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Abstract

We study the link between homeownership, mortgage debt, and entrepreneurship using a model of occupational choice and housing tenure where homeowners commit to mortgage payments. Our model predicts that, as long as mortgage rates exceed the rate of interest on liquid wealth: (i) mortgage debt, by amplifying risk aversion, diminishes the likelihood that homeowners start a business; and (ii) the negative relation between mortgage debt and entrepreneurship is more pronounced when income volatility is higher. Our model further predicts that the relation between housing wealth and entrepreneurship is ambiguously signed because of competing portfolio and hedging considerations. Exploiting the longitudinal dimension of the British Household Panel Survey to control for unobservables, we test and confirm these predictions. A one standard deviation increase in leverage makes a homeowner 10-12 percent less likely to become an entrepreneur.

JEL-Code: L260, D140, G110, R210.

Keywords: entrepreneurship, homeownership, mortgage debt, leverage, commitment.

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1 Introduction

Extensive research has highlighted the impact of housing on a household's exposure to risky assets (Flavin and Yamashita, 2002; Cocco, 2005). House purchases are typically leveraged and mortgage debt affects portfolio choices – in an opposite direction to home equity wealth, as pointed out by Chetty and Szeidl (2012). While most of the literature focuses on the effect of mortgage debt on stock holdings, in this paper we consider its effect on entrepreneurial activity – interpreting the latter as an asset with an expected return and variance. We first provide a model of occupational choice and housing tenure that formalizes the entrepreneurial decision of homeowners with varying degrees of financial leverage. We then test the model predictions using the British Household Panel Survey (BHPS) for the period 1991–2008.

In our model agents choose occupation as dependent workers or entrepreneurs, conditional on their housing tenure and the extent of their mortgage debt. Entrepreneurship in our setting has both benefits and costs. In line with previous work, we assume that entrepreneurship provides non-pecuniary benefits (Hurst and Pugsley, 2011) whose magnitude varies across individuals according to their 'entrepreneurial taste'. On the cost side, we assume that the income of entrepreneurs has a higher variance than that of dependent workers, making entrepreneurship more risky than dependent employment. This is consistent with our data and previous empirical work (Hamilton, 2000).

Our theoretical framework yields two main testable propositions. First, as long as the mortgage rate paid by individuals exceeds the rate of interest earned on liquid wealth, mortgage debt diminishes the likelihood that homeowners start a business (Proposition 1). Second, the negative relation between financial leverage and entrepreneurship is more pronounced when considering homeowners who choose to work in sectors where profits are more volatile (Proposition 2).[1]

The intuition behind these predictions can be summarized as follows. When agents increase their mortgage debt – for a given amount of total wealth and housing – they correspondingly increase the amount of liquid wealth in their portfolio. As long as the cost faced by individuals on the additional mortgage debt exceeds the rate of interest earned on the additional liquid wealth, this implies a reduction in net wealth and amplifies the degree of the borrower's risk aversion. In turn, this increases the likelihood that the utility loss from income uncertainty associated with entrepreneurship exceeds the non-pecuniary benefits associated with entrepreneurship, and reduces the probability that leveraged homeowners will become entrepreneurs (Proposition 1). All else equal, an increase in income uncertainty will strengthen this effect (Proposition 2).

Our model also yields a prediction with respect to the impact of housing wealth on entrepreneurship, although this prediction is ambiguously signed. This is because two competing forces are at play. On the one hand, an increase in housing wealth – attained by an increase in either quantity or values – reduces the share of labour income in an individual's total wealth, thus reducing the importance of labour income risk

[1] Our model provides a counterpoint to Davidoff (2006) who shows that individuals whose labor income co-varies strongly with housing values purchase relatively inexpensive homes. Differently to him, we analyze occupational choice conditional on housing tenure. The timing of transitions into entrepreneurship and home-ownership in our data suggests this is a more natural sequence.

and making entrepreneurship more attractive. On the other hand, more housing increases an individual's exposure to house price risk and discourages entrepreneurship. This ambiguously-signed finding is in sharp contrast with the predictions of a simple model with credit constraints and bank lending against housing – but no portfolio and hedging considerations – where a rise in house prices would raise the collateral value of housing and allow for more borrowing from banks to start an entrepreneurial activity.

In an extension of our model we consider the role of housing consumption commitments in the spirit of Chetty and Szeidl (2007) and Shore and Sinai (2010). In this case, renters can freely adjust their housing consumption vis-a-vis income shocks. However, homeowners have to stick to their initial housing consumption because they face high transaction costs. This version of our framework has two main distinguishing predictions relative to our baseline model, namely that: (i) an increase in the amount of housing in an individual's portfolio has an unambiguously negative effect on entrepreneurship; and (ii) house price considerations have no effects on the likelihood of starting a business. Predictions 1 and 2 instead hold unaffected in the presence of housing consumption commitments.

An important feature of our model is that we allow individuals to differ in unobserved ways in their innate taste for entrepreneurship and the extent of mortgage debt used to finance their housing purchase. In our setting, some homeowners with mortgages still decide to start a business because of their strong innate preferences to be entrepreneurs. Hence in the empirical analysis we control for unobserved individual characteristics using a fixed-effect strategy.

To test the main predictions of our model, we exploit the longitudinal dimension of the British Household Panel Survey (BHPS) covering the period between 1991 and 2008. We construct a detailed monthly-spell dataset that tracks individuals' job histories and tenure choices, coupled with information on time-varying background characteristics. We use this dataset in order to identify the precise timing of individuals' transitions into homeownership and entrepreneurial jobs. Our data reveals that a higher percentage of people transits into homeownership than into entrepreneurship, and at an earlier age. Thus it seems natural to focus on the relation between homeownership and entrepreneurship in this order.

One empirical concern is the need to distinguish between genuine entrepreneurship and other kinds of self-employment (Hurst and Pugsley, 2011; Faggio and Silva, 2014). In this paper, we define entrepreneurs as self-employed individuals with dependent workers. By doing so, we are able to study the link between leverage, housing and genuine entrepreneurship, rather than self-employment out of necessity or as a last-resort option (Alba-Ramirez, 1994; Martinez-Granado, 2002).

We begin our analysis by presenting some stylized facts. OLS estimates indicate a positive association between homeownership and entrepreneurship. However, this relation turns negative once we use fixed effects to control for time-invariant unobservables, such as innate entrepreneurial preferences or persistent wealth. The magnitude of this relation is sizable; individuals who become homeowners are about 25% less likely to become entrepreneurs.

We then proceed with our main empirical investigation and test the model predictions. We show that the

negative relation between homeownership and entrepreneurship is only significant for leveraged homeowners, and this negative link is increasing in the extent of mortgage debt. Using individual time-varying information on the loan-to-value (LTV) ratio of the mortgage, we find that a one standard deviation increase in the LTV is associated with approximately a 10% reduction in the probability of becoming an entrepreneur. This is consistent with Proposition 1 of our model.

To address concerns about endogeneity in our estimates of the link between an individual's tenure status, LTV and entrepreneurship, we extend our main specification in a number of directions. First, we replace individual fixed effects – which control for time-invariant unobservables – with individual-specific housing-spell effects. This specification focuses on the variation in LTV within a specific housing spell, and accounts for changes in individual unobservables when they first become homeowners and at any time when they move home or change their tenure status. This approach thus helps us addressing the endogeneity of tenure choice. These specifications yield an even stronger negative link between leverage and entrepreneurship.

Next, we devise an instrumental variable (IV) strategy based on information on the LTV of newly originated mortgages in the area of an individual's residence obtained from the Survey of Mortgage Lenders (SML). We use this area-level data to predict an individual's LTV. The validity of this approach rests on the assumption that: (i) an individual's LTV changes over time partly because of refinancing decisions dictated by the nature of the mortgages predominantly available in the UK (fixed rates for 2-5 years, and floating afterwards); and (ii) most of the mortgage (re-)financing conditions are dictated by the local housing market and banking circumstances (Muellbauer, 2002). To account for the confounding effect of local economic cycles, we further control for local house prices in some of our specifications. Supplementing our fixed-effect models with this IV strategy fully confirms our previous findings and suggests that a one standard deviation increase in the LTV reduces the propensity to become an entrepreneur by about 12%.

Finally, we directly assess whether leveraged homeowners shy away from riskier entrepreneurial ventures. We collect data on company profits at a detailed sectoral level and construct a proxy for the riskiness of entrepreneurial ventures based on profit variability. Using this information, we show that the negative link between a homeowner's LTV and entrepreneurship holds for homeowners operating in risky sectors, but not for homeowners working in industries with lower profit variability. This provides empirical support for Proposition 2 of our model.

We also show that the negative link between leverage and entrepreneurship is stronger in areas where house prices are highly correlated with profits, and that the effect of housing quantity is not precisely estimated and ambiguously signed. These patterns are consistent with a version of our model in which homeowners have a positive probability of relocation and thus are not 'fully committed' to their housing consumption.

At a first glance, our main findings could also be consistent with a theory based on credit constraints, whereby leveraged home buyers are prevented from taking on additional credit to start a business. While such an interpretation would not alter our main message – i.e., that high indebtedness reduces the likelihood

that individuals start a business – we cannot find any empirical evidence to support it. In particular, for this explanation to hold true, we should detect a positive relationship between house price increases and entry into entrepreneurship: as home values increase, LTV ratios are pushed down and housing becomes a collateral that can be used to borrow. Empirically, however, we find that house price variation has no explanatory power in predicting entrepreneurship and cannot account for the negative link between leveraged homeownership and entrepreneurship. In particular, we show that neither self-reported current housing values nor capital gains accrued since the time of first purchase enter our regressions significantly. This is irrespective of whether we follow Chetty and Szeidl (2012) and instrument housing value appreciation using national house price variation in interaction with proxies for the local elasticity of housing supply. This finding is very similar to Hurst and Lusardi (2004) and Disney and Gathergood (2009), and supports our theoretical framework in which portfolio and hedging considerations give rise to an ambiguously-signed relation between housing wealth and entrepreneurship.

By highlighting a new channel through which mortgage debt hinders productive investments, our paper contributes to the debate on the adverse consequences of household debt on the general economy (Mian et al., 2013). Our findings are of general relevance because most countries subsidize mortgage financing. For instance, the UK have recently introduced the Help to Buy scheme to promote homeownership. For the US, recent research suggests that the mortgage interest deduction (MID) increases the loan size of individual borrowers substantially (Munroe, 2014).[2] Our framework suggests that, by increasing leverage, the MID might increase risk aversion and discourage alternative investments such as entrepreneurship. However, the MID also lowers the effective mortgage interest rate and – if the subsidy is sufficiently strong – the effective mortgage cost could be lower than the interest from liquid wealth, thus reversing the prediction of our model. Other policies that only affect leverage directly – and not indirectly via lowering interest rates – can be expected to have the unintended effect of discouraging entrepreneurial activity.

Our paper is structured as follows. Section 2 discusses the related literature. Section 3 illustrates our theoretical framework. In Sections 4 and 5 we describe our data and present descriptive statistics and stylized facts. Section 6 discusses our main findings. Finally, we provide some concluding remarks in Section 7.

2 Related literature

Our findings contribute to three strands of the literature: (i) the theoretical link between homeownership, entrepreneurship and portfolio choices; (ii) the empirical link between homeownership, house prices, and entrepreneurship; and (iii) the labor market externalities of homeownership.

Both owner-occupied housing and entrepreneurship play a prominent role in the context of portfolio decisions. Henderson and Ioannides (1983) were the first to formulate the proposition that owner-occupiers over-invest in housing. Brueckner (1997) demonstrated that when the investment constraint induced by

[2]Hilber and Turner (2013) further show that the policy may not raise homeownership on aggregate.

owner-occupied housing is binding, homeowners cannot adequately diversify their portfolio. Flavin and Yamashita (2002) examine a household portfolio problem when housing matters both as consumption and investment. They find that the optimal consumption level might exceed the optimal investment quantity. More recently, Cocco (2005) and Chetty and Szeidl (2012) show that homeownership – and in particular homeownership associated with large mortgages – significantly reduces a household's exposure to risky assets, such as stocks. Our results are consistent with the logic presented in this strand of the literature: mortgage debt amplifies a borrower's risk aversion and this in turn increases the likelihood that income uncertainty discourages leveraged homeowners from starting their own business.

