative to the numeraire consumption. It is set at 0.4 which is consistent with the average proportion of household housing expenditures in the US. Then, we assume a housing service flow, g, of 7.5%, which is close to the estimates of housing user costs in the literature.

Insert Table 1 **here**

The risk free rate r_D is set at 3%, while the funding cost ϵ is set at 1%. We follow Corradin, Fillat, and Vergara (2012) in setting the house price mean growth rate process. They use the long Case-Shiller HPI time series dating back to 1925 to estimate the parameters of a 2-regime Markov switching process. They find that a model specification that allows the expected growth of house prices to switch only between two regimes captures sufficiently well the essential dynamics of US house prices. They estimate a yearly growth rate of house prices of -0.49% during the low growth regimes and a growth rate of 9.25% during the high regimes. Their analysis suggests that house prices are most often in a regime of low growth and the probability of being in a high regime is rather low, except in periods of large price appreciation, indicating that high growth regimes in the US tend to occur relatively infrequently. This fact is also reflected in the estimated, time-invariant, transition probabilities of switching to the alternative regime in the next period: the probability of moving from a low to a high growth rate regime, λ_{lh}, is only about 3.42% (i.e., $1-0.9658=0.0342$), while the probability of moving from a high to a low growth rate, λ_{hl}, is 24.14%.

We assume a house price standard deviation of 10%. We consider a fixed housing stock of 100 square feet and we normalize the housing price in the first period, p_0, at 1. Then, our baseline scenario assumes a loan-to-value ratio, ϕ, of 90%.

In order to paramaterize the stochastic process of the entrepreneurial ability we assume that $\overline{\nu} = 0.9$ and $\underline{\nu} = 0.1$, while the probability of switching from low to high skill, θ_{lh}, is 40% and the probability of switching from high to low skill, θ_{hl}, is 30%. In addition, we set the fixed-wage l at 15 such that $E[\Pi] > l$ for certain levels of input of capital k. Capital depreciates at a rate δ of 9%. We set the capital share α at 0.8.

The occupational choice is made by comparing the indirect utility of being a fixed wage worker, V_w, and the indirect utility of being an entrepreneur, V_e. Only if the value of the agent's home equity is bigger than a^*, she chooses to become an entrepreneur. Figure 2 plots the investment in the entrepreneurial activity k (solid red line) with respect to liquid and housing wealth $b_t + h \times p_t$, in a period of low house price appreciation. The capital investment thus depends on the collateral value as well. The capital investment is increasing and concave in $b_t + h \times p_t$, meaning that investment increases with housing value. After transition into entreprenurship, capital investment growth rate is substantially higher than the wealth growth rate. Then, at some level of liquid and housing wealth, the precise value depends on the problem's parameters, and it is optimal for the agent to invest at a lower but still positive rate. When the capital investment is above the 45 degree line, the agent is also using external financing paying the additional premium $\epsilon(k_t - a_t)/k_t$. In Figure 2, we plot also the investment in the entrepreneurial activity k (dashed green line) with respect to $b_t + h \times h_t$, in a period of high house price appreciation. Ceteris paribus, the capital investment is higher in high house price appreciation regime due to the increase of leverage. We provide the capital investment policy at two different times, $T - 10$ (upper panel) and $T - 2$ (lower panel). Intuitively, the entrepreneur invests less when she is approaching the terminal date T.

Insert Figure 2 here

Therefore, we have the testable implication that home equity increases the probability of becoming an entrepreneur. In addition, house price dynamics is also affecting such decision making the home equity trigger time-varying. The model is suggesting that on average an individual with high entrepreneurial skill becomes an entrepreneur holding less home equity in a period of high house appreciation, $a_h^* < a_l^*$. Although the agent is facing limits on the amount of borrowing, the collateral value of the housing stock is more valuable in periods of high house price appreciation and therefore the agent can anticipate her decision exercising her option of becoming an entrepreneur. Then, house price dynamics affect the capital investment as well. The model predicts that on average entrepreneurs should invest more in period of high house price appreciation holding less home equity and should increase leverage relying more on external financing.

5 Data

We evaluate the implications of our model using household level survey data from the Survey of Income and Program Participation (SIPP) of the US Census Bureau from 1996 to 2006. In each survey year, the respondents are asked questions related to business ownership. The survey also contains questions on the value of the house and on the size of the mortgage (if any), which allows us to distinguish the collateral effect of higher household leverage from the wealth effect of higher property values.

The survey contains household-level data on a variety of individual characteristics. In particular, it has a detailed inventory of the household's financials, in addition to demographic characteristics which are theoretically related to entrepreneurial choice and business equity ownership, such as age, education, and marital status. At each moment, SIPP tracks approximately $30,000$ households. During the period considered, information was collected from three consecutive groups of households that were interviewed during the years $1996-2000$ (four times), $2001-2003$ (three times), and $2004-2006$ (two times), respectively. The three

SIPP panels put together contain information on 44,141 unique households, for a total of 108,970 possible observations.

During its active period, each panel is interviewed every year, while panels of households do not overlap across periods. SIPP over-samples from areas with high poverty concentrations, which should be taken into account when interpreting the results. Its longitudinal features enable the analysis of dynamic characteristics, such as changes in employment and income, changes in household and family composition, or housing dynamics. The survey's cross-sectional features allow us to keep track of household wealth. It also allow us to study the empirical implications of the model outlined above. In particular, we focus on the identification that arises when the value of the property and of the home equity changes.

