DISCUSSION PAPER SERIES

DP14935

RENT OR BUY? THE ROLE OF LIFETIME EXPERIENCES ON HOMEOWNERSHIP WITHIN AND ACROSS COUNTRIES

Ulrike M. Malmendier and Alex Steiny Wellsjo

FINANCIAL ECONOMICS

ISSN 0265-8003

RENT OR BUY? THE ROLE OF LIFETIME EXPERIENCES ON HOMEOWNERSHIP WITHIN AND ACROSS COUNTRIES

Ulrike M. Malmendier and Alex Steiny Wellsjo

Discussion Paper DP14935
Published 24 June 2020
Submitted 04 June 2020

Centre for Economic Policy Research
33 Great Sutton Street, London EC1V 0DX, UK
Tel: +44 (0)20 7183 8801
www.cepr.org

RENT OR BUY? THE ROLE OF LIFETIME EXPERIENCES ON HOMEOWNERSHIP WITHIN AND ACROSS COUNTRIES

Abstract

What explains the vast differences in homeownership rates across and within countries? We argue that individual lifetime exposure to inflation play a significant role in the decision to become homeowner. First, we show that immigrants' country-of-origin inflation experiences predict their homeownership rates in the US. Second, using household data from 20 European countries, we estimate that a one log-point increase in personally experienced inflation predicts a 19pp increase in the average individual's likelihood of homeownership. The relationship between homeownership and experienced inflation is robust to other determinants of homeownership as well as any differences across countries and over time.

JEL Classification: R31, E03, G02, D03, D14, D83, D84, E21, G11

Keywords: N/A

Ulrike M. Malmendier - ulrike@econ.berkeley.edu
UC Berkeley, National Bureau of Economic Research and CEPR

Alex Steiny Wellsjo - alexsteiny@berkeley.edu
UC Berkeley

Acknowledgements
We thank Victor Couture, Anthony De Fusco, Amir Kermani, Herve Le Bihan, Charles Nathanson, Nick Sander, Nancy Wallace and workshop participants at Berkeley, Chicago, Duke, Stanford as well as the AEA, Finish Economic Association, ESA conferences, the Household and Behavioral Finance Symposium at Cornell conference, the CEPR Network Event on Household Finance, the BdF/ECB Conference on Household Finance and Consumption, and the UCSD Spring School in Behavioral Economics for helpful comments. This paper uses data from the Eurosystem Household Finance and Consumption Survey, the American Community Survey (from IPUMS), and the Survey of Health, Ageing and Retirement in Europe. We also thank John Landon-Lane and Moritz Schularick for providing historical house-price data.

Rent or Buy? The Role of Lifetime Experiences on Homeownership within and across Countries*

Ulrike Malmendier†
UC Berkeley, NBER, and CEPR

Alexandra Steiny Wellsjo ‡
UC Berkeley

June 4, 2020

Abstract

What explains the vast differences in homeownership rates across and within countries? We argue that individual lifetime exposure to inflation play a significant role in the decision to become homeowner. First, we show that immigrants' country-of-origin inflation experiences predict their homeownership rates in the US. Second, using household data from 20 European countries, we estimate that a one log-point increase in personally experienced inflation predicts a 19 pp increase in the average individual's likelihood of homeownership. The relationship between homeownership and experienced inflation is robust to other determinants of homeownership as well as any differences across countries and over time.

JEL Codes: R31, E03, G02, D03, D14, D83, D84, E21, G11

*We thank Victor Couture, Anthony De Fusco, Amir Kermani, Herve Le Bihan, Charles Nathanson, Nick Sander, Nancy Wallace and workshop participants at Berkeley, Chicago, Duke, Stanford as well as the AEA, Finish Economic Association, ESA conferences, the Household and Behavioral Finance Symposium at Cornell conference, the CEPR Network Event on Household Finance, the BdF/ECB Conference on Household Finance and Consumption, and the UCSD Spring School in Behavioral Economics for helpful comments. This paper uses data from the Eurosystem Household Finance and Consumption Survey, the American Community Survey (from IPUMS), and the Survey of Health, Ageing and Retirement in Europe. We also thank John Landon-Lane and Moritz Schularick for providing historical house-price data.