In a similar vein, Heaton and Lucas (2000) show that running a private business has a significant impact on portfolio choices. Entrepreneurs invest proportionally less in stocks than other dependent workers, especially if they own a significant stake in the business they run. Faig and Shum (2002) bring together housing and entrepreneurial ventures in their analysis and show that households who plan to invest in one of these two activities, which they call 'illiquid projects', hold significantly safer portfolios. Since entrepreneurship and housing are both highly illiquid, those households need a portfolio of liquid assets, which can be readily sold, in order to face liquidity needs.

Our work also touches upon the large empirical literature that investigates the relation between homeownership, house prices, and entrepreneurship. In two related studies using UK macro data, Black et al. (1996) point out that bank loans are often secured on an entrepreneur's house, and De Meza and Webb (1999) argue that liquidity constraints play a major role in determining who sets up a business, and that capital-market failure holds back enterprise.[3] A different view is provided by Hurst and Lusardi (2004), who suggest that the relation between wealth and entrepreneurship is only significant at the very top of the wealth distribution. Moreover, they find that households living in areas which experience strong house price appreciation are not more likely to start an entrepreneurial venture.[4]

Two other papers that explicitly investigate the link between homeownership and entrepreneurship using micro-level data are Fairlie (2010) and Wang (2012). The former presents cross-sectional evidence for the US suggesting that homeownership has a small positive effect on business creation (consistent with our OLS results). The latter investigates the effects on entrepreneurship of a policy that allowed Chinese public-sector employees renting state-owned housing to buy their properties at subsidized prices. More recently, Harding and Rosenthal (2013) provide cross-sectional evidence for the US suggesting that house price gains experienced by homeowners promote entrepreneurship. Adelino et al. (2013) use US data at the MSA level to show that areas with faster house price appreciation between 2002 and 2007 experienced more business start-ups.[5]

[3]The literature on the role played by credit constraints in the decision to become an entrepreneur is vast (Evans and Jovanovic, 1989; Holtz-Eakin and Rosen, 1994; Blanchflower and Oswald, 1998; Michelacci and Silva, 2007; Fairlie and Krashinsky, 2011; Jensen et al., 2014).

[4]A similar result is presented in Disney and Gathergood (2009) using British data.

[5]We believe the discrepancy between their findings and ours might be explained by the fact that our results mainly capture the trade-off between homeownership and entrepreneurship faced by individuals in the presence of financial leverage. Harding and Rosenthal (2013) focus on older individuals aged above 50, who are typically less leveraged and so less affected by the mechanism highlighted in our work. Adelino et al. (2013) instead use aggregated data that lack detailed information on a

Finally, our work is related to the literature that investigates the labor market externalities of owner-occupation.[6] In a series of seminal articles Oswald (1996, 1998, 1999) and in a recent paper Blanchflower and Oswald (2013) suggest that high rates of homeownership are associated to higher levels of unemployment or, more generally, may impair the labor market. Blanchflower and Oswald (2013) suggest that this might be because homeownership is associated with lower levels of mobility and fewer new businesses. A large body of literature has investigated the assertion that homeownership lowers mobility and may thus trigger unemployment, including Munch et al. (2006) and Battu and Phimister (2008). Although the findings from these two studies support Oswald's conjecture that homeowners are less geographically mobile, the authors find no evidence that homeowners are more likely to become unemployed or have longer unemployment spells. Conversely, very few papers (mentioned above) have investigated the link between homeownership and new business start-ups. Our work provides a theoretical explanation – and consistent evidence – for why leveraged homeownership may be associated with fewer new businesses.

3 Theoretical framework

This section develops a model of occupational choice as a function of tenure status and mortgage debt. Similar to Chetty and Szeidl (2012), we model the effect of homeownership on risk taking in financial portfolios, distinguishing between home equity wealth and mortgage debt. However, instead of exploring the effect of mortgage debt on a continuous variable such as stock-holding, we consider its effect on a binary occupational choice – dependent work against entrepreneurship – treating the latter as an asset with an expected return and a variance.

The main insight from our model is that, conditional on individual innate characteristics – including persistent wealth and 'taste for entrepreneurship' – and assuming that mortgage rates exceed interest rates on liquid wealth, increasing mortgage debt *reduces* the likelihood of being an entrepreneur. This occurs because mortgage payments increase the effect of income risk on an individual's utility. Therefore homeowners avoid occupations, such as entrepreneurial activities, where income risk is greatest.

In our framework, agents commit to repay their mortgage debt. Stated differently, individuals make a 'cash commitment' to their mortgage payments and can neither default nor renegotiate the owed installments in the case of negative income shocks. Another type of commitment, the inability to adjust housing consumption because moving is costly, may also be at work. As we show in this section, this form of consumption commitment is not necessary to get our main results.

household's leverage, and cannot track an individual's tenure and employment transitions.

[6] A number of papers have studied other externalities stemming from owner-occupation, including the effect of homeownership on: civic engagement and social capital (e.g., DiPasquale and Glaeser, 1999; Hoff and Sen, 2005; Hilber, 2010); control of local governments (e.g., Fischel, 2001; Dehring et al., 2008); environmental issues and children's education (Dietz and Haurin, 2003); and spending on local public schools (Hilber and Mayer, 2009).

3.1 Assumptions

Utility function: We envisage a two-period setting (period 0 and period 1), in which agents maximize period-1 utility:

$$\mathbb{E}_0 \frac{\left(C_1^{1-\mu} H_1^{\mu}\right)^{1-\gamma}}{1-\gamma}$$

under a budget constraint. We assume that individuals derive utility from the consumption of a standard composite good (C) and housing (H), and that the utility function is characterized by constant relative risk aversion (CRRA). Empirical evidence suggests that household expenditure in housing μ is a constant fraction of income (Davis and Ortalo-Magné, 2011).[7]

Budget constraint: Agents decide to consume the numeraire good and housing out of their total available wealth at the beginning of period 1:

$$C_1 + P_1 H_1 = W_1.$$

Similar to Chetty and Szeidl (2012), we represent wealth as:

$$W_1 = Y_1 + P_1 H_0 - M_0(1 + R_M) + L_0(1 + R_F), \tag{1}$$

where the housing endowment is H_0, the mortgage debt outstanding at period 0 is M_0 which is charged at interest rate R_M, and the liquid wealth outstanding in period 0 is L_0 and it earns an interest of R_F. For simplicity, we omit the subscript i from all these expressions. However, conceptually, individuals can differ in terms of their overall wealth W_1 as well as in their initial allocation of M_0 and L_0. Similarly, R_M could differ across individuals because it is partly be determined by the prevailing market rates, but also related to the borrower's specification conditions, in particular the loan-to-value ratio of the mortgage (see evidence in Besley et al., 2013).[8] In our empirical analysis, we account for this unobserved individual heterogeneity using a number of specifications.

In terms of individual housing tenures, we can think of the following specific cases:

- a renter has $M_0 = 0$ and $H_0 = 0$,
- a homeowner without mortgage has $M_0 = 0$ and $H_0 > 0$, and
- a homeowner with mortgage has $M_0 > 0$ and $H_0 > 0$.

Because period 1 is the last period for all agents, P_1 is both a purchase and a rental price (i.e., there is no material difference between buying and renting).

[7] Note that our utility functions further assumes: (i) complementarity between housing and consumption of the composite good, i.e. $U_{ch} \geq 0$, as in Chetty and Szeidl (2007). This assumption has been extensively used and documented in both the macro and micro finance literature (Lustig and Nieuwerburgh, 2005; Piazzesi et al., 2007; Flavin and Nakagawa, 2008); and (ii) prudence in the consumption of the standard composite good, i.e. $U_{CCC} > 0$. This is equivalent to requiring that additional risk reduces consumption, and it is a common condition in the literature on precautionary savings (Shore and Sinai, 2010).

[8] For simplicity we can think of R_F as being the same for all individuals and predominately determined by financial markets.

Occupational choice: In our setup, workers choose between two occupations, which determine their income. Dependent workers receive constant income $\overline{Y}$ and entrepreneurs receive variable income Y_e. We assume that the income of an entrepreneur is a mean-preserving spread of an employee's income:

$$\mathbb{E}Y_e = \overline{Y},$$

with σ_e^2 indicating the entrepreneurial income variance.[9] This assumption is consistent with the literature on entrepreneurial labor choice: Hamilton (2000) shows that entrepreneurs earn on average the same or less than comparable dependent workers, though their income volatility is significantly larger.[10]

Evidence in Evans and Leighton (1989), Blanchflower and Oswald (1992), and Hurst and Pugsley (2011) suggests that non-pecuniary benefits (e.g. being one's own boss or having flexible working hours) play a first-order role in the business formation decision. Thus, we assume that agents get a positive utility shift $\alpha_i \geq 0$ when they decide to become entrepreneurs, and we allow this 'taste for entrepreneurship' to vary across individuals as indicated by the subscript i.[11] We posit that the α_i's follow a generic cumulative distribution $F(\alpha)$ where α is bounded between 0 and infinity. The total utility for agent i can be characterized as:[12]

$$\begin{array}{ll} U(C,H) & \text{if agent } i \text{ is a worker, and} \\ \frac{1}{\alpha_i}U(C,H) & \text{if agent } i \text{ is an entrepreneur.} \end{array}$$

Individuals maximize their indirect utilities, which depend on wealth W and are denoted by $V(W)$. Before the uncertainty is resolved and a value for Y is drawn, individuals have to choose whether to be workers or entrepreneurs. To do so, they compare the expected utilities of the different employment possibilities.

3.2 The entrepreneurship decision

We study employment decisions conditional on tenure status. An agent chooses to become an entrepreneur if her parameter α_i is above some threshold α^*, and the fraction of agents that do *not* start an entrepreneurial venture is equal to $F(\alpha^*)$. The threshold α^* is defined by:

$$\alpha^* \equiv \frac{\mathbb{E}V(W_1^e)}{\mathbb{E}V(W_1^w)}. \tag{2}$$

In Appendix A, we start from the equivalence shown by equation (2) and assume that entrepreneurial income and house price growth are lognormally distributed. Using a standard approximation, we derive a

[9] Dependent work carries risks too and a more complete model would include a variance for the income of dependent workers, σ_w^2. In practice, as long as $\sigma_e^2 > \sigma_w^2$, this has no material impact on the prediction of our model.

[10] In our empirical analysis, we replicate this fact (see Section 5).

[11] This setting is different from a model à la Lucas (1978) where individuals' entrepreneurial choices are driven by 'business acumen', i.e. the ability to generate extra gains by running a business.

[12] Utilities of the CRRA form take on negative values so that a higher α_i in $\frac{1}{\alpha_i}U(C,H)$ leads to a higher utility level.

closed form solution for the entrepreneurship threshold:

$$\log \alpha^* = \frac{(1-\gamma)^2}{2}\eta_Y \; (\underbrace{\eta_Y \sigma_e^2 + 2\eta_H \sigma_{ep}}_{\text{portofolio effect}} \quad \underbrace{-2\mu\sigma_{ep}}_{\text{hedging effect}} \;), \tag{3}$$

where η_Y and η_H are the fractions of total wealth associated with labor income and housing, respectively, and σ_{ep} is the covariance between house prices and entrepreneurial income. Intuitively, a higher risk aversion γ leads to a higher threshold α^* because, when entrepreneurial income is more volatile, only agents with a strong preference for entrepreneurship start a business. The threshold α^* increases also when labor income is a large fraction of wealth (η_Y is high), because under CRRA preferences this leads to a greater cost of entrepreneurial income volatility.

