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

Ulrike Malmendier and Alexandra Steiny†
UC Berkeley

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Abstract

There are vast differences in homeownership rates across countries. We show that, both within and across countries, people's decision to buy versus rent is strongly affected by macroeconomic shocks that they have experienced over their lifetimes so far. In a simple model with experience-based learning, we show that households are more likely to own their homes if they have experienced high inflation or high growth in the housing market. Using household-level data from 20 countries in the European Central Bank's Household Finance and Consumption Survey (HFCS), we find that a 1 pp increase in experienced inflation predicts an increase of 8 percentage points in homeownership at the national level, and an increase of 45 percent in the odds of homeownership at the individual level. The results are robust to including a vast array of individual and housing-market controls. As predicted by the theory, the estimation result does not hold in countries with primarily variable rate mortgages, and it is weaker when other inflation hedges are easily available. Using data from the American Community Survey, we show that these experiences carry over to predict homeownership among immigrants to the United States. Finally, we also estimate similar effects for the first year of homeownership in the SHARE data. Our results imply that individual lifetime experiences of inflation have a significant and lasting impact on cross-country and within-country homeownership patterns.

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†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 for many households. 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 have 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. Within Europe, for example, less than half of all households in Germany and Austria own their home, compared to over 80% in countries like Slovakia, Hungary, and Spain, as shown in Figure 1. The figure illustrates the wide range of homeownership rates across countries in the European Union and, for comparison, in the United States, where the rate is slightly below 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 44 of 50 U.S. states having homeownership rates between 62% and 75% in 2014.[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 macroeconomic conditions that the current population of a country has experienced over their lifetimes so far also 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 model of experience effects (cf. Malmendier et al. (2016b)), we test whether there is a systematic relationship between experienced inflation and homeownership, both at the national and individual level. We also test for an effect of house-price

[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] 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).

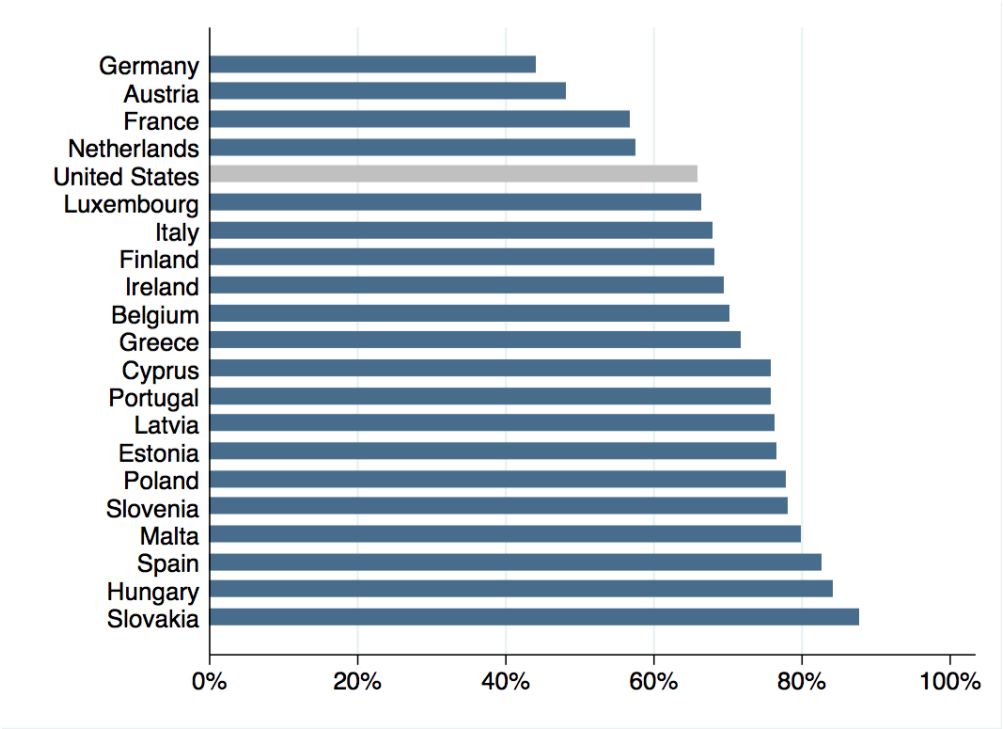

Figure 1. Homeownership rates in Europe and the United States (2008-2015)
Source: ECB Household Finance and Consumption Survey. U.S. homeownership is the average homeownership rate from 2008-2015 from the U.S. Census Bureau Current Population Survey Housing Vacancies and Homeownership questionnaire.

experiences and for interaction effects predicted by the model. Using homeownership data from 20 countries that participate in the European Central Bank's Household Finance and Consumption Survey (HFCS), we show that households are significantly more likely to own their homes if they have experienced higher inflation during their lifetimes so far.

To illustrate the basic idea of our analysis, consider the relationship between the homeownership rates from Figure 1 and historical inflation rates. The left graph of Figure 2 shows the annual inflation for countries in the top quartile of homeownership, and the right graph shows the bottom quartile.[5] The juxtaposition of these graphs points to a strong positive correlation: Countries with high homeownership rates have experienced significantly higher historical inflation, and the difference is particularly strong over the last 70 years, i.e., over the time period homeowners in 2008-2014 have personally experienced.

We formalize the potential impact of the past experiences on present beliefs and deci-

[5]Homeownership rates average at about 80% of households in the top quartile, and at about 50% in the bottom quartile. See Appendix Figure A7 for inflation in all homeownership quartiles.

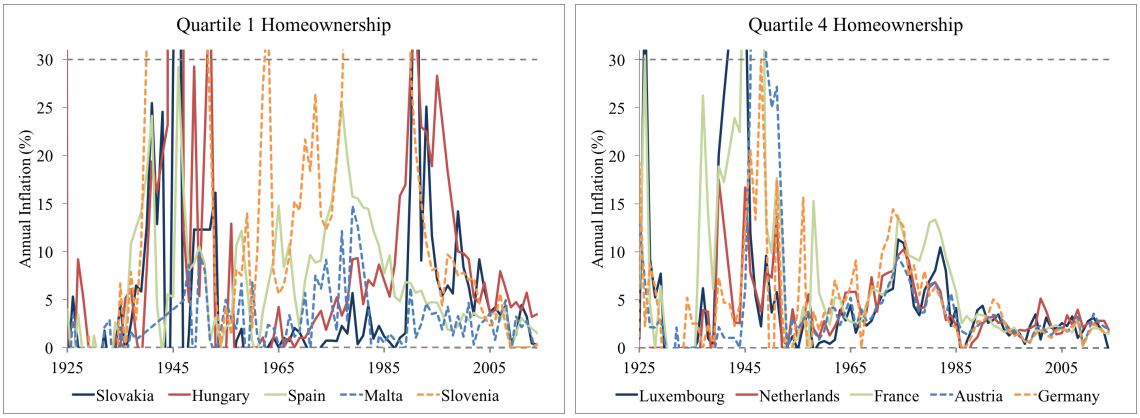

Figure 2. Inflation history in the top and bottom quartiles of homeownership rate
Inflation data sources described in text. Inflation capped (for chart) at 30% above and at 0% below. Quartile 1 includes countries with the highest homeownership rates across all available ECB HFCS waves, and quartile 4 countries with the lowest.

sions as *experience effects*. An emerging empirical literature on experience effects argues that households overweight their own experiences of macroeconomic outcomes when forming expectations, both in the stock market and in the context of inflation (Malmendier and Nagel (2011, 2015), Malmendier et al. (2016a)). We develop a stylized theoretical framework that links experience-based expectations about inflation and about house prices to tenure decisions. Experience-based learners form expectations about future outcomes overweight past realizations that they have personally experienced. As a result, differences in macroeconomic experiences can be used to predict household tenure choice.

The simple model allows us to illustrate two channels through which high inflation experiences induce a higher likelihood of homeownership: (1) the desire to hedge against inflation, and (2) the perceived attractiveness of a fixed-rate mortgages. As for the first channel, real estate has classically been viewed as an inflation hedge (cf. the classic Gordon (1962) growth model).[6] Whether or not real estate is *actually* a good hedge against inflation, experience-based learners value the *perceived* inflation-hedging advantages of real-estate investment. Thus, experience effects imply that 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.

[6]While the Gordon growth model is a good theoretical benchmark model of real estate as an inflation hedge, it relies on the assumption that future rent growth and discount rates are constant and adjust one-for-one with inflation. In response to critique of this assumption, an extensive empirical literature tests 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).

As a second channel, the model points to 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 they overestimate future inflation and perceive mortgage rates to be too low in real terms.

We note that our model assumes that the mechanism of experience effects works through belief formation, similar in spirit to other recent papers that explore the implications of potential homeowners not being fully rational (e.g., Glaeser and Nathanson (2015)). However, it is also possible that experiences affect household preferences. Such an alternative model easily generates some of the same predictions, while others are less immediate. For example, while the experience of high return in the housing market may affect preferences for owning a home, the link between inflation experiences and preferences for housing (relative to other assets) is less straightforward The same holds for the partial reduction in the effect of inflation experiences when other inflation hedges become more easily available. Indeed, research that has examined whether views on homeownership in the U.S. have changed after the housing crisis in the 2000s (e.g, as a result of high foreclosure rates and steep declines in housing prices, see Bracha and Jamison (2012), Drew and Herbert (2013), and Collins and Choi (2010)) finds, perhaps surprisingly, little evidence that recession experiences influence views of housing as a good investment or plans for future homeownership. Regardless of the preferred modeling approach, however, our empirical analysis and conclusions about the role of lifetime experiences for tenure decisions are unaffected.

Turning to the empirical implementation, we focus on inflation as a macroeconomic experience that predicts homeownership. We also consider growth in (real) house prices, though the historical house price data across countries is more limited. We use household microdata from 20 countries participating in the European Central Bank's Household Finance and Consumption Survey (HFCS).

We collect historical inflation and house price data for these 20 countries from Reinhart and Rogoff (2009), the International Monetary Fund, Global Financial Data, Apostolides (2011), and Michal (1960), the Federal Reserve Bank of Dallas, Knoll et al. (Forthcoming), and Bordo and Landon-Lane (2013). For each country, we also build a dataset of housing market and macroeconomic conditions that may affect homeownership decisions, using data from Andrews et al. (2011), the OECD, Bloomberg, and the World Bank. While we use the HFCS sample for our main analyses, we confirm our results and explore further implications of the model using two additional survey data sources: the American Community Survey

(ACS) and the Survey of Health, Ageing and Retirement in Europe (SHARE).

The sample allows for variation in macroeconomic experiences across three dimensions: age, country, and survey year. To calculate measures of macroeconomic experiences, we use a weighted lifetime average, with more recent experiences weighted higher than those in the distant past, building on the parameter estimates from Malmendier and Nagel (2015).

Aggregating experiences to the national level, we find that a 1 pp increase in average experienced inflation (which is close to the average within country standard deviation in lifetime experiences[7]) predicts an 8 pp increase in aggregate homeownership rate. Focusing on individual tenure choice, we find that a 1 pp increase in experienced inflation corresponds to a roughly 45% increase in the odds of homeownership. This effect is not driven by countries who experienced hyperinflation. We also provide evidence for 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.

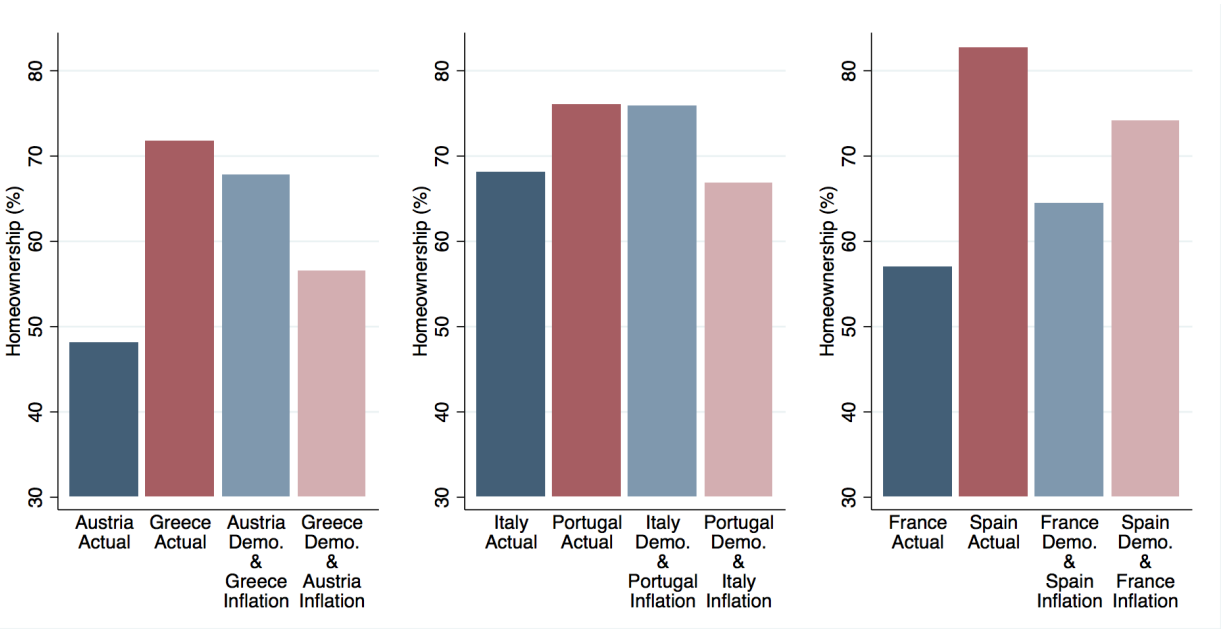

Figure 3. Hypothetical homeownership rates with alternate inflation histories
Actual homeownership from the HFCS data. Hypothetical homeownership rates calculated using the model estimated in Table 6, Column 5 assuming another country's inflation history.

To quantify the implications of our model, we consider the hypothetical homeownership

[7]Over the whole sample, lifetime experienced inflation has a standard deviation of 8%, but the median within-country standard deviations is 1.1%.

rates our results imply if we were to "change" countries' inflation histories.[8] For example, the first graph in Figure 3 shows how homeownership in Austria and Greece would change if we switched their inflation histories. These countries are at opposite ends of the spectrum, with Austria having homeownership under 50% (first bar) and a low inflation history, while Greece has homeownership around 70% (second bar) and a high inflation history. The third bar answers the hypothetical question - what does our model predict homeownership in Austria would be if Austria had Greece's inflation history? Our model predicts a substantial 20pp increase in the homeownership rate for Austria. Likewise, if Greece had Austria's inflation history, we would predict a 15pp drop in homeownership. As another example, consider Italy and Portugal (shown in the second graph), where our model predicts that we can completely close the 8pp difference in homeownership if these countries had the same inflation history.

The first two comparisons demonstrate cases where our model predicts inflation histories have a large effect on cross-country differences in homeownership. The third graph compares France and Spain, where our model predicts that the large gap in homeownership would be reduced by only a third if inflation histories were switched. While the gap between the two countries remains large under the hypothetical inflation histories, note that our model still predicts a substantial role of experienced inflation: the predicted change in homeownership for each country is over 5pp.

While the primary analyses exploit variation in experiences across ages and across countries, we also show that experienced inflation remains a significant predictor of homeownership after controlling for country fixed-effects. In addition, the estimation results are robust to including a number of household demographics, housing market characteristics, macroeconomic conditions, and to alternative formulations of the experience measure.

We use data from two additional sources to provide further evidence that the correlation between experienced inflation and homeownership operates through "experience effects." First, using data from the American Community Survey on over 200,000 immigrants, we find evidence that individuals carry their experiences with them. Differences in experienced inflation continues to predict differences in tenure choices, even after moving to a new housing market. Second, using retrospective data from the SHARE survey of elderly individuals across 14 countries in Europe, we are able to zoom into the time-series of individual tenure decisions and provide suggestive evidence that experienced inflation predicts the hazard of an individual's first home-ownership.

[8]This hypothetical, of course, abstracts from many important considerations. Nevertheless, we find it a useful exercise to quantify our results.

In further analyses, we analyze the effect of house-price experiences over individuals' lifetimes on their tenure choice. We estimate a positive, but weaker and less robust relationship, compared to the experience effect of inflation. In comparing those two potential sources of experience effects, inflation and house price experiences, we have to account for the more limited data availability for historic house-price series across countries. Even within the more limited set of countries and time spans, inflation experiences dominate house price experiences. This may reflect the direct impact on affordability. In fact, we find that in countries where average house price growth has been high, the price-to-rent ratio is higher than in countries with relatively lower house price growth (discussed in more detail in Section 4).