Theory provides little guidance on how to classify "entrepreneurs" (Hurst and Lusardi, 2004). The SIPP allows us to distinguish between direct ownership of business and ownership of business equity, which may or may not be ownership of equity in the household's own business. Specifically, we utilize responses in the survey to the question "Did the household own and operate a business in the previous year?" to define business ownership, and responses to the question "What is the value in dollars of the household's total business equity?" to define ownership of business equity. This strategy is somewhat richer that previous studies utilizing household data on entrepreneurship. For example, Hurst and Lusardi (2004) define entrepreneurship from a question in the Panel Study of Income Dynamics (PSID) which asks household whether they "[...] own a business [...] or have a financial interest in any business enterprise", so they are unable to distinguish between direct and indirect ownership.

In terms of the household's financials, we calculate net wealth as total wealth minus total debt. Total debt includes any mortgage on the household's current home. Total net wealth excludes the value of equity in the house.

To examine the role of property values and household leverage on the transition into entrepreneurship, we create a pooled sample of non-business owners from the three survey waves. A household is defined to enter entrepreneurship if either the household head or the

spouse owns and operates a business in (i) any of the subsequent periods of the same survey wave, or (ii) in the very next period of the same survey wave. Consistent with Hurst and Lusardi (2004), we eliminate households in which the head is still in school or is close to retirement and focus on non-retired household heads between the ages of 22 and 60. There are 39,999 households who were observed more than once, for whom all relevant information is available, and who started out as non-business owners. 678 of those households subsequently became business owners.

Table 2 reports descriptive statistics on the subsample of household that transitioned into entrepreneurship during the following year(s). We compare those to descriptive statistics on the subsample of household that remained non-business owners. On average, those transitioning into entrepreneurship have acquired more education and are more likely to be white, male, and married, as well as to have higher labor income and higher net wealth. Importantly, those transitioning into entrepreneurship own a more expensive house, and this higher property value is reflected in both higher mortgage debt and higher home equity.

Insert Table 2 here

In addition to household information, we include data on GSP growth, state unemployment, and homestead exemptions. The economic rationale for including the first two is clear: a more vibrant economy and a more depressed local labor market can raise the returns to self-employment (see Fairlie, 2010). Regarding the latter, the homestead exemption enables a filer for bankruptcy to retain home equity in his primary residence up to the exemption amount. Because the debts of the firm are personal liabilities of the firm's owner, lending to the firm is legally equivalent to lending to its owner. Berkowitz and White (2004) show that as a result of that, small firms located in states with unlimited homestead exemptions are more likely to be denied credit. A higher exemption may thus increase the probability of transitioning into self-employment by imposing a lower cost on a potential business exit. The homestead exemption ranges from $0 in Maryland to an unlimited amount in 8 US states in 2006.

6 Empirical Analysis

The key implication of our model concerns the effect of the home collateral channel on the transition from fixed-wage income to entrepreneurship. The model predicts that holding all else equal, an increase in house prices will increase the probability that an individual will transition into entrepreneurship. The intuition for this result is that if household leverage remains the same, a higher value of the property will increase the home equity, reducing the effective cost to the agent of switching from fixed income to variable income.

We test this prediction using the following model relating home equity to entrepreneurial choice:

$$\text{Prob}(\text{future business ownership}_{ijt} = 1) = \alpha + \beta \cdot \ln(\text{home equity}_{ijt}) + \gamma \cdot X_{ijt} + \delta \Phi_{jt} + \varepsilon_{ijt}, \quad (12)$$

where X_{ijt} denotes a vector of demographic characteristics, such as race, gender, marital status, and education, for each household i in state j at time t. It also includes variables related to income and liquidity constraints. In particular, it includes the household's current labor income and its net wealth. Not accounting for wealth may bias our estimates upward because wealthier individuals may be simultaneously more likely to become entrepreneurs and to own a more expensive house. Theory predicts that the inability to acquire the capital necessary to start a business is one of the main theoretical obstacles faced by would-be entrepreneurs. A large literature has documented a positive relationship between initial wealth and subsequent business entry (Evans and Jovanovic, 1989; Evans and Leighton, 1989; Fairlie, 1999; Quadrini, 1999). However, more recent studies using detailed survey data have shown that such a positive relationship exists only at the top of the wealth distribution (Hurst and Lusardi, 2004). We take these considerations into account by including an up to third degree polynomial of household net wealth. Φ_{jt} is a matrix of state and year fixed effects and it controls for unobservable factors that are common for all individuals in a state and for all individuals during the same phase of the business cycle. Consistent with the

implications of the model, we expect that $\beta > 0$.

In addition to home equity, we also control for the property value directly. By doing so, we want to distinguish between the effect of owning a higher value property through the "collateral channel" (households are more likely to become entreprneurs if they can extract home equity) and its effect through the "luxury good channel" (households are more likely to become entrepreneurs when they feel richer), as in Hurst and Lusardi (2004).

6.1 Baseline result

In the benchmark estimation of (12), we use ownership and operation of a business firm as the main definition of entrepreneurship. Column (1) of Table 3 reports the regression estimates of the probability of owning and operating a business in the future on home equity and the full range of variables capturing the household's demographic characteristics and financial situation. The regressions results are from a sample of $39,999$ households who were non-business owners at the time of their first interview in each survey wave and for whom all relevant information is available.

Insert Table 3 here

The estimates imply that households whose head has higher average education, is white, and is married, are more likely to transition into entrepreneurship in the future, while the spline of net wealth has no effect on future business ownership. These results are fully consistent with Hurst and Lusardi (2004). In addition, individuals are more likely to become entrepreneurs in states with higher unemployment. This result is consistent with Fairlie (2010) who uses data from the Current Population Survey over $1996 - 2009$ and finds a positive association between local unemployment rates and the probability that an individual starts a business. Finally, as expected, a higher homestead exemption increases the probability of switching from a fixed income to business ownership in the future.