The covariance between house prices and entrepreneurial income instead has an ambiguous effect on the decision to start a business.[13] On the one hand, σ_{eP} increases the overall risk of the portfolio and therefore reduces the likelihood of choosing an entrepreneurial occupation – a standard *portfolio effect*. On the other hand, since agents need to consume housing in period 1 (because $\mu > 0$), entrepreneurship can offer an insurance against housing costs and become more attractive as an occupational choice – a *hedging effect*. This mechanism is similar to the one highlighted in Sinai and Souleles (2005).[14] When $\mu = 0$ households do not want to consume any housing and the model reduces to a standard portfolio choice. The opposing portfolio and hedging effects in our model stem from the dual nature of housing as both consumption and investment.

3.3 Comparative statics

In this subsection we study the effects of mortgage debt and housing wealth on occupational choice. It is important to study these two components of wealth separately since, as we show below, the model predicts an unambiguously negative effect of mortgage debt in contrast to an ambiguous effect of housing wealth.

3.3.1 The effect of mortgage debt

Our objective is to evaluate the effect of changes in mortgage debt (M_1) keeping initial wealth (W_0) constant. We consider an increase in the amount of debt outstanding M_0 matched by an equivalent change in liquid wealth L_0 (assuming that the choice of H_0 has already been made and is treated as exogenous). In this case, net assets in the last period are:

$$W_1 = Y_1 + P_1 H_0 - (M_0 + \Delta M_0)(1 + R_M) + (L_0 + \Delta M_0)(1 + R_F),$$

[13] Strictly speaking, since both the income of dependent workers and entrepreneurs are expected to covary with house prices, σ_{eP} represents the additional covariance associated with entrepreneurial income relative to dependent employment. We ignore the case $\sigma_{eP} < 0$ because in our data entrepreneurial income is strongly and positively correlated with house prices, and more so than the income of dependent workers.

[14] The house price variance σ_p^2 does not enter equation (3) above, despite influencing individual utility (house price variability is disliked by risk averse agents). Both workers and entrepreneurs are affected by σ_p^2 in the same way; when the two utilities are compared, this term cancels out.

and the effective change in wealth is:

$$\frac{\mathrm{d}\ W_1}{\mathrm{d}\ M_0} = -(R_M - R_F).$$

This implies that an increase in the initial mortgage amount – i.e., the leverage chosen in period 0 – decreases net wealth as long as $R_M > R_F$. In our empirical setting $R_M > R_F$ is highly likely to hold since in Britain (unlike in the US) mortgage interests cannot be deducted from income taxes.[15]

With constant relative risk aversion, the variability of entrepreneurial income has a higher utility cost when wealth is lower because risky labor income represents a larger fraction of total wealth (η_Y in equation (3) is bigger). Moreover, a lower wealth increases the impact of house price co-movements with entrepreneurial income on utility through the term η_H in equation (3). Hence, an increase in mortgage debt has a negative effect on the likelihood to become an entrepreneur as long as $R_M > R_F$:

Proposition 1. *Under the assumption that $R_M > R_F$, the link between homeownership and entrepreneurship depends negatively on the extent of mortgage debt.*

On top of this base effect, equations (3) and (4) also point to an important interaction between the wealth share associated with labor income (η_Y) and entrepreneurial risk (σ_e^2). An increase in σ_e^2 makes agents more reluctant to become entrepreneurs and this effect is amplified at high level of mortgage debt, provided that $R_M > R_F$. Hence, we expect that an increase in mortgage debt will have a particularly strong adverse effect on the propensity of a homeowner to become an entrepreneur in sectors where profit variability is high:

Proposition 2. *Under the assumption that $R_M > R_F$, the negative link between financial leverage and entrepreneurship is greater in sectors where profits have a higher variance.*

We test these propositions in our data by looking at the effect of mortgage debt while holding overall wealth constant. To do so, we exploit the longitudinal nature of our data and use fixed effects to control for persistent wealth and individuals' 'entrepreneurial taste' α_i. We also use detailed information on individual and household income sources to account for changes over time in their financial situation.

3.3.2 The effect of housing wealth

The value of housing is reflected in the H_0P_1 term in agents' wealth. Overall, the effect of a change in H_0P_1 is ambiguous. On the one hand, it increases wealth, making η_Y smaller and decreasing the risk associated with labor income. On the other hand, it increases the wealth share of housing (η_H), making the overall portfolio position more risky.[16] To translate our model into empirical predictions, it is useful to distinguish between the effects of changes in housing quantities (H_0) and prices (P_1).

[15]The Mortgage Interest Relief at Source (MIRAS), introduced in 1983, was phased out between 1988 and 2000. Even in the early years of our sample period (spanning 1991 to 2008), the MIRAS subsidy was limited in scope compared to the US Mortgage Interest Deduction. Thus, in our empirical investigation, R_M likely exceeds R_F during the entire sample period. The effect may be ambiguous in countries where mortgage interest deductions are important.

[16]By contrast, when evaluating the effect of mortgage debt, both η_Y and η_H move in the same direction. As a result the effect is unambiguously negative.

When analyzing changes in H_0, we would ideally like to compare the same individual with different quantities of housing but the same level of initial wealth W_0. When the agent has less housing, she holds more risk-free liquid assets L_0. We assume that housing is expected to appreciate more than R_F because it is risky. Therefore, when the agent has more housing, she has a lower η_Y, which reduces α^*. At the same time, more housing brings more risk in the agent's portfolio through η_H, which pushes α^* up. As a result, the overall effect is ambiguous. In the empirical analysis, we mainly use a binary measure of H_0 (homeownership) instead of a continuous measure (quantity of housing in the portfolio). Therefore, we test this (ambiguously-signed) prediction by focusing on the effect of introducing housing in the portfolio – i.e. going from being a renter to being an owner – in specifications that control for the level of debt and housing values, and hold wealth constant. In some extensions, we also use 'number of rooms' to provide a more continuous proxy for H_0.

The effect of an increase in house prices P_1 is similarly ambiguous. On the one hand, an increase in P_1 raises the agent's wealth and decreases η_Y – reducing the negative effect of entrepreneurial income variation. On the other hand, it also increases η_H – thus pushing up the detrimental effect of co-movements of income and house prices. The overall effect depends on the specific magnitude of the parameters that govern two opposing forces – portfolio and hedging effects – which are at play in the model (as shown in more detail in the Appendix). Regarding the first, a high σ_e^2 increases the likelihood of entrepreneurship because the benefits of housing wealth are relatively more useful in reducing entrepreneurial risk as a share of total portfolio risk. However, this beneficial effect is reduced by the fact that entrepreneurial income and house values co-vary. The hedging effect favors entrepreneurship only if the agent is short on housing ($\eta_H < \mu$) and plans to buy more in period 1. In this case a high σ_{ep} has a positive hedging effect on the entrepreneurship and the individual is more likely to choose this occupation. Conversely, if the agent owns more housing than desired ($\eta_H > \mu$), she is long on housing and plans to sell some in period 1. As a result, a high covariance between entrepreneurial income and house prices has a negative effect on utility since it increases the variance of consumption in period 1. We test for this ambiguously-signed prediction directly in our data by exploiting a rich set of information on house values at the individual and local level.

Note that, in contrast to our setting, in a simple model with credit constraints and bank lending against housing – but no portfolio and hedging considerations – a rise in house prices would raise the collateral value of housing and allow for more borrowing from banks to start some entrepreneurial activities. Hence, in such models, the effect of an increase in house prices on entrepreneurship would be unambiguously positive.

3.3.3 Comparative statistics in the no-mobility case

So far we have assumed that agents are free to relocate at the end of period 0. Suppose instead that $H_1 = H_0 = \bar{H}$ because of moving costs or other impediments to housing trades. Stated differently, on top of the 'cash commitments' to service the mortgage, individuals also face a consumption commitment because they cannot freely adjust housing quantity.

In this case we have that:[17]

$$\log \tilde{\alpha}^* = \frac{(1-\gamma)^2(1-\mu)^2}{2}\tilde{\eta}_Y^2\sigma_e^2, \tag{4}$$

where $\tilde{\eta}_Y$ is the fraction of *non-housing* wealth associated with labor income. The threshold $\tilde{\alpha}^*$ does not contain any reference to H_0P_1 nor σ_{eP}, because agents have no control over the quantity of housing they consume.

In this context, the results on leverage and its interaction with the variance of entrepreneurial income (Proposition 1 and 2) are unchanged. However, the comparative statistics with respect to housing wealth change. First, house price movements have no effects: capital gains are irrelevant if agents cannot move. Second, with no mobility, changes in the quantity of housing (H_0) have an unambiguously negative effect on entrepreneurship. Suppose an agent increase her share of housing, e.g. by buying rather than renting the place in which she lives: this has the indirect effect of increasing her labor wealth share $\tilde{\eta_Y}$. If a larger portion of wealth is 'tied up' in housing that cannot be traded, labor income risk has a higher impact on an agent's consumption.

To sum up, when agents are immobile and unable to trade housing, our comparative statistics are as follows: (i) Propositions 1 and 2 continue to hold; (ii) the effect of an increase in the quantity of housing is unambiguously negative; and (iii) house price considerations have no effect for agents that are committed to a fixed level of housing. We test these predictions in our empirical section.

4 Data

The BHPS is a panel dataset covering the period 1991-2008 and providing detailed information on households' tenure choices and characteristics, as well as individuals' current occupations, job-history between interviews, personal characteristics, income and financial situation. The first wave of the panel consists of approximately 5,500 households and more than 10,000 individuals living in the UK. One of the advantages of the BHPS is that it is quite successful in following the same individuals over time, even when they move residence or form new households (e.g., the children of the original BHPS families or divorcees).

At the time of the interview (normally in September), respondents are asked to describe their current labor force status. If they are working, detailed information about their occupation is collected. Respondents are also asked whether their labor force status has changed since their last interview. If the answer is positive, a set of detailed questions is asked about all the occupational spells that occurred between the interview taking place and September of the previous year.[18]

In order to identify the relation between housing tenure, mortgage debt and entrepreneurship, we need

[17] Appendix A contains the relevant derivations.

[18] The way in which the BHPS is structured makes it possible that some inconsistencies arise in the description of the same labor force spell provided by the same person in two different waves. Several authors have discussed the complicated task of reconstructing detailed monthly spells from the BHPS (Paull, 2002; Maré, 2006). We follow the principle that information recorded closest to the date of the beginning of the spell is the most accurate. A similar approach is used in Upward (1999) and Battu and Phimister (2008). We provide a detailed description of our procedure to assemble the data in the Data Appendix.

information about individuals' tenure choices with special attention to the timing of events. We first gather information about respondents' present tenure status. The possible categories are: homeowner with mortgage, homeowner without mortgage, private tenant, and social tenant.[19] We then use the date in which respondents say they moved to their present address to identify the timing of changes in an individual's tenure. If the respondents changed their tenure status from one wave to another and there is a moving date, we take this date as the transition date. Approximately 93% of the individuals have a moving date when making a transition into/out of homeownership. If the respondents change their tenure but there is no moving date, the transition date is imputed as the date of the current interview.[20]

Other controls – such as education level, age, marital status and number of children – are treated as constant between one wave and the other. Changes are assumed to take place at the date of the annual interview.

In terms of sampling, we begin with an initial set including all respondents who gave a full interview in Wave 1 or one of the following waves. We then follow them until they exit the survey for the first time, even if they come back at a later stage. This restriction is imposed to construct a continuous account of an individual's labor force status for every month combined with precise information on her tenure status. In Wave 1 (1991) we have 9,892 individuals. In Wave 18 (2008) we have 6,309 individuals, of which 3,642 are from the initial sample interviewed in Wave 1. Observations decrease gradually, reflecting aging and attrition in the original sample, but children and spouses of original members join the dataset, partially counterbalancing the decreasing tendency.

In our analysis, we focus on heads of household in their prime working age (between 20 and 55) and consider only their employment spells – either as workers or self-employed. By focusing on these individuals, we limit the importance of issues related to labor market participation, since in our data 'head of household' refers to the individual within the household who manages the financial aspects and is the main economic actor.[21]

We only focus on individuals living in England, because for this group we can match precise information about prevailing local housing market conditions. To merge in such information, we use a (restricted-access) identifier for the Local Authority (LA) where the individual lives.[22] We use LA identifiers to merge LA-specific LTV data from the Survey of Mortgage Lenders (SML)to the BHPS.[23] Additionally, we match LA-specific house price data coming from the SML (until 1995) and from the Land Registry (from 1995).[24]

[19]There are other rare options, such as living in an accommodation paid by the employer, which we do not consider in our analysis. This exclusion does not affect our findings.