Relation to previous literature. Our approach is, one the one hand, closely related to prior literature on historical influences on homeownership. For example, prior research has linked the cultural tradition of passing property through family in Southern Europe to the high homeownership rates today, or shown that the dowry laws in Greece continue to contribute to a culture of high homeownership in Greece today, despite their repeal in 1983 (see, e.g., Earley). Similarly, Andrews et al. (2011) argues that differences in the timing and extent of 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. 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.[9]

Our paper builds on several other strings of literature. The empirical 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. Most closely related, in addition to the papers cited above, is the paper by Ampudia and Ehrmann (2014), who also use household data from the HFCS. They exploit its cross-sectional variation to demonstrate that experiencing higher stock-market returns increase households' self-reported tolerance of financial risk and their stock-market participation. Relative to the results estimated on U.S. data by Malmendier and Nagel (2011), European households tend to weight

[9]In a similar spirit, Alesina and Fuchs-Schündeln (2007) argue that past experiences of a given institutional environment affect attitudes today. They find that East Germans, after living under a Communist regime, favor redistribution more than West Germans, even years after reunification. Luttmer and Singhal (2011) similarly find that preferences for redistribution among immigrants are correlated to preferences in their country of birth. Also similarly, Giuliano and Spilimbergo (2009) 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.

recent experiences more highly relative to past experiences, i.e., exhibit a stronger recency bias. In addition to the effect of (weighted) average experiences, they also find that extreme experiences have lasting effects on behavior. As further evidence for the persistence of peak experiences, Ehrmann and Tzamourani (2012) find that the experience of hyperinflation (inflation above 200%) has a lasting effect on beliefs about the importance of price stability.

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 the 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 to live at home for longer and to purchase 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.

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

2 Theoretical Framework

We develop a stylized model of household tenure choice in order to demonstrate how macroeconomic 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 possibility of experience-based belief formation. As discussed above, our predictions do not require real estate to be the best available inflation hedge. We explore the implications of its perceived attractiveness as an inflation hedge under experience-based learning. The model also illustrates a second channel through which inflation experiences affect homeownership, namely, the perceived attractiveness of fixed-rate mortgages.

2.1 Model Set-up

Households. Consider an agent born at time t who lives for one period, until time $t+1$. The agent is endowed with wealth w_t when born and consumes all of her wealth at $t+1$. We distinguish between nominal and real values, and denote inflation in the price of consumption from t to $t+1$ as π_{t+1}. Agents have log utility over consumption in $t+1$, or equivalently over real terminal wealth

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

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

The key decision in this model is the household's choice between buying and renting a home to live in. Households 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 $t+1$.[11] If the agent decides to be a renter, she pays rent H_t at time t. If the agent decides to buy a home, she pays the current house price M_t at time t, and she sells the house at price M_{t+1} at time $t+1$. For simplicity, all houses in the economy are identical in quality, and therefore housing quality does not affect the choice to buy or rent. We normalize the utility from living in a house to 0.

The agent has the option to finance a house purchase with a mortgage. We consider two alternative mortgages that may be available to the buyer: one that carries a fixed-rate and one that carries a variable-rate, tied to inflation. The fixed-rate mortgage of value $m_t^f \in [0, M_t]$ carries a known *nominal* rate of n_t^f. The variable-rate mortgage of value m_t^v

[11] We allow the household to own at most one house.

carries a known *real* rate r_t^v.[12] Households repay the loan with interest in period $t+1$, in nominal terms, $(1+n_t^f)m_t^f$ under the fixed-rate and $(1+r_t^v)(1+\pi_{t+1})m_t^v$ under the variable-rate mortgage.

For simplicity, in this model we assume the mortgage type and amount are exogenously determined (i.e., only one option is available to the buyer), though in reality mortgage choice is endogenous. In addition, households take rent and mortgage rates as exogenously given and do not use them to draw inferences about future inflation or house price growth.

At time t, the agent observes the cost of renting a house, h_t, the price of buying a house, M_t, the mortgage rate n_t^f or r_t^v, and current inflation π_t and real house price growth g_t. If the agent is an experienced-based learner, she will use those realizations of inflation and house prices that she experiences at time t to form beliefs about the future, as described in more detail below.

In addition to housing, the model allows for investment in an alternative asset, and we consider two alternative assumptions about its return. In the first version, the alternative asset pays a known nominal interest rate, n_t. In this framework, housing provides the only opportunity to hedge against inflation. In the second version, we assume instead that the alternative asset is inflation protected and offers a known real return, r_t.

Housing Market. To demonstrate the two channels though which inflation expectations affect homeownership decisions, we assume that real estate is a noisy inflation hedge, i.e., that the change in house prices in each period can be decomposed into (general) inflation, π, and an exogenous 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. Our model ignores, however that, in general equilibrium, house prices also react to demand and supply. Relying on an exogenous process for home prices allows us to show the main effects of experience effects without complicating the model.

The one-period model also abstracts from the potential relationship between experiences and house prices. For example, if rent moves with general inflation and house prices move

[12] In reality, variable-rate mortgages may take many forms, here we assume the nominal interest rate adjusts one-for-one with inflation.

exogenously as given by the equation above, the price-to-rent ratio will remain constant regardless of the path of inflation. High house price growth, on the other hand, will lead to a higher price-to-rent ratio. Indeed, we find suggestive evidence for this in Table A9.

We assume values of initial wealth, inflation, house price growth, rent prices, and mortgage rates are such that wealth in $t+1$ is positive under any realization. This can be achieved, for example, by having sufficiently high initial wealth relative to housing costs. We also assume that π, $g > -100\%$.

Beliefs. We model households' beliefs formation as experience-based learning in the spirit of Malmendier et al. (2016b).

For the exposition of this simple model, we abstract from uncertainty in beliefs and assume that households expect inflation, $\hat{\pi}_{t+1}$, and house price growth, $\hat{g}_{t+1}$. In Appendix Section A, we relax this assumption and simulate households' tenure choices.

It suffices to specify that households' beliefs, $\hat{\pi}_{t+1}$ and $\hat{g}_{t+1}$, are such that they expect inflation and house price growth to be more similar to what they experienced at t than the actual expectations, which we will denote $\bar{\pi}$ and $\bar{g}$. If a household experienced higher than average inflation in t, then they expect inflation tomorrow will be higher than average $\hat{\pi}_{t+1} > \bar{\pi}$. Similarly, experience-based learners that lived through higher than average house price growth in t, believe $\hat{g}_{t+1} > \bar{g}$.

In the empirical analysis, we capture experiences over agents' actual lifetimes so far, and fully model out the belief formation process and weighting function used in Malmendier et al. (2016b). We also allow all other historical data to matter; the key feature is that lifetime experiences receive some extra weight.

2.2 Buy vs. Rent Decision

Households maximize utility by choosing to rent or buy. Below we present the expected utilities for renting, buying with a fixed-rate mortgage, and buying with a variable-rate mortgage under the assumption that the alternative asset pays (1) a known nominal return or (2) a known real return.

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. Under this

assumption, the household's expected utility conditional on renting is

$$\begin{aligned} E_t\left[U_{t+1}(R, h_t, n_t)\right] &= E_t\left[\log\left(w_{t+1}(R, h_t, n_t)\right) - \log(1+\pi_{t+1})\right] \\ &= \log\left((w_t - H_t)(1+n_t)\right) - \log(1+\hat{\pi}_{t+1}) \end{aligned} \tag{1}$$

where $w_{t+1}(R, h_t, n_t)$ is expected nominal wealth in $t+1$ conditional on renting at the prevailing prices.

Households' expected utility conditional on buying with a fixed-rate mortgage $m_t^f \in [0, M_t]$, is

$$\begin{aligned} E_t\left[U_{t+1}(FR, m_t^f, n_t)\right] &= E_t\left[\log\left(w_{t+1}(FR, m_t^f, n_t)\right) - \log(1+\pi_{t+1})\right] \\ &= \log(M_t(1+\hat{\pi}_{t+1})(1+\hat{g}_{t+1}) - m_t^f(1+n_t^f) \\ &\quad + (w_t - (M_t - m_t^f))(1+n_t)) - \log(1+\hat{\pi}_{t+1}) \end{aligned} \tag{2}$$

where $w_{t+1}(FR, m_t^f, n_t)$ is expected nominal wealth in $t+1$ conditional on buying and financing with a fixed-rate mortgage at the prevailing prices.

Similarly, buying with a variable-rate mortgage $m_t^v \in [0, M_t]$ yields

$$\begin{aligned} E_t\left[U_{t+1}(VR, m_t^f, n_t)\right] &= E_t\left[\log\left(w_{t+1}(VR, m_t^v, n_t)\right) - \log(1+\pi_{t+1})\right] \\ &= \log(M_t(1+\hat{\pi}_{t+1})(1+\hat{g}_{t+1}) - m_t^v(1+r_t^v)(1+\hat{\pi}_{t+1}) \\ &\quad + (w_t - (M_t - m_t^v))(1+n_t)) - \log(1+\hat{\pi}_{t+1}) \end{aligned} \tag{3}$$

where $w_{t+1}(VR, m_t^v, n_t)$ is expected nominal wealth in $t+1$ conditional on buying and financing with a variable-rate mortgage at the prevailing prices.

Housing with alternative inflation hedge. In the second version of the model, we assume 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 to maximize their expected utility in $t+1$. The expected utility conditional on renting at the prevailing prices is

$$\begin{aligned} E_t\left[U_{t+1}(R, h_t, r_t)\right] &= E_t\left[\log\left(w_{t+1}(R, h_t, r_t)\right) - \log(1+\pi_{t+1})\right] \\ &= \log\left((w_t - H_t)(1+r_t)(1+\hat{\pi}_{t+1})\right) - \log(1+\hat{\pi}_{t+1}) \end{aligned} \tag{4}$$

where $w_{t+1}(R, h_t, r_t)$ is the nominal expected wealth in $t+1$ conditional on renting at prevailing prices.

The expected utility conditional on buying with a fixed-rate mortgage of value m_t^f carrying a nominal rate n_t^f is

$$\begin{aligned} E_t\left[U_{t+1}(FR, m_t^f, r_t)\right] &= E_t\left[\log\left(w_{t+1}(FR, m_t^f, r_t)\right) - \log(1+\pi_{t+1})\right] \\ &= \log(M_t(1+\hat{\pi}_{t+1})(1+\hat{g}_{t+1}) - m_t^f(1+n_t^f) \\ &\quad + (w_t - (M_t - m_t^f))(1+r_t)(1+\hat{\pi}_{t+1})) - \log(1+\hat{\pi}_{t+1})] \end{aligned} \tag{5}$$

where $w_{t+1}(FR, m_t^f, r_t)$ is the nominal expected wealth in $t+1$ conditional on buying with a fixed-rate m_t^f at prevailing prices.

The expected utility conditional on buying with a variable-rate mortgage of value m_t^v carrying a real rate r_t^v is

$$\begin{aligned} E_t\left[U_{t+1}(VR, m_t^v, r_t)\right] &= E_t\left[\log\left(w_{t+1}(VR, m_t^v, r_t)\right) - \log(1+\hat{\pi}_{t+1})\right] \\ &= \log((1+\hat{\pi}_{t+1})(M_t(1+\hat{g}_{t+1}) - m_t^v(1+r_t^v) \\ &\quad + (w_t - (M_t - m_t^f))(1+r_t))) - \log(1+\hat{\pi}_{t+1}) \end{aligned} \tag{6}$$

where $w(VR, m_t^v, r_t)$ is the nominal expected wealth in $t+1$ conditional on buying with a variable-rate m_t^v at prevailing prices.

Homeownership In our model, there are four possible "markets" the household may be in, depending on the type of mortgage available to them and the availability of alternative inflation hedges.

Without an alternative inflation hedge, households will prefer owning with a fixed-rate mortgage to renting when $E_t[U_{t+1}(FR, m_t^f, n_t)] \geq E_t[U_{t+1}(R, h_t, n_t)]$ and will prefer owning with a variable-rate mortgage to renting when $E_t[U_{t+1}(VR, m_t^v, n_t)] \geq E_t[U_{t+1}(R, h_t, n_t)]$.

In the presence of an alternative inflation hedge, households will prefer owning with a fixed-rate mortgage to renting when $E_t[U_{t+1}(FR, m_t^f, r_t)] \geq E_t[U_{t+1}(R, h_t, r_t)]$ and will prefer owning with a variable-rate mortgage to renting when $E_t[U_{t+1}(VR, m_t^v, r_t)] \geq E_t[U_{t+1}(R, h_t, r_t)]$.

2.3 Effect of Inflation Experiences on Homeownership

If experiencing higher inflation results in an increase in expected inflation, $\hat{\pi}_{t+1}$, relative to a household who experienced lower inflation, then homeownership will be higher when the

utility difference between buying and renting is increasing in inflation.

To determine when this will be the case, in equations (7-10) we take the derivative of the utility difference between owning and renting with respect to expected inflation in each of the four markets.

$$\frac{\partial}{\partial \hat{\pi}_{t+1}} E_t[U_{t+1}(FR, m_t^f, n_t) - U_{t+1}(R, h_t, n_t)] = \frac{M_t(1+\hat{g}_{t+1})}{\hat{w}_{t+1}(FR, m_t^f, n_t)} \tag{7}$$

$$\frac{\partial}{\partial \hat{\pi}_{t+1}} E_t[U_{t+1}(VR, m_t^v, n_t) - U_{t+1}(R, h_t, n_t)] = \frac{M_t(1+\hat{g}_{t+1}) - m_t^v(1+r_t^v)}{\hat{w}_{t+1}(VR, m_t^v, n_t)} \tag{8}$$

$$\frac{\partial}{\partial \hat{\pi}_{t+1}} E_t[U_{t+1}(FR, m_t^f, r_t) - U_{t+1}(R, h_t, r_t)] = \frac{m_t^f(1+n_t^f)}{\hat{w}_{t+1}(FR, m_t^f, r_t)(1+\hat{\pi}_{t+1})} \tag{9}$$

$$E_t[U_{t+1}(VR, m_t^v, r_t) - U_{t+1}(R, h_t, r_t)] = 0 \tag{10}$$

As shown in equation (7), without an alternative inflation-hedge, relative to renting, the utility of buying with a fixed-rate mortgage is increasing in $\hat{\pi}_{t+1}$. If experiencing high inflation results in an upward shift in the expectation of π, this will increase the value of owning with a fixed-rate mortgage over renting. This demonstrates the classic inflation-hedge motivation for homeownership. If house prices move with inflation, investing in real estate provides a way for households to protect themselves from high inflation in the future.

If financing with a variable-rate mortgage (equation (8)), the relative value of ownership is increasing in $\hat{\pi}_{t+1}$ in cases where $M_t(1+\hat{g}_{t+1}) > m_t^v(1+r_t^v)$, or when the real value of the house tomorrow is greater than the outstanding loan (principal and interest). This condition is likely to hold for most of the relevant parameter space. For example, with 80% loan-to-value, and a 5% real mortgage rate (on top of inflation), the derivative will be positive for any $\hat{g}_{t+1} > -15\%$.

With a variable-rate mortgage, high inflation experiences induce a higher utility from purchasing a house only among those potential home buyers who are able to maintain a significant enough stake in the investment. In other words, 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.

Next, we consider how the relative value of ownership changes with inflation when the alternative asset provides a perfect inflation-hedge.

In the presence of alternative inflation hedges, the value of ownership with a fixed-rate

mortgage is increasing in inflation with any positive loan amount (equation (9)). This demonstrates a second motivation for ownership when expected inflation is high - with a nominal fixed-rate mortgage, the *real* mortgage rate, $(1 + n_t^f)/(1 + \pi_{t+1})$, is decreasing in inflation. Therefore, even when households have the ability to hedge against inflation through alternative assets, if households anticipate high inflation, homeownership is attractive as it allows them to borrow "cheaply" with a fixed-rate mortgage.

In this environment, if the household buys the house outright ($m_t = 0$) or finances with a variable-rate mortgage (equation (10)), the relative value of ownership is independent of beliefs about inflation. When the alternative asset pays a known real rate, and the household finances with a variable-rate mortgage that carries a known real rate, households are completely hedged against inflation and therefore beliefs about inflation are irrelevant. 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.

In all four markets, the relative value of ownership is (weakly) increasing in inflation. This leads to our first prediction, that homeownership rates will be higher among households who have experienced higher inflation.

Though the model is very stylized, we use these results to make predictions about the conditions under which experienced inflation predicts homeownership decisions.

How does the effect of experienced inflation depend on the type of mortgage offered? When financing with a fixed-rate mortgage, we should expect experienced inflation to predict higher homeownership whether or not households have access to alternative inflation-hedging opportunities. However, if households can only finance with a variable-rate mortgage, we expect experienced inflation to predict homeownership only when they do not have access to alternative inflation-hedges. This yields our next prediction that the effect of experienced inflation should be weaker among households who only have access to variable-rate mortgages. We test this prediction empirically in Section 4. 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]

[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.

