Rent or Buy? The Role of Lifetime Experiences of Macroeconomic Shocks within and across Countries*

Ulrike Malmendier and Alexandra Steiny†
UC Berkeley

January 4, 2017

Abstract

There are vast differences in homeownership rates across countries. We show that the decision to buy versus rent is strongly affected by macroeconomic shocks that occurred in a country during people's lifetimes. Households are more likely to own their homes if they have experienced higher inflation or, specifically, higher price increases in the housing market during their lifetimes so far. Using household-level data from 13 countries in the European Central Bank's Household Finance and Consumption Survey (HFCS), we exploit differences in individual experiences of price growth to identify the effect on homeownership rates. We find that a 1 pp increase in experienced inflation predicts about a 6% increase in homeownership at the national level and a 28% increase in the odds of homeownership at the individual level. The results are robust to a wide array of individual and housing-market controls. The effect of house-price experiences are less robust, possibly due to the direct effect on the affordability of housing. As predicted by our simple model, the effect of inflation experiences on tenure choice is weaker when alternative inflation hedges are more easily available.

*We thank workshop participants at Berkeley, Chicago, Duke, Stanford as well as the AEA, Finish Economic Association, ESA conferences, the Household and Behavioral Finance Symposium at Cornell conference, and CEPR Network Event on Household Finance for helpful comments.

†Department of Economics, University of California, 501 Evans Hall, Berkeley, CA 94720-3880, ulrike@berkeley.edu and alexsteiny@berkeley.edu

1 Introduction

Buying a home is one of the biggest financial decisions of many households over their lifetimes. The ability to predict household tenure choice, or the decision to rent or buy the main residence, is important also in terms of non-financial outcomes. Higher homeownership levels have been related to more investment in social capital, lower crime rates, and higher real estate prices.[1] Children who grown up in owner-occupied homes have been shown to have better cognitive and behavioral outcomes and achieve higher educational attainment (Haurin et al. (2002) and Green and White (1997)).

Across different countries, however, households appear to make systematically different tenure decisions. Even if we compare households in similar financial situations and across countries in similar economic conditions, the differences in the choice to buy versus rent are large. Within Europe, for example, less than half of all households in Germany and Austria own their home, compared to about 80% in Spain and Cyprus and 90% in Slovakia. (Figure 1 illustrates the wide range of homeownership rates across countries in the European Union and, for comparison, in the United States, where the rate is close to the median.[2]) The variation across states within a country tends to be much smaller. For example, homeownership rates vary considerably less across U.S. states than across European countries, with 43 of 50 U.S. states having homeownership rates between 65% and 75%.[3]

What explains the vast cross-country differences in households' decision to rent versus buy their main residence? Clearly, institutional differences play a large role, as do variation in housing prices and supply, and population demographics.[4]

In this paper, we argue that past experiences of macroeconomic conditions in a country play a significant role in shaping the attitudes and decisions of its inhabitants, above and beyond the influence of contemporaneous policies and institutions. Building on a simple theoretical model, we test whether there is a systematic relationship between experienced inflation, on the one hand, and homeownership, on the other hand, both at the national and individual level. We use homeownership data from 13 countries participating in the

[1] See DiPasquale and Glaeser (1999), Glaeser and Shapiro (2002), Sampson et al. (1997)). Sodini et al. (2016) find that homeownership causes households to have higher labor income, invest more in risky assets, and save more.

[2] We return to a description of the data on European homeownership in more detail later in the paper.

[3] 2010 state homeownership rates from the U.S. Census Bureau.

[4] Examples from the vast prior literature on this topic include Andersen (2011), Andrews and Caldera Sánchez (2011), Clark and Dieleman (1996), Doling (1973), Follain and Ling (1988), Haurin et al. (1996), Henderson and Ioannides (1987), Earley (2004), Ioannides (1987), Painter et al. (2001), and Sinai and Souleles (2005).

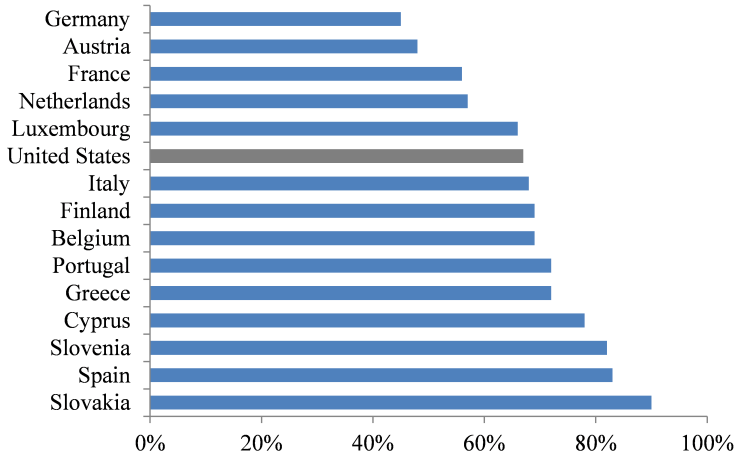

Figure 1: Homeownership rates in Europe and the United States (2008-2011).
Source: ECB Household Finance and Consumption Survey and 2010 U.S. Census.

European Central Bank's Houseehold Finance and Consumption Survey (HFCS), and show that households are more likely to own their homes if they have experienced higher inflation and, in particular, higher price increases in the housing market during their lifetimes so far.

Our approach is, one the one hand, closely related to prior literature on historical influences on homeownership, such as the cultural tradition of passing property through family in Southern Europe or the dowry laws in Greece, which continue to contribute to a culture of high homeownership persisting in Greece today, even after their repeal in 1983 (see, e.g., Earley). Similarly, Andrews et al. (2011) argues that differences in the timing and extent of early (historical) mortgage market reforms help explain persistent cross-country differences in the availability of mortgage financing today. On the other hand, our approach differs from these prior studies in that we focus on a person's lifetime experiences.[5] Our analysis shows that a household's decision to buy versus rent is strongly affected by macroeconomic shocks that occurred during the household's lifetime so far in the country of residence, controlling for current macroeconomic conditions, institutions, and regulations.

To illustrate the basic idea, we consider the relationship between the 2010 homeownership rates across countries (shown in Figure 1) and past inflation rates experienced by these homeowners. In Figure 2, we plot historical annual inflation for European countries since 1925 separately for the top quartile (left graph) and the bottom quartile (right graph) of

[5] In a similar spirit, Alesina and Fuchs-Schündeln (2007) argue that past experiences of a certain institutional environment affects attitudes today, controlling for the current institutions. They find that East Germans, after living under a Communist regime, favor redistribution more than West Germans, even years after reunification.

homeownership rates in 2010.[6] It is easy to see the strong positive correlation. Countries that have high homeownership rates tend to have had much higher historical inflation, and the difference is particularly strong over the last 70 years, i.e., going back to the time threshold of inflation experienced by homeowners alive in 2010.

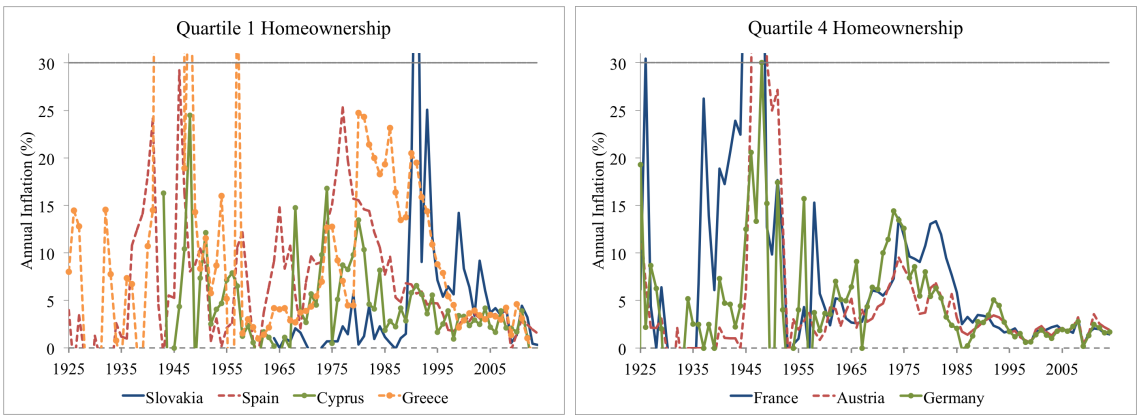

Figure 2: Inflation history, top and bottom quartile of homeownership rate.
Inflation data from Reinhart and Rogoff (2009) and Global Financial Data. Inflation for chart capped above at 30% and below at 0%. Quartile 1 includes countries with the highest homeownership rates, and quartile 4 countries with the lowest.

We formalize the impact of the past on present beliefs and decisions as *experience effects*. An emerging literature on experience effects argues that households overweight their own experiences of macroeconomic outcomes when forming expectations, in particular in the context of inflation experiences (Malmendier and Nagel (2011), Malmendier and Nagel (2015), Malmendier et al. (2016)). In our context, we focus on the role of inflation and, in particular, growth in house prices that occurred in a country during a person's lifetime so far. We develop a stylized theoretical framework that links expectations about inflation to tenure decisions. If households put a higher weight on their own inflation experiences when forming expectations of the future, consistent with Malmendier and Nagel (2011, 2015), then differences in macroeconomic experiences can be used to predict household tenure choice.

The model demonstrates that experiencing higher inflation can lead to a higher likelihood of being a homeowner through two channels: the desire to hedge against inflation, and the attractiveness of a fixed-rate mortgage. Real estate has classically been viewed as an inflation hedge, as captured by the classic Gordon growth model (1962).[7] Whether or not real estate is *actually* a good hedge against inflation, if households believe that real estate is an inflation

[6] Homeownership rates average at about 80% of households in the top quartile, and at about 50% in the bottom quartile. See Appendix Figure A1 for inflation history of all homeownership quartiles.

[7] While the Gordon growth model is a good benchmark for a theoretical basis of whether real estate is an

hedge, households who have lived through high inflation may expect higher inflation in the future and therefore value the inflation-hedging advantages of investment in real estate. Thus higher inflation induces a higher likelihood to own one's home. Similarly, if households believe that house prices will be high in the future, they may be more likely to purchase their home today.[8]

As a second channel for the relationship between homeownership and high inflation experiences, the model also illustrates the perceived attractiveness of fixed-rate borrowing. Even if tenure choice is not influenced by hedging motivates, e.g., because other inflation hedges are available, individuals who have experienced high inflation may be more likely to own their home if they can finance it with a fixed-rate mortgage. The reason is that these individuals overestimate future inflation and perceive mortgage rates to be too low in real terms.

We note that, while our model assumes that the mechanism of experience effects works through belief formation, it is also possible that experience affect household preferences. The empirical predictions of such an alternative model remain the same, with higher inflation experiences inducing a higher likelihood of homeownership, albeit the effect might be reduced when other inflation hedges are easily available. The welfare implications of such an alternative model, however, would be different, and are empirically hard to assess.

To illustrate the potential mechanism, consider Figure 3, which plots homeownership rates and experienced inflation (measured as a weighted average over the lifetime) for 30-59 year olds in Italy and Luxembourg.[9] While much is left out of this simple diagram, the figure suggests that there might be a relationship between inflation experiences and homeownership. In Italy, we see a steep increase in experienced inflation between households in their 30s, 40s, and 50s while in Luxembourg we see a flatter relationship between experienced inflation and age. These trends are mirrored closely in the homeownership rates – the increase across age buckets is steeper in Italy compared to Luxembourg.

Turning to the empirical implementation, we focus on inflation as a macroeconomic experience that predicts homeownership. Another macroeconomic experience that likely

inflation hedge, it relies on the assumption that future rent growth and discount rate are constant and adjust one-for-one with inflation. In response to this critique, there is an extensive literature empirically testing whether real estate and real estate investment trusts (REITs) act as inflation hedges, with mixed results (see for example Anari and Kolari (2002), Brounen et al. (2012), Case and Wachter (2011), Fama and Schwert (1977), and Liu et al. (1997)).

[8] Other recent papers have also explored the consequences of potential homeowners that are not fully rational (e.g., Glaeser and Nathanson (2015)).

[9] We return to a description of the data and calculation of experienced inflation in more detail later in the paper.

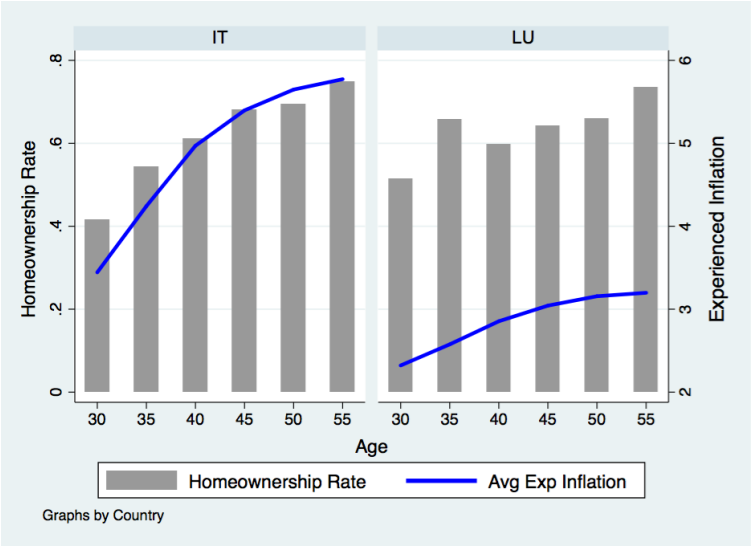

Figure 3: Homeownership and inflation experiences in Italy and Luxembourg.
Note: Homeownership data from ECB Household Finance and Consumption Survey. Homeownership rate by age buckets plotted on the left x-axis with experienced inflation by age group plotted on the right x-axis.

affects homeownership is experienced house prices. While long time series of inflation data are available for most countries, the house price data is more limited, which restricts our ability to calculate comprehensive measures of house price experiences. We therefore focus our analyses on experienced inflation but also present analyses for experienced house prices.