[20]It is possible to change tenure status without changing address. In the UK, for instance, the 'Right-to-Buy' program allows social tenants to buy their house or flat from the local authority (van Ham et al., 2010). Similarly, individuals could buy from their current private landlord. However, this does not seem widespread.

[21]Including unemployment and other labor market status spells in our analysis does not alter our results because prime-age heads of households are predominantly employed.

[22]LAs are local constituencies empowered to exercise planning functions, and can be thought of as self-contained housing markets from a regulatory point of view. England consists of 354 LAs.

[23]The SML has a broad coverage of UK mortgage lenders in addition to building societies, and collects a wide range of mortgage-related information, including purchase price and mortgage amount.

[24]Specifically, we use annual LA-level mix-adjusted house prices – see Hilber and Vermeulen (2012) for details of the computation – and merge this data to our monthly BHPS data at a yearly frequency.

Finally, we collate some proxies for the elasticity of local housing supply – i.e. the LA-specific percentage of developed land and the LA-level refusal rate – as derived by Hilber and Vermeulen (2012).

After implementing these restrictions and cleaning the data, our sample includes approximately 360,000 observations (i.e., individual monthly spells) and 5,200 individuals. The richness and detail of the dataset is a novel element of our analysis. Most panel-type studies of entrepreneurship (Hurst and Lusardi, 2004; Disney and Gathergood, 2009) and their link with housing rely on annual observations and have scant information on mortgage debt.

5 Preliminary descriptive evidence

5.1 Descriptive statistics

The first set of descriptive statistics is presented in Table 1. The first row of Panel A presents descriptive statistics for our proxy for entrepreneurship, i.e. self-employment with dependent workers, indicating that 4.7% of employment spells are classified as entrepreneurial. This figure is substantially lower than the one obtained considering other proxies used in the literature, for example 'all self-employed' – at 14.4% in our sample.[25] We believe our proxy is better at capturing entrepreneurship than alternative and broader self-employment categories.

Panel A shows that the fraction of homeowners in the monthly spell data is 81%.[26] Around 71% of the observations involve homeownership with a mortgage, whereas 9.6% refer to owners with no mortgage. For the former, the LTV on the mortgage is on average 48.8%. This variable is time-varying and calculated as the ratio between individuals' outstanding mortgage debt and self-assessed house value. This ratio varies over time because of amortization and refinancing, as well as changes in the value of the asset. On average, individuals report housing values of approximately £120,000, though this figure is associated with a large standard deviation of £110,000. Finally, the cumulative house price gains experienced by individuals between the time of purchase and the current spell are on average around £40,000.

Panel B tabulates descriptive statistics for background characteristics. These show that the average individual is 39.4 years old; males represent 79% of observations; 75% of the spells refer to coupled individuals, and 46% to individuals with children under the age of 16. Finally, individual and household total incomes in the year prior to the survey stand at £21,060 and £31,839 respectively.

In Table 2, we present additional descriptive statistics on individuals' incomes. A comparison of the first and second row shows that entrepreneurs earn a slightly larger average income than dependent workers, but the median income for these two groups is very close at £18,500 and £18,322, respectively. The last two columns show that entrepreneurship is a riskier choice than dependent employment. The overall

[25]The percentage of self-employment in our sample is consistent with Blanchflower and Shadforth (2007), who use several years of data from the Labour Force Survey to document that self-employment in the UK has stayed between 12% and 15% in the 1991 to 2007 period.

[26]This figure is close to the one reported by Battu and Phimister (2008), at 79%. They use the same data to study the effect of homeownership on unemployment duration.

standard deviation of entrepreneurs' incomes is 2.3 times larger than the figure for dependent workers (respectively at £33,608 and £14,528). The same holds true if we look at the standard deviation of incomes within-individuals over time. This evidence is consistent with Hamilton (2000) and supports our modeling assumptions.

In Table 3, we display the incidence of transitions into and out of homeownership and entrepreneurship. Around 18% of all individuals make at least one homeownership transition (for example 'rent' to 'own') and 5.4% at least two transitions (e.g. 'rent' to 'own', to 'rent' again). The figures also show that more people transit into homeownership than out of it, and that more transitions involve mortgages than outright ownership. A substantial fraction of individuals with mortgages transits into outright homeownership, though some of them – as well as some outright owners – revert back to renting. We also find that 5.9% of the spells involve one transition into or out of entrepreneurship, and 3.3% involve more than one entrepreneurial transition.

We also investigate the characteristics of individuals who transit into and out of homeownership and entrepreneurship. Our findings are presented in Table 4. Relative to those who become homeowners without a mortgage, individuals who use a loan to purchase their property are younger (30.4 vs. 37.4 years), less likely to have children and be in a relationship (62.3% vs. 67.7%), and less affluent (£13,547 vs. £16,105). Individuals who become entrepreneurs are older (at 35.4) than individuals transiting into homeownership with a mortgage, but younger than outright owners. This suggests a time-line where individuals first purchase a property with a mortgage, then decide their occupation, and eventually pay off the mortgage. This is consistent with our modeling framework and empirical analysis, where we focus on the effect of housing and mortgage debt on occupational choices.

We also find that individuals who become entrepreneurs are better off in terms of prior income and are more likely the be in a relationship and have children. We do not detect any clear pattern in terms of age, family arrangements and income for people transiting out of homeownership and entrepreneurship. This suggests that these movements cannot be easily explained by demographic factors and that other individual specific considerations might be taking place in ways that simultaneously affect the tenure status and entrepreneurship. We return to these issues below.

5.2 Descriptive stylized facts

In Table 5, we present a descriptive regression analysis that relates entrepreneurship to homeownership. Regression coefficients are obtained from fitting the following linear probability model:

$$Entrep_{ilt} = \eta_i + \beta\ own_{ilt} + X_{ilt}\gamma + \phi_l + \omega_t + \varepsilon_{ilt} \tag{5}$$

where the dependent variable $Entrep_{ilt}$ is our proxy for an entrepreneurial job, and the explanatory variable of interest is an individual's housing tenure status own_{ilt}. The subscript ilt identifies individual i living in

location l at time t. X_{ilt} is the set of time-varying controls discussed above, while ϕ_l and ω_t represent location and time fixed effects. Location (LA) fixed effects (ϕ_l) include persistent geographical disparities in labor and housing markets and differences in local political and institutional factors, whereas the time fixed effects (ω_t) capture unobserved factors that are specific to the year and/or month of interview. Finally, η_i captures unobserved individual factors, such as taste for entrepreneurship (α_i in our model) and persistent wealth (related to W_1, the balance between M_0 and L_0, and the mortgage cost R_f), which may simultaneously determine occupational choice and tenure status. The error-term ε_{ilt} is assumed to be uncorrelated with all the right-hand side variables, although we allow for correlation in residual shocks across individuals within locations and cluster standard errors at the LA level.

Columns (1) and (2) of Table 5 present simple cross-sectional (OLS) estimates of Equation 5. In Column (1), we append year-of-interview and month-of-interview effects, as well as dummies for the sector of employment (using the SIC92 classification at 1-digit level), while in Column (2) we further include the controls detailed in Table 1, as well as LA dummies. The two specifications indicate a positive and significant association between homeownership and entrepreneurship. Although the estimated coefficients are attenuated when adding individual controls and LA effects, the estimates remain sizable and highly significant.

In Columns (3) to (7), we control for individuals' unobservables – η_i in Equation 5 – by estimating fixed-effect models. In stark contrast to the OLS regressions, we find that the correlation between homeownership and entrepreneurship is negative and significant. To assess the robustness of this finding to time-varying characteristics and local unobservable factors, in Column (4) we add the control variables detailed in Table 1, as well as LA dummies. The set of controls includes both individual and household total income in the year prior to the survey (in logs). Conditional on individual fixed effects, these variables capture changes in the financial situation of an individual and her household with respect to the previous year, and therefore proxy for changes in an individual's wealth. Finally, in Column (5) we retain the set of controls included in Column (4), but drop LA dummies since only 30% of the individuals change their place of residence over the period of our analysis. The results in Columns (4) and (5) still present a significant, negative correlation between homeownership and entrepreneurship.

Part of the findings presented in Column (3)-(5) might be driven by individuals who sell their property in order to extract equity from their home and then become entrepreneurs. To explore the relevance of this channel, in Columns (6) and (7) of Table 1, we focus on individuals' spells that correspond to transitions into and out of homeownership, respectively. In Column (6), we follow individuals who start off as renters and then become homeowners (plus individuals who start off as owners and stay as such throughout the period). In Column (7), by contrast, we track individuals who finish as renters after having been homeowners (plus individuals who start off as renters and do not change tenure throughout the sample period), and exclude any renting spells that took place before homeownership. Our findings suggest that the negative correlation between homeownership and entrepreneurship comes from individuals who become homeowners. The estimated effect is larger and more precisely estimated than before. Conversely, the link between tenure

status and entrepreneurship for individuals switching out of homeownership is estimated to be small and insignificant.

In Column (8) we augment the specification of equation (5) with a dummy variable identifying homeowners with a mortgage. We find that the negative correlation between homeownership and entrepreneurship is sizable and significant *only* for homeowners with a mortgage. Conversely, the association between outright ownership and business start-up is small and insignificant.

Finally, we provide some related evidence by studying the time-evolution in the correlation between homeownership and entrepreneurship. Specifically, we estimate fixed-effect models that add to the baseline specification of equation (5) both a linear and a quadratic term in the monthly duration since the time of becoming a homeowner. Our results show that the linear count carries a positive and significant coefficient (0.016; s.e. 0.008), while the squared duration carries a negative and borderline significant estimate (-0.005; s.e. 0.003). This implies an inverted U-shaped relationship between the time since becoming a homeowner and the probability of becoming an entrepreneur. Our results are presented graphically in Figure 1. These results show that – on impact – the correlation between homeownership and entrepreneurship is as large as -0.018, but that as time goes by, this negative relation becomes less quantitatively meaningful. It takes 4 years (48 months) for the effect to become statistically insignificant at the 5% level. However, the effect of homeownership never turns positive, even when considering fairly long time horizons, e.g. after 10 years (120 months).[27] The pattern in these estimates is consistent with the possibility that as time passes by and homeowners repay some of their mortgage – i.e. they de-leverage – the negative association between tenure and entrepreneurship becomes less marked.

To sum up, the set of stylized facts collected in this section is consistent with the insights from our theoretical framework. In the next section, we directly test its predictions.

6 Main findings: Taking the model to the data

6.1 The negative link between leverage and entrepreneurship

Proposition 1 states that – as long as the mortgage cost faced by individuals is higher than the interest rate they earn on liquid wealth – the link between homeownership and entrepreneurship depends negatively on the extent of financial leverage.

To test Proposition 1, we start by adding to the specification described in equation (5) a time-varying measure of the LTV ratio (described above). We further control for the direct effect of housing wealth by including in our empirical model self-assessed housing values (alongside the dummy for owner occupation). Our first set of results is reported in Columns (1) and (2) of Table 6. In Column (1), we present OLS associations. These show that homeownership *per se* is not associated with entrepreneurship. Conversely,

[27] Consistently, if we only include in the empirical model the linear duration term, we find a very small and insignificant coefficient implying that the relation between time in homeownership and entrepreneurship never crosses the zero line.

housing wealth displays a strong and significant correlation with entrepreneurship. A £100,000 increase in housing values – approximately a one standard deviation change – is associated with a 40% increase in entrepreneurship. This is consistent with previous cross-sectional findings in the literature (Black et al., 1996). Finally, the LTV of the outstanding mortgage has no significant association with entrepreneurship.