How does the effect of experienced inflation depend on the availability of alternative inflation hedges? Without alternative inflation hedges, we should expect to see such experience effects when households are financing with a fixed-rate mortgage and (under most 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 following 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 a measure of the amount of inflation-linked government bonds issued (as a percent of GDP over the last 5 years). Inflation linked-bonds are not an ideal proxy for ability to hedge against inflation as access to them is likely limited to higher wealth and financially sophisticated investors. Including individuals for whom this is not a good proxy for access to alternative inflation hedges adds noise to the estimation. Therefore, in analyses with this proxy, we exclude households in the lowest decile of wealth, who in fact make up less than 1% of all bond owners in our sample.[14]

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 20 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 two waves, this survey collected information on finances and consumption of almost 150,000 households across 20 countries. The first wave of the survey was conducted in 2008-2011 (primarily in 2010) and included 15 countries: Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Italy, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia,

[14]The choice of how many wealth deciles to exclude and over what period of time to measure issues of government-linked bonds is admittedly arbitrary. We test the robustness of our results to these decisions in Section 4.

and Spain. The second wave of the survey was conducted in 2011-2015 (primarily in 2014). In addition to the 15 countries that participated in the first wave, the second wave also includes Estonia, Ireland, Latvia, Hungary, and Poland.

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. In our analyses, we use deciles of wealth and income, calculated across survey respondents. We test the robustness of our analyses to several alternative specifications of wealth and income such as using log values instead of deciles, using nominal rather than real values, and adjusting for purchasing power parities.

While few households are missing the family characteristic and employment variables in our analysis, we do have a substantial amount of missing wealth or income data (about

40% of the overall sample). 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. Ireland and Malta provide only 5-year age buckets, so we use the midpoint of the age bucket.

In our main analyses, we include all households surveyed, regardless of where the household head was born. Country of birth is missing in the wave 1 data from France and the Netherlands and in both waves in Spain. 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 aggregate population of countries surveyed (inverse probability of being sampled and non-response). In a robustness analysis, we also use the ECB-provided replicate weights (bootstrap weights accounting for the sampling design).

Table 1 summarizes real estate participation (as measured in the HFCS data) in the 35 country-wave combinations 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 Slovakia, Hungary, and Spain.

Figure 1 displays graphically the wide range of homeownership rates across countries in the HFCS sample and, for comparison, in the United States. It is also striking that homeownership rates across U.S. states vary considerably less than across Europe: 43 of 50

[15]We do not find strong evidence that experience effects are weaker for non-natives in the ECB sample. 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. This data is available in the American Community Survey, where we do find that immigrants' experiences in their native countries predict homeownership in their new country.

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 140,000 households across 20 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 35,000. 55% of household heads are married, 23% are single, and the remaining household heads are widowed or divorced. 26% of household heads are educated at the tertiary ISCED-97 level (college in the U.S.) and 44% are educated at the upper secondary level (high school in the U.S.). The remaining 30% 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.

Ireland, Luxembourg, and Finland are the youngest countries with an average age less that 49, while Portugal and Italy are the oldest with an average age around 53. Belgium has the highest college education rate (40%) while Italy and Portugal have the lowest (13%). In Slovenia, Greece, and Malta, less than 50% of household heads are employed compared to 63% in Netherlands and Luxembourg. In Malta and Spain, 56% of households have children, while less than 30% do in Austria, Denmark, and Finland. 70% of households are headed by a male in Portugal compared to 33% in Latvia. Only 40% of households are married in Estonia and Finland, while 68% are married in Cyprus and Malta. Hungary, Poland, and Estonia have median income less than 10,000 while Ireland and Luxembourg have median income above 38,000. Latvia, Hungary, and Estonia have the lowest median wealth (less than 25,000) while Luxembourg and Belgium have the highest (above 175,000).

3.2 Inflation Data

Our primary source for historical inflation data is Reinhart and Rogoff (2009), which we use for all countries available. 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.

The Reinhart and Rogoff series end in 2010, so we extend the data to 2015 using inflation data from the International Monetary Fund (IMF).

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

Several countries are not included in the Reinhart and Rogoff data, so we use alternative historical inflation data, described in more detail below.

For Cyprus and Malta, we use data from Apostolides (2011) for inflation from 1922 to 1938. We then use data from Global Financial Data (GFD) from 1943 on for Cyprus and data from 1947 on for Malta.

For Luxembourg, we obtain inflation data from Global Financial Data extending to 1922. For Estonia and Latvia, we also obtain GFD extending back to 1922, however, we use GFD data from the Soviet Union from 1945 to 1990 for Estonia and 1992 for Latvia, years during which these countries were controlled by the Soviet Union, and therefore no CPI for the individual country is available.

Similarly, for Slovenia, we use GFD data for Yugoslavia from 1929-1943 and from Slovenia from 1952 on. For Slovakia, we use GFD data from Czechoslovakia from 1922-1948, cost-of-living index data from Michal (1960) from 1953-1959, and GFD data for Slovakia from 1964 on.

Belgium, Cyprus, Estonia, Germany, Greece, Hungary, Ireland, Latvia, Luxembourg, Malta, Poland, Slovakia, and Slovenia have gaps in the inflation series ranging from 1 to 8 years, with most gaps occurring during the 1940s. We linearly interpolate over the CPI index when possible (Estonia, Latvia, Slovakia, Luxembourg) and over inflation rates when an underlying consistent CPI is not available (Belgium, Cyprus, Germany, Greece, Hungary, Malta, Slovenia, Poland, Ireland, Hungary).

In additional analyses, we also use historical inflation from Reinhart and Rogoff for Denmark, Sweden, Switzerland, and the United States (extended to 2015 using the IMF data). We also obtain historical inflation for the Czech Republic from Global Financial Data from 1922. The GFD series has a gap from 1949-1963, which we fill in part using data from Michal (1960) and linearly interpolate the remaining years (1960-1963).

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 is only available for 9 of the 20 ECB countries: Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, and Spain. 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 and Current Macroeconomic Data

Housing Market 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).

Inflation protected bonds (% of GDP) is a proxy for how much access households have to alternative inflation hedges. Specifically, we calculate this as the dollar amount of government inflation protected bonds issued over the last 5 years (obtained from Bloomberg) divided by the GDP over the last 5 years (obtained from the World Bank). Annual issues and GDP are adjusted for inflation before combining.

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 also obtain annual price-to-rent ratios from the OECD for 11 of the countries in our sample. The OECD price-to-rent ratio is an index with a baseline for each country equal to the long-run average price-to-rent ratio within the country, where the long-run is defined as starting in 1980 or the average over all available data if the data begins after 1980.

We normalize all continuous comparative housing market measures to have a mean of 0 and variance of 1 in our sample.

Macroeconomic We also obtain several macroeconomic variables from the World Bank for each year of the survey. Specifically, we use measures of GDP, population size, GDP per capita, and the unemployment rate. We also obtain data on household final consumption expenditure per capita, which is the market value of all goods and services purchased by households. This measure excludes home purchases, but does include imputed rent for owner-occupied dwellings.

To facilitate comparisons across countries, GDP, GDP per capita, and household consumption per capita are in real 2010 USD dollars. For regressions, we normalize the macroeconomic variables to have a mean of 0 and variance of 1 in our sample.

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 at

that time. 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

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

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 2015.[17]

Figure 4 shows the distribution of experienced inflation in the sample. Roughly 6% of our sample has experienced inflation above 10%, all of which are from Estonia, Greece, Hungary, Poland, and Slovenia.

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.

Our measure of experienced inflation as a weighted average over the lifetime is meant to describe relative differences in inflation experiences, but is not tied to any specific notion

[17] Inflation data in Slovenia begins in 1929.

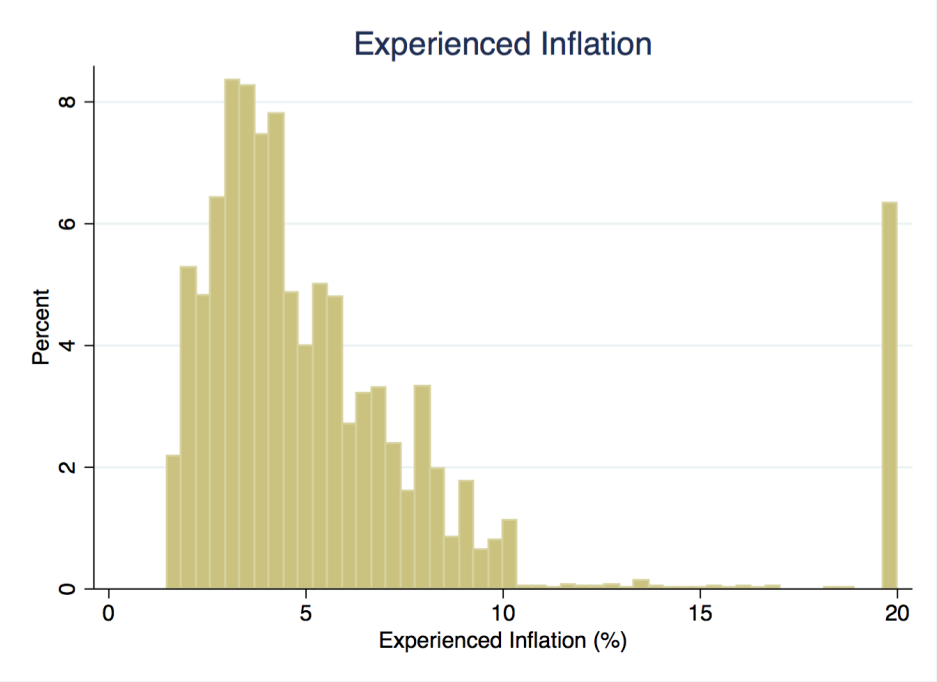

Figure 4. Distribution of experienced inflation
Note: Histogram plots the distribution of experienced inflation in the HFCS sample. Experienced inflation capped at 20% for graph.

of inflation beliefs. Alternatively, Malmendier and Nagel (2015) model individuals who use inflation experiences to recursively estimate an AR(1) model of inflation in order to generate one-year inflation forecasts. While similar in spirit, this approach is focused on short-term inflation predictions, while homeownership decisions are likely based on beliefs about inflation over longer periods. Extending the AR(1) model to a long-term inflation forecast is not immediate, as we have to take a stance on the relevant forecast period (e.g., inflation over 5, 10, 20 years) as well as how individuals forecast forward (e.g., iterate the AR(1) forward, apply the 1-year forecast to all future periods, anticipate learning in the future). For these reasons, we leave this approach as a robustness exercise (see Appendix Table A3 and Section 4.5).

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. In our analyses, we weight countries by the average population across survey years (obtained from the World Bank).

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 percent of households living in owner-occupied housing (homeownership rate) on the y-axis. The red line in the figure on the left plots the best fit in all countries and shows a positive relationship between experienced inflation and homeownership. However, looking at the data, the relationship is clearly non-linear, with a stronger correlation for relatively lower inflation countries (shown in the panel on the right) and a weaker relationship for high inflation countries (which are already at a high homeownership rate around 88%).

The results are 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 with all countries (shown in Column 1), a 1pp increase in country average experienced inflation corresponds to a 0.8pp higher homeownership rate. Excluding the high inflation countries in Column 2, the magnitude is much larger, with a 1pp increase in average experienced inflation predicting a 9pp increase in the homeownership rate. In Column 3, we include all countries but calculate two experience measures: the average of experienced inflation capping each individual's experience at 10% and the percent of individuals with experienced inflation above 10%. We find a positive relationship between experienced inflation under 10% and a slightly negative relationship with the percent of individuals experiencing very high inflation (above 10%).

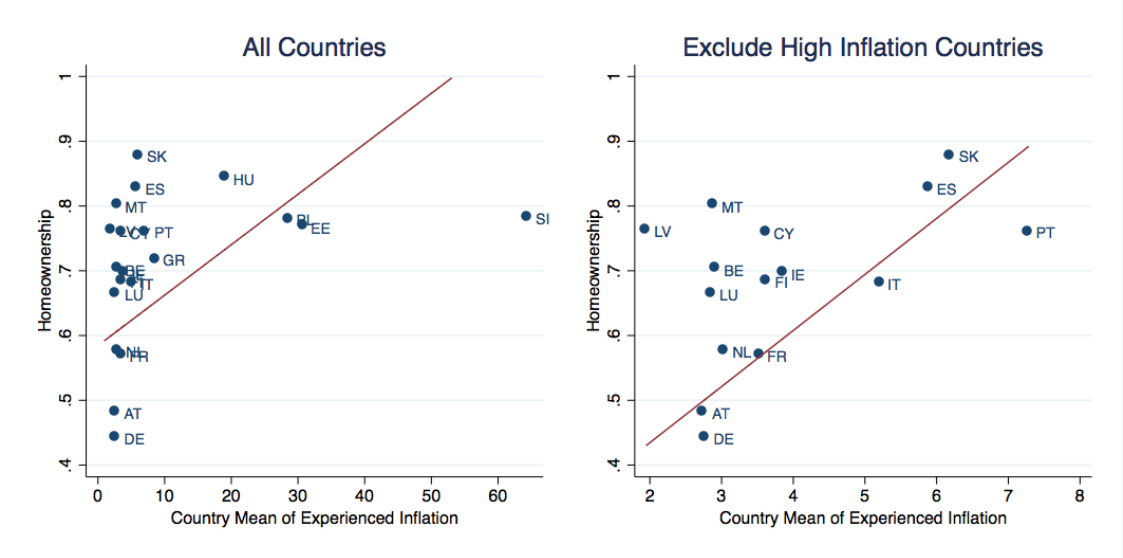

Figure 5. Homeownership rate by experienced inflation
Note: Scatter plot of country average experienced inflation on the x-axis and homeownership rate on the y-axis. Red line shows linear fit, weighted by population.

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 and survey year).

We run logit regressions on the household-level data.[18] Our key dependent variable is a binary indicator of whether the household owns their primary residence, or household-level homeownership (Own HMR).[19] The key independent variable is household experienced inflation, calculated using household head's age, country, and survey year 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, decile of net wealth, and decile of household gross income.[20] We also control for survey wave. We use the HFCS multiple imputation data, which allows us to use the full sample despite missing data for some households. Missing variables are primarily wealth and income.[21] 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 test the robustness of our results to using the HFCS replicate weights (bootstrap weights accounting for the sampling design).

In Table 6, we report the odds ratios and standard errors for our main analysis. We report two sets of results, in Columns (1)-(4) we report results for experienced inflation excluding the highest inflation countries (Estonia, Greece, Hungary, Poland, and Slovenia). In the remaining countries, all households have lifetime experienced inflation below 10%. In Columns (5)-(8) we run the parallel analyses including the high inflation countries. In these regressions, we cap the experienced inflation measure at 10% and include an indicator for households who experienced inflation above 10%. The results using these two methods are very similar.

Controlling for household demographics, we find that a 1pp increase in experienced inflation predicts a 47% increase in the odds of being a homeowner. On a baseline homeownership rate of about 62%, this corresponds to an 8pp increase in the likelihood of being a homeowner. To compare, this is slightly larger than the predicted increased probability of ownership for

[18] The choice of logit regression is not critical, our main results are robust to probit and OLS specifications.

[19] Our main results also hold if we define the dependent variable as owning any property.

[20] Wealth and income are converted to 2010 Euros and deciles are calculated across the entire sample.

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

households with a child. Including the high inflation countries in Column 5, we find that experiencing a 1pp increase in experienced inflation (below 10%) predicts a similar increase in the likelihood of homeownership. As in the country-level regressions, we also find that experiencing inflation above 10% predicts a slightly lower likelihood of ownership. Under this specification, experiencing inflation above 10% is roughly equivalent to having a lifetime experience of 9% inflation.

Many of the household demographic variables we control for in the baseline analysis predict homeownership, several of which we report 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. Across most specifications, households with a household head who completed college are less likely to own. 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 the largest predictor of homeownership, but conditional on wealth, there is not a clear relationship between ownership and income. We also find that homeownership is higher in the second wave of the survey.

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, 3, 5 and 6.[22]

Motivated by the theoretical framework, we predict that experienced inflation has less predictive power among households who have access to alternative inflation-hedges. As described above, we use a measure of government-issued inflation-protected bonds as a percent of GDP over the last 5 years as a proxy for access to inflation-hedging assets. We think this proxy is not very relevant for the lowest wealth households and thus we exclude households in the lowest wealth decile from this analysis. In Columns 2 and 6, we find that experienced inflation positively predicts homeownership, but that the relationship is attenuated in countries with more access to inflation-protected bonds.

The choice of over how many years to aggregate bond issues and how many wealth deciles to exclude is somewhat arbitrary. We test the robustness of the results in Columns 2 and 6 to these choices. We find that the results are robust to defining the period over 10 years rather than 5. Results are mixed if use only issues in the current year, which makes sense

[22]With only 20 countries, we do not test the interaction of these hypotheses.

as year-to-year the amount of issues can be noisy. The results are partially robust to the choice of the sample. In the full sample of 20 countries, we continue to find that having inflation protected bonds attenuates the experience effect if we exclude up to the lowest 3 deciles. Including the full sample, the relationship is statistically insignificant. In the restricted sample of 15 countries, the coefficient continues to be negative for excluding the lowest 2 or 3 deciles, but is statistically insignificant.