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

‡Department of Economics, University of California, Berkeley, 530 Evans Hall #3880, Berkeley, CA 94720-3880, alexsteiny@berkeley.edu.

Participation in the housing market varies widely, both across and within countries. As in the case of other asset markets, notably the stock market, researchers have struggled to fully explain participation decisions. Within Europe, for example, less than half of all households own their home in Germany and Austria, compared to over 80% in Slovakia, Hungary, and Spain. And only 57% of households own their home in France, but 83% do in neighboring Spain. There are also sizable cross-sectional differences within countries. In Italy, for example, 49% of 30-year-olds own their home, but 80% of 60-year-olds. The pattern reverses in the Netherlands, where more 30-year-olds than 60-year-olds are homeowners.

What explains this "housing-market participation puzzle"? Why do households with similar demographics and in similar financial situations make systematically different tenure decisions? Clearly, institutional differences play a role in the cross-country differences, as do variations in house prices, housing supply, and population demographics.[1] In this paper, we identify a novel and economically meaningful determinant of homeownership decisions both within and across countries: We show that *past* macroeconomic and institutional conditions experienced by the population of potential homeowners strongly predict investment in the housing market, even decades later, and above and beyond the influence of contemporaneous policies and institutions.

Our argument builds on the notion that past experiences of political, institutional, and economic conditions exert a longlasting influence on attitudes and beliefs (Alesina and Fuchs-Schündeln, 2007; Luttmer and Singhal, 2011; Giuliano and Spilimbergo, 2009). In our context, the conjecture is that past experiences of high inflation trigger the desire to protect financial wealth from devaluation and have a longlasting influence on home purchases. As motivating evidence for this conjecture consider the relationship between homeownership and historical inflation in Figure 1. The left graph plots annual inflation for countries in the top quartile of homeownership in Europe (with an average rate of 80%); the right graph shows the bottom homeownership quartile (with an average rate of 50%).[2] The graphs illustrate that high-homeownership countries have witnessed significantly higher historical inflation over the past 60 years, which homeowners in the data have personally lived through.

[1] Prior evidence includes Andersen (2011), Andrews and Caldera Sánchez (2011), Andrews et al. (2011), Chiuri and Jappelli (2003), Clark and Dieleman (1996), Doling (1973), Fisher and Jaffe (2003), Follain and Ling (1988), Gwin and Ong (2008), Haurin et al. (1996), Henderson and Ioannides (1987), Hilber (2007), Earley (2004), Ioannides (1987), Painter et al. (2001), and Sinai and Souleles (2005).

[2] The data is from the 2008-2014 European Household Finance and Consumption Survey, discussed in detail below. See Appendix-Figure A.10 for details on all homeownership quartiles.

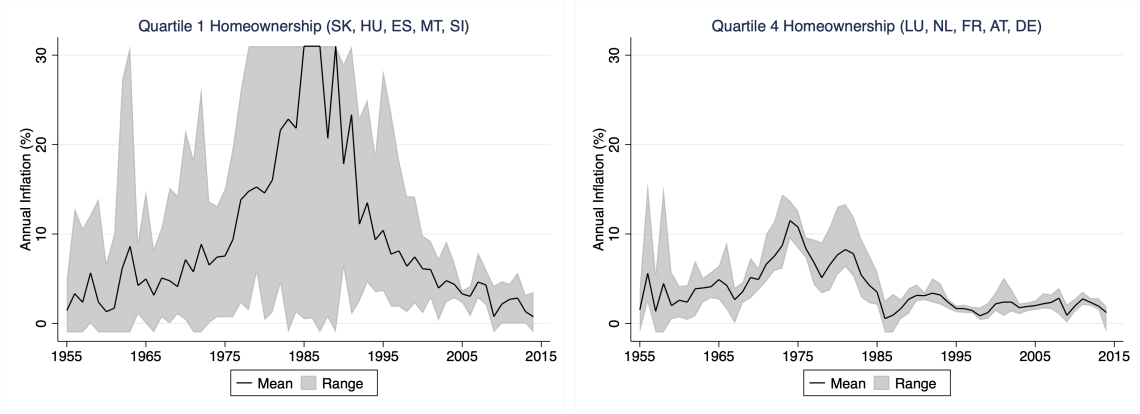


Figure 1. Inflation history in the top and bottom quartiles of homeownership rate