In Column (2), we move to an individual fixed-effect specification. As already discussed, these account for unobserved individual factors (η_i in our empirical model) such as taste for entrepreneurship – which we denoted by α_i in our model – and persistent wealth – which in our theoretical framework is related to W_1, the balance between M_0 and L_0, and the mortgage cost R_f faced by individuals. Results show that conditional on the LTV ratio, homeownership is not significantly associated with entrepreneurship – its effect is estimated to be very close to zero. We further test this result by adding to our specification a variable counting the 'number of rooms' for homeowners to proxy more continuously for the quantity of housing consumed. This extension does not change our results: neither the dummy for owner-occupation nor the number of rooms enter the regression significantly. This is so irrespective of whether we allow the latter to have a linear and/or quadratic effect, or a more flexible impact by including separate dummies for different numbers of rooms (up to 10). Similarly, self-assessed house values have no impact on entrepreneurship. Conversely, the LTV ratio enters our specification with a negative, sizable and significant effect. The point estimate implies that a one standard deviation increase in the LTV is associated with a reduction in the probability of being an entrepreneur by about 9.5%.[28]

These findings are consistent with the predictions of our model. First, the negative relation between LTV and entrepreneurship supports Proposition 1. Second, the lack of a clear association between entrepreneurship and homeownership (or house values/other proxies for housing quantity) is consistent with the ambiguous effect of housing wealth.[29]

One concern with our fixed-effect estimation is that it partials out individual, household, location and time-invariant unobservables, but cannot control for time-varying unobserved factors. Adding time-varying individual and household level controls mitigates this problem. In particular, we control for the number of children and marital status, which have been shown to be strongly associated with homeownership and entrepreneurship (Linneman and Wachter, 1989; Evans and Leighton, 1989; Hilber, 2007). Moreover, we control for individual and household-level income in the year prior to the survey. Conditional on individual fixed effects, these variables capture changes in households' financial conditions over time and therefore proxy for wealth changes. Nevertheless, the potential for biases in our estimated relationship remains, and we next present a set of extensions that help address these issues.

To begin with, in Columns (3) and (4) we replace individual fixed effects with individual-housing-spell

[28] We tested the robustness of our results to the inclusion of LA fixed effects or the inclusion of Travel-To-Work Area (TTWA) effects – on top of individual fixed effects. TTWAs are 243 functional areas drawn by the Office for National Statistics to identify self-contained local labor markets. We also experimented with alternative clustering structures, including two-way clustering at the individual and LA level. None of these checks affected our conclusions.

[29] The results are not affected if we replace self-assessed housing values with a measure of the net equity held by individuals in their home – i.e. the difference between the value of the property and the amount of the outstanding loan. The fixed-effect specification still yields insignificant coefficients on homeownership and net equity, but a sizable, negative and significant effect of the LTV.

effects. These specifications exploit the variation in LTV within a specific housing spell, and account for changes in individuals' unobservables when they first become homeowners and at any time when they move home or change their tenure status. In short, these specifications help addressing the endogeneity of tenure choice, and the potential endogenous variation in the LTV when individuals move between homes – i.e. they change spell *within* homeownership. These specifications yield a slightly stronger negative link between leverage and entrepreneurship. In Column (3), we include all individuals in our estimation sample and find that a one standard deviation increase in LTV reduces the probability of being an entrepreneur by approximately 14%. Next, in Column (4) we focus only on homeowners (i.e. we drop renters from the estimation sample), thus by-passing the possibility that the endogeneity of the home-ownership decision biases our findings. This specification confirms our previous finding: a one standard deviation change in LTV reduces entrepreneurship by approximately 12%.[30]

One additional concern is that the LTV at which an individual initially borrows as well as the LTV on the outstanding mortgage may be endogenous. Individuals have some discretion about their initial LTV as well as the LTV on the outstanding amount of mortgage because of refinancing decisions. To address these concerns we devise an instrumental variable (IV) strategy based on information on the LTV of newly originated mortgages in the area of an individual's residence. Using data from the Survey of Mortgage Lenders (SML), we construct an instrument which equals the time-varying local LTV in the LA of an individual's residence for homeowners (and is set to zero for renters). The aim of this variable is to predict the exogenous part of the initial LTV at which an individual borrows and the subsequent values of the LTV on the outstanding mortgage. The validity of this approach rests on the assumption that: (i) an individual's LTV will change over time partly because of refinancing decisions dictated by the nature of the mortgages predominantly available in the UK (fixed rates for 2-5 years, and floating afterwards); and (ii) most of the mortgage conditions will be dictated by the local housing market and banking circumstances (Muellbauer, 2002). We also we address potential endogeneity issues with self-reported housing values by following the approach used by Chetty and Szeidl (2012) and instrumenting this variable using the variation in national house prices in interaction with (time-fixed) proxies for local housing supply elasticities, namely the share of developed land in the LA and the average LA planning refusal rate. In essence, our approach treats local LTVs and the interaction between local housing supply elasticity and national house prices as exogenous to individuals' unobservables.

Column (5) in Table 6 reports our individual fixed-effect IV estimates and confirms our previous conclusions. A one standard deviation change in LTV reduces the probability of becoming an entrepreneur by approximately 11.5%. Conversely, housing wealth has no effect on entrepreneurship. Further augmenting this specification with LA fixed effects yield a very similar coefficient on the LTV at -0.022 (10% significant). This is not surprising given that only 30% change their LA of residence. Similarly, controlling for the effect

[30]Using net equity – i.e. the difference between the value of the property and the outstanding loan – instead of housing values provides the same conclusions irrespective of the exact details of the individual-housing-spell specification used.

of outright ownership in this specification does not substantially affect our point estimates – increasing slightly to -0.024 – although the effect of the LTV becomes less precisely estimated.[31]

In Appendix C we discuss an additional set of checks that we perform on our main specification (tabulated in Appendix Table 1). The results are all based on specifications that include individual fixed effects.

6.2 The role of entrepreneurial risk

Proposition 2 of our model states that the negative link between mortgage debt and entrepreneurship is more pronounced for leveraged homeowners in riskier sectors. To test this proposition, we collect information contained in the Structural Business Statistics prepared by Eurostat.[32] We assemble data on industry-level profits at the NACE 2-digit sector level on an annual basis for the 1997 to 2007 period. This sectoral level of aggregation can be mapped to the standard industry classification provided in the BHPS (SIC92), providing a sufficient level of detail by dividing the economy into 45 sectors.

Using this data, we calculate the coefficient of variation of industry-level profits (i.e. profit variability adjusted for mean returns) for the available period as a proxy for business riskiness, and split our dependent variable into entrepreneurs in risky sectors and entrepreneurs in non-risky sectors. We then run separate regressions with these two outcomes to investigate whether the negative link between entrepreneurship and mortgage debt is more pronounced and significant in industries characterized by more risk.[33]

Our results are displayed in Columns (1) and (2) of Table 7, where we split our dependent variable using the median of the distribution of the coefficient of variation of profits in the individual sample (at 0.131). A comparison of the two columns reveals that entrepreneurship is only adversely affected by mortgage debt for leveraged homeowners in risky sectors. Using the median of the raw standard deviation of profits (i.e. profit variability *unadjusted* for mean returns) does not change our findings. The negative effect of mortgage debt on the chances of becoming an entrepreneur in sectors with standard deviation of profits above the median is -0.019 (5% level of significance), but this becomes much smaller at -0.007 and insignificant for entrepreneurs in sector with profit variability below the median. These results are consistent with Proposition 2.

Our model also predicts that – unless homeowners are immobile and fully committed in terms of housing consumption – the effect of mortgage debt should be more significant when profits are highly correlated with house prices. Conversely, if homeowners cannot relocate and are tied to a fixed housing amount, house price considerations should not magnify the negative effect of leverage on entrepreneurship.

We investigate this possibility in the subsequent columns of Table 7. To start with, we use prices at the LA level to measure their correlation with profits in different sectors of the economy. We then construct

[31] Individual-housing-spell IV estimates of the LTV are substantially smaller, at -0.007, and not significant. We believe this specification yields less meaningful estimates because a substantial part of the instrument's power comes from predicting the initial LTV. This variation is effectively absorbed with individual-housing-spell effects.

[32] This can be accessed at http://epp.eurostat.ec.europa.eu/portal/page/portal/european_business/ data/database, where more information on the data construction and availability is also provided.

[33] An alternative way of performing this test is to split our sample into individuals who work in risky sectors and those who do not. When we do this and run two regressions with two different samples – as opposed to two different dependent variables – we find similar results. Results are available from the authors upon request.

alternative dependent variables that consider individuals who are entrepreneurs working in sectors and living in areas that display an above median/below median correlation between profits and local house prices. We present our findings in Columns (3) and (4), respectively. Our results reveal that the effect of mortgage debt is substantially larger and only significant in areas that entail some house price risk. In particular, the effect of mortgage debt for individuals who are entrepreneurs in a sector and live in areas where the correlation between house prices and profits is above the median is ten times bigger (-0.020) than the effect for individuals facing lower correlation (-0.002). We find a very similar pattern if we consider the covariance (instead of correlation) between local house prices and sector profits (-0.019 vs. -0.004), or the correlation between national house prices (instead of local) and profits (also -0.020 vs. -0.002).[34]

These findings complement the evidence presented in Section 6.1 on the ambiguous effect of housing quantity. They confirm that the predictions of our model stem from commitments to mortgage payments – i.e. a form of 'cash commitment' – rather than commitments to a fixed housing quantity – i.e. a 'consumption commitment'.

6.3 Credit constraints as an alternative explanation?

The results discussed so far could be consistent with an alternative theory based on credit constraints: leveraged homeowners find it hard to obtain additional finance to start their business because they are already burdened with a substantial loan on their house. However, for this explanation to hold true, we should detect a positive relationship between house price increases and entry into entrepreneurship. This is because, as home values increase, LTV ratios are pushed down and housing becomes a collateral that can be used to relax credit constraints. The results discussed in Section 6.1 broadly dispel this possibility. In this section, we provide additional evidence which is inconsistent with this alternative explanation. The results are presented in Table 8.

To begin with, we calculate the cumulative change in housing values using the variation in an individual's self-assessed house value, and considering the change between the time when the property was purchased and the current date. This gives a neat measure of any capital gains (or losses) accrued to an individual through homeownership, allowing us to test whether the equity position built into someone's real estate investment can be used as a collateral in setting up a business.

As shown in Column (1), OLS estimates point to a positive correlation between cumulative house price gains and entrepreneurship: a one standard deviation increase in this variable is associated with an 18% increase in the probability of being an entrepreneur. Homeownership is also positively associated with entrepreneurship, while the LTV is not. However, as soon as we include individual fixed effects as in Column (2), cumulative house price gains are neither positively nor significantly associated with entrepreneurship.

[34] We also split our regressions to separately consider individuals living in areas with above/below median median house price volatility as measured by the coefficient of variation. Our evidence shows that the effect of mortgage debt on entrepreneurship is slightly more sizable (at -0.010) in areas with high price variation than in areas with low price volatility (at -0.007) – however this difference is much less pronounced than the heterogeneity presented in Table 7. This suggests that the effective 'risk margin' is the one represented by the variation of profits and their correlation with house prices, as suggested by our model.

Conversely, we still find a negative and significant association between mortgage debt and entrepreneurship.

In the next two columns of the table we address endogeneity concerns that might affect our findings. In Column (3), we control for individual-housing-spell effects and focus on homeowners only (as in Column 4 of Table 6). We still find a sizable and negative association between LTV and entrepreneurship, but no evidence that cumulative house price gains affect the probability of being an entrepreneur. Next, in Column (4), we follow the strategy used in Column (5) of Table 6 and supplement our fixed-effect approach with an IV strategy. For the individual LTV, we use the same instrument we adopted in Section 6.1. For self-assessed cumulative house price gains, we create two instruments by first computing the national cumulative house price changes for the period relevant to each individual, and then by multiplying these figures by our proxies for the local elasticity of supply of housing – namely the share of developed land in the LA and the average LA refusal rate. This is only a slight modification to the instruments used above and follows the logic of Chetty and Szeidl (2012).[35] Results from these specifications still provide no evidence that cumulative house price gains matter. Conversely, the negative effect of mortgage finance on entrepreneurship maintains its size and significance.