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 17 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 Columns 3 and 7, 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 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 Columns 4 and 8, we add country fixed effects to the baseline analysis, to test whether experienced inflation predicts homeownership *within* country. In our data, the variation in macroeconomic experiences within country comes from age differences and survey year (if the country participated in more than one wave). Because age is a large source of the variation in these regressions, we do not attempt to jointly estimate both age and country effects.[23] Controlling for country fixed effects, we find that a 1pp increase in experienced inflation predicts an 8% increase in the odds of homeownership. It is also interesting to note the sign reversal on the coefficient for experiencing inflation above 10% between Columns 5

[23]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.

and 8. This indicates that the negative coefficient in Column 5 may be driven by average country differences, and that within country, experiencing even very high inflation predicts higher homeownership.

Note that including country fixed-effects allows for any historical differences not captured by our experience measures (e.g., former Soviet countries having high homeownership). Indeed, including an indicator for countries that were formerly in the Soviet sphere of influence, we find that they have significantly higher homeownership when we define the indicator without Germany (i.e., Estonia, Hungary, Latvia, Poland, Slovenia, Slovakia) and significantly lower homeownership if we include Germany.

In Table 7, we take a hybrid approach to controlling for differences across housing markets in each country while still allowing for the cross-country variation in average experiences. 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, buyer transaction costs, and price-to-rent ratio described in Section 3. Controlling for all of these measures in Column 6, we find that a 1pp increase in experienced inflation predicts a 27% increase in the odds of homeownership. We show the results for the specification with all countries; the results are similar excluding high inflation countries.

In Appendix Table A2, we also test the robustness to controlling for macroeconomic conditions at the time of the survey. We obtain these macroeconomic variables, described in Section 3, from the World Bank and match them to households by country and year of the survey. In Columns 1, 3, and 4 we should that our results are robust to including current and one-year lagged GDP per capita (normalized to 2010 USD), unemployment, and inflation. In Column 2, we find that the effect of experienced inflation is attenuated and only marginally significant when we control for household expenditure per capital (also normalized to 2010 USD). However, in Column 5 we again find a statistically significant relationship between homeownership and experienced inflation when we jointly control for the macroeconomic variables. The results excluding high inflation countries are similar.

In a cross-country analysis, it is important to control for country-specific market factors or macroeconomic conditions that may impact household tenure choice. However, it is also important to note that the market conditions 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."

Another approach to dealing with cross-country differences in housing markets is to look at the homeownership decisions of individuals in the *same* housing market. To do this, we use data from the 2001-2015 American Community Surveys (ACS) to look at homeownership choices of individuals who have immigrated to the United States from one of the 20 European countries we study in the HFCS.[24]

If we are capturing the predictive power of experienced inflation, rather than differences in housing markets and macroeconomic conditions, we should expect that experiences continue to matter when individuals move to a new market. In this analysis, we calculate the same weighted average of experienced inflation over the lifetime of the household head, using experience in their birth country from year of birth to year of immigration to the U.S. and U.S. inflation after. In addition to demographic controls, described below, we control for years living in the U.S. as a percent of the household head's life.

In all analyses, we control for age, gender, educational attainment, employment status, marital status, having any children who are living in the home, and income. We measure educational attainment using three levels: below high school, high school, and four or more years of college. Employment status is coded as employed, unemployed, and not in the labor force. For marital status, we categorize household heads as single, married, widowed, or divorced and also include an indicator equal to 1 if the household head is married and the spouse is a U.S. native. We control for decile of household income, where income is adjusted for inflation over the survey years and deciles are calculated out of the entire ACS sample (including natives). In all regressions, we also control for survey year fixed-effects.

Table 8 reports the results of this analysis. In Column 1, we regress an indicator for homeownership on experienced inflation (continuous under 10% and an indicator for being above 10%), demographic controls, and survey year fixed-effects in the sample of households with a household head born in one of the European countries in the HFCS. As in our main analyses in 6, we find that experienced inflation below 10% is positively correlated with homeownership.

Is this positive relationship explained by immigrants with high experienced inflation

[24]Data from the 2001-2015 American Community Surveys was obtained from IPUMS (2015).

moving to higher homeownership states? In Column 2, we include as a control the homeownership rate among households headed by a U.S. native. Immigrants are more likely to own if they move to a state with a higher homeownership rate; however, conditional on the native homeownership rate where they move, immigrants with higher experienced inflation (below 10%) are more likely to own. Column 3 shows that the positive relationship between homeownership and experienced inflation (under 10%) is robust to including country of birth fixed-effects.

In Column 4, we expand the analysis to also include all households headed by a U.S. native. In Column 4 we include an indicator for native born households and in Column 5 we include the full set of birth country fixed-effects. Similar to the results on the European-born sample, we find a positive significant effect of experienced inflation under 10% and a negative effect of experiencing inflation above 10%. Note that the magnitude of the coefficient increases quite dramatically when we include U.S. natives in the analysis, most of whom have relatively low inflation compared to the immigrant population (see Appendix Table A6). In units of standard deviations, the coefficients are more similar. The standard deviation of experienced inflation among immigrants is four times as large as in the full sample.

4.4 House Price Experience

In addition to experienced inflation, experienced house price growth may also predict homeownership. As outlines in Section 2, 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. 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 9.

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

(9 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 by re-scaling 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, and find that the prediction is stronger in the subsample. 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 each of these regressions. Surprisingly, the magnitudes are very similar with a 1 standard deviation increase in experienced house price growth predicting a 20% increase in the odds of ownership, or a 4pp increase on average homeownership of 62% to 66%. 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 inflation continues to predict homeownership, but that experiencing higher house price growth, if anything, predicts lower homeownership.

There are several possible explanations for why the results on house price experiences are less robust than those of experienced house price growth. First, the house price data is more limited. By limiting the analysis to a subset of countries or only a shorter time horizon, we limit the variation and statistical power of our analyses. However, the strength of the experienced inflation results casts doubt on this as an explanation. Second, house price changes may be less apparent to households than general inflation. Households may be more familiar with changes in prices of goods frequently purchased and pay relatively little attention to changes in house prices. Third, households may pay attention to nominal rather than real house price changes. We also find little support for this explanation in our data. Without controlling for experienced inflation, nominal house prices experiences do predict homeownership (with slightly larger effects than experienced real house prices), but the effect is smaller than that of general inflation and not robust to including country fixed-effects.

Fourth, there may be a direct impact of house price experience on affordability. In Appendix Table A9, we investigate this hypothesis directly. We obtain yearly price-to-rent ratios from the OECD for 11 of the countries in our sample. The OECD price-to-rent ratio is an index with a baseline for each country equal to the long-run average price-to-rent ratio

within the country.[25] Aggregating to the country level, we regress the average price-to-rent ratio on average experiences. We find no statistically significant relationship between a country's inflation experiences and the price-to-rent ratio, but a strong positive relationship between experiences of house price growth and price-to-rent ratio. Countries with high experienced house price growth (relative to other countries) also have a high price-to-rent ratio (relative to the country's long-run average).

4.5 Robustness

We test the robustness of our main analysis 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 60% of the sample when we control for wealth and income (Columns 2 and 5). Using this limited data in Column 2, the coefficient on experienced inflation is slightly attenuated. 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 education 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 A3, we test two alternative methods of controlling for inflation experiences. In Columns 1 and 6, we report standardized coefficients from our main regressions in Table 6.

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. We find that inflation volatility does predict homeownership on its own (Columns 2 and 7), but that the effect is largely washed out when we also include the level of experienced inflation (Columns 3 and 8). This suggests that the level, rather than the variance, in experienced inflation is they key predictor of homeownership.

In Columns 4 and 9, we use an AR(1) model as described in Malmendier and Nagel (2015) to estimate households' one-year inflation prediction from their lifetime experienced inflation. Rather than estimating the gain parameter in our sample, we use the parameter

[25]The long-run is defined as all data since 1980, or all available data if the indicator begins after 1980.

estimated in the U.S. sample of 3.044. We find that the predicted inflation measure over the next-year (calculated from life experiences) significantly predicts likelihood of being a homeowner in the sample of all countries, but not in the subsample excluding high inflation countries.[26] This is not surprising as perhaps the estimated forecast of one-year inflation is not relevant for homeownership decisions, which are long-term investments.

Extending the AR(1) model to a long-term inflation forecast is not immediate. We have to take a stance on the relevant forecast period for homeownership decisions as well as how individuals make long-term forecasts. In Columns 5 and 10, we take one such approach, assuming that individuals recursively estimate an AR(1) model of inflation up to the year before the survey. We then assume that they use the estimated coefficients (as of the survey year) to iterate the model forward T periods to make a projection of inflation in each subsequent year, T. Using this approach, we find that the 5-year aggregate inflation forecast significantly predicts ownership in both the low inflation and full set of countries. We also find significant relationships using the predicted 2, 10, and 20-year inflation forecasts. In addition to the choice of timing, there are alternative ways of modeling long-term forecast formation, for example, assuming people anticipate future learning or assuming that people project their one-year forecast onto all future years. For these reasons, we prefer the lifetime weighted average approach of measuring experience effects and use this in our main analyses.

In Appendix Table A4, we test the robustness of our results to the treatment of households with high inflation experience. In our baseline analyses, we either exclude very high inflation countries or include a capped measure of experienced inflation and an indicator for households who experienced inflation above the cap of 10%. We find that the results were largely robust to either of these treatment of high inflation observations. In this table, we explore several alternatives.

First, in Column 1, we include all countries and do not cap the measure of experienced inflation. Relative to the baseline model, the predictive power of experienced inflation is mitigated, but still positive and statistically significant. Another way of limiting the impact of outliers is to use the log of lifetime experienced inflation to predict homeownership (Column 2). Here, we also find a positive and statistically significant effect of experienced inflation on homeownership in the full sample of countries.

In Column 3, we take an alternative method of capping experienced inflation. Rather than capping the lifetime average of experienced inflation, in this regression we cap each year's inflation at 50% before calculating a weighted average over the lifetime. In this way,

[26]The results are robust to using alternative gain parameters from 2-5.

we limit the effect that any given year's inflation has on lifetime experiences. We also include an indicator for whether the household ever lived through inflation above 50% (i.e., whether any year in their experienced inflation measure was capped). In this analysis, we also find that the measure of capped experienced inflation positively and significantly predicts higher homeownership, with the indicator for ever experiencing inflation above 50% does not.[27]

In Appendix Table A5, 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 B). In Column 3, we show that the main results are also robust to using nominal, rather than real income and wealth. In Column 4, we show the main results are robust to adjusting real income and wealth for purchasing power parity across countries. Finally, in Column 5, we test the robustness to defining the wealth and income deciles within rather than across countries.

Our main results are also robust to including age fixed-effects instead of age as a continuous variable and to controlling for cohort (birth) year fixed-effects instead of age. In our main analyses, we control for survey wave fixed-effects as most surveys occur over a concentrated period., however, our results are robust to including survey year fixed-effects.

We also test the robustness of the results to clustering standard errors by country. Clustering increases standard errors on experienced inflation under 10% by a factor of 5, but the effects remain statistically significant at the 1% level. Because we have only 20 countries, we also use the score bootstrap approach (Kline et al. (2012)): the average p-value for the coefficient on experienced inflation under 10% (across the 5 imputations) is 0.02 in the sample excluding high inflation countries and 0.002 in the sample with all countries.

4.6 SHARE data

Our main analyses test the hypothesis that macroeconomic experiences predict homeownership *at the time of the survey*. However, homeownership is persistent and therefore the relevant experience measure may really be experiences at the point of first home-ownership. With retrospective data from the Survey of Health, Ageing, and Retirement in Europe (SHARE), we are able to zoom in on the first home purchase and ask whether macroeconomic experiences through the life predict if and when an individual first purchases a

[27]The choice of a 50% cap is arbitrary, but does not meaningfully alter results. With a cap of 25% or 100% in each year, we also predict a significant positive relationship between the capped average experienced inflation and homeownership. With a 25% cap, we also find a positive relationship with the indicator for ever experiencing inflation above 25%.

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 14 countries in Europe. 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. We also calculate a measure of experienced inflation for each of these individual-year observations using the individual's country and age as described in Section 4.1.[28]

We drop about 6% of individuals with incomplete homeownership histories or who never established their own household. The final sample includes 26,691 individuals in 17,959 households from 14 countries. Appendix Table A7 displays summary statistics for the sample.

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. The key independent variable is experienced inflation (which we cap at 10%). As in our main analyses, we also include an indicator for experiencing inflation above 10%. In all analyses, we control for gender of the individual. We also control for several time-varying demographics: whether the individual is married, has a child under the age of 18, and is employed. In Columns 1 and 2, we limit the analysis to the 65% of individuals with complete demographic data over the relevant time frame. In Columns 3 and 4 we use all available data, filling covariates with 0 when missing and including indicators for missing demographics. In Columns 2 and 4, we also add country fixed-effects. Standard errors are clustered by household (defined at the time of the survey).[29]

Appendix Table A8 shows the estimated hazard ratios from the cox proportional hazard model. In Columns 1 and 3, we find that a 1pp increase in experienced inflation under 10% predicts a 5-7% increase in the hazard of becoming a homeowner, with an attenuated effect for individuals who experienced very high inflation. The results are robust to controlling

[28]For Ireland and the Czech Republic, we are missing early-life inflation experiences data for 22 individuals born before 1922. For these individuals, we re-normalize the weights to sum to 1 over available inflation years.

[29]Our main results are unweighted as it is not clear that the SHARE survey weights are appropriate for the retrospective data, however our results are robust to using the calibrated cross sectional individual weights.

for country fixed-effects in Columns 2 and 4, with a 1pp increase in experienced inflation predicting an 8% increase in the hazard of homeownership.

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 within and across countries. We show that these correlations are not explained by a number of housing market and macroeconomic conditions and provide additional support for experience effects by showing that experienced inflation predicts ownership among immigrants who move to the same housing market and that experience through the life predicts the hazard of first home-ownership.

The results of this paper tie into the literature on the long-run effects of macroeconomic events such as high inflation and economic crises.[30] 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.

[30]See for example DeLong and Summers (2012), Giuliano and Spilimbergo (2009), and Oreopoulos et al. (2012).

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

Country	Wave	HH in sample	Actual Pop. (M)	Year of Survey	Homeownership Rate	Own other property (%)	Own any property (%)
Austria	1	2,249	8.4	2011	48%	14%	53%
	2	2,818	8.5	2014	48%	12%	52%
Belgium	1	2,164	10.9	2010	69%	16%	73%
	2	2,030	11.2	2014	71%	19%	75%
Cyprus	1	1,202	1.1	2010	78%	54%	86%
	2	1,248	1.2	2014	74%	48%	84%
Estonia	2	2,099	1.3	2013	77%	33%	81%
Finland	1	10,046	5.4	2010	69%	30%	72%
	2	10,073	5.5	2014	67%	31%	70%
France	1	13,817	64.7	2009	56%	29%	62%
	2	11,167	66.3	2014	58%	26%	64%
Germany	1	3,388	80.7	2011	45%	18%	49%
	2	4,264	81.0	2014	44%	21%	50%
Greece	1	2,860	11.1	2009	72%	38%	79%
	2	2,859	10.9	2014	71%	36%	77%
Hungary	2	5,810	9.9	2014	84%	24%	87%
Ireland	2	5,194	4.6	2013	70%	23%	72%
Italy	1	7,243	59.4	2011	68%	26%	72%
	2	7,249	60.7	2015	68%	24%	71%
Latvia	2	1,155	2.0	2014	76%	41%	82%
Luxembourg	1	922	0.5	2010	66%	28%	74%
	2	1,565	0.6	2014	67%	26%	74%
Malta	1	801	0.4	2010	78%	31%	80%
	2	938	0.4	2014	81%	35%	84%
Netherlands	1	1,268	16.6	2010	57%	6%	58%
	2	1,217	16.9	2014	58%	9%	59%
Poland	2	3,274	38.0	2014	78%	20%	81%
Portugal	1	4,095	10.6	2010	77%	29%	80%
	2	5,782	10.5	2013	75%	30%	79%
Slovakia	1	2,056	5.4	2010	90%	15%	91%
	2	2,030	5.4	2014	85%	20%	87%
Slovenia	1	327	2.0	2010	82%	23%	84%
	2	2,411	2.1	2014	74%	31%	79%
Spain	1	5,717	46.3	2009	83%	37%	86%
	2	5,600	46.7	2011	83%	41%	87%

Notes: Data from HFCS. Weighted averages are representative of the population. Survey year is the median survey year for each country-wave. Actual population is the average over survey years, obtained from the World Bank.

Table 2. Summary of HFCS household characteristics

Variable	Mean	Median	SD	N	Percent Imputed
Age	51.2	51	15.4	136,938	0.0
Male	0.56	1	0.50	136,938	0.0
Has child	0.41	0	0.49	136,938	0.0
Net wealth (2010 Euros)	211,205	85,068	631,366	136,855	34.9
Gross income (2010 Euros)	36,667	27,015	40,854	136,933	18.7
Martial Status				136,928	0.0
Single/never married	0.23				
Married or legal union	0.55				
Widowed	0.10				
Divorced	0.12				
Education Level (ISCED-97)				136,536	0.2
Primary or below	0.15				
Lower secondary	0.15				
Upper secondary	0.44				
Tertiary	0.26				
Employment Status				136,937	0.1
Employed	0.56				
Unemployed	0.06				
Retired	0.27				
Other out of workforce	0.11				

Notes: HFCS sample summary statistics weighted to be representative of the population within and across countries. Mean and median are the average across imputations. Standard deviation is the square-root of the average variance in each imputation.