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

On the micro level, a second piece of motivating evidence comes from a homeownership survey that we fielded in several European countries. We asked homeowners about good reasons to purchase a home. Half of the respondents identify inflation hedging as an important reason (second highest after "piece of mind"), and a third say that concerns about inflation impacted their own decision to buy, with the latter result being concentrated among homeowners who personally experienced high inflation (see Figure 2 and Appendix Figure A.1).[3] Overall the inflation-hedge motive turns out to be more important to homeowners than reasons such as tax benefits to owners, better selection of homes to buy versus rent, low mortgage rates, and even increasing house prices. In fact, if we take the motivation to "protect against inflation" and to "protect against rent price increases" together, concerns about price increases dominate all other categories (72% of respondents selected at least one of these options). In other words, whether real estate is indeed a suitable inflation hedge, as proposed in the the classic Gordon (1962) growth model, or not, as some authors argue empirically,[4] households appear to *believe* it to be true and important.

Our key research question in this paper is whether differences in inflation experi-

[3] We surveyed 700 European homeowners in Austria, Germany, Ireland, Italy, Portugal, and Spain on what they believed to be good reasons for buying a home. Out of 10 options, "real estate is a good investment if there is inflation" was selected by 50% of respondents, ranking second of the options. 283 respondents reported experiencing high inflation and 391 did not. See Appendix A for more details.

[4] Empirical tests of whether real estate and real estate investment trusts (REITs) act as inflation hedges have mixed results; cf. Anari and Kolari (2002), Brounen et al. (2014), Case and Wachter (2011), Fama and Schwert (1977), and Liu et al. (1997).

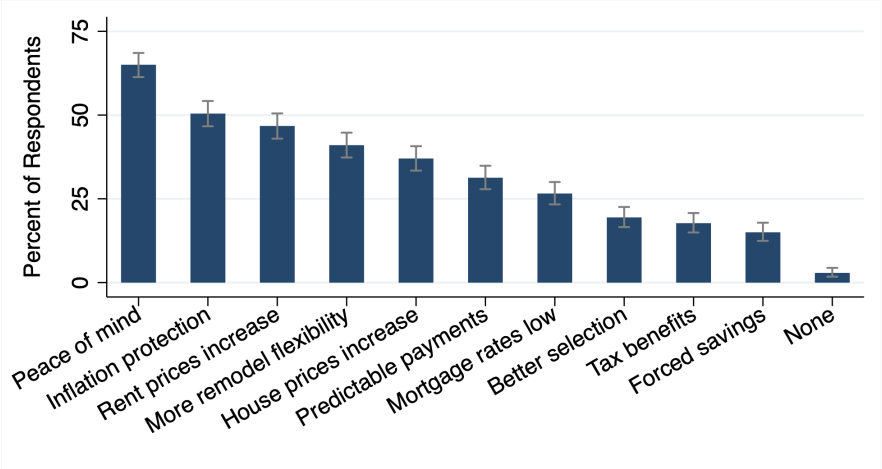


Figure 2. What do you think are good reasons for buying a home?

Note: Respondents were asked to select all options that apply. Order of options was randomized. Figure shows percent of respondents selecting each option and 95% confidence intervals. Survey responses from 700 homeowners in Germany, Ireland, Italy, Portugal, and Spain. See Appendix A for more details.

ences over the past decades help predict household tenure choice and the composition of housing markets, both across and within countries, and beyond the influence of other known determinants of individual tenure decisions.