Turning to our variable of interest, we find that holding demographic characteristics, net wealth, disposable income, and the business cycle constant, individuals are more likely to make the transition to business ownership in the future if they have higher home equity in their house. In terms of our model, this is because when house prices increase and raise the value of the property, holding the mortgage fixed, individuals can now extract more equity from the house to buy working capital if they are to switch from fixed income to variable income. The null hypothesis that current home equity has no effect on future business ownership is rejected with $p < 0.01$. The point estimate of the coefficient on home equity implies that for an individual with the sample mean demographic and income characteristics, an increase in the value of the property that results in a 10% increase in home equity increases the probability that the household will transition into entrepreneurship in the future by 0.026 percentage points. Given a mean share of agents who transition into entrepreneurship in the future in the analysis sample of 1.7%, this is equivalent to a 1.5% increase in the probability that the household will transition into entrepreneurship in the future.

Column (2) of Table 3 replicates column (1) with entrepreneurship defined as the probability of a non-business owner becoming an entrepreneur in the very next period. This allows us to include all observations of households which are interviewed more than once, and not just the first observation. The results remain qualitatively unchanged: the strong positive association between home equity and transition to entrepreneurship survives this alternative definition of the switching horizon. Again, the null hypothesis that current home equity has no effect on future business ownership is rejected with $p < 0.01$. The point estimate of the home equity coefficient implies that for an individual with the sample mean demographic and income characteristics, an increase in the value of the property that results in a 10% increase in home equity increases the probability that the household will transition into entrepreneurship in the future by 0.017 percentage points, corresponding to a 1% increase in the probability that the household will transition into entrepreneurship in the next period.

In columns (3) and (4), we repeat the regressions in (1) and (2), but this time we also add the natural logarithm of the value of the house on the right-hand side of the regression. In this way, we control for the impact of home values on entrepreneurship through the "luxury good" channel. Namely, if home value appreciation makes the homeowner feel wealthier, and by extension increases her willingness to purchase the luxury attributes that come with self-employment (such as flexible working time or the ability to work from home), our estimate of the the collateral channel may be upward biased. Our results point to such wealth effect of property value appreciation, but the effect is not significant. Importantly, the estimate of the collateral channel survives this alternative test.

6.2 Alternative definitions of entrepreneurship

In Table 4, we replicate the first two columns of Table 3 after employing alternative definitions of business ownership. In column (1), we define transition into business ownership as a dummy variable equal to one if the household declares zero business equity in the current period but positive business equity in the future. This definition accounts for the fact that individuals may become business owners not just by starting a business themselves, but also by investing in other agents' businesses. In column (2), we use the same definition but look at whether households acquire business equity in the very next period. In both cases, the null hypothesis that current home equity has no effect on future business equity ownership is rejected with $p < 0.01$. In terms of numerical effect, for example the point estimate of the home equity coefficient in column (1) implies that an increase in the value of the property that results in a 10% increase in home equity, holding everything else at their sample mean values increases the probability that the household that presently owns no business equity will own business equity in the future by 0.033 percentage points. Given a mean share of agents who acquire business equity in the future in the analysis sample of 16.8%, this is equivalent to a 0.2% increase in the probability that a household that does not own business equity today will own business equity in the future.

Insert Table 4 here

In the next two columns of Table 4, we employ the definition used in Hurst and Lusardi (2004), namely, we define business owners as households which are either running and operating their own business or own business equity. We find that the positive association between home equity and the probability of transition into business ownership continues to be statistically strong (at the 1% level) for this broader definition of entrepreneurship. Importantly, all regressions in Table 4 include our exhaustive set of variables which proxy for demographic characteristics, net wealth, disposable income, the local business cycle, and homestead exemptions. This implies that the positive correlation between home equity and business ownership is not due to the high correlation between home equity and net wealth, disposable income, or changes in the return to entrepreneurship.

6.3 Instrumental variables results

The main empirical challenge in identifying the underlying effects relates to left-out variable bias. For example, home equity may be negatively correlated with a component of labor income that is observable to the household but not to the econometrician. If this is the case, then individuals with low home equity may be less likely to transition into entrepreneurship not because they can extract less equity from their house to invest in their business, but because their lifetime fixed income is higher than what the econometrician observes. Alternatively, as pointed out by Chetty and Szeidl (2012), households may vary in the degree of their risk aversion. If housing is considered a risky investment (Chetty and Szeidl, 2007), more risk averse individuals may prefer to buy smaller houses, resulting in lower home equity. If more risk averse individuals are also less likely to transition into entrepreneurship, then the positive association between home equity and business ownership will be entirely spurious.

To address these issues, we modify the approach introduced in Chetty and Szeidl (2012) and exploit two instruments to generate variation in home equity. The first instrument is

the change in average *state-wide* house prices between the year when the house was bought and the current year. The intuition for this approach is the following. Consider two identical houses which were bought during the same year, but we observe the two households during different periods in time. The two households have the same mortgage (if they had the same initial assets) because the purchase price was the same, but the household observed during a housing boom will have higher home equity. Alternatively, consider two houses which have an identical price today, but one was bought in the past when home prices were high and the second was bought in the past when home prices were low. The household which owns the first house is likely to have lower equity (as it enjoyed less home price appreciation).