To further investigate the importance of credit constraints, we conduct an additional set of exercises. First, we estimate the effect of cumulative house price gains while controlling for the difference between the outstanding value of the loan and the initial house value. This allows us to isolate the effect of 'actual' equity gains as opposed to equity gains potentially used to reduce the outstanding amount of loan (via re-financing). This modification does not change our results. Next, we replace cumulative house price gains measured in pounds with cumulative house price gains expressed in percentages of the initial housing value. This has no effect on our conclusions. Finally, we follow Adelino et al. (2013) and investigate whether our findings differ for individuals operating in capital intensive sectors. To do so, we exploit figures on the average investment per employee obtained from Eurostat and interact both variables of interest – namely the LTV and the cumulative house price gains – with the capital intensity of the sector where individuals work. Both interactions display very small and insignificant coefficients, and the overall effect of cumulative house price gains remain insignificant. Conversely, the effect of mortgage debt on entrepreneurship retains its size and significance.[36]

This set of tests suggests that credit constraints are not the main mechanism behind our findings. The results are instead consistent with our theoretical framework in which the effect of house prices on entrepreneurship is not clearly signed and depends on the relative strength of portfolio and hedging considerations. Our findings are also consistent with Hurst and Lusardi (2004) who show that households living in areas which experience strong house price appreciation are not significantly more likely to start an entrepreneurial venture.[37]

[35] Note that using these instruments separately leads to very similar conclusions.

[36] We also address this issue by running regressions similar to the ones presented in Table 7 and splitting our dependent variable to consider leveraged homeowners working in sectors with average investment per employee above/below the median value of the investment distribution (approximately £5,800). This does not change our conclusions.

[37] In a similar vein, Disney and Gathergood (2009) replicate Hurst and Lusardi (2004)'s results using BHPS data.

7 Conclusion

In this paper we study the link between mortgage debt and entrepreneurship. Our interest in this relationship rests on the notion that flourishing entrepreneurial activities can be conducive to higher economic growth and an acceleration of innovation. Previous analyses of the labor market effects of homeownership have focused on unemployment spells and duration, thus neglecting an important channel whereby housing might affect the country-wide economic performance.

We develop a model of occupational choice and housing tenure, where homeowners commit to mortgage payments. In our model entrepreneurship is associated with non-pecuniary benefits that vary across individuals and costs arising from greater income uncertainty. The model yields two testable predictions: (i) conditional on individual characteristics, wealth and preferences, and as long as mortgage rates exceed the rate of interest of liquid wealth, mortgage debt diminishes the likelihood that homeowners start a business; and (ii) the negative relation between mortgage debt and entrepreneurship is more pronounced for homeowners working in risky sectors.

In our empirical analysis we exploit the longitudinal dimension of the British Household Panel Survey to test these predictions while controlling for individual time-fixed unobservables and time-varying observables. Our findings confirm both predictions and support the mechanism proposed in our model whereby an increase in mortgage debt reduces net wealth and thereby amplifies the borrower's risk aversion. In turn, this implies that leveraged homeowners will be less likely to take up a risky entrepreneurial activity. We also empirically test an alternative mechanism based on credit constraints, but find no evidence in support of it.

Our findings have important policy implications. Virtually all developed countries – including the United States and the United Kingdom – have set in place policies that favor homeownership, mostly by making it easier to finance home purchases with a loan. These policies include mortgage interest rate deductibility, non-taxation of owner-occupation related capital gains and imputed rents, the creation of secondary mortgage markets and government-sponsored enterprises (such as Fannie Mae and Freddie Mac) with implicit or explicit government backing or direct government guarantees of mortgages (such as Britains recent Help to Buy policy). Recent research (Glaeser and Shapiro, 2003; Frame and White, 2005; Hilber and Turner, 2013) point out that these policies are associated with huge costs and can have perverse effects by raising prices and lowering homeownership attainment of low and moderate income households.

Do policies that promote homeownership by encouraging increasing financial leverage always depress entrepreneurial activities? Our answer is nuanced. Consider the US mortgage interest deduction (MID) policy. On the one hand, according to our theoretical framework, the MID increases leverage (Munroe, 2014) and thus increases risk aversion and discourages entrepreneurship. On the other hand, the MID lowers the effective mortgage cost and – if the subsidy is strong enough – may reverse our assumption that the (effective) mortgage rate exceeds the interest from liquid wealth, and thereby the main prediction of our model. To assess this possibility, we use figures in Poterba and Sinai (2011) who report the average

mortgage interest deduction subsidy rate for various age-income groups. The group with the highest average subsidy rate is the one for household heads aged 25-35 who have an annual household income over $250,000. For this group the average subsidy rate is 0.315. Using the Freddie Mac primary mortgage rate (as a proxy for the before-tax R_m), the Treasury yields from Bloomberg (as a proxy for R_f), and the maximum average subsidy rate of 0.315 to compute the after-tax mortgage interest rate (effective R_m), we find that during the last 15 years the after-tax rate typically significantly exceeded the Treasury yield. However, during the period between 2004 and early 2007 – a period with an extraordinarily low risk premium attached to mortgages – the spread between the after-tax mortgage rate and the Treasury yield was essentially zero. Moreover, depending on the state of an individual's residence and her specific tax status, the combined subsidy rate for some households may exceed 50%, generating a negative $R_m - R_f$ spread during time periods with ultra-low risk premia. Nevertheless, our back-of-the-envelope calculations suggest that even in the US, where the mortgage interest deduction is sizable, under normal circumstances and for the majority of households the effective cost of borrowing significantly exceeds the yield on liquid risk-free assets. Thus our model predictions are likely to hold.

Much more clear-cut is the effect of policies that affect leverage directly – and not indirectly via lowering interest rates – and therefore very likely have the unintended consequence of discouraging entrepreneurial activity.

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Appendices

A Proofs

A.1 The baseline case

The indirect utility of an agent with wealth W_1 is:

$$\begin{aligned} V(W_1) &= \frac{1}{1-\gamma}\left\{[(1-\mu)W_1]^{1-\mu}\left(\frac{\mu W_1}{P_1}\right)^{\mu}\right\}^{1-\gamma} \\ &= \underbrace{\frac{1}{1-\gamma}\left\{(1-\mu)^{1-\mu}\mu^{\mu}\right\}^{1-\gamma}}_{\phi}\left(W_1^{1-\mu}\frac{W_1^{\mu}}{P_1^{\mu}}\right)^{1-\gamma} \\ &= \phi\left(\frac{W_1}{P_1^{\mu}}\right)^{1-\gamma}. \end{aligned} \tag{A.1}$$

The entrepreneurship choice: Our goal is to compute α^* in equation 2, namely the level of α_i that makes the agent indifferent between entrepreneurship and employed work. Using equation A.1, we can write α^* as follows:

$$\begin{aligned} \alpha^* &= \frac{\phi\ \mathbb{E}\left(W_1^e P_1^{-\mu}\right)^{1-\gamma}}{\phi\ \mathbb{E}\left(W_1^w P_1^{-\mu}\right)^{1-\gamma}} \\ &= \frac{\mathbb{E}\left(\frac{Y_e+H_0P_1-M_1+L_1}{P_1^{\mu}}\right)^{1-\gamma}}{\mathbb{E}\left(\frac{\overline{Y}+H_0P_1-M_1+L_1}{P_1^{\mu}}\right)^{1-\gamma}} \end{aligned} \tag{A.2}$$

We can rewrite wealth and house prices in the following way:

$$W_1 = (\overline{Y} + H_0\overline{P}_1 - M_1 + L_1)(1 + \eta_Y\tilde{y} + \eta_H\tilde{p}) \approx (\overline{Y} + H_0\overline{P}_1 - M_1 + L_1)e^{\eta_Y\tilde{y}+\eta_H\tilde{p}},$$

$$P_1 = \overline{P}_1(1+\tilde{p}) \approx \overline{P}_1 e^{\tilde{p}},$$

where η_y is the share of income out of total wealth, η_h is the share of housing, and the variables denoted with a tilde represent percentage deviations from expected values.

Since the the constant part of indirect utility is the same for both workers and entrepreneurs, we can rewrite equation A.2 as:

$$\alpha^* = \frac{\mathbb{E}e^{[\eta_Y\tilde{y}+(\eta_H-\mu)\tilde{p}](1-\gamma)}}{\mathbb{E}e^{(\eta_H-\mu)\tilde{p}(1-\gamma)}}.$$

Assuming lognormality, the above equation reduces to:

$$\alpha^* = \frac{\exp\left\{\frac{(1-\gamma)^2}{2}\left[\eta_Y^2\sigma_e^2 + 2\eta_Y(\eta_H-\mu)\sigma_{eP} + (\eta_H-\mu)^2\sigma_P^2\right]\right\}}{\exp\left\{\frac{(1-\gamma)^2}{2}\left[(\eta_H-\mu)^2\sigma_P^2\right]\right\}},$$

or

$$\alpha^* = \exp\left\{\frac{(1-\gamma)^2}{2}\left[\eta_Y^2\sigma_e^2 + 2\eta_Y(\eta_H - \mu)\sigma_{eP}\right]\right\}, \tag{A.3}$$

which leads directly to equation 3.

The effect of housing: Define $H_0P_1 = H^*$. We are interested in the derivative with respect to H^* of equation 3:[38]

$$\frac{\mathrm{d}\ \eta_Y}{\mathrm{d}\ H^*}\ (\eta_Y\sigma_e^2 + 2\eta_H\sigma_{ep} - 2\mu\sigma_{ep}) + \eta_Y\ (\frac{\mathrm{d}\ \eta_Y}{\mathrm{d}\ H^*}\sigma_e^2 + 2\frac{\mathrm{d}\ \eta_H}{\mathrm{d}\ H^*}\sigma_{ep}).$$

We have that:

$$\eta_Y = \frac{Y_1}{Y_1 + H^* - M_1 + L_1} = \frac{Y_1}{W_1}$$

$$\eta_H = \frac{H^*}{Y_1 + H^* - M_1 + L_1} = \frac{H^*}{W_1}$$

and therefore:

$$\frac{\mathrm{d}\ \eta_Y}{\mathrm{d}\ H^*} = -\frac{Y_1}{W_1^2}$$

$$\eta_H = \frac{H^*}{Y_1 + H^* + M_1 - L_1} = \frac{1}{W_1} - \frac{H^*}{W_1^2} = \frac{W_1 - H^*}{W_1^2} = \frac{Y_1 - M_1 + L_1}{W_1^2} \approx -\frac{\mathrm{d}\ \eta_Y}{\mathrm{d}\ H^*},$$

where the last step in the equation above assume $L_1 - M_1 \approx 0$. The derivative becomes:

$$\frac{\mathrm{d}\ \eta_Y}{\mathrm{d}\ H^*}\ (2\eta_Y\sigma_e^2 + 2\eta_H\sigma_{ep} - 2\mu\sigma_{ep}) - \eta_Y\ 2\frac{\mathrm{d}\ \eta_Y}{\mathrm{d}\ H^*}\sigma_{ep}$$

$$= 2\ \frac{\mathrm{d}\ \eta_Y}{\mathrm{d}\ H^*}\ [\eta_Y\sigma_e^2 + (\eta_H - \eta_Y)\sigma_{ep} - \mu\sigma_{ep}].$$

The sign of $\frac{\mathrm{d}\ \eta_Y}{\mathrm{d}\ H^*}$ is negative, but the sign of the expression inside the parenthesis is ambiguous. To see this more conveniently, we can rearrange the equation as follows:

$$2\ \frac{\mathrm{d}\ \eta_Y}{\mathrm{d}\ H^*}\ [\eta_Y(\sigma_e^2 - \sigma_{ep}) + (\eta_H - \mu)\sigma_{ep}].$$

Focusing on the first expression in the square brackets, an increase in H^* promotes entrepreneurship because it reduces the share of wealth associated with labor income and so the effect of income risk. However, this effect is mitigated by the covariance σ_{ep}, which increases risk. These two opposing forces are standard portfolio effects. Turning on to the next expression, $(\eta_H - \mu)\sigma_{ep}$ highlights the potential for a beneficial hedging effect of housing. This depends on the difference between the actual housing share (η_H) and the desired one (μ). When the agent owns more housing that what is desired ($\eta_H > \mu$), she plans to sell some housing the period 1 (she is long on housing) and the covariance between entrepreneurial income and house prices has a negative effect on utility since it increases the variance of consumption in period 1. Conversely, when the agent is short on housing ($\eta_H < \mu$), the covariance σ_{ep} has a positive hedging effect

[38] For notational simplicity, we ignore the term $\frac{(1-\gamma)^2}{2}$. This has no bearing on this discussion.

on entrepreneurial choice.