We start from a simple theoretical framework that motivates the link between histories of past inflation, beliefs about future inflation, and homeownership. Building on recent formalizations of experience-based learning (cf. Collin-Dufresne et al. (2016), Malmendier et al. (2016b), and Schraeder (2015)), we assume that the histories of inflation an individual has personally experienced, both in general and in house prices, shape her beliefs about future realizations of the same variables.

The model illustrates two channels through which high inflation expectations induce a higher likelihood of homeownership: (1) the desire to protect oneself from high inflation and (2) the perceived attractiveness of a fixed-rate mortgage. That is, consistent with our survey results, households perceive real estate as an inflation hedge: When they experience an inflationary period, they anticipate higher future inflation and higher nominal interest rates, and therefore higher real rates of return on real estate, compared to non-inflation hedging assets. Similarly, if past experiences in the housing market induce households to anticipate higher future house prices, they are more likely to purchase their home today. As for the second channel, the perceived attractiveness of fixed-rate borrowing reflects that individuals who overestimate future inflation also perceive fixed mortgage rates to be too low in real terms. As a result, they

are more likely to purchase a home if they can finance it with a fixed-rate mortgage.

The model also predicts that the link between past inflation and homeownership rates depends on features of the mortgage market. In countries with predominantly variable-rate mortgages, the link should be weaker. Note that the latter prediction helps tease out the belief-based channel: While prior experiences may also affect *preferences* for owning a home, those should be orthogonal to the prevalence of variable-rate mortgages.[5] At the same time, our empirical analysis and conclusions about the role of past lifetime experiences for tenure decisions are independent of the channel.

We test the model predictions using 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), Michal (1960), the Federal Reserve Bank of Dallas, Knoll et al. (2017), and Bordo and Landon-Lane (2014). For each country, we also build a dataset of housing-market and macroeconomic conditions that are relevant to homeownership decisions, using data from Andrews et al. (2011), the OECD, Bloomberg, and the World Bank. To measure the macroeconomic experiences of individuals in these countries, we calculate their weighted lifetime average experience at each point in time, using the learning-from-experience parameter estimates of Malmendier and Nagel (2015).

Our identification exploits variation in individual exposure to inflationary periods across three dimensions: age, country, and survey year. We first conduct an analysis of households that holds the housing market constant. The sample consists of households from the same 20 countries that we will analyze in the HFCS, but who immigrate to the U.S. and make tenure decisions in the U.S. housing market. Using data of over such 200,000 immigrants from the American Community Survey (ACS), we find that inflation histories in their countries of origin significantly predict their homeownership decisions, even after they moved to a new and common housing market.

We then analyze the HFCS data both on the national level and the individual level. Aggregating experiences to the national level, we find that a 1 log-point increase in personal inflation experience predicts a 13 pp increase in the aggregate homeownership rate. Focusing on individual tenure choice, we estimate that a 1 log-point increase in

[5] The belief-based mechanism follows the direct evidence on beliefs in the empirical experience-effects literature, including Malmendier and Nagel (2015), Malmendier et al. (2016a), Malmendier and Shen (2017), and Botsch and Malmendier (2019). It is similar in spirit to other papers that explore the implications of potential homeowners not being fully rational, e. g., Glaeser and Nathanson (2015).

experienced inflation corresponds to a 19 pp increase in the likelihood of ownership for the average household. Furthermore, we provide evidence on heterogeneity along two dimensions consistent with experience effects as the mechanism: experienced inflation is a stronger predictor of ownership in countries with access to fixed-rate financing, and the effect is stronger in singles than couples, who may differ in their experiences.

We also estimate a significant influence of past experiences on homeownership within country. While the first set of estimations exploits variation in experiences both across ages *and* across countries, experienced inflation remains a significant predictor of homeownership after controlling for country fixed effects and even country-time fixed effects. The fixed effects specification rules out housing-market or other contemporaneous macroeconomic conditions as the sole driver of the link between macroeconomic histories and ownership. Relying on only the within-country variation, our estimates imply that a one log-point increase in experienced inflation increases the predicted probability of homeownership for the average household by 6 to 9 pp.