Chetty and Szeidl (2012) acknowledge that instruments based on local house price fluctuations may fail to satisfy the exclusion restriction due to selection bias (individuals who buy a house when house prices are high may have different risk preferences) or to bias stemming from omitted variables, such as unobservable time-varying wealth. Similar to them, we address this potential criticism by employing an instrument based on fluctuations in *national* house prices. To that end, we calculate the change in average US-wide house prices between the year when the house was bought and the current year. Furthemore, we interact the national-level house price increase with the MSA-level topological elasticities of housing supply from Saiz (2010) which are available for 95 MSAs. These elasticities capture the amount of developable land in each metro area and are estimated by processing satellite-generated data on elevation and presence of bodies of water. The main idea behind this instrument is the same as in the previous case: a higher house price appreciation implies higher equity today, and this effect is stronger in MSAs with less elastic housing supply due to topological reasons, where adjustment in response to aggregate demand shocks takes place on the price margin.

In Table 5, we repeat the empirical exercises reported in Tables 3 and 4 in the case of future business ownership, but this time we instrument home equity with the two instruments we just described. The first-stage regressions (available upon request) imply that just like

in Chetty and Szeidl (2012), the relevance condition for the two instruments is satisfied.

Insert Table 5 here

Even with this identification strategy at hand, the null hypothesis that current home equity has no effect on future business ownership is rejected in both cases, with $p < 0.05$ in column (1) and $p < 0.10$ in column (2). The point estimate of the coefficient on home equity implies that an increase in the value of the property that results in a 10% increase in home equity increases the probability that the household will transition into entrepreneurship in the future by about 0.11 percentage points when the first instrument is used (column (1)), and by about 0.24 percentage points when the second instrument is used (column (2)). In the latter case, this is equivalent to a 14.2% increase in the probability that the household will transition into entrepreneurship in the future. The increase in the magnitude of the coefficients relative to the OLS case implies that the OLS estimates are downward biased, potentially because a larger house may be considered a safe rather than a risky investment. Hence, risk-averse individuals - also the ones less likely to become entrepreneurs - may be buying larger houses, introducing a negative correlation between home equity and business ownership.

6.4 The effect of housing booms

The second implication of our model that we wish to test is captured by Figure 2. Agents switch from fixed income to entrepreneurship earlier during house price boom. The intuition behind this prediction is that holding current home equity constant, would-be entrepreneurs will be on the margin more likely to switch to business ownership if they expect to be able to extract more equity from their house in the future to cover capital expenditures. This effect will be larger for agents with a larger mortgage at present as they expect a higher increase in home equity in the future. In this sense, we distinguish the direct effect of housing booms on entrepreneurship through signaling conditions associated with a favorable

business environment, from its indirect effect through the collateral channel.

In order to test this prediction, we need to utilize a variable capturing regional US house price booms over the sample period. To proxy for persistent high house price appreciation at US state level, and similar to the previous section, we use the MSA-level elasticities of local housing supply from Saiz (2010). The downside of these elasticities is that they are time-invariant and do not directly capture changes in house prices. However, there is abundant evidence that during the US housing boom of the early-to-mid 2000s, regions with low elasticities of housing supply, such as California and Florida, experienced a much larger house price appreciation than regions where adjustment in response to aggregate demand shocks can take place on the supply margin, such as Kansas or Oklahoma. This is the rationale behind the wise use of MSA housing supply elasticities in recent empirical work, to capture house price booms (e.g., Mian and Sufi, 2011; Chaney, Sraer, and Thesmar, 2012).

The implication of our model relating housing booms to entrepreneurial transition is tested using a modification of (12), namely

$$\begin{aligned}\text{Prob(future business ownership}_{imjt}=1) = \; & \alpha+\beta_1\cdot\ln(\text{home equity}_{imjt})\\ & +\beta_2\cdot\ln(\text{home equity}_{imjt})\cdot\text{MSA elasticity}_m\\ & +\beta_3\cdot\text{MSA elasticity}_m+\gamma\cdot X_{imjt}\\ & +\delta\Phi_{jt}+\varepsilon_{imjt},\end{aligned} \tag{13}$$

where we have now introduced variation not only at the state (j) level, but also at the within-state MSA (m) level. Consistent with the implications of the model, we expect that $\beta_1 > 0$ and $\beta_2 > 0$. The first prediction is the same as before, namely, agents with access to higher home equity today are more likely to transition into entrepreneurship tomorrow. The second prediction says that in regions where average house prices are appreciating more - or, in regions with low elasticity of housing supply - agents are more likely to transition into entrepreneurship at lower levels of home equity as they expect to have access to higher

home equity tomorrow.

Column (1) of Table 6 replicates column (1) of Table 3, but we have now added the interaction of the natural logarithm of home equity with the MSA elasticity of housing supply, as well as the MSA elasticity on its own. The interaction variable turns out to have the expected sign: households with lower home equity are more likely to transition into entrepreneurship in markets with less elastic housing supply. The effect is significant at the 5% statistical level. On its own, home equity is not significantly correlated with the probability of future transition into entrepreneurship. Finally, regions with lower elasticity of housing supply tend to have higher rates of new business creation, and this effect is marginally significant.

Insert Table 6 **here**

In column (2), we use our instrumental variable procedure. Because the local elasticity of housing supply is now interacted with home equity, we use an instrument for home equity which is not derived from MSA elasticities. In particular, we use the first instrument developed in the previous sub-section, namely, the change in average *state-wide* house prices between the year when the house was bought and the current year. This time, the estimate of β_1 related to the collateral channel is significant at the 5%, confirming the strong positive correlation between present home equity and future transition into entrepreneurship. As in the OLS case, the estimate of β_2 is positive, and this time significant at the 1% level. This result again suggests that by allowing households to extract more equity in the future in order to invest in their business, a hot housing market may stimulate entrepreneurship at lower levels of home equity today. The magnitude of the coefficient on the interaction term increases by about 50%, implying that OLS may be downward-biased, potentially because agents are more risk averse in booming housing markets.