Table 3. Summary of housing market measures

Country	Home-ownership Rate	PVR	Inflation Protected Bonds (% GDP)	Tenant Protection	Rent Control	Tax Benefits	Buyer Trans. Cost	Price-to-Rent Ratio
Slovakia	88%	1	0	-2.4			-2.6	
Hungary	84%	1	0.901	-1.7	-0.6		-1.3	
Spain	83%	1	0.009	0.9	-0.8	0.5	0.0	1.4
Malta	80%		0					
Slovenia	78%	1	0	-2.0	-1.7		-2.6	
Poland	78%	1	0	-1.1	-1.3		-0.2	
Estonia	77%	1	0				-2.3	
Latvia	76%		0					
Portugal	76%	1	0	1.3	-0.3	-0.4	-0.9	-1.2
Cyprus	76%		0					
Greece	72%	1	0.435	1.8	-0.6	1.5	2.4	-0.5
Belgium	70%	0	0.007	-2.0	-0.8	1.0	2.7	1.6
Ireland	70%	1	0	-2.0	-1.2	-0.2	-1.3	-1.1
Finland	68%	1	0.019	-1.4	-1.7	1.5	-1.5	0.9
Italy	68%	0	1.607	-0.1	-0.8	-0.6	0.1	-0.5
Luxembourg	66%	1	0.001	-2.5	0.1	-0.5	0.5	
Netherlands	58%	0	0	-1.9	1.6	2.9	-1.0	0.4
France	57%	0	0.829	0.9	-0.3	0.3	1.0	0.8
Austria	48%	0	0	1.1	0.2	-0.5	-0.8	-0.2
Germany	44%	0	0.317	-0.2	1.3	-0.9	-0.6	-0.9

Notes: Table is sorted by the homeownership rate (the percent of households who own their main residence), in the HFCS sample. Housing market variables were constructed using data from Andrews et al. (2011), Bloomberg, the World Bank, and the OECD. Prevalence of variable rate mortgages (PVR) is a binary variable equal to 1 if variable rate mortgages are the prevailing type of interest rate on mortgages. Inflation protected bonds is total issues of inflation protected government bonds in the last 5 years, as a percent of GDP over the same period. 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. Price-to-rent ratio is an index with a baseline for each country equal to the long-run average price-to-rent ratio within the country, where the long-run is defined as starting in 1980 or the average over all available data if the data begins after 1980. Tenant protection, rent control, tax benefits, transaction costs, and price-to-rent ratio are normalized to have a mean of 0 and variance of 1 in the sample.

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

	Experienced Inflation (%)				Actual Inflation (%)		
Country	Mean	Median	SD	N	Mean	Median	SD
Austria	2.8	2.7	0.6	5,067	5.6	2.4	12.8
Belgium	2.9	3.1	0.5	4,194	3.6	2.8	4.1
Cyprus	3.6	3.7	0.5	2,450	3.5	2.8	5.5
Estonia	30.8	32.1	5.1	2,099	16.4	1.4	104.8
Finland	3.6	3.9	1.1	20,119	6.4	3.4	9.6
France	3.5	3.6	1.1	24,984	7.8	3.5	11.8
Germany	2.8	2.9	0.7	7,652	4.0	2.8	7.0
Greece	8.6	8.0	2.5	5,719	25.1	5.5	84.6
Hungary	19.1	9.9	25.5	5,810	363.2	4.8	2521.5
Ireland	3.9	4.2	1.0	5,194	4.5	2.8	5.8
Italy	5.2	5.3	1.2	14,492	11.4	4.2	38.4
Latvia	2.0	1.9	0.4	1,155	1.3	1.3	11.3
Luxembourg	2.9	3.0	0.4	2,487	5.2	2.7	9.4
Malta	2.9	3.0	0.2	1,739	2.4	2.1	3.8
Netherlands	3.0	3.1	0.4	2,485	3.3	2.8	4.2
Poland	28.6	30.6	5.3	3,274	19.5	5.5	67.7
Portugal	7.3	7.9	1.4	9,877	6.1	3.1	9.2
Slovakia	6.2	6.1	0.7	4,086	4.8	1.6	11.3
Slovenia	64.5	68.0	17.6	2,738	57.1	10.1	209.6
Spain	5.9	6.2	1.1	11,317	6.6	4.7	6.5
All	5.8	3.7	8.0	136,938			
All (country equal weight)	10.5	4.1	16.5	136,938			
Across Country							
Mean	5.8	5.9	1.6	20			
Median	3.5	3.6	1.1	20			
Mean (country equal weight)	10.5	10.5	3.4	20			
Median (country equal weight)	3.7	4.0	1.1	20			

Notes: Data is the HFCS non-imputed survey data and inflation as described in Section 3. Experienced inflation summary statistics are weighted to a representative population within and across countries unless otherwise noted. "Country equal weight" indicates summary statistics are weighted to be representative within country, but equal weighted across countries. "Across Country" statistics report the mean or median across country sample statistics in the top panel. Actual inflation is based on annual inflation from 1925 to 2015 (1929 to 2015 for Slovenia).

Table 5. Inflation Experiences and Country-Level Homeownership

Sample:	All	Exclude High Inflation	All
Dependent Var: Homeownership	(1)	(2)	(3)
Average Experienced Inflation	0.008**		
	(0.003)		
Average Experienced Inflation (Under 10%)		0.087***	0.075***
		(0.018)	(0.018)
Percent with Experienced Inflation Capped at 10%			-0.003**
			(0.001)
Constant	0.584***	0.261***	0.303***
	(0.063)	(0.082)	(0.083)
Observations	20	15	20
R^2	0.247	0.736	0.738

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: OLS regression coefficients with robust standard errors in parentheses. Data is the HFCS non-imputed data, averaged to the country level using representative weights. Countries weighted by population from the World Bank. Dependent variable is the percent of households who own their main residence. High inflation countries include Slovenia, Estonia, Poland, Hungary, and Greece. Experienced inflation is the weighted average of inflation over the household head's lifetime, with linearly declining weights from year before the survey to birth year. In Column 3, we winsorize households' experienced inflation at 10%.

Table 6. Inflation Experiences and Household-Level Homeownership

	Exclude High Inflation Countries				Include High Inflation Countries			
Dep. Var: Own Main Residence	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exp. Inflation (under 10)	1.467***	1.534***	1.253***	1.084**	1.415***	1.480***	1.221***	1.077**
	(0.026)	(0.035)	(0.031)	(0.037)	(0.018)	(0.029)	(0.027)	(0.031)
Exp. Inflation capped at 10					0.688***	0.588***	1.192**	1.587***
					(0.050)	(0.073)	(0.099)	(0.141)
Inflation Protected Bonds		0.892				0.869		
		(0.105)				(0.092)		
Exp. Infl. (under 10) X Infl. Protect.		0.948**				0.959**		
		(0.022)				(0.019)		
Exp. Infl. Capped X . Infl. Protect						6.911***		
						(1.238)		
PVR			7.795***				5.539***	
			(1.558)				(0.942)	
Exp. Infl. (under 10) X PVR			0.841***				0.904***	
			(0.028)				(0.025)	
Exp. Infl. Capped X PVR							.	
Demographic Controls	Yes	Yes	Yes	Yes (no age)	Yes	Yes	Yes	Yes (no age)
Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	No	No	No	Yes	No	No	No	Yes
Observations	116,807	105,829	111,470	116,807	136,437	123,125	131,100	136,437
Countries	15	15	12	15	20	20	17	20
Pseudo R^2	0.520	0.489	0.533	0.539	0.516	0.486	0.527	0.536

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Table reports exponentiated coefficients (odds ratios) from logit regressions with robust 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 is the weighted average of inflation over the household head's lifetime, with linearly declining weights from year before the survey to birth year. Demographic controls include household head gender, marital status, whether the household head has any children, education level, employment status, and deciles of net wealth and household income. In regression with country fixed effects, we do not estimate an effect of age. Inflation protected bonds is issues of government inflation-linked bonds, measured as a percent of GDP over the last 5 years. Regressions with this inflation protected bonds (Columns 2 and 6) exclude households in the lowest wealth decile. PVR is an indicator for having primarily variable rate mortgages in the country. High inflation countries include Slovenia, Estonia, Poland, Hungary, and Greece.

Table 7. Household-Level Homeownership and Housing Market Controls

	All Countries					
Dep. Var.: Own Main Residence	(1)	(2)	(3)	(4)	(5)	(6)
Exp. Infl. (under 10)	1.490***	1.393***	1.338***	1.453***	1.368***	1.270***
	(0.020)	(0.017)	(0.021)	(0.019)	(0.021)	(0.025)
Exp. Infl. Capped at 10	0.422***	0.826***	0.909	0.623***	1.300*	1.744***
	(0.032)	(0.059)	(0.127)	(0.046)	(0.175)	(0.239)
Tenant Protection	0.763***					0.951**
	(0.013)					(0.021)
Rent Control		0.946**				0.781***
		(0.024)				(0.026)
Tax Benefits to Homeowners			1.290***			1.355***
			(0.032)			(0.044)
Buyer Trans. Cost				0.845***		0.779***
				(0.012)		(0.014)
Price-to-Rent Ratio					1.141***	0.951
					(0.025)	(0.032)
Demographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Wave FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	129,001	124,915	113,101	131,100	110,614	110,614
Countries	16	15	12	17	11	11
Pseudo R^2	0.524	0.522	0.530	0.522	0.527	0.534

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Table reports exponentiated coefficients (odds ratios) from logit regressions with robust 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 is the weighted average of inflation over the household head's lifetime, with linearly declining weights from year before the survey to birth year. Demographic controls include household head gender, marital status, whether the household head has any children, education level, employment status, and deciles of wealth and income. All regressions also include fixed-effect for survey wave. 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. Price-to-rent ratio is a comparison of the cost of ownership and renting relative to the country's long-run average. Housing market variables obtained from Andrews et al. (2011) and OECD and are normalized to have a mean of 0 and variance of 1 across all available data.

Table 8. Inflation Experiences and Household-Level Homeownership in the ACS

Sample:	Immigrants from HFCS			All	
Dep. Var.: Homeowner	(1)	(2)	(3)	(4)	(5)
Exp. Inflation (under 10)	1.106***	1.107***	1.071***	1.684***	1.699***
	(0.008)	(0.008)	(0.009)	(0.008)	(0.008)
Exp. Infl. Capped at 10	0.693***	0.645***	0.713***	0.064***	0.081***
	(0.033)	(0.031)	(0.037)	(0.002)	(0.004)
Native Homeownership Rate in Year-State		1.071***	1.073***		
		(0.002)	(0.002)		
Years in U.S. (% of Life)	1.015***	1.015***	1.015***	1.022***	1.022***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Native				5.864***	
				(0.146)	
Demo. Controls & Year FE	Yes	Yes	Yes	Yes	Yes
Country of Birth FE	No	No	Yes	No	Yes
State and State X Year FE	No	No	No	Yes	Yes
Observations	200,426	200,426	200,426	12,468,374	12,468,374
Pseudo R^2	0.223	0.237	0.240	0.267	0.267

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Table reports exponentiated coefficients (odds ratios) from logit regressions with robust standard errors in parentheses. Data is the 2001-2015 ACS survey data, using representative weights. Dependent variable is an indicator for homeownership. Experienced inflation is the weighted average of inflation over the household head's lifetime, with linearly declining weights from year before the survey to birth year, using inflation from the birth country from birth year to year of immigration to the U.S., and only U.S. inflation for natives. Demographic controls include household head age, gender, marital status and if married whether household head is U.S. native, whether the household head has any children in the home, highest education level (below high school, high school, at least 4-years of college), employment status, and decile of total household income relative to the entire ACS population. All regressions also include fixed-effects for survey year. Native homeownership rate is the homeownership rate among households headed by an individual born in the U.S. calculated using the ACS from the same state and year. The sample in Columns 1-3 are household heads born in one the 20 ECB HFCS countries. In Columns 4 and 5 we also include households headed by a U.S. native.

Table 9. Experiences of Real House-Price Growth and Household-Level Homeownership

Dependent Var: Own Main Residence	(1)	(2)	(3)	(4)	(5)	(6)
Experienced Inflation (std.)	2.015***	1.723***	1.272***	1.723***	1.617***	1.191***
	(0.083)	(0.075)	(0.095)	(0.062)	(0.055)	(0.072)
Experienced Real House Price Growth (Full History, std.)		1.201***	0.784**			
		(0.044)	(0.088)			
Experienced Real House Price Growth (Partial History from 1975, std.)					1.197***	0.931
					(0.031)	(0.092)
Demographic Controls	Yes	Yes	Yes (no age)	Yes	Yes	Yes (no age)
Wave FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	No	No	Yes	No	No	Yes
Observations	70,267	70,267	70,267	92,440	92,440	92,440
Countries	6	6	6	9	9	9
Pseudo R^2	0.514	0.515	0.522	0.531	0.533	0.541

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Table reports exponentiated coefficients (odds ratios) from logit regressions with robust 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). Table reports exponentiated coefficients (odds ratios) from logit regressions with robust 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). Experience measures are calculated as the weighted average over the household head's lifetime, with linearly declining weights from year before the survey to birth year (re-scaling the weights for partial history). Note, all countries in analysis have average experienced inflation under 10%. 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, Ireland, Italy, Luxembourg, the Netherlands, and Spain. All experience measures are standardized within the regression sample. 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. All regressions also include fixed-effect for survey wave.

APPENDIX

A Simulation

In Section 2 we develop a stylized theoretical framework that links experience-based expectations about inflation and about house prices to tenure decisions. In the simple theoretical framework, we assume that agents have fixed expectations about future inflation and house price growth to derive closed form comparative statics. In this appendix, we relax this assumption and provide simulations of housing choices under alternative assumptions about the distribution of beliefs. We also show that the key predictions from Section 2 are robust to alternative levels of risk aversion, most reasonable loan-to-value ratios, different mean beliefs of real house price growth, and alternative returns and mortgage rates.

We begin by simulating the simple model of Section 2 with fixed expectations. In Figure A1, we plot the rental price (as a percent of the house price,h_t/M_t) at which the agent is indifferent between renting and owning as a function of expected inflation in each of the four markets: fixed- vs. variable-rate mortgage and with an alternative asset that pays a known nominal or real return. We assume that agents expect next period house price growth, $g = 2\%$, and plot the indifferent rent to price ratio as a function of expected inflation, which ranges from $1 - 10\%$.

In each of the simulations below, we assume the following values unless otherwise noted.

- Agents have log utility over real wealth.
- Initial wealth, $w_t = 200$.
- House price, $M_t = 100$.
- Loan-to-value ratio, $m_t/M_t = 0.8$.
- The alternative asset offers either a real return $r = 5\%$ or a nominal return $n = 9\%$.
- The fixed-rate mortgage carries a nominal rate $n^f = 11\%$.
- The variable-rate mortgage carries a real rate $r^v = 7\%$.

Figure A1 demonstrates the key takeaways from Section 2. First, in all four markets, the slope is (weakly) negative, indicating that all else equal, expecting higher inflation increases the willingness to pay for ownership. Figure A1 also shows that the effect of experienced inflation on ownership should be stronger when agents have access to fixed- rather than variable-rate mortgages, evident by the fact that the blue lines (fixed-rate in a market with or without alternative inflation hedges) are steeper than the corresponding red lines for

variable-rate mortgages. Similarly, the graph shows that the effect of experienced inflation will be stronger in a market without alternative inflation hedges as the solid lines (fixed- and variable-rate mortgages in a market without inflation hedges) are steeper than the corresponding dashed lines (fixed- and variable-rate mortgages in a market with alternative hedging opportunities).