A.2 The case with housing consumption commitment

When homeowners can't move, the quantity of housing they consume is fixed and is denoted by $\bar{H} = H_0 = H_1$. Their indirect utility becomes:

$$\begin{aligned} V_{nm}(W_1) &= \frac{\left(C_1^{1-\mu}\bar{H}^{\mu}\right)^{1-\gamma}}{1-\gamma} \\ &= \frac{1}{1-\gamma}\left[(W_1 - P_1\bar{H})^{1-\mu}\bar{H}^{\mu}\right]^{1-\gamma} \\ &= \underbrace{\frac{\bar{H}^{\mu(1-\gamma)}}{1-\gamma}}_{\phi_{nm}}(W_1 - P_1\bar{H})^{(1-\mu)(1-\gamma)} \qquad \text{(A.4)} \\ &= \phi_{nm}(Y_1 - M_1 + L_1)^{(1-\mu)(1-\gamma)}. \qquad \text{(A.5)} \end{aligned}$$

Notice that house prices do not appear in the last expression above. Therefore, house prices and the co-movement of house prices and entrepreneurial income have no effect on the entrepreneurial choice of agents who cannot move.

The entrepreneurship choice: Using the same approximation as in section A.1, equation A.5 can be rewritten as $\phi_{nm}(\bar{Y} - M_1 + L_1)e^{\tilde{\eta}_Y \tilde{y}}$. Notice that share $\tilde{\eta}_Y$ is higher than the share of income out of total wealth (η_Y) because housing is not included in the computation of $\tilde{\eta}_Y$ (i.e. it cancels out because it stays the same):

$$\tilde{\eta}_Y = \frac{Y_1}{W_1 - P_1\bar{H}} = \frac{Y_1}{Y_1 - M_1 + L_1}.$$

In the case with housing consumption commitment, we thus have that:

$$\begin{aligned} \tilde{\alpha}^* &= \frac{\phi_{nm}\mathbb{E}(Y_1^e - M_1 + L_1)^{(1-\mu)(1-\gamma)}}{\phi_{nm}\mathbb{E}(Y_1^w - M_1 + L_1)^{(1-\mu)(1-\gamma)}} \\ &= \frac{(\bar{Y} - M_1 + L_1)\mathbb{E}e^{\eta_Y \tilde{y}(1-\mu)(1-\gamma)}}{(\bar{Y} - M_1 + L_1)\mathbb{E}e^{0}} \\ &= \mathbb{E}e^{\tilde{\eta}_Y \tilde{y}(1-\mu)(1-\gamma)} \\ &= \exp\left\{\frac{(1-\mu)^2(1-\gamma)^2}{2}\tilde{\eta}_Y^2\sigma_e^2\right\}, \qquad \text{(A.6)} \end{aligned}$$

where we take advantage of the assumption that non-entrepreneurial labor income is not risky.

As in the case with free mobility, because of risk aversion, the expected utility for entrepreneurs is lower than that for dependent workers. However, it is not possible to establish whether immobility raises or diminish the likelihood of starting a business relative to the case without consumption commitments. Comparing the above formula with equation 3, we have that, on the one hand, $\tilde{\eta}_Y > \eta_Y$, but on the other hand, $(1-\mu)^2(1-\gamma)^2 < (1-\gamma)^2$. Moreover, equation 3 contains the additional term $2(\eta_H - \mu)\sigma_{ep}$, which

represents the potential hedging benefits of housing. This is absent when individuals cannot sell, and further complicate the comparison of equation 3 with equation A.6.

B Construction of monthly job histories from the British Household Panel Survey

In this section, we provide a description of the way we construct monthly job spells and solve inconsistencies in the BHPS. We follow the principle that information recorded closest to the date of the beginning of the spell is the most accurate. A similar approach is used in Upward (1999) and Battu and Phimister (2008).

To begin with, consider that the BHPS contains a longitudinal file identifying every person that ever appeared in the survey, indicating in which waves he or she was interviewed. From this file we construct the list of individuals that belong to the initial sample, i.e. those with a full interview in Wave 1, as well as those who fill in a full interview for the first time in one of the subsequent waves.

Next, in every wave of the BHPS, interviewed individuals appear in a 'respondent file', which contains information on the current labor force and occupational status — and if they have changed their labor market status between two waves — in a 'job history file' that collects detailed information for every occupational spell, such as job characteristics, starting date, ending date and sector of occupation. In order to construct labor market spells, we use the following iterative strategy for every wave, starting from Wave 1 (1991) or the first wave in which an individual first appears, and working towards to the most recent wave (Wave 18 in 2008):

1. We carry out consistency checks in the 'job history file' and, separately, in the 'respondent file' (more details on this below);

2. We append the 'respondent file' on top of the 'job history file' in order to check the consistency between the two — in particular regarding the starting date of the current job and the history of jobs reported in the history file. We name the resulting file 'wave w' file, where w indicates the wave under consideration;

3. We append the file 'wave w' on top of the combined file from the previous wave, that is, 'wave w-1', and check the consistency of the information provided in the two files.

4. Once we have appended all waves, we compute the duration in months of every spell and we expand the dataset so that every observation corresponds now to one specific month. We call the resulting file the 'labor spell file'.

In the original data, every labor market spell comes with a starting/ending date, and inconsistencies arise because of overlaps between these dates. In order to address inconsistencies, we look for problematic cases both: (a) in the within-file, i.e. within the 'job history file' and separately within the 'respondent file';

and (b) within-wave, i.e. within the combined file obtained by appending the 'respondent' and the 'job history' files. The general idea is to resolve overlaps by preferring answers recorded closest to the date of the beginning of the spell. Note that our 'within-file' and 'within-wave' approach also solves situations that could arise because of between-wave overlaps. In detail, we proceed as follows:

- *Within-file checks:* (a) Spells that display a starting date earlier than the interview of the previous year are recoded as starting on the day of the interview of the previous year. This is because, up to the date of the previous interview, we trust information from the previous wave more than retrospective information ; (b) Spells starting after the current date of interview are considered as starting on the date of interview. Discrepancies of this type probably emerge as a coding error in the original data; (c) For the 'job history file' only, we check that the sequence of spell starting dates is increasing. If this is not the case, we drop the spell(s) that cause the inconsistency.

- *Within-wave checks:* (a) If a spell from the 'job history file' has a missing starting date, the starting date is imputed as the mean of the starting dates of the two adjacent job history spells. Stated differently, we center this job spell in the middle of the two adjacent ones; (b) If a spell from the 'respondent file' has a missing starting date, two possibilities arise. If there is no 'job history file' spell for the same individual, the starting date of this spell is imputed as the date of the previous interview. If instead there is a pre-dating spell in the 'job history file', the starting date of the current job is imputed as the date of the current interview; (c) We check that the sequence of starting dates in the combined 'respondent'/'job history' file —i.e. the 'wave' file —is increasing. If not, we drop the spell that causes the inconsistency; (d) We check that point (c) holds true when we iteratively append 'wave files' from subsequent waves of the BHPS.

C Additional robustness checks

In this section, we briefly discuss an additional set of robustness checks we perform on our main specification. The related findings are present in Appendix Table 1. In Column (1) we perform our analysis using only yearly data. This approach relies only on the housing tenure and the employment status declared at the time of the interview, and uses the variation in these variables between annual surveys. Our previous findings are confirmed: we still find a negative and sizable association between LTV and entrepreneurship.

In Column (2) we revert to our monthly dataset and include in our specification a control for the (log of) local house prices. This variable is meant to control for the confounding effect of local economic cycles, which might drive local housing market conditions – and thereby individuals' LTV – and entrepreneurship. This additional control does not affect our results.

Columns (3) and (4) assess the robustness of our results along geographical dimensions. First, we investigate whether the results may be driven by the geographical mobility of workers upon becoming

homeowners. For example, individuals who choose to purchase a bigger house – thus taking larger mortgages – might leave urban areas, directly affecting their chances of becoming entrepreneurs. Previous evidence shows that more entrepreneurs cluster into denser cities because of urbanization and localization economies (Glaeser, 2009; Glaeser and Kerr, 2010). To address this concern, in Column (3) we exclude from our analysis individuals who make either urban-to-rural or rural-to-urban residential moves, and only consider immobile workers (approximately 87% of the observations). Despite this reduction in sample size, this does not affect our results. Similarly, excluding London from our sample (Column 4) or considering separately predominantly urban and predominantly rural areas (results not tabulated) does not affect our findings.

Finally, we check whether our results only stem from a handful of sectors or whether they are economy-wide. In Column (5), we exclude the following sectors from our analysis: agriculture; fishing and forestry; electricity, gas and water; public administration; private households with employees; and workers of international organizations/bodies. This approach follows Glaeser (2009) and Faggio and Silva (2014) who use self-employment data to study the spatial distribution of entrepreneurial activities in the US and UK, respectively. These restrictions do not change our conclusions. We also investigate whether our results differ for services and manufacturing. Although our conclusions remain valid for both sectors, the point estimates are small and not significant when we only consider manufacturing. This result may be due to the fact that only approximately 25% of the observations come from individuals working in manufacturing. Moreover, the share of self-employed with dependent workers – i.e. our entrepreneurs – is significantly smaller for this sector, at only 2.3%.

Tables and figures

Table 1: Summary statistics – BHPS individual level monthly dataset

Variable	Mean	Std. Dev.
Panel A: Entrepreneurs + homeowners		
Entrepreneur	0.046	0.210
Homeowner	0.810	0.392
Homeowner, with mortgage	0.713	0.452
Homeowners, outright (no mortgage)	0.097	0.296
Loan-to-value ratio on outstanding mortgage (owners with mortgage)	0.488	0.261
House value (all owners)	119,887	109,052
Cumulative house price gains (all owners)	39,597	86,557
Panel B: Controls		
Age	39.36	8.96
Male	0.787	0.409
Household total income (previous year)	31,839	22,033
Individual total income (previous year)	21,060	16,144
Children under 16 (yes=1, no=0)	0.457	0.498
Coupled (yes=1, no=0)	0.745	0.436
Education: Higher Degree	0.038	0.192
Education: First Degree	0.152	0.359
Education: Higher Non Degree/Teaching Qual.	0.080	0.272
Education: A Level (or equiv.)	0.229	0.420
Education: O Level (or equiv.)	0.266	0.442
Education: CSE (or equiv.)	0.070	0.255
Education: None of these	0.165	0.371

Note: The sample only includes heads of household aged between 20 and 55 living in England (excludes Scotland and Wales). Summary statistics of control variables refer to the sample where all controls are non-missing. Number of observations: 366168. Number of individuals: 5193. Panel is unbalanced. 'Entrepreneur' includes self-employed with dependent employees. Loan-to-value ratio of outstanding mortgage is time-varying and calculated as value of outstanding mortgage liabilities divided individual self-reported assessment of property value (measured in GB pounds). LTV capped at 1.25; values above 1.25 recoded as 1.25. House value is time-varying, self-reported and measured in GB pounds. Cumulative house price gains measure the cumulative house price change expressed in GB pounds experienced by homeowners from time of purchase up to the period under consideration. In the regression analysis age is controlled semi-parametrically by including the following dummies: age between 20 and 24; age between 25 and 29; age between 30 and 34; age between 35 and 39; age between 40 and 44; age between 45 and 49; age between 50 and 54; age 50 or above.

Table 2: Summary statistics – Income variation for workers and entrepreneurs

Individual total income (previous year):	Mean	Median	Standard Deviation	Within-individual Standard Deviation
Dependent workers (employees)	21,195	18,332	14,528	7,050
Entrepreneurs: dependent	27,407	18,500	33,608	14,354

Note: Within-individual standard deviation shows average within-individual over-time standard deviation of individual income for different employment categories. See Table 1a for further information on sample construction and variable definitions.