6.5 Home equity, transition to entrepreneurship, and leverage

So far we have only tested the predictions of our model related to the effect of home equity on the decision to switch from a fixed wage to being an entrepreneur. In this section, we test the implications of the model related to how new entrepreneurs finance business investment. In particular, the model predicts that once the agent transitions into entrepreneurship, she levers up in order to maximize investment in her new business. Second, and more specifically, the model predicts that if the house is an efficient collateral, a new entrepreneur will convert her home equity into business investment by increasing her mortgage up to the maximum loan-to-value ratio allowed. Putting these two pieces of evidence together would provide a fuller picture of the collateral channel associated with higher house prices.

We test this implication of the model by estimating the following equation:

$$\Delta \text{Debt}_{ijt} = \alpha + \beta \cdot \ln(\text{home equity}_{ijt-1}) + \gamma \cdot X_{ijt} + \delta \Phi_{jt} + \varepsilon_{ijt}, \tag{14}$$

where the independent variable is, in turns, the change in total debt and the change in mortgage debt between period $t-1$ and period t for household i in state j who became entrepreneurs between $t-1$ and t. Consistent with the implications of the model, we expect that $\beta > 0$ in both cases. Because there are too many missing data points on various types of debt, we take the less restrictive definition of business ownership (the agent either owns and operates a business, or owns business equity) used in columns (2) and (4) of Table 4. The subsample of such individuals with non-missing information is reduced to a maximum of $2,235$ observations.

Column (1) of Table 7 reports the OLS estimates from the regression of the change in mortgage debt on last period home equity, controlling for demographic characteristics, time-varying state characteristics, and state and year fixed effects. The estimate of β in equation (14) implies that after switching to entrepreneurship, individuals with with higher home equity lever up more than identical individuals who have less equity in their house.

However, this effect is no longer statistically significant in column (2) where we report the estimate from an IV regression where home equity is instrumented using the US-wide change in house prices between the year of home purchase and the current year, interacted with the MSA-wide housing supply elasticity from Saiz (2010).

Insert Table 7 here

In columns (3) and (4), we report the estimates from OLS and IV regression of the change in mortgage debt on home equity for new entrepreneurs. The reported estimates imply that after switching to entrepreneurship, individuals with higher home equity accumulate substantially more mortgage debt. Numerically, a new entrepreneur increased her mortgage by 0.13 of a standard deviation more than an otherwise identical new entrepreneur who last period had twice lower home equity. The result remains statistically significant in column (4) where we again instrument home equity with the US-wide change in house prices between the year of home purchase and the current year, interacted with the MSA-wide housing supply elasticity from Saiz (2010). Our results thus broadly confirm the conjecture that the financing of the business is different when the business owner can readily use her house as collateral.

7 Conclusion

In this paper, we estimate the causal effect of home equity and leverage on entrepreneurship. We define entrepreneurship as the probability of owning and operating a business, as the probability of owning strictly positive business equity, or as either of the two. For all definitions, we find a strong positive effect of home equity on the probability that a non-business owning household will switch to entrepreneurship in the future. Numerically, a 10% increase in home equity increases the probability that a non-business owning household will switch to entrepreneurship in the future by up to 14%. This effect is robust to controlling for a wide range of demographic and income characteristics, for the local business cycle, and for

the bankruptcy code. It also exists independently of a "luxury good" component of housing whereby individuals whose house is appreciating in value can be more likely to purchase the non-pecuniary benefits associated with running a business.

We also find that during housing booms, agents switch to entrepreneurship at lower levels of home equity, arguably because they expect to be able to extract more equity in the future. Finally, we find a strong positive correlation between home equity in the previous period and the increase in (particularly mortgage) debt in this period for new business owners. The intuition is that once agents switch from a fixed-income job to entrepreneurship, they draw down their home equity to finance their business investment, confirming that real estate is indeed efficient collateral.

In order to make sure that our results are not driven by an unobservable individual trait, such as risk aversion, we employ an Instrumental Variable procedure whereby we use changes in state-wide and in national house prices, as well as the topological elasticity of housing supply in the agent's MSA, to extract the exogenous component of changes in home equity. Our main results remain robust to this alternative specification.

Our reduced form estimates imply potentially important linkages between housing and real economic activity. For example, our results suggest that the housing boom before the Great Recession may have resulted in higher rates of new business creation, while increasing levels of mortgage debt since 2006 may have depressed self-employment, denting the positive effect on new business creation of higher unemployment. As such, our results may have important implications for various policy initiatives aimed at reducing the burden of household leverage during the recession. In future work, it would also be instructive to incorporate an analysis of the implications for entrepreneurship of reducing transaction costs in the housing market and of various exemptions related to housing in the case of personal bankruptcy.