We use household microdata from 13 countries participating in the European Central Bank's Household Finance and Consumption Survey (HFCS) to provide evidence for a relationship between experiences of price growth and homeownership decisions. The sample allows for variation in macroeconomic experiences across two dimensions: age and country. To calculate measures of macroeconomic experiences, we use a weighted lifetime average, with more recent experiences weighted higher than those in the distant past.

Aggregating experiences to the national level, we find that a 1pp increase in average experienced inflation predicts a 6pp increase in aggregate homeownership rate. Focusing on individual tenure choice, we find that a 1 pp increase in experienced inflation corresponds to a 28% increase in the odds of homeownership. We also test two additional predictions of the theoretical model, that inflation experiences will be a better predictor of homeownership in countries with limited access to alternative inflation hedges and in those with access to fixed-rate financing.

While the primary analyses exploit variation in experiences across ages and across coun-

tries, we also show that experienced inflation remains a significant predictor of homeownership after controlling for country fixed-effects. We show that the results are robust to including a number of household demographics, housing market characteristics, and to alternative formulations of the experience measure. In addition to general price growth, we find that experienced house price growth predicts homeownership choices, though the effect is less robust. Finally, using retrospective data from the SHARE survey of elderly individuals across 13 countries in Europe, we also provide suggestive evidence that experienced inflation predicts the hazard of an individual's first home-ownership.

Previous literature. Our paper builds on several string of literature. The literature on experience effects shows that life experiences of macroeconomic events such as inflation and stock returns have significant impacts on expectations and financial decisions. For example, Malmendier and Nagel (2011) find that stock and bond market experiences predict future investment decisions. Malmendier and Nagel (2015) show that experienced inflation can be used to predict individuals' inflation expectations and likelihood to borrow using fixed- versus variable-rate mortgages.

A recent paper by Ampudia and Ehrmann (2014) uses household data from the HFCS, the same dataset used in our analysis, to demonstrate that macroeconomic experiences influence the amount of risk households are willing to take. For example, they find that experiencing higher stock market returns increase households' self-reported tolerability of financial risk and stock market participation. The authors employ the same approach as used by Malmendier and Nagel (2011) to measure experiences and find that, relative to households in the U.S., European households tend to weight recent experiences more highly relative to past experiences. In addition to the weighted average summary of lifetime experiences, they also find that extreme market experiences have lasting effects on behavior. As further evidence for the persistence of extreme experience effects, Ehrmann and Tzamourani (2012) find that experiences of hyperinflation (inflation above 200%) have lasting effects on beliefs about the importance of price stability. Similarly, Giuliano and Spilimbergo find that recession experiences during one's youth have lasting impacts on beliefs about redistribution, confidence in the government, and attitudes on the importance of work versus luck.

After the housing crisis in the 2000s, a new vein of research has also examined whether preferences for homeownership in the U.S. have changed as a result of high foreclosure rates and steep declines in housing prices. Bracha and Jamison (2012), Drew and Herbert (2013), and Collins and Choi (2010) test the hypothesis that recession experiences influence housing preferences, but, perhaps surprisingly, find little evidence that such a relationship exists.

This paper also relates to the larger literature on determinants of tenure choice. These can broadly be classified as household characteristics (such as family structure, employment status, and wealth) and market factors (such as rent prices, tax benefits to homeowners, and structure of the credit market).

Household demographics that are important to homeownership decisions are typically age, marital status, presence of children, and employment status.[10] Household financial status measured by income, wealth, and access to mortgage debt are also key predictors of homeownership (Drew and Herbert (2013)). Tenure choice is also correlated with preferences for type of home as some types of residences (i.e., single detached units) are more often available for sale than for rent (Andersen (2011)).

In addition to the household-level characteristics that determine tenure choice, many features of the housing market (such as prices and regulations) have been shown to influence aggregate homeownership rates. Looking across OECD member countries, Andrews and Caldera Sánchez (2011) cite policies such as tax relief on mortgage debt and rent regulations as drivers of aggregate homeownership rates. Focusing on the large differences in the homeownership rates across European countries, Earley (2004) finds that countries with high homeownership rates tend to be poorer, have lower levels of mortgage debt (and have been slower to develop financial markets), and have cultures or government policies that encourage children living at home for longer and/or purchasing their first home later. Earley also cites transaction costs, relative price of renting versus owning, and the supply of housing available for renting versus owning as potential drivers of differences in homeownership rates.

The rest of the paper proceeds as follows. Section 2 describes a theoretical framework demonstrating how inflation expectations can influence tenure choice. Section 3 describes the data. Section 4 describes the analyses of the relationship between macroeconomic experiences and homeownership. Section 5 concludes.

2 Theoretical Framework

In this section, we develop a stylized model of household tenure choice, demonstrating how inflation experiences can influence the decision to rent or buy a home. Real estate has classically been viewed as an inflation hedge, as characterized by the seminal Gordon growth model (1962). Our model builds on Gordon's theoretical setting and introduces the possi-

[10] See for example Andrews and Caldera Sánchez (2011), Bracha and Jamison (2012), Drew and Herbert (2013), and Collins and Choi (2010).

bility of experience-based belief formation. We allow experiences of inflation to affect beliefs about future inflation.

In this stylized model, we demonstrate two channels through which experiencing high inflation, and thus expecting higher inflation in the future, can increase the likelihood of homeownership. First, there is an inflation-hedging motive, which increases with expected inflation. Second, even if households can perfectly hedge against inflation using other assets, expecting high inflation makes owning a home with a fixed-rate mortgage more attractive.

2.1 Model Set-up

Households In this simple model, we consider an agent born at time t that lives for one period. When born, the agent observes current inflation (i.e., price changes from $t-1$ to t). An experienced-based agent will use the inflation realized in t to form beliefs about the future, as described in more detail below.

The agent also observes the cost of renting a house, H_t, and of buying a house, M_t, which the agent takes to be exogenous. The key decision we focus on in this model is the household's choice between buying and renting a home to live in from t to $t+1$. If the household decides to be a renter, it pays rent H_t at time t. If the household decides to buy a home, it must pay the current house price M_t at time t.

We assume that the agent has the option to finance the purchase with a fixed-rate mortgage of value $m_t \in [0, M_t]$. All mortgages last for one period and carry a nominal fixed rate of n_t^{fix}. Hence, a household with a mortgage m_t raised at time t will need to pay back the mortgage with interest, $(1+n_t^{fix})m_t$, at $t+1$. At $t+1$, the homeowner also sells the house at the new price M_{t+1}.

We allow the household to own at most one house. For simplicity, all houses in the economy are identical in quality, and therefore housing quality does not affect the choice to buy or rent.

The household is endowed with wealth w_t when born and consumes all of their wealth at $t+1$. Inflation in the price of consumption from t to $t+1$ is π_{t+1}, and is realized at $t+1$.

Households have log utility over consumption in $t+1$, or equivalently over real terminal wealth. For a household born at t,

$$U_t = u(c_{t+1}) = \log\left(\frac{w_{t+1}}{1+\pi_{t+1}}\right)$$

where w_{t+1} is nominal wealth at $t+1$.

Given initial wealth w_t, households make a housing decision to maximize expected real terminal wealth subject to a minimum housing constraint, which requires the household to either rent or own a house from t to $t+1$. We normalize the utility associated with living in a house to 0.

In addition to housing, there is a single alternative asset. Below we describe the model for two different assumptions about the return on the alternative asset. In the first version of the model, the alternative asset pays a known nominal interest rate, n_t. In this framework, housing is the only inflation hedge. In the second version of the model, we instead assume the alternative asset is inflation-protected and offers a known real return, r_t.

Households use only experienced inflation and house prices to form beliefs about the future. Households take rent and mortgage rates as exogenously given and do not use them to draw inferences about future inflation or house price growth.

Housing Market To demonstrate the channels though which inflation expectations affect homeownership decisions, we assume that real estate is a perfect inflation hedge, i.e., that house prices move one-for-one with inflation. The main results are similar if we allow for exogenous house price changes. See Appendix B for more detail.

Letting M_t be the nominal house price at time t, the relationship between nominal house prices M_t and M_{t+1} is defined by

$$M_{t+1} = M_t(1 + \pi_{t+1})$$

where π_{t+1} is inflation between t and $t+1$.[11]

We consider a simple version of this framework where inflation is either high or low, denoted π^H and π^L, where π^H occurs with probability p_{π_H}.

Beliefs Household beliefs about inflation are biased in the direction of their experience. Denoting household beliefs with $\hat{p}$, experience-biased households born at t believe that the high inflation state will occur in $t+1$ with probability $\hat{p}_{\pi_H} > p_{\pi_H}$ if the household experienced high inflation at t. Similarly, experience-biased households that lived through low inflation in time t believe the high inflation state will occur in $t+1$ with probability $\hat{p}_{\pi_H} < p_{\pi_H}$. (This is a stylized way to capture the experience effect of inflation, which we use for simplicity of exposition. In the empirical analysis, we allow all life-time experiences to affect the beliefs.

[11] Of course in general equilibrium, house prices would react to demand and supply. The simplification of having an exogenous process for home prices allows us to make our main points without complicating the model.

We even allow other historical data to matter; the key feature is that lifetime experiences receive some extra weight.)

2.2 Housing as the only inflation hedge

In this version of the model, the alternative asset pays a nominal rate n_t between t and $t+1$, known to households at time t.

Households choose to rent or buy by maximizing expected utility conditional on renting or buying with a fixed-rate mortgage of $m_t \in [0, M_t]$.

The household's expected utility from renting given equilibrium rental price H_t is

$$E_t\left[u(c_{t+1}|\text{renting})\right] = \log\left((w_t - H_t)(1+n_t)\right) - E_t\left[\log(1+\pi_{t+1})\right].$$

We assume that fixed-rate mortgages are offered at competitive prices in this simple economy and that there is no risk of default, so $n_t^{fix} = n_t$. In this case, household expected utility conditional on buying a house is equivalent under all mortgage amounts $m_t \in [0, M_t]$ and is given by

$$E_t\left[u(c_{t+1}|\text{buying})\right] = E_t\left[\log\left(M_t(1+\pi_{t+1}) + (w_t - M_t)(1+n_t)\right)\right] - E_t\left[\log(1+\pi_{t+1})\right].$$

Households decide to buy if $E_t\left[u(c_{t+1}|\text{buying})\right] \geq E_t\left[u(c_{t+1}|\text{renting})\right]$, or if

$$\begin{aligned}&\hat{p}_{\pi_H}\left[\log\left(M_t(1+\pi_H) + (w_t - M_t)(1+n_t)\right)\right] + \\ &(1-\hat{p}_{\pi_H})\left[\log\left(M_t(1+\pi_L) + (w_t - M_t)(1+n_t)\right)\right] \geq \log\left((w_t - H_t)(1+n_t)\right).\end{aligned}$$

The relative value of buying is increasing with expectation of future inflation ($\hat{p}_{\pi_H}$), but the relative value of renting is constant with respect to beliefs. When housing is the only available inflation-hedge, expecting higher inflation effectively increases the expected real return to homeownership relative to the non-inflation protected alternative asset.

Now, assume the household has access to a variable rate mortgage, which carries a known real rate, r_t. The household's utility from buying a house with a variable rate mortgage of

value $v_t \leq M_t$ is

$$\begin{aligned} E_t\left[u(c_{t+1}|\text{buying with VR } v_t)\right] &= E_t\left[\log\left(\frac{M_{t+1}}{1+\pi_{t+1}} - v_t(1+r_t) + (w_t - (M_t - v_t))\frac{1+n_t}{1+\pi_{t+1}}\right)\right] \\ &= E_t\left[\log\left((1+\pi_{t+1})(M_t - v_t(1+r_t)) + (w_t - M_t + v_t)(1+n_t)\right)\right] \\ &\quad - E_t\left[\log(1+\pi_{t+1})\right]. \end{aligned}$$

The relative utility of buying with a variable rate fixed to inflation relative to renting is increasing in π_{t+1} when $M_t > v_t(1+r_t)$. In this environment, potential home buyers like inflation when they maintain a significant enough stake in the investment. Financing with a variable rate mortgage introduces a tension for potential homebuyers. High inflation increases the nominal value of the home, but also the nominal interest paid on the mortgage. Homeowners only profit from high inflation if the increase in the nominal home price can offset the mortgage interest paid. Assuming a reasonable loan-to-value rate and modest real interest rate, this condition will hold. For example, with 20% LTV, experienced inflation predicts higher homeownership when real interest rates are below 25%.