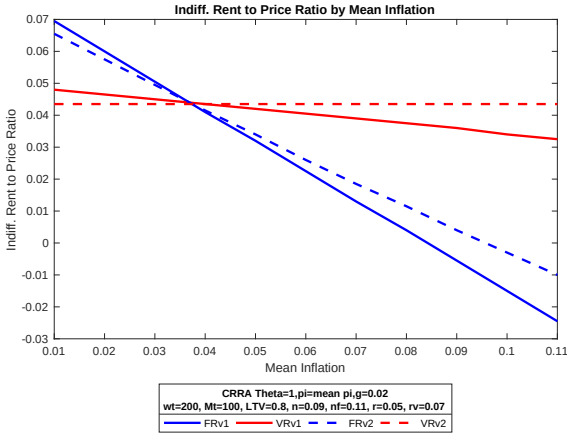
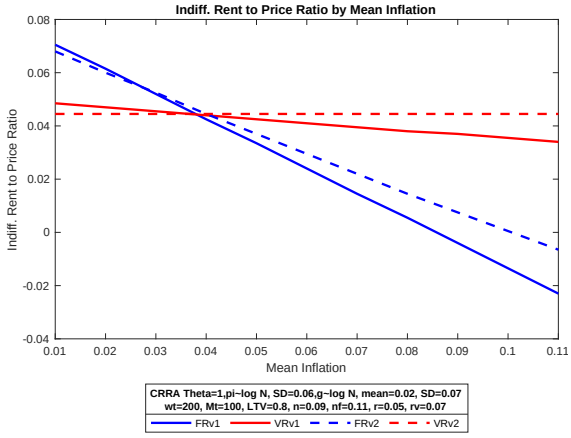


Figure A1. Simulation with fixed expectations

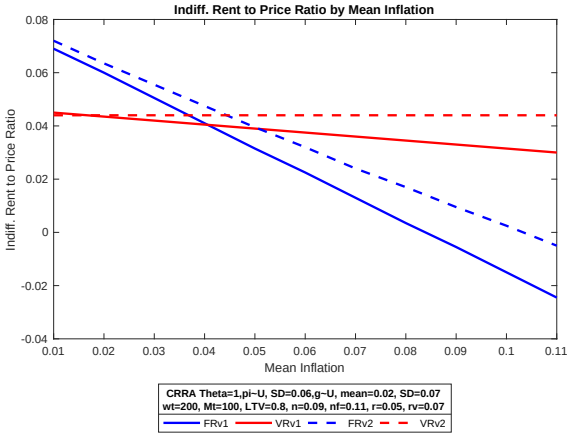
Figure A1 demonstrates graphically the results in Section 2. In the remainder of this section, we demonstrate that the key results are robust to a number of alternative assumptions.

A.1 Distribution of Expectations

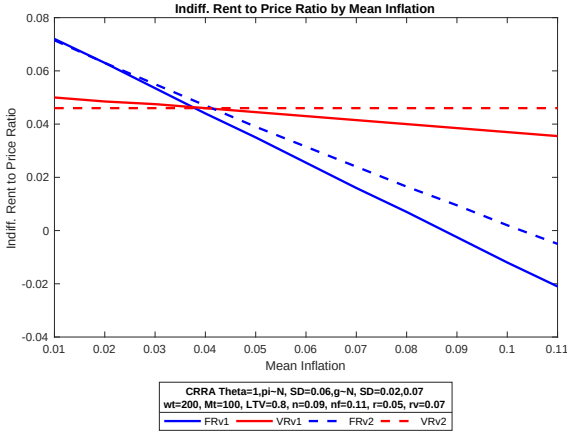
The most natural extension of the theoretical framework is to allow agents to have a distribution of beliefs over future inflation and house price growth. In Figure A2, we present results assuming agents have lognormal, uniform, or normally distributed beliefs. Roughly consistent with the actual data, we assume the standard deviation of inflation beliefs is 6% and that real house price growth is distributed with mean of 2% and standard deviation of 7%. Under all three distributional assumptions, the key predictions of the theoretical framework hold.



(a) Lognormal Distribution



(b) Uniform Distribution

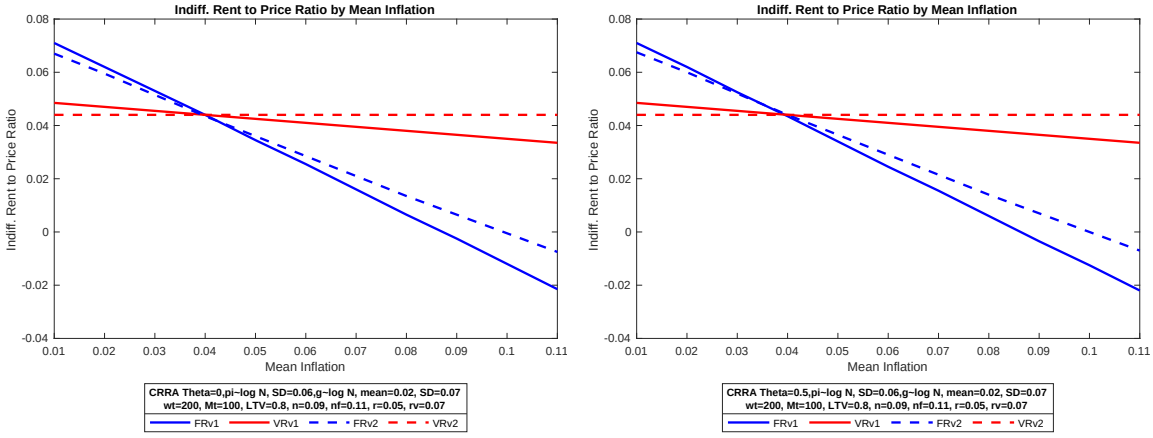


(c) Normal Distribution

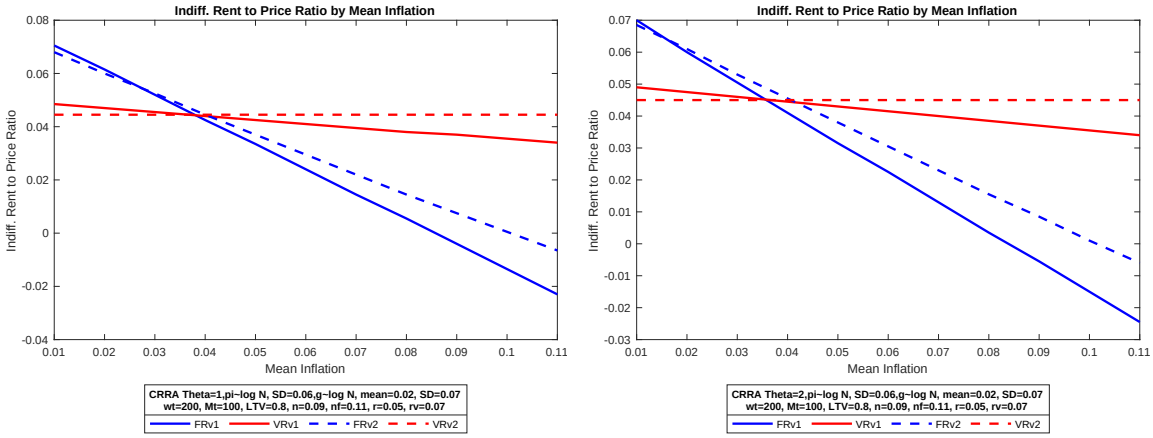
Figure A2. Simulation with distribution of beliefs

A.2 Risk Aversion

In the theoretical framework, we assume log utility. In this section, we show that the results are robust to agents having more or less risk averse preferences. We assume a constant relative risk aversion and show the results for a range of possible risk aversions in Figure A3. We assume agents' beliefs about next period's inflation and house price growth are lognormally distributed.



(a) Risk Neutral (CRRA $\theta = 0$) (b) Low Risk Aversion (CRRA $\theta = 0.25$)

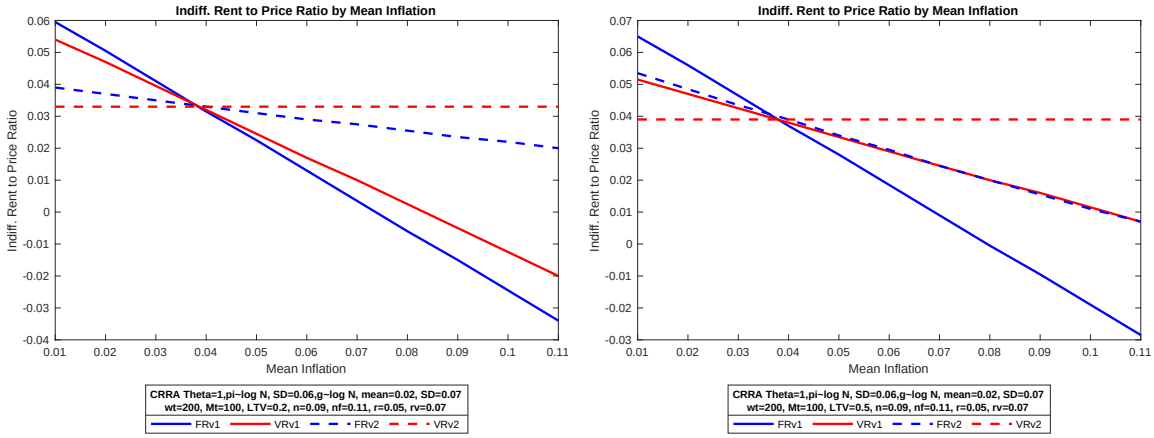


(c) Log Utility (CRRA $\theta = 1$) (d) High Risk Aversion (CRRA $\theta = 2$)

Figure A3. Simulation with alternative levels of risk aversion

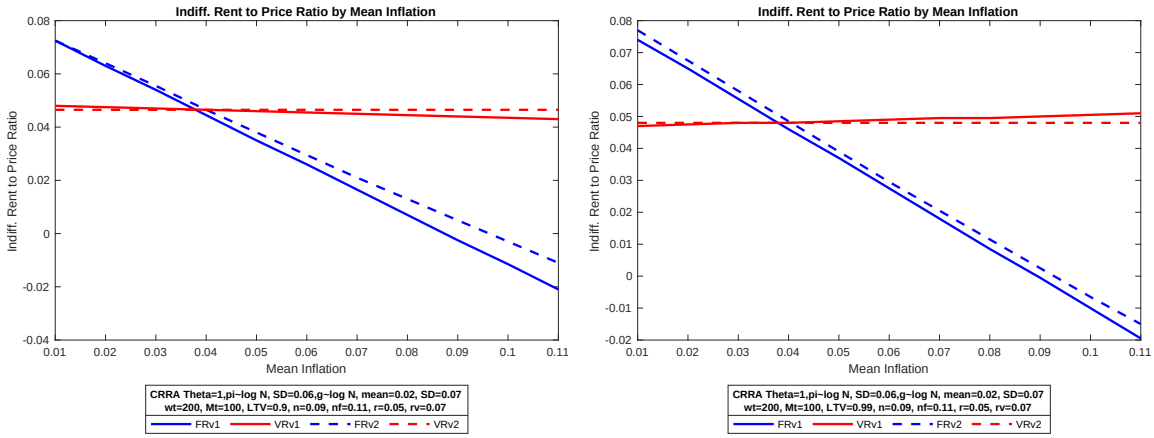
A.3 Loan-to-Value

In the baseline simulation, we assume the mortgage value is 80% of the value of the home. The main results are robust to lower loan-to-values ratios (Figure A5 (a) and (b)), but do break down at the highest levels (Figure A5 (d)) as predicted in the theoretical section. In Figure A5 (d), we see that willingness to pay for ownership is actually slightly decreasing in experienced inflation in the market for variable-rate mortgage without an alternative inflation hedge. The prediction that we should see stronger experience effects in fixed- over variable-rate markets still holds, but we no longer get the prediction that we should see larger experience effects in countries without alternative inflation hedges.



(a) 20% LTV.

(b) 50% LTV.



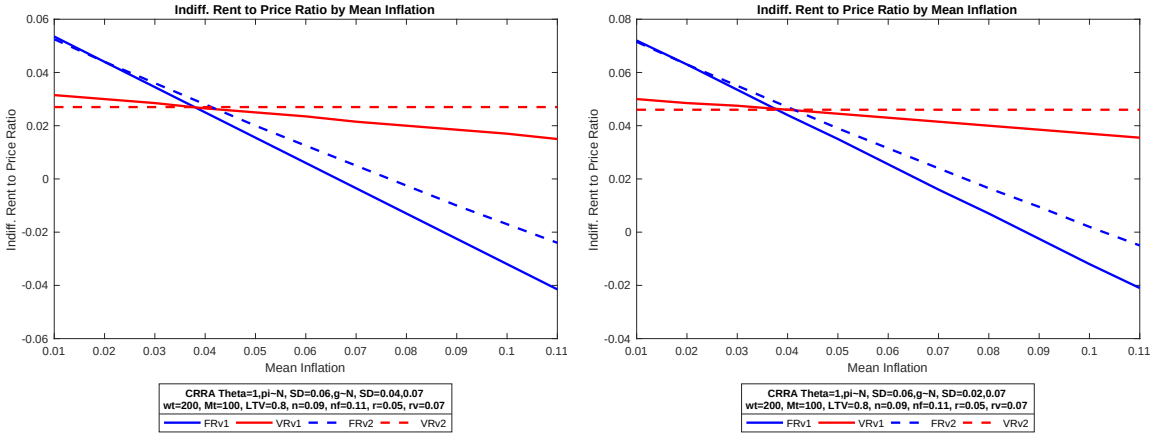
(c) 90% LTV.

(d) 99% LTV.

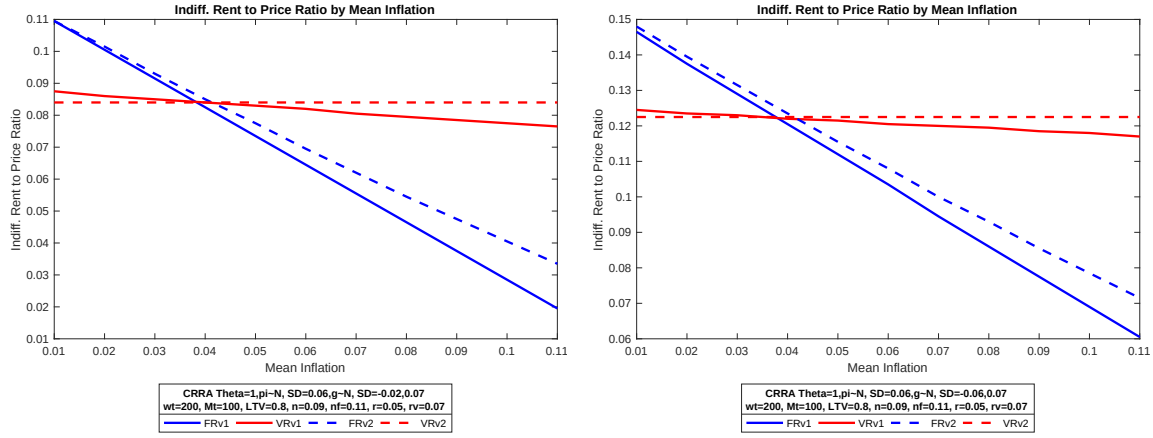
Figure A4. Simulation with alternative loan-to-value ratios

A.4 Real House Price Growth

In this section, we vary the assumptions about the mean real house price growth. To allow for the possibility of negative expected real house price growth, in this section we assume beliefs about future inflation and house price growth are normally distributed. The results are qualitatively unchanged for both higher and lower expectations of real house price growth.



(a) Mean g 4%. (b) Mean g 2%.

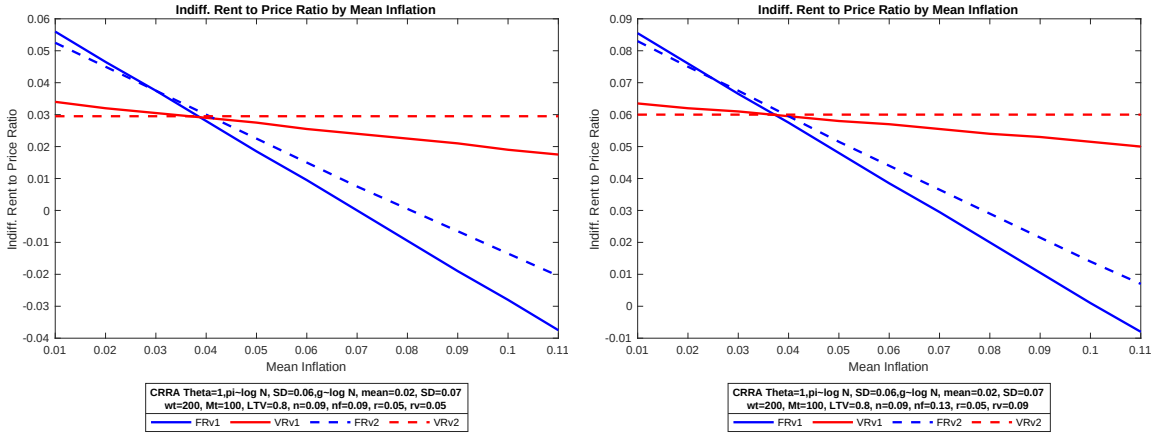


(c) Mean g -2%. (d) Mean g -6%.