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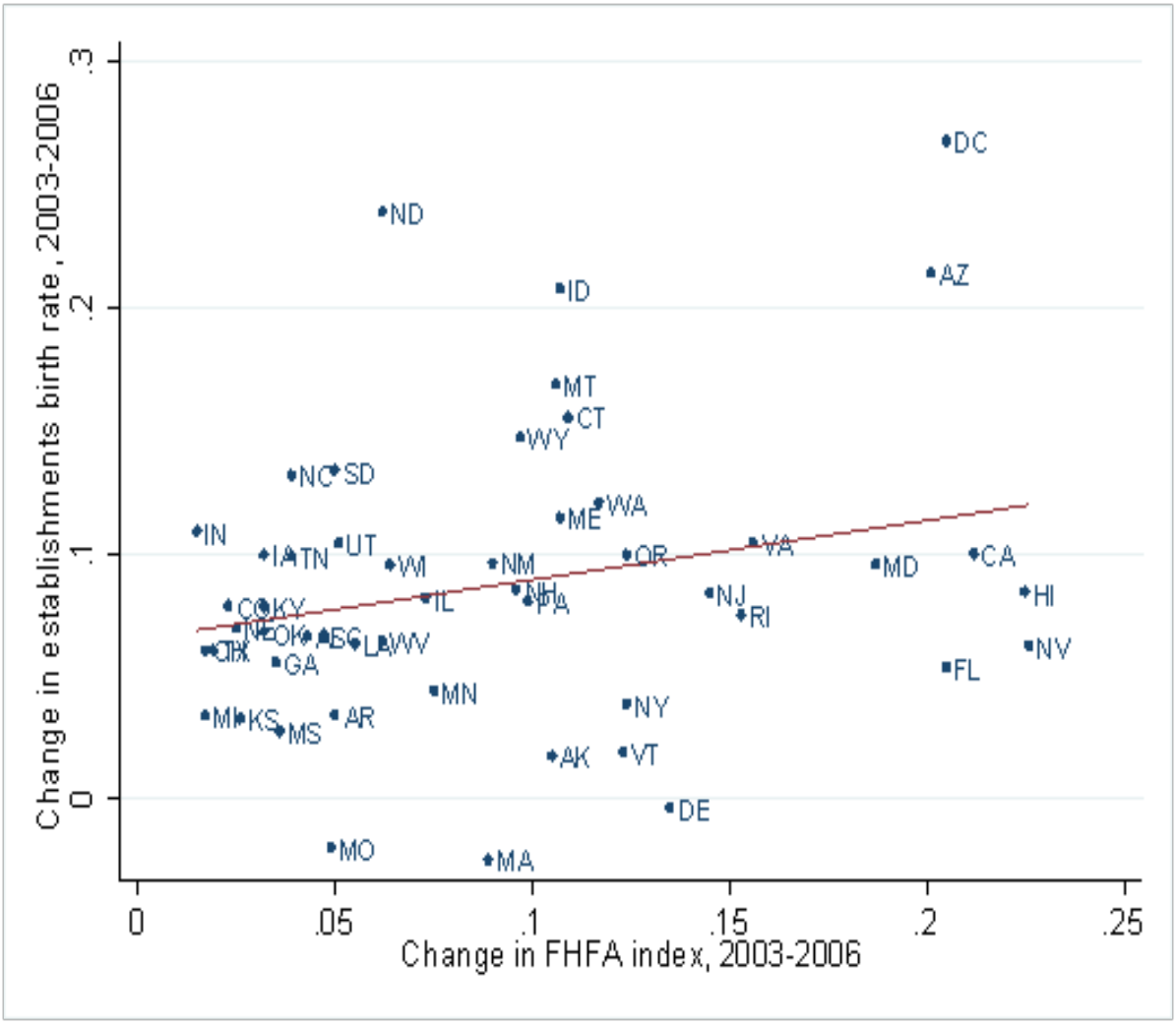

Figure 1: The figure plots the change in establishments births between 2003 and 2006 (the peak of the housing boom) against the change in the state-level Federal Housing Finance Agency house price indexes over the same period, inflation adjusted, for the 50 US states plus the District of Columbia.