2.3 Housing in a market with perfect inflation hedges

The first version of the model shows that beliefs about inflation can affect the desire to own a home through the inflation-hedge motive. However in the real world, households may have other (perhaps superior) inflation hedge investment opportunities. In the second version of the model, we assume that households have access to another perfect inflation hedge. Specifically, that the alternative asset is inflation-protected and pays a *real* rate r_t between t and $t+1$, known to households at time t.

Again, households choose to rent or buy by maximizing expected utility. The expected value of renting at the prevailing prices is

$$E_t\left[u(c_{t+1}|\text{renting})\right] = \log\left((w_t - H_t)(1+r_t)\right).$$

When the alternate asset provides a known real rate, household beliefs about inflation (specifically deviations from the true expected inflation), drive preferences for fixed-rate mortgages and the expected utility of being a homeowner is no longer independent of the

financing decision. The expected utility of buying with a fixed-rate mortgage m_t is

$$\begin{aligned} E_t\left[u(c_{t+1}|\text{buying with } m_t)\right] &= E_t\left[\log\left(\frac{M_{t+1}}{1+\pi_{t+1}} - \frac{m_t(1+n_t^{fix})}{1+\pi_{t+1}} + (w_t - (M_t - m_t))(1+r_t)\right)\right] \\ &= \hat{p}_{\pi_H}\log\left(m_t\left[(1+r_t) - \frac{(1+n_t^{fix})}{1+\pi_H}\right] + w_t + (w_t - M_t)r_t\right) \\ &+ (1-\hat{p}_{\pi_H})\log\left(m_t\left[(1+r_t) - \frac{(1+n_t^{fix})}{1+\pi_L}\right] + w_t + (w_t - M_t)r_t\right). \end{aligned}$$

To determine how experiences impact household buy versus rent decisions, we recognize that the utility of renting is fixed with respect to beliefs and look at how the utility of buying varies with household beliefs.

First, note that if the house is purchased outright ($m_t = 0$), the value of buying is not dependent on beliefs about future inflation. This is because we have removed the inflation-hedge motive completely, and with no fixed-rate mortgage, inflation beliefs do not play a role.

With a nominal fixed-rate mortgage, the *real* mortgage rate, $(1+n_t^{fix})/(1+\pi_{t+1})$, is decreasing in expected inflation. Therefore, when households buy with some positive mortgage amount $m_t > 0$, the value of buying increases with expected inflation.

But the choice of mortgage amount is likely endogenous. In this model we assume that households have enough cash to buy the house outright or can finance the purchase of their home by borrowing the alternative asset rather than using the mortgage. In the case where the alternative asset also pays a fixed nominal rate, borrowing with the mortgage is equivalent to borrowing at the alternative asset rate. When the alternative asset pays a known real rate, the household will want to borrow via a nominal fixed-rate mortgage approximately whenever the alternative asset real rate of return is higher than the expected *real* mortgage rate.

Consider the simplified case in which households believe that $\pi_{t+1} = \hat{\pi}$ with certainty. Then, conditional on buying, households will choose a full mortgage, $m_t = M_t$, when

$$1 + r_t > \frac{1+n_t^{fix}}{1+\hat{\pi}}$$

and no mortgage, $m_t = 0$, otherwise. This condition implies that households would buy with a fixed-rate mortgage only when they expect relatively high inflation. This makes the nominal fixed-rate mortgage look like an attractive way to borrow compared to the prevailing

interest rate for other assets, r_t.

In the environment with an asset that offers a known real return, household beliefs about inflation can still drive homeownership decisions, but only through the fixed-rate mortgage, which allows households to borrow at a rate they believe is advantageous.

Note that in this framework, with no default risk, a variable rate mortgage that adjusts perfectly to inflation would carry, in real terms, the same rate as the alternative asset, r_t. Then, the utility of buying is independent of the variable rate mortgage amount, which we will denote v_t, with

$$\begin{aligned} E_t\left[u(c_{t+1}|\text{buying with VR } v_t)\right] &= E_t\left[\log\left(\frac{M_{t+1}}{1+\pi_{t+1}} - v_t(1+r_t) + (w_t - (M_t - v_t))(1+r_t)\right)\right] \\ &= E_t\left[\log\left(w_t + (w_t - M_t)r_t\right)\right]. \end{aligned}$$

This is equivalent to buying the house outright and therefore experienced inflation would not predict higher homeownership in countries that charge a variable rate mortgage that adjusts perfectly with inflation. While in practice a variable mortgage rate may be set to serve multiple purposes (e.g., to increase rates over time), this simple representation captures the intuition that benchmarking the variable rate to some measure of inflation attenuates the role of inflation beliefs in tenure choice.

Although this is a very stylized model, we use it to make two predictions about when experienced inflation should influence homeownership decisions that we later test empirically.

Though the model is very stylized, we use the results to make predictions about the conditions under which experienced inflation predicts homeownership decisions. Without alternative inflation hedges, we should expect to see such experience effects when households are buying outright, financing with a fixed-rate mortgage, and (under some conditions) when financing with a variable-rate mortgage. Alternatively, if households have access to perfect inflation hedges, we should only expect to see experience effects among households who have access to a fixed-rate mortgage. Assuming households face a mix of funding opportunities, this leads to the first prediction: experienced inflation should be a better predictor of homeownership in countries with less access to inflation-hedges. To proxy for access to alternative inflation hedges in our empirical analysis, we use an indicator for whether the country has outstanding government bonds linked to euro-area inflation, which includes France, Germany, Greece, and Italy (Garcia and van Rixtel (2007)).[12] While inflation-

[12]We do not include countries that issued inflation-protected bonds in earlier years: Finland in the early 1990s, Austria in 2003, and Belgium in 2004.

protected government bonds are certainly not the only, or best, way to hedge against country-specific inflation, their availability may signal a developed financial market with easier access to alternative hedging opportunities.

Second, we predict that the predictive power of experienced inflation will be higher in countries where households face fixed-rate, instead of variable-rate, mortgages. From the model, we see that higher experienced inflation increases the value of ownership with a fixed-rate mortgage, with or without alternative inflation hedges. The value of homeownership when financed by a variable-rate mortgage is only increasing in experienced inflation when there are no inflation hedges, or when the loan-to-value amount is relatively large (compared to prevailing interest rates). This combination of directional effects leads us to predict that the effect of experienced inflation on homeownership decisions will be attenuated amongst households who face variable-rate mortgage financing. To proxy for availability of fixed and variable rate mortgages in our empirical analysis, we would ideally like to measure mortgage supply. We instead can only proxy with an equilibrium measure of the prevalence of variable-rate mortgages in each country, obtained from Andrews et al. (2011) and described more in detail below.[13]

The model makes sharper predictions about the interaction of financing opportunities and availability of alternative inflation hedges, which we would ideally like to test in the empirics. However, with only 13 countries in our sample and an uneven distribution across types, we test only the main effects of access to inflation hedges and fixed-rate mortgages and not the interactions.

3 Data

3.1 Household Finance and Consumption Survey Data

In this paper, we use household-level microdata from the Eurosystem Household Finance and Consumption Network's Survey (HFCS). Conducted by the European Central Bank (ECB) in 2008 to 2011, this survey collected information on households' finances and consumption from 15 countries. For reasons described below, we exclude Malta and Slovenia from all analyses, resulting in a total of 13 countries in our sample: Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Italy, Luxembourg, Netherlands, Portugal, Slovakia, and Spain.

[13] In the analysis, we assume that variable-rate mortgages are linked to inflation in some way (e.g., targeting a nominal interest rate), but recognize that there are other forms of variable rates.

The goal of the HFCS is to collect harmonized data across the euro area, with a sample that is representative at both the euro area aggregate and individual country level. The target population is all private households and their current members residing in the national territory. Each country conducts its own survey, working to integrate the HFCS questions and methodology into any preexisting surveys of household finances and consumption.

From the HFCS microdata for each country, we obtain the age, gender, marital status, highest education level, and employment status of the household head. We also observe whether the household head has any children.

In our analyses, we measure marital status with indicator variables for the following response: single/never married, married or consensual union on a legal basis, widowed, and divorced. Highest level of education attained by household head is measured in the HFCS using the International Standard Classification of Education (ISCED 1997), a seven category system. The HFCS education level categories are: primary or below (No formal education or below ISCED 1 or ISCED 1), lower secondary (ISCED 2), upper secondary (ISCED 3 or ISCED 4), and tertiary (ISCED 5 or ISCED 6). For comparison to the United States education system the categories can be roughly mapped as primary or below is equivalent to primary school educated, lower secondary is middle school, upper secondary is high school, and tertiary level is college educated.

We represent employment status with indicator variables indicating whether the household head is employed, unemployed, retired, or not in the work force (not retired). The indicator for not in the work force (not retired) includes household heads who are students, on sick/maternity/other leave, permanently disabled, doing compulsory military service, fulfilling domestic tasks, and other not working for pay.

At the household level, we measure net wealth and total gross income. We convert all monetary values to 2010 Euros using country-specific inflation from 2010 to the time of the survey. Approximately 40% of the sample was surveyed in 2010. We test the robustness of our main analyses to using nominal wealth and income. In addition to adjusting for inflation between survey years, we also test the robustness of our analyses to adjusting wealth and income for purchasing power parities, using 2010 OCED purchasing power parities for actual individual consumption.

While few households are missing the family characteristic and employment variables in our analysis, we do have a substantial amount of missing wealth and income data (about half of the overall sample, including all French households). For these missing data points, the ECB provides multiple imputed data. Five copies of the data are provided in which missing

values are imputed via stochastic imputation which estimates missing values conditional on observed variables. We use multiple imputation techniques (Rubin (2004)) to include the full imputed sample in our analyses.

In additional analyses, we use data on the household's current home equity, calculated as current value of the property minus current mortgages with household main residence as collateral. We also use the current value of the household main residence and value at the time of purchase to calculate a real gain from homeownership due to house price appreciation.

We focus on HFCS household heads aged 20-80 at the time the surveys were conducted in 2008-2011. We exclude Malta from all analyses as data on age of household head is unavailable. In our main analyses, we also exclude Slovenia, which had over 1800% inflation in 1987.[14] Slovenia and Malta make up only 2% of the total sample. In our main analyses, we include all households surveyed, regardless of where the household head was born as France, Spain, and the Netherlands do not have information whether the household head is a native of the country. In countries with this indicator, almost 90% of household heads are natives. Our main results are robust to limiting analyses to natives only.[15]

We measure survey year at the individual level, using the year the interview was actually conducted if available, and otherwise the start year of the survey period for the country.

In our baseline analyses, we use household weights provided by the European Central Bank (ECB) that are representative of each country and the EU population (inverse probability of being sampled and non-response). We also use the ECB-provided replicate weights (bootstrap weights accounting for the sampling design) for use with the multiple imputation data.

Table 1 summarizes real estate participation (as measured in the HFCS data) in the 13 countries in our sample. We find a wide range of homeownership rates across countries in our sample. Less than half of households own their main residence in Austria and Germany while homeownership rates are above 80% in Spain and Slovakia.

Homeownership rates vary significantly across Europe. In Germany and Austria, less than half of households own their home, compared to about 80% in Spain and Cyprus and 90% in Slovakia. Figure 1 displays the wide range of homeownership rates across countries in the European Union and, for comparison, in the United States.

[14] We test the robustness of our main results to including Slovenia with a capped measure of inflation in Appendix Table A3.

[15] We do not find strong evidence that experience effects are weaker for non-natives. This is not surprising given that the ECB does not provide the country of origin so we cannot tell what experiences non-natives have had. In addition, most non-natives have lived in their current country for a substantial amount of time (an average of 23 years).

It is also striking that homeownership rates across U.S. states vary considerably less than across Europe: 43 of 50 states have homeownership rates between 65% and 75%.[16]

In Table 2, we show summary statistics for the household characteristics used in our analyses. Our sample includes almost 57,000 households across 13 countries. The average household head is 51 years old. 56% of household heads are male and 41% have children. The average net wealth, in 2010 Euros, is about 200,000 and average household income is about 36,000. 55% of household heads are married, 23% are single, and the remaining household heads are widowed or divorced. 25% of household heads are educated at the tertiary ISCED-97 level (college in the U.S.) and 43% are educated at the upper secondary level (high school in the U.S.). The remaining 32% are educated at the lower secondary level or below. 56% of household heads were employed at the time of the survey, with 6% unemployed, and 27% retired.

3.2 Inflation Data

We obtain historical inflation data from Reinhart and Rogoff (2009), Global Financial Data, and the International Monetary Fund (IMF). Reinhart and Rogoff primarily use consumer price indices (CPI). In a discussion of the calculation of the CPI by the Bureau of Labor Statistics, Greenlees and McClelland (2008) point out that the CPI is meant to capture housing costs. Historically this has included house prices, while more recently the CPI is designed to target housing consumption rather than investment.

For Austria, Belgium, Germany, Finland, France, Greece, Italy, Netherlands, Portugal, and Spain, we use the Reinhart-Rogoff inflation data from 1925 through 2010. We use 2011 data from the IMF, to extend the series for countries that were surveyed in 2011.