Figure A5. Simulation with alternative real mean house price growth, normally distributed beliefs

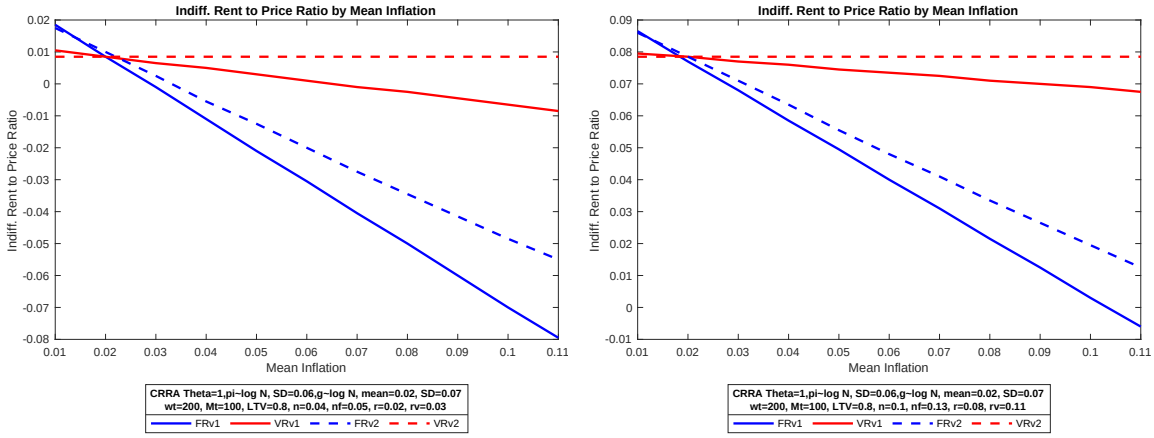
A.5 Returns and Mortgage Rates

In this section, we return to the assumption of lognormal beliefs and vary the interest rate on the alternative asset and mortgage rates. In the baseline model, the interest on the mortgage is 2% higher than the return on the corresponding alternative asset. In Figure A6, we show that the results are robust to closing that gap (A6a) and widening the gap (A6b). Figures A6(c) and (d) show that the results are also robust to the level of rates.



(a) No Gap.

(b) Larger Gap.



(c) Lower Rates.

(d) Higher Rates.

Figure A6. Simulation with alternative rates

B Discussion of wealth controls

In our main analyses, we control for the decile 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 Column 1 of Appendix Table A5 we try to address this endogeneity by removing home equity (current value of home minus outstanding debt) from net wealth. Experienced inflation continues to predict higher odds of homeownership, at statistically significant levels. The explanatory power of this model over the baseline treatment of wealth is significantly lower (Pseudo R^2 of 0.23 compared to 0.52 in our baseline model, Table 6 Column 1).

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 households who, if owners, reported the purchase price of their home, so the sample size in Column 2 is substantially smaller. Using this alternative definition of wealth, the effect of experienced inflation remains large and statistically significant.

Measuring wealth net of the increase in home price is not ideal for several reasons. First, this is a noisy measure as we can at most observe the increase in price of 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.

C Additional Figures and Tables

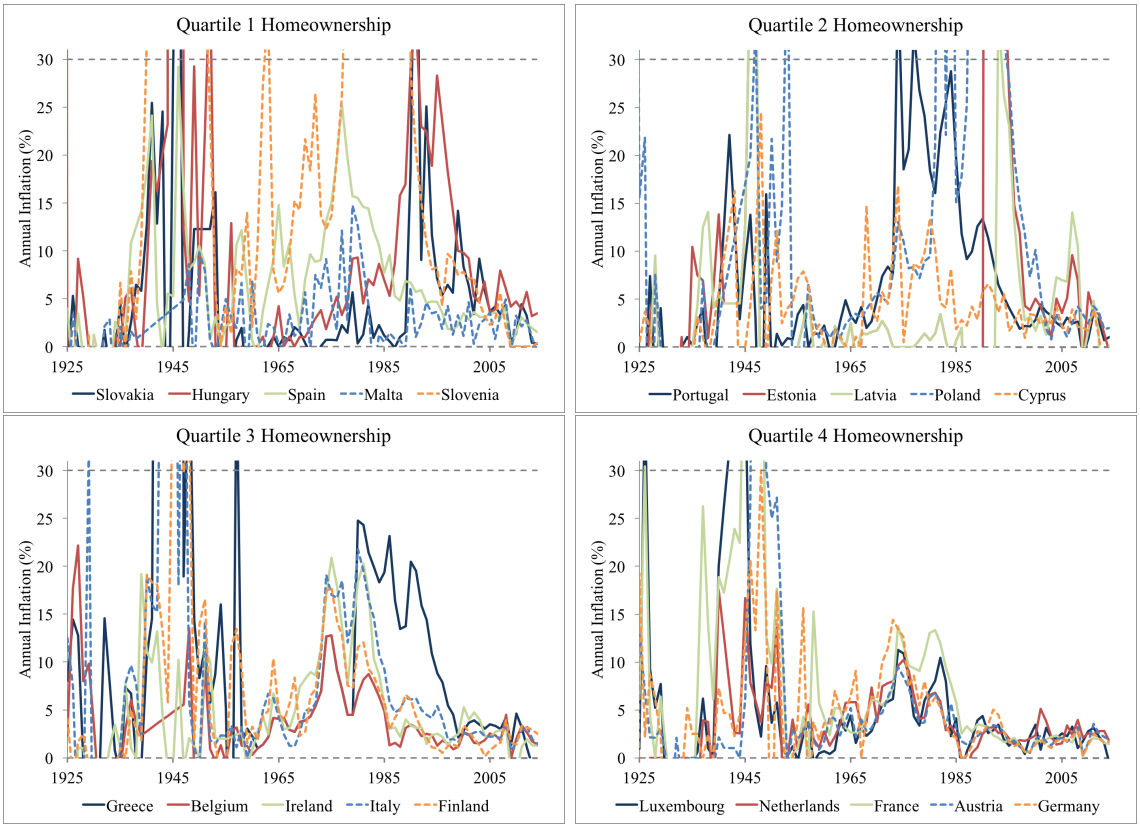


Figure A7. Inflation history, stratified by quartile of homeownership rate
Note: Inflation data sources described in the text. Inflation for chart capped above at 30% and below at 0%. Quartile 1 includes countries with the highest homeownership rates across all available ECB HFCS waves and quartile 4, the lowest.

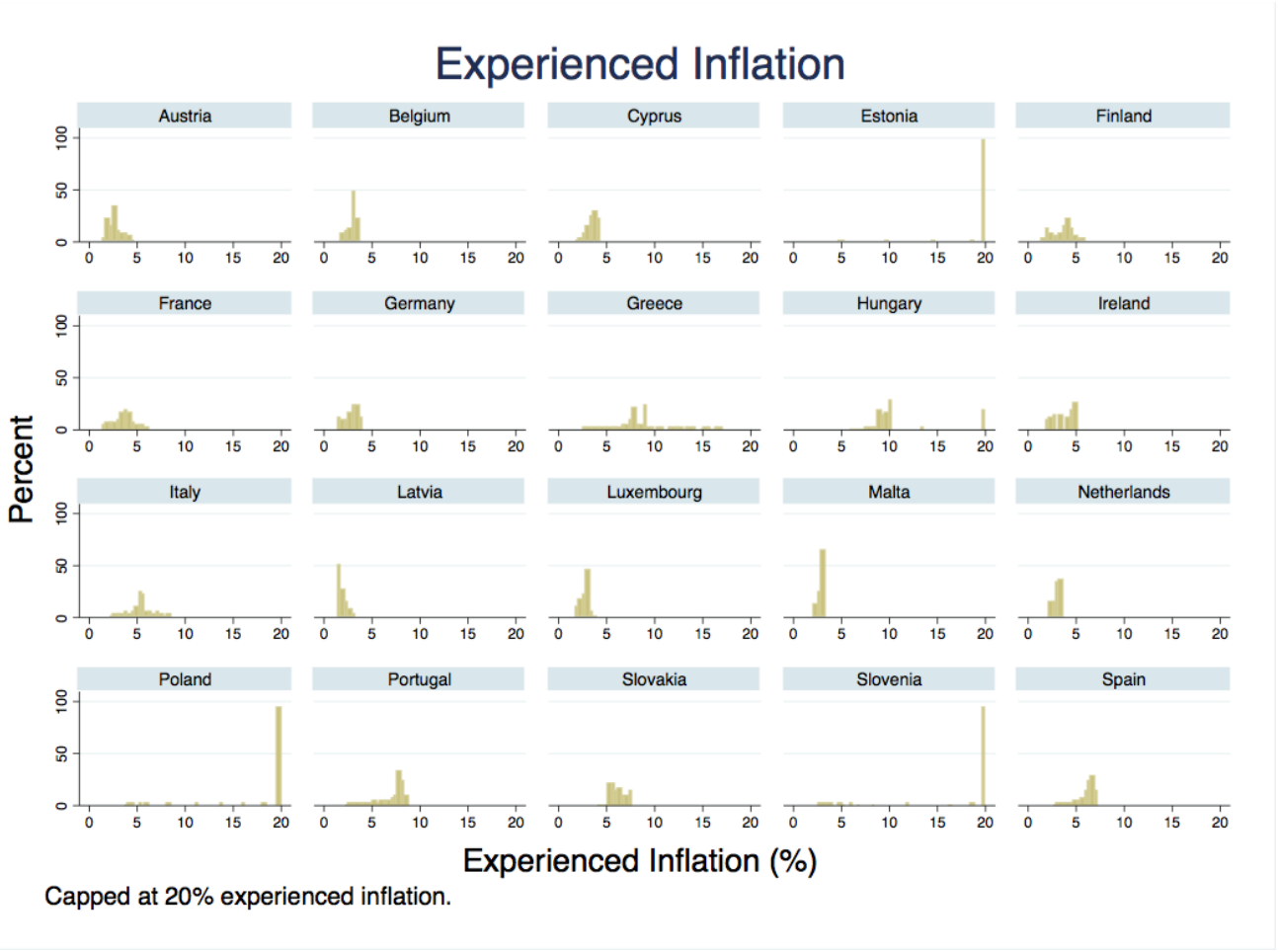


Figure A8. Distribution of Experienced Inflation, by Country
Note: Inflation data sources described in the text. Experienced inflation in chart capped at 20%.

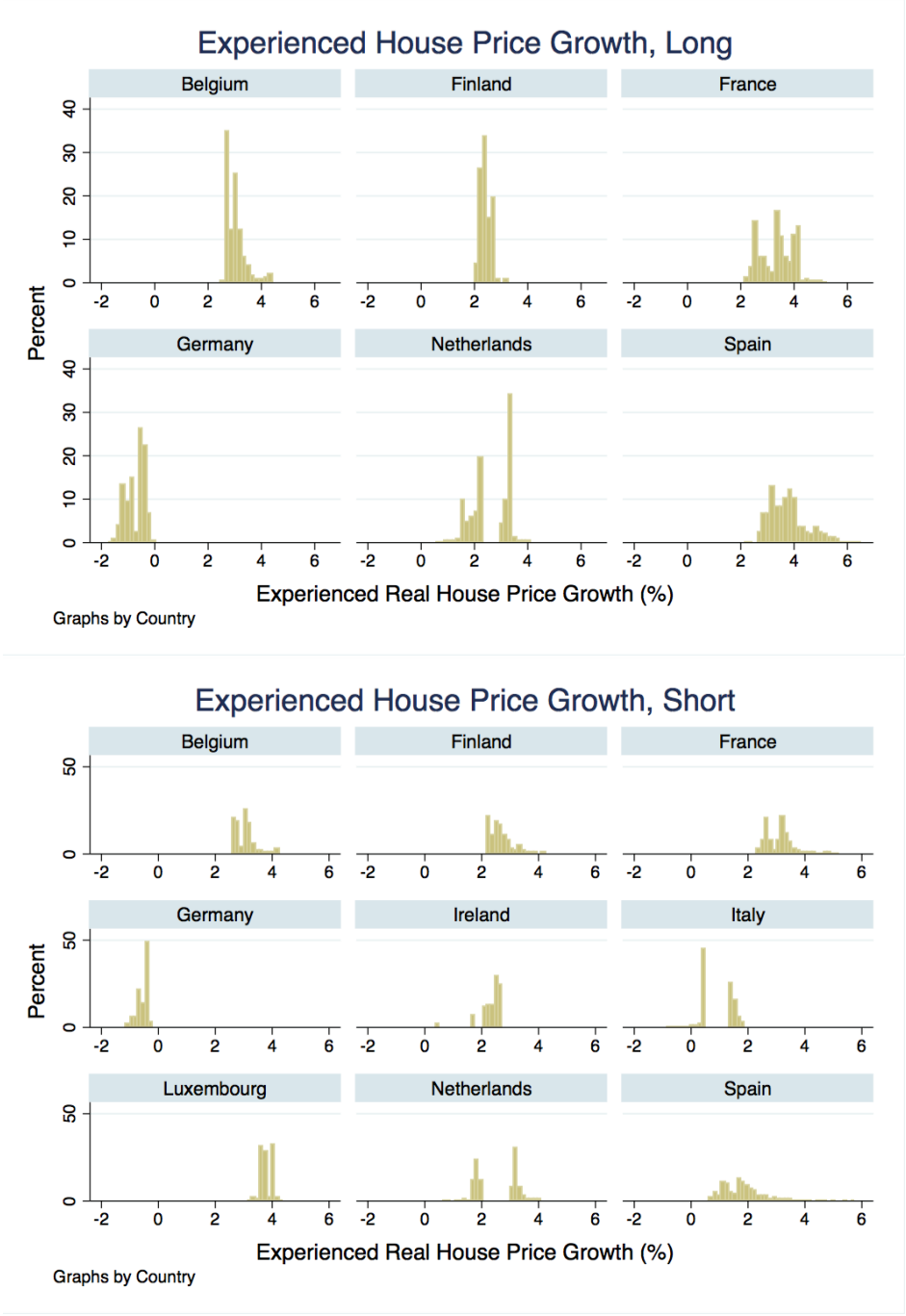


Figure A9. Distribution of Experienced House Price Growth, by Country
Note: House price data sources described in the text.

Table A1. Inflation Experiences and Household-Level Homeownership, non-imputed data

	Exclude High Inflation Countries			Include High Inflation Countries		
Dep. Var: Own Main Residence	(1)	(2)	(3)	(4)	(5)	(6)
Exp. Infl. (under 10)	1.467***	1.373***	1.595***	1.415***	1.410***	1.446***
	(0.026)	(0.035)	(0.020)	(0.018)	(0.023)	(0.014)
Exp. Infl. capped at 10				0.688***	1.155	0.240***
				(0.050)	(0.113)	(0.016)
Age	0.987***	0.989***	1.019***	0.991***	0.991***	1.027***
	(0.003)	(0.004)	(0.002)	(0.002)	(0.003)	(0.002)
Male	0.916*	0.852**	1.094***	0.925*	0.877**	1.097***
	(0.046)	(0.055)	(0.036)	(0.042)	(0.052)	(0.033)
Married	1.804***	1.680***	2.477***	1.761***	1.669***	2.396***
	(0.116)	(0.147)	(0.102)	(0.105)	(0.137)	(0.093)
Widowed	1.612***	1.472***	1.222***	1.585***	1.472***	1.219***
	(0.164)	(0.193)	(0.082)	(0.145)	(0.175)	(0.076)
Divorced	1.061	1.042	0.780***	1.071	1.070	0.774***
	(0.085)	(0.116)	(0.042)	(0.080)	(0.110)	(0.039)
Educ:2 (middle school)	0.869*	0.715***	1.194***	0.915	0.852**	1.114**
	(0.063)	(0.062)	(0.057)	(0.061)	(0.066)	(0.050)
Educ:3 (high school)	1.017	0.799**	1.865***	1.004	0.928	1.631***
	(0.074)	(0.072)	(0.083)	(0.065)	(0.073)	(0.065)
Educ:5 (college)	0.791***	0.627***	2.792***	0.783***	0.731***	2.438***
	(0.067)	(0.067)	(0.139)	(0.059)	(0.069)	(0.111)
Has Child	1.367***	1.389***	1.399***	1.376***	1.370***	1.449***
	(0.073)	(0.097)	(0.048)	(0.067)	(0.089)	(0.046)
Employed	1.462***	1.277***	1.714***	1.432***	1.297***	1.676***
	(0.111)	(0.118)	(0.086)	(0.098)	(0.110)	(0.077)
Unemployed	1.466***	1.452***	0.827***	1.409***	1.412***	0.838***
	(0.143)	(0.189)	(0.056)	(0.124)	(0.169)	(0.052)
Retired	1.537***	1.521***	1.291***	1.491***	1.548***	1.221***
	(0.128)	(0.164)	(0.073)	(0.111)	(0.152)	(0.064)
Second Wave	1.447***	1.335***	1.255***	1.472***	1.456***	1.185***
	(0.069)	(0.092)	(0.039)	(0.067)	(0.090)	(0.035)

See notes on next page.

Table A1. Inflation Experiences and Household-Level Homeownership, non-imputed data (cont'd.)