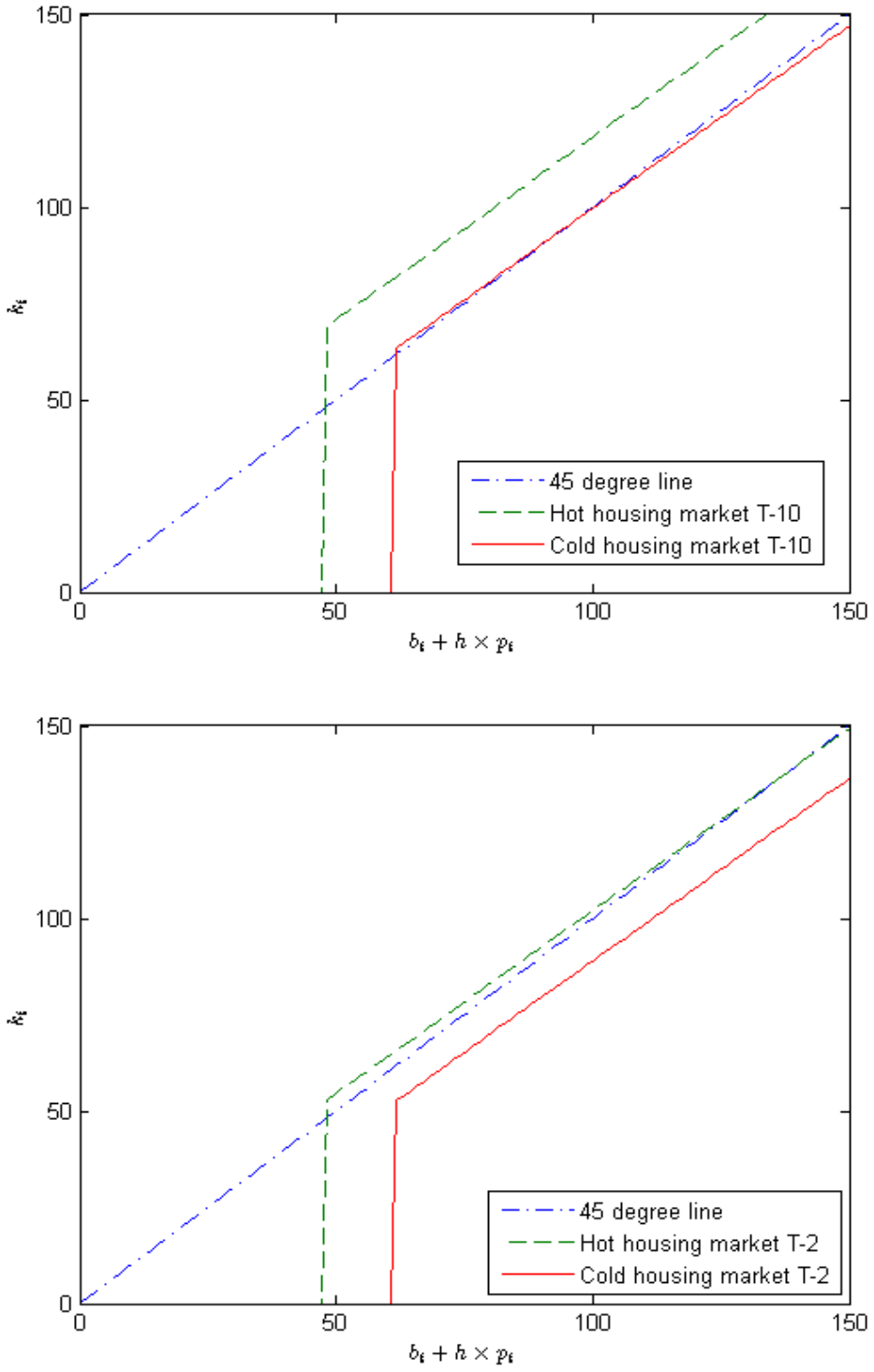

Figure 2: The figure plots the investment in the entrepreneurial activity k with respect to the liquid and housing wealth $b_t + h \times p_t$, in a period of low (solid red line) and high (dashed green line) house price appreciation at time $T - 10$ (upper panel) and $T - 2$ years (lower panel).

Table 1: **Parameters used for benchmark calibration.**

Variable	Symbol	Value
Horizon	T	20 (years)
Curvature of the utility function	γ	2
Housing consumption relative to numeraire	$1-\beta$	0.4
Flow of housing services	g	0.075
Time preference	ρ	0.03
Risk free rate	r_D	0.03
Intermediation cost	ϵ	0.01
Loan-to-value ratio	ϕ	0.9
Housing stock	H	100 (square feet)
House price drift - high growth regime	μ_h	0.0925
House price drift - low growth regime	μ_l	0.004
House price - Prob. switching from high to low	λ_{hl}	0.241
House price - Prob. switching from low to high	λ_{lh}	0.034
House price standard deviation	σ	0.10
Capital depreciation	δ	0.09
Capital share	α	0.8
Entrepreneurial ability - high regime	$\overline{\nu}$	0.9
Entrepreneurial ability - low regime	$\underline{\nu}$	0.1
Entrepreneurial ability – Prob. switching from high to low	θ_{hl}	0.30
Entrepreneurial ability – Prob. switching from low to high	θ_{lh}	0.40
Fixed wage	l	15

Table 2: **Descriptive Statistics of New Business Owners and Non-business Owners: Polled Sample 1997-2006.** The sample includes all households in SIPP for the 1996-2000, 2001-2003, and 2004-2006 waves, between the age of 22 and 60 that did not own a business the first time they were interviewed. All statistics are means. The unweighted percentage of households that became subsequent business owners is 0.017.

	Subsequent non-business owner	Subsequent business owner	p-value of difference
Age	41.56	42.94	0.51
Dum. High school	0.253	0.209	< 0.01
Dum. Some college	0.322	0.314	0.07
Dum. College or more	0.260	0.381	< 0.01
Dum. Black	0.133	0.048	< 0.01
Dum. Female	0.489	0.403	< 0.01
Dum. Married	0.549	0.701	< 0.01
Family labor income	51,155	65,084	0.03
Dum. Unemployed	0.027	0.023	0.08
Household net wealth (no housing)	70,713	158,071	0.08
Home equity	47,534	82,661	< 0.01
Mortgage	42,519	65,116	< 0.01
Home property value	90,054	147,777	< 0.01

Table 3: **Future Business Ownership and Home Equity: OLS Results from the Pooled Sample 1996-2006.** The table reports marginal probit estimates of becoming a business owner in the future (columns (1) and (3)) or in the next period (columns (2) and (4)). The sample is composed of households in SIPP for the 1996-2000, 2001-2003, and 2004-2006 waves, between the age of 22 and 60 that did not own and operate a business the first time they were interviewed. Standard errors clustered by state reported in parentheses.