The Reinhart-Rogoff data does not include Cyprus, Luxembourg, and Slovakia, and so we use historical inflation data from Global Financial Data. Unfortunately, inflation data from Global Financial Data does not extend as far back as the Reinhart-Rogoff series. In Cyprus, data begins in 1943 (affecting household heads aged 67 and up). In Slovakia, data begins in 1964 (affecting household heads over 46).

Belgium, Germany, Greece, and Luxembourg have gaps in the inflation series in the 1940s ranging from 1 to 7 years. Inflation was linearly imputed across missing data years.

[16] 2010 state homeownership rates from the U.S. Census Bureau.

3.3 House Price Data

We obtain our house price indices from several sources.

We obtain real house price indices from the Federal Reserve Bank of Dallas from 1975 onward. The house price index for each country was chosen by the Federal Reserve Bank of Dallas to be most consistent with the quarterly U.S. house price index for existing single-family houses produced by the Federal Housing Finance Agency and is seasonally adjusted. Using this data we cannot compare relative house prices across countries, and instead compare house price growth. Using the fourth quarter index values, we calculate annual house price growth within each country.

House price data from the Federal Reserve Bank of Dallas was unavailable for Austria, Cyprus, Greece, Portugal, and Slovakia. Therefore, analyses with experienced real house price growth from these data are limited to 8 of the 13 countries we use in the HFCS data. Using this data, we are able only to construct a partial measure of experienced real house price growth and so we look to other sources to construct a more complete measure of experiences.

Using historical house price index time series provided by Knoll et al. (Forthcoming) and Bordo and Landon-Lane (2013), we are able to construct full experience measures for 6 of the countries in our HFCS sample. From Knoll et al. (Forthcoming), we obtain nominal house price indices in Belgium, Finland, France, Germany, and the Netherlands which we convert to real house price growth using the inflation data described above. We supplement the Knoll et al. (Forthcoming) data with real house price index data for Spain Bordo and Landon-Lane (2013) to get complete historical real house price growth data for 6 of the countries in our HFCS sample.

3.4 Housing Market Data

We obtain country level measures of housing markets close to the time of the ECB survey, summarized in Table 3.

Prevalence of variable rate mortgages is a binary variable equal to 1 if variable rate mortgages were the prevailing type of interest rate. This measure is available for all countries in the sample except for Cyprus and was also obtained from Andrews et al. (2011).

Tenant protection provides a comparative measure of tenant-landlord regulations in the private rental market in 2009 from Andrews et al. (2011). This accounts for regulation such as requirements for evicting a tenant and deposit requirements. This measure does not

include rent control. Tenant protection is unavailable for Cyprus.

Rent control, obtained from Andrews et al. (2011), is a composite indicator increasing in the extent of controls of rents. Measured in 2009, this variable captures the degree to which landlords and the tenants are free to negotiate rent levels. This measures accounts for any restrictions in rent setting, such as a cap on rent price increases or restrictions on types of costs that can be passed-through to tenants. Rent control is unavailable for Cyprus and Slovakia.

Tax benefits to homeowners was measured in 2009 and provides a comparative measure of tax relief on debt financing of homeownership from Andrews et al. (2011). In particular, this measures the extent to which mortgage interest payments are deductible from taxable income and the availability of tax credits for loans. The measure of tax relief to homeowners is unavailable for Cyprus and Slovakia.

Transaction costs measures the average cost associated with purchasing a home, including transfer taxes, real estate agent fees, notary fees, legal fees, and registration fees. This measure does not account for any tax breaks available to home buyers. This measure is available for all countries in the sample except for Cyprus and was obtained from Andrews et al. (2011).

We normalize all continuous comparative housing market measures to have a mean of 0 and variance of 1 across countries in our sample. We do not normalize the binary indicator of having primarily variable rate mortgages.

4 Empirical Analysis

We test the hypothesis that experienced inflation predicts investment in the real estate market through two sets of analyses. Aggregating the data to the country level, we run an OLS regression of homeownership rate on average experienced inflation in each country. We then do the parallel analysis at the household-level, using a Logit regression to predict household homeownership using experienced inflation, controlling for household characteristics that are typically found to influence tenure choice.

4.1 Measures of Experience

As a measure of experienced inflation over one's life, we calculate a weighted average of experienced annual inflation. The weighted average consists of annual inflation (measured in percent) from year of birth to the year before the survey. Consistent with the work of

Malmendier and Nagel (2011), the most recent returns are given the highest weights with linearly decreasing weights back to a weight of zero in birth year.

Specifically, the experienced inflation for household i in year t is given by

$$\pi_{i,t} = \frac{\sum_{k=1}^{age_{i,t}-1} w_{i,t}(k)\pi_{t-k}}{\sum_{k=1}^{age_{i,t}-1} w_{i,t}(k)}$$

where the weights are given by

$$w_{i,t}(k) = \frac{age_{i,t} - k}{age_{i,t}}$$

When complete data is unavailable, we sum over all available years and rescale the denominator to be the sum of weights for available data years. For experienced inflation, this applies to older households in Cyprus and Slovakia. This approach maintains the feature that recent years will matter more for younger than older households.

Table 4 summarizes the measure of experienced inflation constructed for households in each country of our sample. The right set of columns summarizes actual inflation in each of these countries from 1925 to the survey year. For Cyprus and Slovakia, we summarize actual inflation for all available years.

Figure 4 shows the distribution of experienced inflation in the sample. There are 450 households in our sample with experienced inflation above 10%, almost all coming from Greece.

A key assumption in our construction of the experience measures is that experiences matter from birth to the survey year. By including all experiences up to the survey year, we are assuming that households are continuously updating their tenure status. An alternative assumption is that homeownership is sticky, and that once a household decides to purchase their home, they will continue to be an owner. Using data from the Survey of Health, Ageing, and Retirement in Europe, described in more detail below, we are able to identify when individuals fist become homeowners. Using this dataset, we test whether experiences through their life predict when individuals first purchase their home.

4.2 Country Analysis

In the first analysis, we treat each country as an observation, collapsing to country averages using the survey weights representative of the population.

Figure 5 shows this data graphically in a scatter plot of the countries in our analysis with average experienced inflation (in percentage points) measured on the x-axis and the

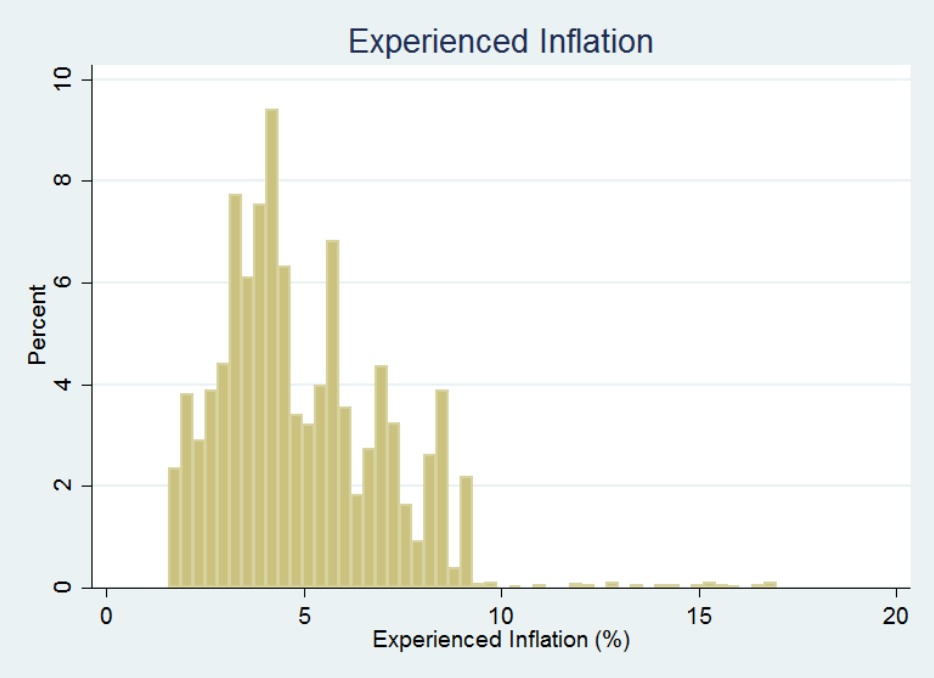

Figure 4: Distribution of experienced inflation.
Note: Histogram plots the distribution of experienced inflation in the HFCS sample.

percent of households living in owner-occupied housing (homeownership rate) on the y-axis. We plot both linear and quadratic fits of the data, shown formally using OLS regression in Table 5. We find a significant positive relationship between a country's average experienced inflation and the homeownership rate. In the linear model, a 1pp increase in country average experienced inflation corresponds to a 6pp higher homeownership rate in the linear model. The quadratic model also predicts a positive relationship between experienced inflation and homeownership in the range of most of our data (average experienced inflation from 3-8%).

4.3 Household Analysis

In addition to using aggregate experiences to predict differences in homeownership rates across countries, we also test whether individual differences in experiences predict likelihood of individual homeownership. In these analyses, we have variation in experiences across individuals in different countries and also within country (by age).

We run logit regressions on the household-level data. Our key dependent variable is a binary indicator of whether the household owns their primary residence, or household-level homeownership (Own HMR). The key independent variable is household experienced

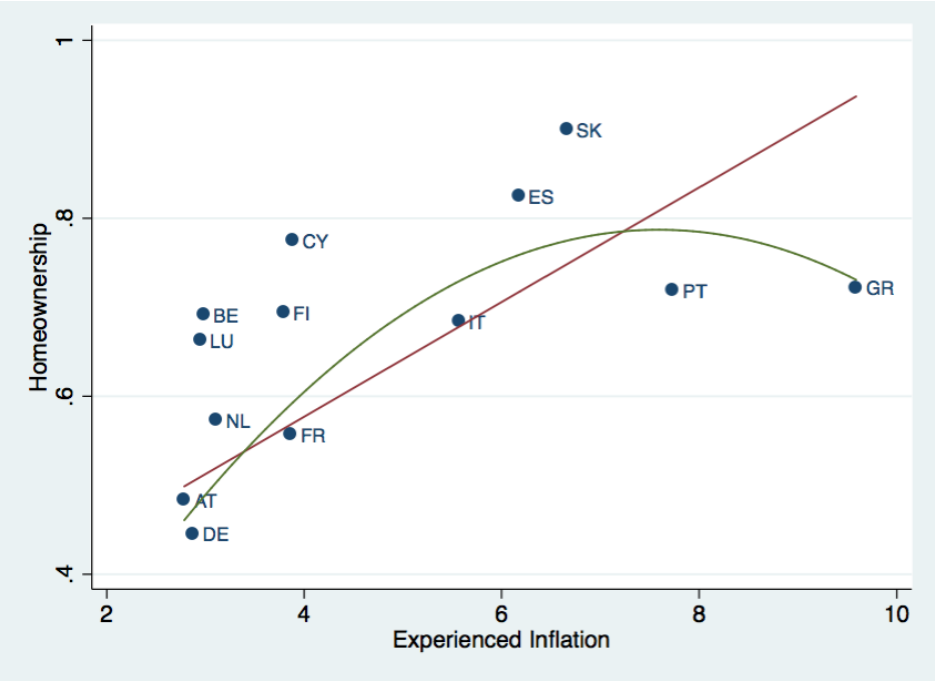

Figure 5: Homeownership rate by experienced inflation.
Note: Scatter plot of country average experienced inflation on the x-axis and homeownership rate on the y-axis. Red line shows weighted linear fit. Green line plots weighted quadratic fit.

inflation, calculated using household head's age and country as described above.

In our main specifications, we control for household demographics that are likely to be related to homeownership: age, gender, having children, marital status, educational attainment, employment status, log net wealth, and log total gross income (measured in 2010 Euros). We use the HFCS multiple imputation data, which allows us to use the full sample despite missing net wealth and gross income for some households.[17] In all analyses, we use the HFCS household weights that are representative of each country and the EU population (inverse probability of being sampled and non-response). We also use the HFCS replicate weights (bootstrap weights accounting for the sampling design) in analyses with the multiple imputation data.

In Table 6 we report the odds ratios and standard errors for our main analysis. Controlling for household demographics, we find that a 1pp increase in experienced inflation predicts a 28% increase in the odds of being a homeowner. On a baseline homeownership rate of about 60%, this corresponds to a 6pp increase in the likelihood of being a homeowner.

[17] As a robustness, we run our main analyses on the subsample with complete data. See Appendix Table A1.

Many of the household demographic variables we control for in the baseline analysis predict homeownership, reported fully in Column 1 of Appendix Table A1. We find that age has a slightly negative effect on the likelihood of homeownership. Households headed by men are significantly less likely to be homeowners. We find that married and widowed household heads are significantly more likely to own a home than single household heads. Households with a household head in the lowest education group are the most likely to be homeowners. Having a child is a strong predictor of being a homeowner. Relative to being out of the work force, we find that employed, unemployed, and retired household heads are more likely to be homeowners. We find that net wealth is a strong predictor of homeownership, but income is negatively correlated.