	Exclude High Inflation Countries			Include High Inflation Countries		
Dep. Var: Own Main Residence	(1)	(2)	(3)	(4)	(5)	(6)
Wealth Decile 1	0.005***	0.003***		0.003***	0.002***	
	(0.001)	(0.001)		(0.000)	(0.000)	
Wealth Decile 2	0.003***	0.001***		0.003***	0.002***	
	(0.000)	(0.000)		(0.000)	(0.000)	
Wealth Decile 3	0.018***	0.009***		0.021***	0.010***	
	(0.002)	(0.002)		(0.003)	(0.002)	
Wealth Decile 4	0.076***	0.050***		0.079***	0.052***	
	(0.010)	(0.008)		(0.011)	(0.009)	
Wealth Decile 5	0.210***	0.153***		0.208***	0.154***	
	(0.029)	(0.026)		(0.028)	(0.026)	
Wealth Decile 6	0.400***	0.294***		0.396***	0.296***	
	(0.060)	(0.052)		(0.058)	(0.052)	
Wealth Decile 7	0.594***	0.538***		0.591***	0.537***	
	(0.094)	(0.102)		(0.093)	(0.101)	
Wealth Decile 8	0.821	0.681**		0.814	0.691*	
	(0.117)	(0.133)		(0.115)	(0.135)	
Wealth Decile 9	0.837	0.711*		0.829	0.710*	
	(0.115)	(0.127)		(0.113)	(0.126)	
Income Decile 1	2.035***	2.675***		2.449***	3.264***	
	(0.347)	(0.574)		(0.397)	(0.673)	
Income Decile 2	1.556***	1.977***		1.720***	2.123***	
	(0.264)	(0.419)		(0.281)	(0.432)	
Income Decile 3	1.622***	2.032***		1.669***	2.022***	
	(0.253)	(0.393)		(0.249)	(0.382)	
Income Decile 4	1.505***	1.813***		1.506***	1.713***	
	(0.222)	(0.340)		(0.214)	(0.315)	
Income Decile 5	1.509***	1.913***		1.491***	1.801***	
	(0.217)	(0.358)		(0.211)	(0.330)	
Income Decile 6	1.400**	1.743***		1.383**	1.675***	
	(0.197)	(0.326)		(0.193)	(0.308)	
Income Decile 7	1.439***	1.642***		1.422***	1.596**	
	(0.192)	(0.310)		(0.186)	(0.297)	
Income Decile 8	1.667***	1.979***		1.663***	1.939***	
	(0.238)	(0.372)		(0.234)	(0.362)	
Income Decile 9	1.521***	1.753***		1.533***	1.752***	
	(0.229)	(0.344)		(0.230)	(0.342)	
Imputed Data?	Yes	No	No	Yes	No	No
Observations	116,807	70,374	116,555	136,437	80,389	136,164
Countries	15	15	15	20	20	20
Pseudo R^2	0.520	0.559	0.163	0.516	0.551	0.160

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Table reports exponentiated coefficients (odds ratios) from logit regressions with robust standard errors in parentheses. Data is the HFCS multiple imputation data in Columns 1 and 4 and the non-imputed data in Columns 2, 3, 5, and 6. With imputed data, number of observations is the maximum N across the 5 imputations and Pseudo R2 is the average across the 5 imputations. Observations are weighted using the HFCS representative weights. Dependent variable is an indicator for owning the household main residence (Own HMR). Experienced inflation is the weighted average of inflation over the household head's lifetime, with linearly declining weights from year before the survey to birth year. Demographic controls include household head gender, marital status, whether the household has any children, education level, employment status, and deciles of wealth and income. All regressions also include fixed-effect for survey wave. The reference groups for demographic variables are education level of primary or below according to the ISCED-97 categorizations, single/never married, out of the work force (not retired), and the highest deciles of wealth and income.

Table A2. Inflation Experiences and Household-Level Homeownership – Additional Macroeconomic Control Variables

	Exclude High Inflation Countries				
Dependent Var: Own Main Residence	(1)	(2)	(3)	(4)	(5)
Exp. Infl. (under 10)	1.227***	1.028*	1.305***	1.451***	1.127***
	(0.017)	(0.015)	(0.018)	(0.019)	(0.023)
Exp. Infl. Capped at 10	0.748***	0.621***	1.174**	0.651***	0.607***
	(0.050)	(0.044)	(0.093)	(0.047)	(0.048)
GDP per Capita	0.905				0.716
	(0.204)				(0.279)
Lagged GDP per Capita	0.775				2.665**
	(0.173)				(1.078)
Household Expenditure per Capita		0.295***			2.264
		(0.100)			(1.661)
Lagged Household Expenditure per Capita		1.449			0.131***
		(0.477)			(0.096)
Unemployment			1.243***		1.520***
			(0.085)		(0.199)
Lagged Unemployment			1.027		0.789**
			(0.072)		(0.094)
Inflation				1.009	1.101***
				(0.018)	(0.031)
Lagged Inflation				0.854***	0.931***
				(0.007)	(0.010)
Demographic Controls	Yes	Yes	Yes	Yes	Yes
Observations	136,437	136,437	136,437	136,437	136,437
Countries	20	20	20	20	20
Pseudo R^2	0.518	0.527	0.518	0.518	0.531

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Table reports exponentiated coefficients (odds ratios) from logit regressions with robust 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 is the weighted average of inflation over the household head's lifetime, with linearly declining weights from year before the survey to birth year. Demographic controls include household head gender, marital status, whether the household head has any children, education level, employment status, and deciles of wealth and income. All regressions also include fixed-effect for survey wave. Macroeconomic variables (other than inflation) are from the World Bank and include current value and 1-year lagged GDP per capita, household final consumption expenditure per capita, and unemployment. Inflation data from the sources as described in Section 3. All macroeconomic variables are normalized to have a mean of 0 and variance of 1 in our sample.

Table A3. Alternative Measures of Inflation Experiences and Household-Level Homeownership

Dep. Var: Own	Exclude High Inflation Countries					All Countries				
Main Residence	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Exp. Inflation (under 10, std.)	1.868*** (0.055)		1.880*** (0.057)			2.180*** (0.064)		2.183*** (0.064)		
Exp. Inflation Capped at 10						0.688*** (0.050)		0.613*** (0.046)		
Std. Dev. of Exp. Infl. (std.)		1.214*** (0.024)	0.985 (0.019)				1.272*** (0.042)	1.080*** (0.007)		
Pred. AR(1) 1-Year Infl. Forecast (std.)				0.987 (0.014)					1.278*** (0.038)	
Pred. AR(1) 5-Year Infl. Forecast (std.)					1.135*** (0.022)					1.176*** (0.043)
Demo. Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	116,807	116,807	116,807	116,807	116,807	136,437	136,437	136,437	136,437	136,437
Countries	15	15	15	15	15	20	20	20	20	20
Pseudo R^2	0.520	0.509	0.520	0.507	0.508	0.516	0.493	0.516	0.492	0.491

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Notes: Table reports exponentiated coefficients (odds ratios) from logit regressions with robust 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 is the weighted average of inflation over the household head's lifetime, with linearly declining weights from year before the survey to birth year. Volatility is measured as the standard deviation of annual experienced inflation over the lifetime. Predicted inflation is predicted from experienced inflation using an AR(1) model. 5-year forecast calculated by iterating estimated AR(1) model forward, fixing coefficients as estimated in the survey. Continuous experience measures are standardized within sample (i.e., across the 15 low inflation countries in Columns 1-5 and across all 20 countries in Columns 6-10). Demographic controls include household head gender, marital status, whether the household head has any children, education level, employment status, and deciles of wealth and income. All regressions also include fixed-effect for survey wave.

Table A4. Alternative Treatment of High Experienced Inflation

Dependent Var: Own Main Residence	(1)	(2)	(3)
Experienced Inflation	1.059***		
	(0.003)		
Log Experienced Inflation		2.745***	
		(0.095)	
Experienced Inflation (Cap Each Year at 50% Before Averaging)			1.258***
			(0.010)
Ever Experience Inflation Above 50			1.025
			(0.046)
Demographic Controls	Yes	Yes	Yes
Observations	136,437	136,437	136,437
Countries	20	20	20
Pseudo R^2	0.501	0.512	0.511

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Table reports exponentiated coefficients (odds ratios) from logit regressions with robust 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). In Column 1, experienced inflation is the weighted average of inflation over the household head's lifetime, with linearly declining weights from year before the survey to birth year (not winsorized). In Column 2 the key independent variable is log of experienced inflation. In Column 3 we construct a weighted average of experienced inflation using annual inflation capped above and below at 50% and also include an indicator for having ever lived through inflation above 50%. Demographic controls include household head gender, marital status, whether the household head has any children, education level, employment status, and deciles of wealth and income. All regressions also include fixed-effect for survey wave.

Table A5. Inflation Experiences and Household-Level Homeownership with Alternative Household-Wealth Measures

	Exclude High Inflation Countries				
Dep. Var.: Own Main Residence	(1)	(2)	(3)	(4)	(5)
Experienced Inflation	1.736***	1.684***	1.463***	1.416***	1.871***
	(0.024)	(0.027)	(0.026)	(0.024)	(0.032)
Wealth and Income Deciles	Wealth net home equity	Wealth net HMR gain	Nominal	PPP-adj	Within-country
Demographic Controls	Yes	Yes	Yes	Yes	Yes
Observations	116,807	86,772	116,807	116,807	116,807
Countries	15	15	15	15	15
Pseudo R^2	0.230	0.426	0.519	0.528	0.475

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Table reports exponentiated coefficients (odds ratios) from logit regressions with robust standard errors in parentheses. Data is the HFCS multiple imputation data. With imputed data, number of observations is the maximum N across the 5 imputations and Pseudo R2 is the average across the 5 imputations. Observations are weighted using the HFCS representative weights. Dependent variable is an indicator for owning the household main residence (Own HMR). Experienced inflation is the weighted average of inflation over the household head's lifetime, with linearly declining weights from year before the survey to birth year. Demographic controls include household head gender, marital status, whether the household head has any children, education level, employment status, and deciles of wealth and income. All regressions also include fixed-effect for survey wave. In Column 1, wealth is calculated net home equity for owners with available price data. Column 2 excludes homeowners who do not report the purchase price of their home. Wealth net HMR gain is net wealth minus the gain from price appreciation of homeowner's current home. Column 3 controls for nominal wealth and income. Column 4 adjusts wealth and income for purchasing power parity. In Column 5, wealth and income deciles are defined within-country.

Table A6. Summary of ACS Data – Household Heads Born in U.S. and HFCS Countries

Country	Households	Experienced Inflation (%)				Homeownership
		Mean	Median	Std. Dev.	% Abv. 10	
Austria	3,605	4.08	4.07	0.86	0.0%	76.5%
Belgium	2,375	3.55	3.71	0.60	0.0%	65.8%
Cyprus	302	3.88	3.83	0.50	0.0%	75.3%
Estonia	355	18.80	4.30	20.72	37.7%	60.4%
Finland	1,230	4.29	4.33	0.86	0.0%	66.3%
France	12,108	4.00	4.02	0.96	0.0%	62.2%
Germany	65,887	$2.1\text{x}10^5$	3.88	$4.7\text{x}10^6$	0.2%	67.6%
Greece	10,328	6.58	5.13	3.19	16.2%	74.4%
Hungary	4,955	59.48	11.20	70.70	53.6%	69.5%
Ireland	9,222	4.36	4.19	0.80	0.0%	70.0%
Italy	25,288	4.94	4.45	1.32	0.1%	79.9%
Latvia	1,319	3.08	3.70	1.36	0.0%	69.3%
Netherlands	6,416	3.68	3.84	0.62	0.0%	74.0%
Poland	22,733	19.15	10.28	15.86	50.5%	68.1%
Portugal	11,737	4.94	4.19	1.68	1.1%	72.8%
Slovakia	4,030	4.63	4.24	1.73	0.4%	66.3%
Slovenia	12,535	52.40	63.56	39.50	68.9%	63.1%
Spain	6,001	4.53	4.37	1.08	0.0%	59.8%
United States	12,267,948	3.68	3.78	0.51	0.0%	67.6%
Total European	200,426	66,863.78	4.21	2,617,757.00	13.7%	69.4%
Total with U.S.	12,468,374	1,137.05	3.78	340,934.90	0.2%	67.7%
Total European, under 10%	200,426	5.14	4.21	2.32		
Total with U.S., under 10%	12,468,374	3.70	3.78	0.62		

Notes: Summary of experienced inflation and homeownership in the ACS sample of households with household head born in one the 20 HFCS countries or the United States. Experienced inflation is the weighted average of inflation over the household head's lifetime, with linearly declining weights from year before the survey to birth year, using inflation from the birth country from birth year to year of immigration to the U.S., and only U.S. inflation for natives.

Table A7. Summary of SHARE Data

Country	Homeownership			Experienced Inflation (%)				
	Ever Own	Mean Age First Own	Ind. Obs.	Mean	Median	SD	% Above 10	Ind.-Year Obs.
Austria	69%	30.3	909	8.19	6.55	6.02	22%	21,294
Belgium	86%	30.6	2,731	3.74	3.56	1.10	0%	46,074
Czech Republic	63%	28.6	1,778	3.45	3.02	2.65	3%	41,636
Denmark	89%	28.4	1,919	5.36	5.05	1.53	0%	26,567
France	81%	33.7	2,254	9.54	8.09	4.77	30%	47,308
Germany	65%	32.8	1,802	$2.9\text{x}10^{7}$	5.59	$3.4\text{x}10^{8}$	2%	46,192
Greece	90%	31.5	2,935	26.74	13.22	29.11	68%	46,101
Ireland	90%	29.9	792	5.86	5.22	2.43	6%	11,635
Italy	78%	33.7	2,417	12.64	10.22	8.70	53%	53,018
Netherlands	74%	31.1	2,135	4.60	4.43	0.87	0%	46,181
Poland	69%	27.9	1,882	21.67	10.96	23.63	52%	36,980
Spain	87%	32.2	2,122	8.31	7.84	1.84	21%	37,825
Sweden	87%	31.4	1,781	5.24	4.86	1.37	0%	30,814
Switzerland	65%	36.4	1,234	3.21	3.31	0.71	0%	34,978
Total	79%	31.4	26,691	$2.5\text{x}10^{7}$	5.70	$1.0\text{x}10^{8}$	21%	526,603

Notes: Summary statistics of microdata obtained from Wave 3 of the Survey of Health, Ageing, and Retirement in Europe. For homeownership, each observation is an individual. Summary statistics describe the percent of individuals who ever own their home, and the average age at first ownership for individuals who ever own. For summary statistics of experienced inflation, each observation is an individual-age, for ages 20 to the minimum of age of first ownership and age at survey year. Experienced inflation is the weighted average of inflation over the household head's lifetime, with linearly declining weights from year before the observation year to birth year.

Table A8. Inflation Experiences and First Year of Homeownership in the SHARE data

	(1)	(2)	(3)	(4)
Exp. Inflation (under 10)	1.052***	1.076***	1.074***	1.079***
	(0.005)	(0.007)	(0.005)	(0.006)
Exp. Infl capped at 10	0.824***	0.766***	0.736***	0.714***
	(0.026)	(0.026)	(0.021)	(0.022)
Male	0.989	0.986	1.041***	1.029**
	(0.015)	(0.015)	(0.013)	(0.013)
Married	11.430***	11.839***	9.712***	10.253***
	(0.378)	(0.388)	(0.307)	(0.323)
Has child under 18	0.496***	0.499***	0.528***	0.541***
	(0.012)	(0.012)	(0.011)	(0.012)
Employed	1.513***	1.539***	1.122***	1.239***
	(0.042)	(0.042)	(0.026)	(0.029)
Sample	Complete Covariates		All Available Data	
Indicators for Missing Covariates			Yes	Yes
Country Fixed Effects	No	Yes	No	Yes
Observations	237,291	237,291	522,200	522,200
IN_ind	17,412	17,412	26,691	26,691
Countries	14	14	14	14
Pseudo R^2	0.038	0.041	0.026	0.031

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Hazard ratios estimated from Cox proportional hazards model with failure defined as the first year of homeownership after establishing own household. Standard errors are clustered at the household level. Data are unweighted individual responses from the SHARE Wave 3 retrospective survey. Indicators for being married, having children under the age of 18, and being employed are time-varying. Columns 1 and 2 include only individuals with complete demographic data from age 20 to first year of homeownership or survey year if never a homeowner. In Columns 3 and 4, demographic indicators are filled with 0's for approximately 50% of observations with at least one missing covariate. Experienced inflation is the weighted average of inflation over the household head's lifetime, with linearly declining weights from observation year to birth year.

Table A9. Using Experiences to Predict Price-to-Rent Ratio

Dependent Var: Price-to-Rent Ratio (Standardized)	(1)	(2)	(3)	(4)	(5)
Avg. Exp. Inflation	0.083		0.072		0.162
	(0.237)		(0.122)		(0.231)
Avg. Exp. House Price Growth (Full History)		0.469***	0.440***		
		(0.034)	(0.075)		
Avg. Exp. House Price Growth (Partial History)				0.544***	0.511***
				(0.086)	(0.096)
Constant	-0.311	-0.612***	-0.822	-0.669***	-1.272
	(1.109)	(0.034)	(0.387)	(0.151)	(0.721)
Observations	11	6	6	8	8
R^2	0.019	0.950	0.954	0.711	0.753

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: OLS regression coefficients with robust standard errors in parentheses. Data is the HFCS non-imputed data, averaged using representative weights. Countries weighted by population from the World Bank. Dependent variable is the price-to-rent ratio relative to the country long-run average, averaged across survey years. Note, all countries in analysis have average experienced inflation under 10%. Experience measures are calculated as the weighted average over the household head's lifetime, with linearly declining weights from year before the survey to birth year (re-scaling the weights for partial history). 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, Ireland, Italy, Luxembourg, the Netherlands, and Spain. All experience measures are standardized.