Table 3: Transitions into and out of homeownership and entrepreneurship

	% (numbers) of individuals making at least...	
	One transition	Two transitions
Panel A: Homeownership		
Overall	18.3 (949)	5.8 (303)
Transition in	13.3 (691)	0.9 (46)
Transition out	10.8 (561)	1.0 (53)
Panel B: Homeownership with mortgage		
Overall	25.5 (1326)	7.7 (402)
Transition in	16.2 (840)	1.4 (72)
Transition out	17.1 (888)	1.7 (86)
Panel C: Homeownership without mortgage		
Overall	12.6 (654)	3.6 (188)
Transition in	9.7 (504)	1.0 (50)
Transition out	6.5 (338)	0.6 (30)
Panel D: Entrepreneur, dependent		
Overall	5.9 (305)	3.3 (173)
Transition in	4.8 (249)	1.1 (59)
Transition out	4.4 (229)	1.0 (53)

Note: The sample only includes heads of household aged between 20 and 55 living in England (excludes Scotland and Wales). Total number of individuals: 5193. Panel is unbalanced.

Table 4: Summary statistics of individual characteristics –
Time of transitions into and out of homeownership and entrepreneurship

	Time of transition into...	Time of transition out of...
Panel A: Homeownership with mortgage		
Age	30.35 (7.87)	33.88 (9.22)
Children	0.325 (0.469)	0.378 (0.485)
Coupled	0.623 (0.485)	0.626 (0.484)
Individual total income	13,647 (9,161)	14,969 (10,418)
Panel B: Homeownership without mortgage		
Age	37.40 (8.49)	32.31 (8.82)
Children	0.429 (0.495)	0.302 (0.460)
Coupled	0.677 (0.468)	0.559 (0.497)
Individual total income	16,105 (11,781)	14,596 (10,715)
Panel C: Entrepreneur		
Age	35.42 (8.42)	35.89 (8.13)
Children	0.494 (0.501)	0.498 (0.501)
Coupled	0.803 (0.398)	0.830 (0.377)
Individual total income	17,539 (15,246)	17,225 (14,896)

Note: Sample includes heads of household aged between 20 and 55 living in England (excludes Scotland and Wales). Number of individuals: 5193. Panel is unbalanced. Figures are means and standard deviations (in parenthesis) of listed characteristic.

Table 5: The Correlation between Homeownership and entrepreneurship - OLS and fixed-effect regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable is: Entrepreneur	OLS	OLS	FE All Trans.	FE All Trans.	FE All Trans.	FE Trans. In	FE Tran. Out	FE All Trans.
Homeowner	0.036	0.014	-0.011	-0.012	-0.013	-0.022	-0.009	-0.002
	(0.006)***	(0.006)**	(0.005)**	(0.006)**	(0.005)**	(0.009)**	(0.010)	(0.009)
Homeowner, with mortgage								-0.012
								(0.007)*
Year & month dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LA dummies	No	Yes	No	Yes	No	No	No	No
Controls	No	Yes	No	Yes	Yes	Yes	Yes	Yes

Note: See Table 1 for further information on sample characteristics and variable definitions. Year dummies refer to the year when the BHPS interview was carried out. Month dummies refer to calendar months during which the employment spell took place. LA dummies refer to the Local Authority of residence (343 LAs matched to English-resident BHPS individuals). Household and individual income included in logs. Column (6) only includes people who are or become homeowners. Column (7) only includes people who are or become renters. Standard errors clustered at the LA level. **: 5% significant; ***: 1% significant. Controls as listed in Table 1.

TABLE 6: HOMEOWNERSHIP AND ENTREPRENEURSHIP – THE ROLE OF MORTGAGE DEBT

	(1) OLS Full Sample	(2) Ind. FE Full Sample	(3) Spell FE Full Sample	(4) Spell FE Owners Only	(5) Ind. FE + IV Full Sample
Homeowner	-0.000	0.001	0.019		
	(0.009)	(0.009)	(0.013)		
Loan-to-value (LTV)	-0.005	-0.017	-0.025	-0.022	-0.021
of mortgage	(0.010)	(0.008)**	(0.009)***	(0.010)**	(0.012)*
House value	0.018	-0.000	-0.001	-0.001	0.003
(× £100,000)	(0.004)***	(0.002)	(0.002)	(0.002)	(0.006)
Kleibergen-Paap First Stage	--	--	--	--	*59.36*

Note: Regressions run on the monthly dataset. All regressions include year dummies; monthly dummies; SIC92 1-digit sector dummies; and individual controls. See notes to Table 1 and 5 for more details. Standard errors clustered at the LA level. *: 10% significant; **: 5% significant; ***: 1% significant. Instrumental variable (IV) regression in Column (5) instruments individual's LTV with local LTV obtained using data from the Survey of Mortgage Lenders at the LA level; and self-reported house values with national house price variation interacted with local proxies for the elasticity of housing supply (LA-level percentage of developed land and LA-level refusal rates). The instruments are time-varying and set to zero for years in which individuals are renters.

TABLE 7: HOMEOWNERSHIP AND ENTREPRENEURSHIP – MORTGAGE DEBT AND RISK

	(1) FE	(2) FE	(3) FE	(4) FE
	Coeff. of Variation of Profits		*Correlation of Profits and Local HP*	
	Above Median	Below Median	Above Median	Below Median
LTV of mortgage	-0.016	-0.010	-0.020	-0.002
	(0.009)*	(0.006)	(0.007)**	(0.007)
Additional controls	*House Val. & Own*	*House Val. & Own*	*House Val. & Own*	*House Val. & Own*

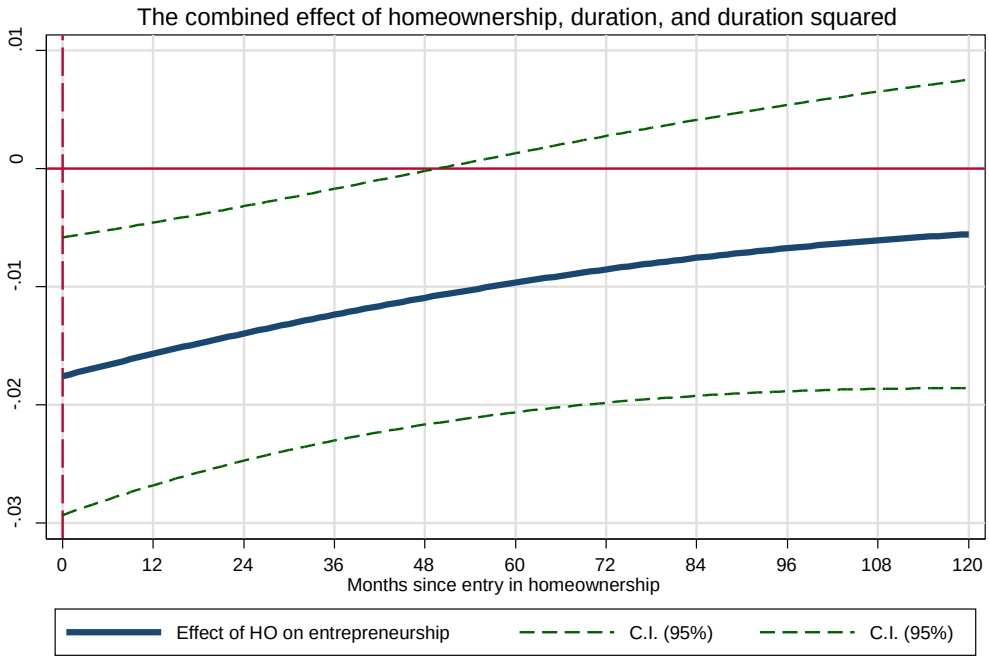
Note: Regressions run on the monthly dataset. All regressions include year dummies; monthly dummies; SIC92 1-digit sector dummies; and individual controls. See notes to Tables 1 and 5 for more details. Standard errors clustered at the LA level. *: 10% significant; **: 5% significant; ***: 1% significant. Columns (1) and (2) split the dependent variable using the median of the coefficient of variation of profits in the sector of employment. Data obtained from Eurostat for the years 1997 to 2007 and merged using NACE sector at the 2-digit level. Columns (3) and (4) split the dependent variable using the median of the correlation between sectoral profits and house prices at the LA level. House price series at the LA level obtained from the Land Registry for the years 1997 to 2007. Median values of coefficient of variation of profits; and correlation between profits and local house price: 0.131; and 0.845.

TABLE 8: HOMEOWNERSHIP AND ENTREPRENEURSHIP – HOUSE PRICES GAINS

	(1) OLS Full Sample	(2) Ind. FE Full Sample	(3) Spell FE Owners Only	(4) Ind. FE + IV Full Sample
Homeowner	0.016	0.003		
	(0.009)*	(0.008)		
Loan-to-value (LTV) of mortgage	-0.009	-0.018	-0.021	-0.017
	(0.012)	(0.009)**	(0.010)**	(0.010)**
Cumulative house price gains (× £100,000)	0.0098	-0.0023	-0.0015	-0.000
	(0.0045)**	(0.0045)	(0.0057)	(0.008)
Kleibergen-Paap First Stage	--	--	--	*87.87*

Note: Regressions run on the monthly dataset. All regressions include year dummies; monthly dummies; SIC92 1-digit sector dummies; and individual controls. See notes to Table 1 and 5 for more details. Standard errors clustered at the LA level. *: 10% significant; **: 5% significant; ***: 1% significant. Cumulative house price (HP) gains measured as the cumulative house price change expressed in GB pounds experienced by homeowners from time of purchase up to the period under consideration. These are based on individuals' self-reported housing values. Column (4) instruments cumulative house price gains using national house price cumulative gains interacted with local proxies for the elasticity of housing supply (LA-level percentage of developed land and LA-level refusal rates); and LTV using local LTV obtained using data from the Survey of Mortgage Lenders at the LA level.

FIGURE 1: THE LINK BETWEEN HOMEOWNERSHIP AND ENTREPRENEURSHIP OVER TIME



Note: Results used to obtain the graph come from the specification including homeownership and both a linear and a quadratic term in the months elapsed since becoming homeowner (and controls as in Column 5, Table 5). Estimated effects as follows. Homeownership: -0.018 (0.006)***; Months since homeowner, linear term (x100): 0.016 (0.008)**; Months since homeowner, quadratic term (x1000): -0.0005 (0.0003)*. Dashed lines are confidence intervals at the 95% level obtained from standard errors clustered at the LA level.

Data Appendix

Additional Results

Appendix Table 1 : Homeownership and entrepreneurship – Further robustness checks

	(1) Yearly Data	(2) Control for Local HP	(3) Immobile Workers	(4) Excluding London	(5) Excl. Selected Sectors
Homeowner	-0.014	-0.017	-0.018	-0.015	-0.021
	(0.008)*	(0.008)**	(0.009)**	(0.009)*	(0.009)**
Additional controls	*House Val. & Own*	*House Val. & Own*	*House Val. & Own*	*House Val. & Own*	*House Val. & Own*

Note: All regressions include year dummies; monthly dummies (except for Column 1); SIC92 1-digit sector dummies; and individual controls. See notes to Tables 1 and 5 for more details. Standard errors clustered at the LA level. *: 10% significant; **: 5% significant; ***: 1% significant. Column (1) uses BHPS annual datasets. All other regressions run on the monthly dataset. Column (2) further control for the log of local house prices (on top of the self-reported housing values). Column (3) only considers individuals always living either in urban areas or in rural areas (no urban-to-rural and rural-to-urban movers). Urban and rural areas determined on the basis of population density (see Faggio and Silva, 2012) for more details; sample includes approximately 87% of the observations. Column (4) excludes London; sample includes around 88% of the observations. Regressions in Colum (4) exclude the following sectors: Agriculture; Fishing and Forestry; Mining; Electricity, Gas and Water; Public Administration; Household with Employees; and International Organizations. Sample includes approximately 88% of the observations.