As discussed in Section 2, our theoretical framework predicts that inflation beliefs will have less predictive power for households without access to alternative inflation hedges and fixed-rate mortgages. We test these predictions in Columns 2 and 3.[18]

Motivated by the theoretical framework, we predict that experienced inflation has less predictive power in countries with more access to alternative inflation-hedges. As described above, we use an indicator for outstanding government-issued inflation-protected bonds as a proxy for access to inflation-hedging assets. In Column 2, we find that experienced inflation positively predicts homeownership, but that the relationship is attenuated in countries with access to inflation-protected bonds.

To proxy for availability of fixed-rate mortgages, we use a measure of whether most mortgages in the country carry variable rates (obtained from Andrews et al. (2011) for 12 of the countries in our sample). If this reflects relative supply rather than demand of variable rate mortgages (compared to fixed-rate), we would predict that in countries with primarily variable rate mortgages, experienced inflation should have less predictive power. In Column 3, we confirm this pattern; experienced inflation predicts an increased likelihood of homeownership in general, but the effect is attenuated in countries with primarily variable rate mortgages. There are many possible channels for this relationship, unfortunately we cannot distinguish between them. For example, it may be that the composition of mortgages affects access to financing and thus the homeownership rate. Alternatively, homeownership rates may influence the composition of mortgages in the country (e.g., marginal homeowners are more likely to have a variable rate mortgage).

In our main analysis, we abstract from country differences when using macroeconomic

[18] With only 13 countries, and only one country with both primarily variable rate mortgages and availability of inflation-protected bonds, we do not test the interaction of these hypotheses.

experiences to predict homeownership decisions. However, there are almost surely important differences across countries that influence households' tenure choices. For example, each country likely has differing housing regulations, supply of homes available for purchase vs. renting, transaction costs, or cultural differences that make ownership more or less appealing. In Column 4, we add country fixed effects to the baseline analysis, to test whether experienced inflation predicts homeownership *within* country. In our data, the only variation in macroeconomic experiences within country comes from age differences. Therefore we do not attempt to jointly estimate both age and country effects.[19] Controlling for country fixed effects, we find that a 1pp increase in experienced inflation predicts a 9% increase in the odds of homeownership.

In Table 7, we take a hybrid approach to controlling for differences across housing markets in each country while still controlling for age effects. In these analyses, we test the robustness of our main result to the inclusion of country-level measures of tenant protection, rent control, tax benefits to homeowners, and buyer transaction costs described in Section 3. Controlling for all of these measures in Column 5, we find that a 1pp increase in experienced inflation predicts an 18% increase in the odds of homeownership.[20]

In a cross-country analysis, it is important to control for country-specific market factors that may impact household tenure choice. However, it is also important to note that the market factors may evolve endogenously with homeownership. For example, if Greek households have an innate preference for homeownership, households may be more likely to own their home and support regulations and politics that favor homeownership, such as increased tax benefits to homeowners. Moreover, if macroeconomic experiences drive preferences for homeownership and homeowners support different policies than renters, we may expect experiences to drive policy. For example, in a quote from the German National Report on TENLAW: Tenancy Law and Housing Policy in Multi-level Europe, Cornelius and Rzeznik (2014), "since renting is the dominant housing choice in Germany, the political system is highly sensitive to tenants' rights, and perceived threats to the status quo typically receive prominent media attention and political responses."

[19] Because we find that age and homeownership are negatively correlated, we do not think that this is a particularly meaningful restriction. Rather, the mechanism through which older household heads are more likely to own seems to be coming through correlated attributes such as wealth accumulation and family structure.

[20] Note, we do not include the indicator for primarily variable rate and the corresponding interaction with inflation in these regressions because we have only 11 countries in the analysis. Including these measures, we estimate a statistically insignificant main effect of experienced inflation.

4.4 House Price Experience

In addition to experienced inflation, experienced house price growth may also predict homeownership. For example, if people hold experience-biased beliefs, households that have lived through periods of high real house price growth may believe house prices will continue to grow in the future and therefore value ownership. Our baseline theoretical framework assumes zero real house price growth, though we show that the main results hold with exogenous real house price growth in Appendix B. In addition to beliefs, experienced house price growth may also influence preferences for homeownership or risk.

While historical inflation data has been collected for many countries, historical data on house prices is much more scarce. For this reason we focus our analyses on inflation experiences, but explore the relationship between homeownership and experienced house price growth in Table 8.

Given the available data, we construct two measures of experienced real house price growth, described in more depth in Section 3. In the first measure we use only countries for which we have a complete house price history for the households in our sample. To do this, we use historical time series from Knoll et al. (Forthcoming) and Bordo and Landon-Lane (2013) which covers 6 of the countries in our HFCS sample.

Using real house price data from the Federal Reserve Bank of Dallas, we are able to construct a second measure of experienced real house price growth that covers more countries (8 of the countries in our sample) but is limited to house prices from 1975 onward. We construct this partial measure of experienced real house price growth as discussed in Section 4.1, rescaling weights for the available data years. This measure does not capture differences in experiences prior to 1975. Instead, variation in experiences come from the feature that recent years will matter more for younger than older households.

In Columns 1 and 4, we replicate the main finding that experienced inflation predicts higher homeownership when we restrict analysis to the countries with house price data. In Columns 2 and 5, we add the measures of experienced real house price growth. We find that homeownership is significantly predicted by experienced house price growth in the sample of 8 countries using incomplete house price data; however the relationship is statistically insignificant in the sample of 6 countries with complete house price data. In both of these regressions, the effect of experienced inflation remains relatively stable and statistically significant. In Columns 3 and 6, we add country fixed effects (and remove age effects). Controlling for country fixed effects, we find that the experienced house price growth using complete data positively and significantly predicts homeownership, while the effect of experienced inflation

is statistically insignificant. Using partial experienced house price growth, we find that both macroeconomic experience measures positively predict homeownership.

4.5 Robustness

We test the robustness of our main analyses to a number of alternative specifications.

In Appendix Table A1, we test the sensitivity of our main estimates to the use of the multiple imputation data. Using only the non-imputed data, we limit the analysis to about 40% of the sample when we control for wealth and income (Column 2).[21] Using this limited data in Column 2, the coefficient on experienced inflation is attenuated. Almost all of the missing demographic data are the wealth and income measures. In Column 3, we estimate the model on non-imputed data without including wealth and income controls. Expanding the sample by excluding wealth and income controls, we find that the estimated coefficient on experienced inflation is slightly larger than the benchmark model. Controlling for wealth and income drastically changes both the explanatory power of the model and the effect of other demographic coefficients. Most noticeably, we find a positive effect of age and eduction and a negative effect of unemployment that we don't see in the model controlling for wealth and income. This may indicate that one mechanism through which age, education, and employment affect ownership is through wealth accumulation.

In Appendix Table A2, we test two alternative methods of controlling for inflation experiences.

First, we test the hypothesis that inflation volatility predicts individual homeownership. We calculate individual experienced inflation volatility as the variance of inflation over the lifetime. For these analyses we exclude households in Cyprus and Slovakia for whom we do not have complete lifetime inflation data. We find that inflation volatility does predict homeownership on its own, but that the effect is completely washed out when we also include our measure of the level of experienced inflation. This suggests that the level, rather than the variance, in experienced inflation predicts homeownership.

In Column 3, we use an AR(1) model as described in Malmendier and Nagel (2015) to estimate households' inflation predictions from their lifetime experienced inflation. Rather than estimating the gain parameter in our sample, we use the parameter estimated in the U.S. sample of 3.044. This analysis excludes Cyprus and Slovakia as we have incomplete inflation data. We find that the predicted inflation measure (calculated from life experiences)

[21] France is excluded from these analyses as none of the respondents have available wealth data.

significantly predicts likelihood of being a homeowner, though the relationship is small in magnitude.[22]

In Appendix Table A3, we test the robustness of our results to the treatment of high inflation years. Our baseline experience measure treats inflation in a very linear way. In calculating our measure of experienced inflation, the effect of increasing inflation in any given year from 1% to 2% is equivalent to that of increasing inflation from 30% to 31%. This might be problematic for several reasons. First, these CPI measures are somewhat noisy and may be noisier in times of high inflation. Second, our measures of experience are meant to capture differences between the inflation that households actually experience. It is possible that after some threshold, there is little perceptible difference. For example, the difference between 0 and 5% inflation may be more noticeable to households than the difference between 50 and 55% inflation.

Specifically, we calculate a capped measure of experienced inflation as described in Section 4.1 using a capped measure of inflation in each year. So, for example, in Column 1, we calculate experienced inflation using a capped measure of annual inflation restricted above at 25% and below at -25%. In our regressions, we also include an indicator for whether the household experienced any year outside of the unrestricted range. Because the choice of cap is arbitrary, we test three thresholds: 25% (affecting 40% of households in 10 countries), 50% (affecting 20% of households in 7 countries), and 100% annual inflation (affecting 5% of households in 3 countries). Note that the lower threshold is irrelevant for almost all households, as there is only one relevant data year with inflation below 25%. Across these thresholds, we see a remarkably stable coefficient on experienced inflation calculated using capped annual inflation. The coefficient on the indicator for living through inflation above the cap at any point in time is variable, suggesting that there may be non-linearities in the relationship between very high inflation experiences and homeownership.

The results in Column 1 indicate that experienced inflation over 25% plays a meaningful role with respect to predicting homeownership. At 50% the indicator is insignificant, indicating that inflation up to 50% captures much of the predictive power, with additional inflation experiences not contributing to the predictive power. In Column 3, the combination of the lower coefficient on experienced inflation and the negative coefficient on the indicator for experiencing inflation above 100% tells us experienced inflation above 50% does not have

[22] Relative to $\theta = 3$, we found slightly larger effects for higher $\theta = 4$ and smaller effects for $\theta = 2$. We also estimated the regression using a long-run forecast, constructed by iterating the AR(1) model estimated at time t, 5, 10, and 20 years forward. Estimates of 5- and 10-year forecasts predicted homeownership roughly as well as the 1-year forecast, with less predictive power in the 20-year forecast estimate.

the same predictive power as experienced inflation below 50%.

In Appendix Table A4, we test alternative methods for controlling for household wealth. In Columns 1 and 2, we show that the predictive power of experienced inflation is robust to controlling for measures of household wealth net of home equity or house price appreciation (discussed more in depth in Appendix A). In Columns 3 and 4, we show that the main results are also robust to using nominal, rather than real log income and wealth and to adjusting real log income and wealth for purchasing power parity across countries.

Our results are also robust to including age fixed effects instead of a linear effect of age, controlling for cohort (birth) year instead of age, and controlling for survey year.

4.6 SHARE data

Our main analyses test the hypothesis that macroeconomic experiences predict homeownership at the time of the survey. With retrospective data from the Survey of Health, Ageing, and Retirement in Europe (SHARE), we are able to test a similar yet distinct hypothesis - do macroeconomic experiences through the life predict if and when an individual first purchases a home?

The SHARE microdata consists of a panel following elderly individuals (above age 50) in countries across Europe, starting with the first wave in 2004 to the most recent wave in 2015. We use data collected primarily in 2008-2009, from the SHARELIFE wave of the study for 13 countries in Europe.[23] In this wave, study participants were asked retrospective questions about several major aspects of their life, such as family structure, employment status, and homeownership. The data allows us to construct a yearly panel for each individual from age 20 to the year of the survey with indicators for whether the individual was married, had children under the age of 18, was employed, whether they had established their own household, and tenure status. Appendix Table A5 displays summary statistics for the sample that we use in our analysis.

Using this data, we estimate a cox proportional hazard model, defining a failure as the first year in which the individual was a homeowner after establishing their own household. We allow for a flexible baseline hazard over age and control for gender in all analyses. The key independent variable is experienced inflation (which we cap each year at 25%) an indicator for whether experienced inflation was capped, summarized in Appendix Table A6.[24] Note that

[23] The SHARELIFE data was collected for 14 countries, but we exclude the Czech Republic due to a lack of historical inflation data.

[24] Because we have the German hyperinflation and other high inflation outliers that the SHARE sample has lived through, we cannot construct a simple weighted average as we do for the HFCS sample.

due to the limited variation in birth years within a country, the indicator for experiencing inflation above 25% is essentially an indicator for living in Austria, Germany, Spain, Italy, France, Greece, or Poland.

Appendix Table A7 shows the estimated hazards from the cox proportional hazard model. In column 1, we find that a 1pp increase in experienced inflation predicts a 3% increase in the hazard of becoming a homeowner, with an attenuated effect for individuals who experienced inflation above 25%. Controlling for country fixed-effects in column 2, the main effect of experienced inflation becomes statistically insignificant. This is not surprising as we have essentially only one generation per country, and therefore relatively little variation in macroeconomic experiences within country.

In columns 3 and 4, we include time-varying covariates for marital status, an indicator for having children under the age of 18, and employment status. One drawback of the retrospective SHARE data is that the time-varying covariates are incomplete and so to maximize the sample, we fill missing data with 0s. In column 3, we find that experienced inflation significantly predicts homeownership. Similar to the results in column 1, the effect is attenuated for individuals who have experienced inflation above 25%. When we add country fixed effects in column 4, the main effect of experienced inflation is smaller but remains statistically significant.