	Business owner in future (1)	Business owner next period (2)	Business owner in future (3)	Business owner next period (4)
Log(Home equity)	0.0026***	0.0017***	0.0020***	0.0009*
	(0.0007)	(0.0006)	(0.0006)	(0.0005)
Log(House value)			0.0015	0.0021
			(0.0019)	(0.0014)
Age	-0.0001	-0.0000	-0.0001	-0.0000
	(0.0001)	(0.0000)	(0.0001)	(0.0001)
Dum. high school	0.0025	0.0079**	0.0024	0.0080**
	(0.0030)	(0.0033)	(0.0030)	(0.0032)
Dum. some college	0.0016	0.0077***	0.0014	0.0075***
	(0.0027)	(0.0026)	(0.0027)	(0.0026)
Dum. college or more	0.0067**	0.0118***	0.0062*	0.0112***
	(0.0034)	(0.0033)	(0.0035)	(0.0033)
Wealth	0.0006***	0.0005***	0.0006**	0.0004***
	(0.0002)	(0.0001)	(0.0002)	(0.0001)
Wealth^2	-0.0000	-0.0000	-0.0000	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Wealth^3	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Earned income	-0.0132	-0.0066	-0.0152	-0.0095
	(0.0131)	(0.0080)	(0.0139)	(0.0089)
Dum. female	-0.0018	-0.0011	-0.0018	-0.0011
	(0.0013)	(0.0010)	(0.0013)	(0.0010)
Dum. black	-0.0080***	-0.0054***	-0.0079***	-0.0052***
	(0.0017)	(0.0013)	(0.0018)	(0.0013)
Dum. married	0.0038***	0.0032***	0.0037***	0.0030***
	(0.0012)	(0.0009)	(0.0012)	(0.0010)
Dum. unemployed	-0.0055**	-0.0020	-0.0055**	-0.0020
	(0.0023)	(0.0021)	(0.0023)	(0.0021)
State unemployment	0.0022**	0.0012	0.0022*	0.0012
	(0.0011)	(0.0008)	(0.0011)	(0.0008)
GSP growth	-0.0006	-0.0003	-0.0006	-0.0003
	(0.0005)	(0.0004)	(0.0005)	(0.0004)
Homestead exemption	0.0022***	0.0015**	0.0022***	0.0014**
	(0.0008)	(0.0007)	(0.0008)	(0.0007)
F.E. State & Year	X	X	X	X
Num. Obs.	39,999	53,352	39,999	53,352

Table 4: **Future Business Equity and Home Equity: OLS Results from the Pooled Sample 1997-2006.** The table reports marginal probit estimates of owning business equity in the future (column (1)) or in the next period (column (3)), and of either owning and operating a business, or owning business equity, in the future (column (2)) or in the next period (column (4)). The sample is composed of all households in SIPP for the 1996-2000, 2001-2003, and 2004-2006 waves, between the age of 22 and 60 that did not own business equity (columns (1) and (3)), or that did not own business equity or own and operate a business (columns (2) and (4)) the first time they were interviewed. Standard errors clustered by state are reported in parentheses.

	Business equity in future	Business owner or business equity in future	Business equity next period	Business owner or business equity next period
	(1)	(2)	(3)	(4)
Log(Home equity)	0.0033*	0.0006	0.0015**	0.0025**
	(0.0018)	(0.0020)	(0.0008)	(0.0011)
Income/ demographic controls included?	Yes	Yes	Yes	Yes
F.E. State & Year	X	X	X	X
Num. Obs.	33,147	32,949	75,854	75,616

Table 5: **Future Business Ownership and Home equity: IV Results from the Pooled Sample 1997-2006.** The table reports marginal probit estimates of the transition into business ownership in the future. The sample is composed of all households in SIPP for the 1996-2000, 2001-2003, and 2004-2006 waves, between the age of 22 and 60 that did not own and operate a business the first time they were interviewed. In column (1), Log(Home equity) is instrumented using the change in house prices in the state between the year when the house was bought and the present year. In column (2), Log (Home equity) is instrumented using the US-wide change in house prices between the year when the house was bought and the present year, interacted with the MSA-level topological elasticity of housing supply from Saiz (2010). Standard errors clustered by state are reported in parentheses.

	Business owner in future (1)	Business owner in future (2)
Log(Home Equity)	0.0113**	0.0237*
	(0.0046)	(0.0131)
Income/demographic controls included?	Yes	Yes
F.E. State & Year	X	X
Num. Obs.	36,776	36,636

Table 6: **Future Business Ownership, Home Equity, and Housing Booms: OLS and IV Results from the Pooled Sample 1997-2006.** The table reports marginal probit and IV estimates of the transition into business ownership in the future. The sample is composed of all households in SIPP for the 1996-2000, 2001-2003, and 2004-2006 waves, between the age of 22 and 60 that did not own and operate a business the first time they were interviewed. Elasticity MSA is the MSA-level topological elasticity of housing supply from Saiz (2010). In column (2), Log(Home equity) is instrumented using the change in house prices in the state between the year when the house was bought and the present year. Standard errors clustered by state are reported in parentheses.

	OLS	IV
	(1)	(2)
Log(Home equity)	-0.0005	0.0086**
	(0.0017)	(0.0044)
Elasticity MSA	-0.0142*	-0.0238**
	(0.0085)	(0.0116)
Log(Home equity) X Elasticity MSA	0.0017**	0.0025**
	(0.0008)	(0.0011)
Income/demographic controls included?	Yes	Yes
F.E. State & Year	X	X
Num. Obs.	39,849	36,636

Table 7: **Home Equity and Other Types of Finance for Business Owners: OLS and IV Results from the Pooled Sample 1997-2006.** The table reports OLS and IV estimates of the change in total and in mortgage debt. ΔTotal debt refers to the change in the total (mortgage and non-mortgage) debt from the last period to the current period. ΔMortgage debt refers to the change in the value of the mortgage debt from the last period to the current period. The sample is composed of all households in SIPP for the 1996-2000, 2001-2003, and 2004-2006 waves, between the age of 22 and 60 that did not own business equity or operated a business in the previous period, but that do in this period. In columns (2) and (4), Log(Home equity) is instrumented using the US-wide change in house prices between the year when the house was bought and the present year, interacted with the MSA-level topological elasticity of housing supply from Saiz (2010). Standard errors clustered by state are reported in parentheses.

	Δ Total Debt		Δ Mortgage	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
Log(Home equity)$_{t-1}$	0.100**	0.579	0.147***	0.908*
	(0.038)	(0.489)	(0.033)	(0.532)
Income/demographic controls included?	Yes	Yes	Yes	Yes
F.E. State & Year	X	X	X	X
R^2	0.049	0.091	0.057	0.097
Num. Obs.	2,235	2,085	1,810	1,725