While the retrospective nature of the SHARE data allows us to investigate the impact of inflation experiences through an individual's life, the data are limiting in two key respects: the lack of information on demographics over time and the limited diversity in the age of the population. While these results are suggestive that experiencing higher inflation predicts individual homeownership decisions, they are not as robust as we would like. For example, we find weaker effects when we limit the sample to the 50% of individual with complete demographic data through the sample. We find similar results if we use a threshold of 50% instead of 25% to cap inflation experiences. We also find weaker (and sometimes negative) results when we weight the data using sample weights designed to be representative of the elderly population at the time of the survey. Similar to the analysis with the HFCS data, we also test the predictive power of experienced inflation at the time of the survey on tenure status at the time of the survey. We find that experienced inflation significantly predicts ownership without country fixed effects. Controlling for country fixed effects, we find a negative relationship between experienced inflation and homeownership in the survey year, but a large positive effect for individuals who experienced inflation above 25%.

5 Conclusion

In this paper we present evidence that macroeconomic experiences are correlated with households' tenure choice. In particular, we hypothesize that households overweight their own experiences when developing expectations about inflation and that this heterogeneity in inflation expectations can explain differences in the likelihood of being a homeowner. Consistent with this hypothesis, we find correlations between experienced inflation and homeownership.

The results of this paper tie into the literature on the long-run effects of macroeconomic events such as high inflation and economic crises.[25] In this paper we provide evidence for correlations between homeownership and experienced inflation. If these are causal relationships, monetary policy decisions may have long-lasting impacts on homeownership rates in the future.

[25] See for example DeLong and Summers (2012), Giuliano and Spilimbergo, and Oreopoulos et al. (2012).

References

A. Alesina and N. Fuchs-Schündeln. Good-bye lenin (or not?): The effect of communism on people's preferences. *The American Economic Review*, 97(4):1507–1528, 2007.

M. Ampudia and M. Ehrmann. Macroeconomic experiences and risk taking of euro area households. *Bank of Canada Working Paper (No. 2014-10)*, 2014.

A. Anari and J. Kolari. House prices and inflation. *Real Estate Economics*, 30(1):67–84, 2002.

H. S. Andersen. Motives for tenure choice during the life cycle: the importance of non-economic factors and other housing preferences. *Housing, Theory and Society*, 28(2): 183–207, 2011.

D. Andrews and A. Caldera Sánchez. Drivers of homeownership rates in selected oecd countries. *OECD Publishing (No. 849)*, 2011.

D. Andrews, A. Caldera Sánchez, and Å. Johansson. Housing markets and structural policies in oecd countries. 2011.

D. G. Blanchflower and A. J. Oswald. Does high home-ownership impair the labor market? *National Bureau of Economic Research No. w19079*, 2013.

M. D. Bordo and J. Landon-Lane. What explains house price booms?: History and empirical evidence. *National Bureau of Economic Research No. 19584*, 2013.

A. Bracha and J. C. Jamison. Shifting confidence in homeownership: The great recession. 2012.

P. Bracke, C. Hilber, and O. Silva. Homeownerhip and entrepreneurship. 2012.

D. Brounen, P. Eichholtz, S. Straetmans, and M. A. Theebe. Inflation protection from homeownership: Long-run evidence: 1814-2008. *Available at SSRN 2158633*, 2012.

B. Case and S. M. Wachter. Inflation and real estate investments. *U of Penn, Inst for Law & Econ Research Paper*, (11-33), 2011.

W. A. Clark and F. M. Dieleman. Households and housing. *Choice and outcomes in the housing market*, 1996.

J. M. Collins and L. Choi. The effects of the real estate bust on renter perceptions of homeownership. *Available at SSRN 1569009*, 2010.

J. Cornelius and J. Rzeznik. Tenlaw: Tenancy law and housing policy in multilevel europe–national report for germany, 2014.

J. B. DeLong and L. Summers. Fiscal policy in a depressed economy. *Brookings Papers on Economic Activity*, 44(1 (Spring)):233–297, 2012.

D. DiPasquale and E. L. Glaeser. Incentives and social capital: are homeowners better citizens? *Journal of urban Economics*, 45(2):354–384, 1999.

J. Doling. A two-stage model of tenure choice in the housing market. *Urban Studies*, 10(2): 199–211, 1973.

R. B. Drew and C. E. Herbert. Postrecession drivers of preferences for homeownership. *Housing Policy Debate*, 23(4):666–687, 2013.

F. Earley. What explains the differences in homeownership rates in europe? *Housing Finance International*, 19(1):25, 2004.

M. Ehrmann and P. Tzamourani. Memories of high inflation. *European Journal of Political Economy*, 28(2):174–191, 2012.

Eurosystem Household Finance and Consumption Network. The eurosystem household finance and consumption survey-results from the first wave. Technical report, European Central Bank, 2013.

E. F. Fama and G. W. Schwert. Asset returns and inflation. *Journal of financial economics*, 5(2):115–146, 1977.

J. R. Follain and D. C. Ling. Another look at tenure choice, inflation, and taxes. *Real Estate Economics*, 16(3):207–229, 1988.

J. A. Garcia and A. A. van Rixtel. Inflation-linked bonds from a central bank perspective. *ECB Occasional Paper*, (62), 2007.

P. Giuliano and A. Spilimbergo. Growing up in a recession: Beliefs and the macroeconomy. *NBER Working Paper 15321*.

E. L. Glaeser and C. G. Nathanson. An extrapolative model of house price dynamics. *National Bureau of Economic Research No. w21037*, 2015.

E. L. Glaeser and J. M. Shapiro. The benefits of the home mortgage interest deduction. *National Bureau of Economic Research No. w9284*, 2002.

M. J. Gordon. *The investment, financing, and valuation of the corporation*. RD Irwin, 1962.

R. K. Green and M. J. White. Measuring the benefits of homeowning: Effects on children. *Journal of Urban Economics*, 41(3):441–461, 1997.

J. S. Greenlees and R. B. McClelland. Addressing misconceptions about the consumer price index. *Monthly Lab. Rev.*, 131:3, 2008.

D. R. Haurin, P. H. Hendershott, and S. M. Wachter. Borrowing constraints and the tenure choice of young households. Technical report, National Bureau of Economic Research, 1996.

D. R. Haurin, T. L. Parcel, and R. J. Haurin. Does homeownership affect child outcomes? *Real Estate Economics*, 30(4):635–666, 2002.

J. V. Henderson and Y. M. Ioannides. Owner occupancy: investment vs consumption demand. *Journal of Urban Economics*, 21(2):228–241, 1987.

International Monetary Fund. World economic outlook database, 2014.

Y. M. Ioannides. Residential mobility and housing tenure choice. *Regional Science and Urban Economics*, 17(2):265–287, 1987.

K. Knoll, M. Schularick, and T. Steger. No price like home: Global house prices, 1870-2012. *American Economic Review*, Forthcoming.

C. H. Liu, D. J. Hartzell, and M. E. Hoesli. International evidence on real estate securities as an inflation hedge. *Real Estate Economics*, 25(2):193–221, 1997.

U. Malmendier and S. Nagel. Depression babies: Do macroeconomic experiences affect risk-taking? *The Quarterly Journal of Economics*, 126:373–416, 2011.

U. Malmendier and S. Nagel. Learning from inflation experience. *The Quarterly Journal of Economics*, qjv037, 2015.

U. Malmendier, S. Nagel, and Z. Yan. The making of hawks and doves: Inflation experiences and voting on the fomc. *Working Paper*, 2016.

P. Oreopoulos, T. von Wachter, and A. Heisz. The short-and long-term career effects of graduating in a recession. *American Economic Journal: Applied Economics*, 4(1):1–29, 2012.

G. Painter, S. Gabriel, and D. Myers. Race, immigrant status, and housing tenure choice. *Journal of Urban Economics*, 49(1):150–167, 2001.

C. M. Reinhart and K. Rogoff. *This time is different: eight centuries of financial folly*. princeton university press, 2009.

D. B. Rubin. *Multiple imputation for nonresponse in surveys*, volume 81. John Wiley & Sons, 2004.

R. J. Sampson, S. W. Raudenbush, and F. Earls. Neighborhoods and violent crime: A multilevel study of collective efficacy. *Science*, 277(5328):918–924, 1997.

T. Sinai and N. S. Souleles. Owner-occupied housing as a hedge against rent risk. *Quarterly Journal of Economics*, (2):763–789, 2005.

P. Sodini, S. Van Nieuwerburgh, R. Vestman, and U. von Lilienfeld-Toal. Identifying the benefits from home ownership: A swedish experiment. *Available at SSRN 2785741*, 2016.

Table 1: Summary of real estate participation rates in HFCS countries

Country	Households in sample	Actual Population (M)	Year of Survey	Home-ownership Rate	Own other property (%)	Own any property (%)
Slovakia	2,056	5.4	2010	90%	15%	91%
Spain	5,717	46.6	2008	83%	37%	86%
Cyprus	1,202	1.1	2010	78%	54%	86%
Greece	2,860	11.2	2009	72%	38%	79%
Portugal	4,095	10.6	2010	72%	27%	76%
Finland	10,046	5.4	2010	69%	30%	72%
Belgium	2,164	10.9	2010	69%	16%	73%
Italy	7,243	59.3	2011	68%	26%	72%
Luxembourg	923	0.5	2010	66%	28%	74%
Netherlands	1,268	16.6	2010	57%	6%	58%
France	13,817	65.0	2009	56%	29%	62%
Austria	2,250	8.4	2010	48%	14%	53%
Germany	3,388	81.8	2010	45%	18%	49%

Notes: Weighted averages are representative of the population. Table is sorted by the homeownership rate (the percent of households who own their main residence). Actual population in 2010 obtained from the World Bank. Year of survey is the start year of the survey period for that country.

Table 2: Summary of HFCS household characteristics

Variable	Mean	Median	SD	N
Age	51	50	15.5	56,791
Male	0.56	1	0.50	56,791
Has child	0.41	0	0.49	56,791
Net wealth (2010 Euros)	206,576	100,100	492,144	31,669
Household gross income (2010 Euros)	36,407	28,419	37,302	48,244

Martial Status	Percent
Single/never married	23
Married or Consensual union on a legal basis	55
Widowed	10
Divorced	11

Education Level (ISCED-97 classification)	Percent
Primary or below	17
Lower secondary	15
Upper secondary	43
Tertiary	25

Employment Status	Percent
Employed	56
Unemployed	6
Retired	27
Other out of workforce	11

Notes: HFCS sample summary statistics weighted to be representative of the population.

Table 3: Summary of housing market measures from Andrews et al. (2011)

Country	Households in sample	Homeownership Rate	PVR	Tenant Protection	Rent Control	Tax Benefits
Slovakia	2,056	90%	1	-1.25		
Spain	5,717	83%	1	0.79	-0.65	0.03
Cyprus	1,202	78%				
Greece	2,860	72%	1	1.39	-0.43	0.93
Portugal	4,095	72%	1	1.07	-0.10	-0.70
Belgium	2,164	69%	1	-0.65	-1.53	0.91
Finland	10,046	69%	0	-1.05	-0.65	0.45
Italy	7,243	68%	0	0.15	-0.65	-0.86
Luxembourg	923	66%	1	-1.35	0.23	-0.78
Netherlands	1,268	57%	0	-0.95	1.88	2.06
France	13,817	56%	0	0.80	-0.10	-0.09
Austria	2,250	48%	0	0.91	0.45	-0.80
Germany	3,388	45%	0	0.13	1.55	-1.16

Notes: Table is sorted by the homeownership rate (the percent of households who own their main residence). Household in sample and homeownership rate from HFCS sample. Housing market variables were obtained from Andrews et al. (2011). Prevalence of variable rate mortgages (PVR) is a binary variable equal to 1 if variable rate were the prevailing type of interest rate on mortgages. Tenant protection is a comparative measure of tenant-landlord regulations. Rent control is a composite indicator increasing in the extent of controls of rents. Tax benefits is a comparative measure of the tax relief on debt financing of homeownership. Transaction costs measures the average cost associated with purchasing a home, including transfer taxes, real estate agent fees, notary fees, legal fees, and registration fees. Tenant protection, rent control, and tax benefits are normalized to have a mean of 0 and variance of 1 across countries in our sample.

Table 4: Summary of experienced and actual annual inflation by country

	Experienced Inflation (%)				Actual Inflation (%)		
Country	Mean	Median	SD	N	Mean	Median	SD
AT	2.8	2.8	0.7	2,249	5.9	2.7	13.2
BE	3.0	3.2	0.5	2,164	3.7	2.9	4.3
CY	3.9	4.1	0.4	1,202	4.7	3.8	5.0
DE	2.9	3.0	0.7	3,388	4.2	3.5	7.2
ES	6.2	6.5	1.0	5,717	7.0	5.5	6.6
FI	3.8	4.1	1.2	10,046	6.6	4.0	9.8
FR	3.9	4.0	1.1	13,817	8.3	4.5	12.2
GR	9.6	9.1	2.5	2,860	26.8	7.0	87.3
IT	5.6	5.7	1.2	7,243	12.1	4.7	39.6
LU	2.9	3.0	0.4	922	5.5	2.8	9.7
NL	3.1	3.2	0.4	1,268	3.4	2.9	4.3
PT	7.7	8.3	1.3	4,095	6.5	3.3	9.5
SK	6.7	6.6	0.6	2,056	5.2	2.2	9.1
Total	4.4	3.9	2.0	57,027			

Notes: Experienced inflation summary statistics are weighted to a representative population. Actual inflation is based on annual inflation from 1925 to the year prior to the survey year (Cyprus begins in 1943 and Slovakia begins in 1964).

Table 5: Country Level OLS Regression of Homeownership on Experience

Dependent Var: Homeownership	(1)	(2)
Average Experienced Inflation	0.064***	0.214***
	(0.020)	(0.052)
Experienced Inflation Squared		-0.014***
		(0.004)
Constant	0.319***	-0.027
	(0.089)	(0.136)
Observations	13	13
R^2	0.652	0.791

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Notes: OLS regression coefficients with standard errors in parentheses. Data is the HFCS non-imputed data, using representative weights. Dependent variable is the weighted percent of household who own their main residence.

Table 6: Logit of household-level homeownership on inflation experiences

Dependent Var: Own Main Residence	(1)	(2)	(3)	(3)
Experienced Inflation	1.283***	1.357***	1.082**	1.093**
	(0.025)	(0.039)	(0.034)	(0.041)
Inflation Protected Bonds		0.960		
		(0.167)		
Exp. Inflation X Inflation Protected Bonds		0.881***		
		(0.028)		
PVR			5.985***	
			(1.199)	
Exp. Inflation X PVR			0.909***	
			(0.031)	
Demographic Controls	Yes	Yes	Yes	Yes (no age)
Country FE	No	No	No	Yes
Observations	54,019	54,019	52,889	54,019
Countries	13	13	12	13
Pseudo R^2	0.546	0.551	0.554	0.559

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Notes: Table reports exponentiated coefficients (odds ratios) from logit regressions with standard errors in parentheses. Data is the HFCS multiple imputation data, using representative weights. Number of observations is the maximum N across the 5 imputations. Pseudo R2 is the average across the 5 imputations. Dependent variable is an indicator for owning the household main residence (Own HMR). Demographic controls include household head gender, marital status, whether the household head has any children, education level, employment status, log net wealth, and log income. In regression with country fixed effects, we do not estimate an effect of age. Inflation protected bonds is an indicator for France, Germany, Greece, and Italy, the three countries in our sample that offer inflation protected government bonds. PVR is an indicator for having primarily variable rate mortgages in the country, excludes Cyprus.

Table 7: Logit of household-level homeownership on inflation experiences, controlling for differences across housing markets

Dependent Var: Own Main Residence	(1)	(2)	(3)	(4)	(5)	(6)
Experienced Inflation	1.337***	1.191***	1.220***	1.307***	1.181***	1.093**
	(0.027)	(0.020)	(0.024)	(0.024)	(0.023)	(0.041)
Tenant Protection	0.711***				0.950	
	(0.033)				(0.047)	
Rent Control		0.910**			0.818***	
		(0.036)			(0.034)	
Tax Benefits to Homeowners			1.134***		1.149***	
			(0.049)		(0.054)	
Buyer Trans Cost				0.756***	0.732***	
				(0.028)	(0.030)	
Demographic Controls	Yes	Yes	Yes	Yes	Yes	Yes (no age)
Country FE	No	No	No	No	No	Yes
Observations	52,889	50,900	50,900	52,889	50,900	54,019
Countries	12	11	11	12	11	13
Pseudo R^2	0.549	0.548	0.549	0.548	0.551	0.559

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Notes: Table reports exponentiated coefficients (odds ratios) from logit regressions with standard errors in parentheses. Data is the HFCS multiple imputation data, using representative weights. Number of observations is the maximum N across the 5 imputations. Pseudo R2 is the average across the 5 imputations. Dependent variable is an indicator for owning the household main residence (Own HMR). Demographic controls include household head gender, marital status, whether the household head has any children, education level, employment status, log net wealth, and log income. Tenant protection is a comparative measure of tenant-landlord regulations. Rent control is a composite indicator increasing in the extent of controls of rents. Tax benefits is a comparative measure of the tax relief on debt financing of homeownership. Transaction costs measures the average cost associated with purchasing a home. Housing market variables obtained from Andrews et al. (2011) are normalized to have a mean of 0 and variance of 1 across countries in our sample.

Table 8: Logit of household-level homeownership on inflation and real house price growth experiences

Dependent Var: Own Main Residence	(1)	(2)	(3)	(4)	(5)	(6)
Experienced Inflation	1.474***	1.429***	1.164	1.257***	1.222***	1.309***
	(0.061)	(0.064)	(0.154)	(0.040)	(0.037)	(0.131)
Experienced Real House Price Growth (Full History)		1.021	1.249**			
		(0.023)	(0.138)			
Experienced Real House Price Growth (Partial History, from 1975)					1.052**	1.576***
					(0.024)	(0.218)
Demographic Controls	Yes	Yes	Yes (no age)	Yes	Yes	Yes (no age)
Country FE	No	No	Yes	No	No	Yes
Observations	34,332	34,332	34,332	42,256	42,256	42,256
Countries	6	6	6	8	8	8
Pseudo R^2	0.535	0.535	0.542	0.551	0.551	0.560

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Notes: Table reports exponentiated coefficients (odds ratios) from logit regressions with standard errors in parentheses. Data is the HFCS multiple imputation data, using representative weights. Number of observations is the maximum N across the 5 imputations. Pseudo R2 is the average across the 5 imputations. Dependent variable is an indicator for owning the household main residence (Own HMR). Demographic controls include household head gender, marital status, whether the household head has any children, education level, employment status, log net wealth, and log income. Full history of experienced real house price growth obtained from Knoll et al. (forthcoming) for Belgium, Finland, France, Germany, and the Netherlands. Full history of experienced real house price growth obtained from Bordo and Landon Lane (2013) for Spain. Partial history of experienced real house price growth obtained from the Federal Reserve Bank of Dallas for Belgium, Finland, France, Germany, Italy, Luxembourg, the Netherlands, Spain.

A Appendix: Discussion of wealth controls

In our main analyses, we control for the log of total household net wealth at the time of the survey. One concern with including wealth as an independent variable is that wealth may be endogenous if owning a home acts as a means of forced savings or asset accumulation. Ideally, we would like to observe all household characteristics immediately before the decision to purchase or rent their home. In this idealized regression, we would not have an endogeneity problem as wealth would not be affected by tenure status.

In Columns 1 and 2 of Appendix Table A4 we try to address this endogeneity by removing home equity (current value of home minus outstanding debt) from net wealth. Experienced inflation and real house price growth continue to predict higher odds of homeownership, at statistically significant levels.

One concern with this analysis is that we are over correcting. With this definition of wealth, a household suffers a large drop in wealth immediately after purchasing a home, while we should really view those households as having the same wealth. As a way to try to improve upon the measure of wealth, we create an additional wealth variable which removes wealth accumulated from purchase date of a household's current home to the time of the survey associated with an increase in the price of the home. We can only calculate this measure for a subset of the data, so the sample size in Columns 3 and 4 is significantly smaller. Using this alternative definition of wealth, the effect of experienced inflation remains large and statistically significant; however, high experienced house price growth negatively predicts homeownership.

Measuring wealth net of the increase in home price is not ideal for several reasons. First, this is a noisy measure as we only observe the increase in price associated with the current home and not any previous owned property. Inertial effects in homeownership are likely to be problematic if the household currently owns, the may be more likely to have owned in the past. Another problem with this variable is that it does not account for additional investment into the home. If the value of the home increases because the homeowner invested in adding a second floor, we would subtracting more than just asset accumulation from being a homeowner. Another concern is that for homeowners, this measure does not represent their counterfactual had they not purchased their home. For example, if a household purchased their home 20 years ago, we subtract 20 years of price increases but presumably, the household would have invested their home equity elsewhere and would have received a return on their investment. For these reasons, we leave this as a robustness exercise.

B Appendix: Model with Exogenous Real House Price Growth

In this appendix, we extend the model of Section 2 to allow for exogenous shocks to real house prices. We assume that households form experienced-biased beliefs about shocks to real house prices in the same way as they form experience-biased beliefs about inflation.

Housing Market The change in house prices in each period can be decomposed into (general) inflation, π, and a housing-specific component g. Letting M_t be the nominal house price at time t, the relationship between nominal house prices M_t and M_{t+1} is defined by

$$M_{t+1} = M_t(1 + \pi_{t+1})(1 + g_{t+1})$$

where π_{t+1} is inflation between t and $t+1$ and g_{t+1} is the real house price growth, i.e., on top of inflation, during the same period.[26]

Real house price growth g_t varies independently from π_t and can also take on either a high or low value, denoted g_H and g_L. The probability of the high state occurring is p_{g_H}. We assume $\pi_H, \pi_L, g_H, g_L > -1$.

Beliefs Household beliefs about inflation and real house price growth are biased in the direction of their experience. Denoting household beliefs with $\hat{p}$, experience-biased households have beliefs $\hat{p}_{\pi_H} > p_{\pi_H}$ if a household born at t experienced high inflation at t and $\hat{p}_{\pi_H} < p_{\pi_H}$ if the household experienced low inflation. Similarly, $\hat{p}_{g_H} > p_{g_H}$ if the household experienced high g at time t and $\hat{p}_{g_H} < p_{g_H}$ if the household experienced low g.

B.1 Housing as the only inflation hedge

In this version of the model, the alternative asset pays a nominal rate n_t between t and $t+1$, known to households at time t.

Households choose to rent or buy by maximizing expected utility conditional on renting or buying with a fixed-rate mortgage of $m_t \in [0, M_t]$.

[26] Of course in general equilibrium, g would react to demand and supply. The simplification of having an exogenous process for home prices allows us to make our main points without complicating the model.

The household's expected utility from renting given equilibrium rental price H_t is

$$E_t\left[u(c_{t+1}|\text{renting})\right] = \log\left((w_t - H_t)(1+n_t)\right) - E_t\left[\log(1+\pi_{t+1})\right].$$

We assume that fixed-rate mortgages are offered at competitive prices in this simple economy and that there is no risk of default, so $r_t^{fix} = n_t$. In this case, household expected utility conditional on buying a house is equivalent under all mortgage amounts $m_t \in [0, M_t]$ and is given by

$$E_t\left[u(c_{t+1}|\text{buying})\right] = E_t\left[\log\left(M_t(1+\pi_{t+1})(1+g_{t+1}) + (w_t - M_t)(1+n_t)\right)\right] - E_t\left[\log(1+\pi_{t+1})\right]$$

As in Section 2, we see that the relative value of buying is increasing with beliefs about future inflation. In this model, the relative value of buying is also increasing with expectations of real house price growth. This is intuitive because the only role played by the g_{t+1} shocks is to increase future house prices.

B.2 Housing in a market with perfect inflation hedges

In the second version of the model, we assume that households have access to a perfect inflation hedge. Specifically, that the alternative asset is inflation-protected and pays a *real* rate r_t between t and $t+1$, known to households at time t.

Again, households choose to rent or buy by maximizing expected utility. The expected value of renting at the prevailing prices is

$$E_t\left[u(c_{t+1}|\text{renting})\right] = E_t\left[\log\left((w_t - H_t)(1+r_t)\right)\right]$$

When the alternate asset provides a known real rate, household beliefs about inflation (specifically deviations from the true expected inflation), drive preferences for fixed-rate mortgages and the expected utility of being a homeowner is no longer independent from the financing decision.

$$\begin{aligned} E_t\left[u(c_{t+1}|\text{buying with } m_t)\right] &= E_t\left[\log\left(\frac{M_{t+1}}{1+\pi_{t+1}} - \frac{m_t(1+n_t^{fix})}{1+\pi_{t+1}} + (w_t - (M_t - m_t))(1+r_t)\right)\right] \\ &= E_t\left[\log\left(M_t(1+g_{t+1}) + m_t\left[(1+r_t) - \frac{(1+n_t^{fix})}{1+\pi_{t+1}}\right] + (w_t - M_t)(1+r_t)\right)\right]. \end{aligned}$$

Again, we find that the relative value of buying is increasing in anticipated real house price growth.

Similar to Section 2, the relationship between experienced inflation and the relative value of homeownership depends on the mortgage type. Without an inflation hedge motivation, inflation only impacts the value of buying through the fixed-rate mortgage. As beliefs about future inflation are increasing, borrowing at the fixed-rate n_t^{fix} becomes increasingly more attractive relative to the known real rate, r_t.

Allowing for a variable rate mortgage that carries a known real rate equal to that on the alternative asset, r_t, the utility of buying is

$$\begin{aligned} E_t\left[u(c_{t+1}|\text{buying with VR } v_t)\right] &= E_t\left[\log\left(\frac{M_{t+1}}{1+\pi_{t+1}} - v_t(1+r_t) + (w_t - (M_t - v_t))(1+r_t)\right)\right] \\ &= E_t\left[\log\left(M_t\left((1+g_{t+1}) - (1+r)\right) + w_t(1+r_t)\right)\right]. \end{aligned}$$

Like buying outright, the relative value of buying with a variable rate mortgage is increasing in expectations of g_{t+1} but independent of expectations of future inflation.

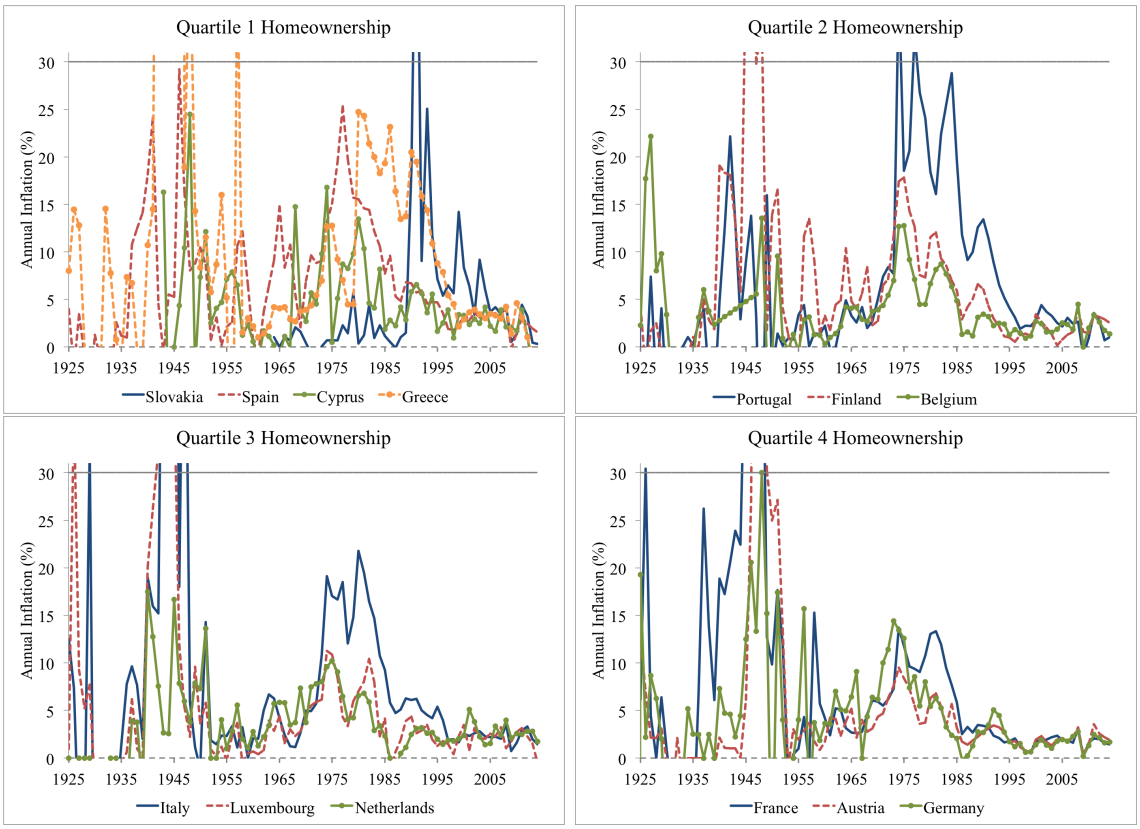

Figure A1: Inflation history, stratified by quartile of homeownership rate.
Note: Inflation data from Reinhart and Rogoff (2009) and Global Financial Data. Inflation for chart capped above at 30% and below at 0%. Quartile 1 includes countries with the highest homeownership rates and quartile 4, the lowest.

Table A1: Logit of household-level homeownership on inflation experiences, non-imputed data

Dependent Var: Own Main Residence	(1)	(2)	(3)
Experienced Inflation	1.283***	1.192***	1.418***
	(0.025)	(0.036)	(0.019)
Age	0.988***	0.993	1.025***
	(0.004)	(0.006)	(0.002)
Male	0.823***	0.755**	1.087*
	(0.061)	(0.087)	(0.050)
Married	1.698***	1.472**	2.313***
	(0.164)	(0.242)	(0.137)
Widow	1.653***	1.689**	1.191*
	(0.260)	(0.407)	(0.112)
Divorced	0.994	1.129	0.750***
	(0.130)	(0.260)	(0.060)
Educ: 2 (Middle School)	0.691***	0.522***	1.267***
	(0.070)	(0.080)	(0.081)
Educ: 3 (High School)	0.805**	0.522***	1.784***
	(0.073)	(0.084)	(0.097)
Educ: 5 (College)	0.541***	0.398***	2.589***
	(0.060)	(0.075)	(0.168)
Has Child	1.312***	1.197	1.416***
	(0.100)	(0.145)	(0.068)
Employed	1.341**	1.111	1.406***
	(0.162)	(0.187)	(0.099)
Unemployed	1.714***	1.645*	0.698***
	(0.308)	(0.430)	(0.068)
Retired	1.562***	1.286	1.061
	(0.209)	(0.257)	(0.086)
Log real net wealth	5.007***	5.679***	
	(0.181)	(0.298)	
Log real income	0.642***	0.585***	
	(0.046)	(0.060)	
Observations	54,019	26,745	56,788
Countries	13	12	13
Pseudo R^2	0.546	0.582	0.149

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Notes: Table reports exponentiated coefficients (odds ratios) from logit regressions with standard errors in parentheses. Data is the HFCS multiple imputation data, using representative weights. With imputed data, number of observations is the maximum N across the 5 imputations and Pseudo R2 is the average across the 5 imputations. Dependent variable is an indicator for owning the household main residence (Own HMR). The reference groups for demographic variables are education level of primary or below according to the ISCED-97 categorizations, single/never married, and out of the work force (not retired). France excluded from all analyses with net wealth.

Table A2: Logit of household-level homeownership on alternative measures of inflation experience

Dependent Var: Own Main Residence	(1)	(2)	(3)
Standard Deviation of Experienced Inflation	1.019***	0.996	
	(0.003)	(0.003)	
Experienced Inflation		1.280***	
		(0.027)	
Predicted Inflation AR(1)			1.104***
			(0.014)
Demographic Controls	Yes	Yes	Yes
Observations	53,160	53,160	50,869
Countries	13	13	11
Pseudo R^2	0.540	0.547	0.544

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Notes: Table reports exponentiated coefficients (odds ratios) from logit regressions with standard errors in parentheses. Data is the HFCS multiple imputation data, using representative weights. Number of observations is the maximum N across the 5 imputations. Pseudo R2 is the average across the 5 imputations. Dependent variable is an indicator for owning the household main residence (Own HMR). Experienced inflation volatility is the standard deviation of annual experienced inflation over the lifetime. Predicted inflation is predicted from experienced inflation using an AR(1) model. Demographic controls include household head age, gender, marital status, whether the household head has any children, education level, employment status, log net wealth, and log income. Excludes households with incomplete inflation data in Cyprus and Slovakia.

Table A3: Logit of household-level homeownership on capped inflation experiences

Dependent Var: Own Main Residence	(1) Cap: +/- 25%	(2) Cap: +/- 50%	(3) Cap: +/- 100%
Experienced Inflation (Capping Each Year)	1.244***	1.273***	1.255***
	(0.026)	(0.024)	(0.024)
Indicator for Experiencing Capped Inflation	1.478***	1.046	0.725***
	(0.119)	(0.078)	(0.066)
Demographic Controls	Yes	Yes	Yes
Observations	54,327	54,327	54,327
Countries	14	14	14
Pseudo R^2	0.547	0.546	0.546

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Notes: Table reports exponentiated coefficients (odds ratios) from logit regressions with standard errors in parentheses. Data is the HFCS multiple imputation data, using representative weights. Number of observations is the maximum N across the 5 imputations. Pseudo R2 is the average across the 5 imputations. Dependent variable is an indicator for owning the household main residence (Own HMR). Experienced Inflation (capping each year) is a weighted average of experienced inflation calculated using annual inflation capped above and below at the stated threshold. Indicator for Experiencing Capped Inflation is 1 if the household experienced inflation above or below the cap value in any year. Demographic controls include household head age, gender, marital status, whether the household head has any children, education level, employment status, log net wealth, and log income.

Table A4: Logit of household-level homeownership on inflation experiences, alternative household wealth measures

Dependent Var: Own Main Residence	(1)	(2)	(3)	(4)
Experienced Inflation	1.498***	1.518***	1.289***	1.233***
	(0.024)	(0.028)	(0.025)	(0.023)
Log real wealth (Net home equity)	1.413***			
	(0.024)			
Log real wealth (Net HMR gain)		3.057***		
		(0.099)		
Log real income	1.314***	0.772***		
	(0.057)	(0.046)		
Log nominal wealth			5.011***	
			(0.182)	
Log nominal income			0.640***	
			(0.046)	
Log real wealth (PPP Adjusted)				5.056***
				(0.184)
Log real income (PPP Adjusted)				0.664***
				(0.048)
Demographic Controls	Yes	Yes	Yes	Yes
Observations	52,067	35,792	54,019	52,889
Countries	13	13	13	12
Pseudo R^2	0.202	0.423	0.546	0.548

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Notes: Table reports exponentiated coefficients (odds ratios) from logit regressions with standard errors in parentheses. Data is the HFCS multiple imputation data, using representative weights. Number of observations is the maximum N across the 5 imputations. Pseudo R2 is the average across the 5 imputations. Dependent variable is an indicator for owning the household main residence (Own HMR). Demographic controls include household head age, gender, marital status, whether the household head has any children, education level, employment status, and log real income (unless otherwise noted). Column 1 only includes households with current home price. Column 2 only includes households who reported the purchase price of their home.

Table A5: Summary of SHARE individual characteristics

Country	Ever homeowner?	Mean age first homeowner	Ever married?	Mean age first married	Ever had children?	Mean age had first child	Ever employed?	Mean age first employed	N
Austria	64%	30.3	77%	24.8	85%	25.6	93%	20.8	971
Germany	63%	32.8	79%	25.1	87%	26.2	97%	21.2	1,854
Sweden	87%	31.4	71%	26.3	88%	26.3	99%	21.5	1,787
Netherlands	74%	31.1	80%	24.9	83%	26.9	95%	20.8	2,142
Spain	83%	32.2	90%	25.8	81%	26.9	80%	21.6	2,224
Italy	76%	33.7	91%	25.7	87%	27.0	82%	21.8	2,493
France	80%	33.7	74%	24.6	84%	26.1	93%	21.4	2,278
Denmark	89%	28.4	71%	26.1	87%	25.8	98%	21.4	1,922
Greece	88%	31.5	88%	26.4	86%	27.8	73%	23.2	3,002
Switzerland	63%	36.4	73%	26.3	82%	27.7	98%	21.1	1,274
Belgium	85%	30.6	79%	24.1	85%	25.9	91%	21.1	2,748
Poland	68%	27.9	90%	23.7	86%	24.7	93%	21.3	1,907
Ireland	87%	29.9	83%	27.1	82%	28.3	94%	20.6	819
Total	78%	31.5	81%	25.4	85%	26.5	90%	21.5	25,421

Notes: Unweighted summary statistics of microdata obtained from Wave 3 of the Survey of Health, Ageing, and Retirement in Europe.

Table A6: Experienced inflation in SHARE sample from age 20 to year of survey

Country	Experienced Inflation (%)			Percent lived
	Mean	SD	Observations	through inflation > 25%
Austria	5.36	1.67	47,621	88
Germany	5.52	1.16	86,637	72
Sweden	5.80	1.28	87,094	2
Netherlands	4.49	0.82	99,455	0
Spain	8.58	1.65	107,681	94
Italy	7.63	1.95	118,945	74
France	7.32	2.32	107,458	70
Denmark	5.73	1.33	87,806	3
Greece	9.40	2.63	138,879	96
Switzerland	3.23	0.63	59,157	1
Belgium	4.00	0.95	130,075	0
Poland	9.86	3.98	86,147	96
Ireland	6.62	2.07	38,516	0
Total	6.63	2.82	1,195,471	49

Notes: Experienced inflation summary statistics are unweighted across observations. Each observation is an individual-age for individuals who participated in the SHARE Wave 3 survey, for ages 20 to age at survey year. Inflation data from Reinhart and Rogoff (2009) and are capped at 25% in each year.

Table A7: Estimation of Cox proportional hazard model with SHARE data, failure is first year of homeownership after establishing own household

	(1)	(2)	(3)	(4)
Exp. Inflation (Capping Each Year at 25%)	1.026***	1.004	1.031***	1.011***
	(0.003)	(0.003)	(0.003)	(0.003)
Indicator for Experiencing Capped Inflation%	0.825***	0.807***	0.783***	0.803***
	(0.013)	(0.019)	(0.014)	(0.020)
Male	0.918***	0.913***	0.993	0.981
	(0.013)	(0.012)	(0.016)	(0.016)
Married (miss=0)			4.800***	5.009***
			(0.109)	(0.114)
Has child under 18 (miss=0)			0.630***	0.637***
			(0.012)	(0.012)
Employed (miss=0)			1.138***	1.189***
			(0.022)	(0.024)
Country Fixed Effects	No	Yes	No	Yes
Observations	481,393	481,393	481,393	481,393
Pseudo R^2	0.001	0.004	0.020	0.024
Countries	13	13	13	13

Robust standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Notes: Hazard ratios estimated from Cox proportional hazards model with failure as first year of homeownership after establishing own household. Indicators for being married, having children under the age of 18, and being employed are time-varying and filled with 0s for approximately 50% of observations with at least one missing covariate. Data are unweighted individual responses from the SHARE Wave 3 retrospective survey.