The magnitude of the estimated relation is substantial relative to the effect sizes of other factors discussed in the literature cited above. In the baseline specification, a one standard deviation change in log experienced inflation is associated with a change in homeownership roughly two to three times larger than a one standard deviation change in measures of rent control, tax benefits to homeowners, and buyer transaction costs, and more than 10 times as large as a one standard deviation change in tenant protection measures.[6]

The robustness of our results to the inclusion of country-time fixed effects and the robustness across data sets address alternative explanations based on housing-market features or other macroeconomic conditions, and point to a significant role of prior lifetime experiences. However, lifetime experiences other than exposure to high inflation may play a role. For example, across countries, inflation is negatively correlated with GDP per capita and household expenditure per capita. And within country, inflation is negatively correlated with unemployment and interest rates, at least over relatively short time periods.[7] While we cannot easily disentangle inflation experiences from all other macroeconomic experience effects, our focus on inflation reflects the prior evidence on inflation affecting inflation beliefs, interest rate beliefs, home purchases and mortgage decisions. We do, however, consider prior experiences in the housing

[6] For the effect sizes of these and other factors, see Andrews and Caldera Sánchez (2011), Andrews et al. (2011), Earley (2004), Fisher and Jaffe (2003), Gwin and Ong (2008), Hilber (2007).

[7] Data obtained for the HFCS countries from the World Bank from 2000-2015.

market as an additional predictor of homeownership decisions. Using a similarly constructed measure of lifetime experiences of *house* prices, we estimate a positive, albeit weaker and less robust, relationship compared to the effect of experienced inflation. One reason is the more limited availability of historical house-price data across countries, compared to inflation data. Even within the more limited set of countries and time spans, though, inflation experiences dominate house-price experiences. This may reflect the direct impact of house-price growth 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 low house-price growth.

Overall, our analyses reveal a novel, strong, and very robust determinant of the composition of housing market participants—the long-lasting effects of past inflation conditions experienced by the cohorts of potential homeowners. These influences appear to be a significant factor in explaining the large differences in housing markets across countries as well as the within-country changes over time.

Relation to previous literature. Our paper relates to the literature on the determinants of tenure choice, broadly classified as market factors and household characteristics. Among the market factors, homeownership has been linked to tax benefits, rent prices, transaction costs, housing supply, and other government policies.[8]. Most closely related to our work, several of these papers argue that historical influences have a long-lasting impact on housing markets. Earley (2004) links the cultural tradition of passing property through family in Southern Europe to the high homeownership rates today and argues that the dowry laws in Greece continue to contribute to a culture of high homeownership, despite their repeal in 1983. Andrews et al. (2011) argue 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. Our approach differs from these prior studies of historical influences in that we focus on a person's lifetime experiences. We show that personal experiences are predictive of homeownership even when controlling for current macroeconomic conditions, institutions, regulations, and country-specific cultural influences.

Household-level characteristics that have been linked to homeownership include household demographics (such as age, marital status, presence of children, and employment status), measures of household financial status (such as income, wealth, and

[8] As discussed, for example, in Andrews et al. (2011), Andrews and Caldera Sánchez (2011), and Earley (2004)

access to mortgage debt), and preferences over types of home (e.g., apartment vs. single-detached unit).[9] We show that our analyses are robust to controlling for a vast array of both household and market determinants.

Our paper also builds on the growing literature on experience effects, which shows that life experiences of macroeconomic events such as inflation and stock returns have significant impacts on expectations and financial decisions. Most closely related 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 increases 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 recent experiences more highly, i. e., exhibit stronger recency bias. They also find that "extreme" experiences have lasting effects on behavior. Relatedly, Ehrmann and Tzamourani (2012) find that the experience of hyperinflation has a lasting effect on beliefs about the importance of price stability. We note that in our data, the estimated effect is not driven by countries who experienced hyperinflation. Past work has also shown that inflation experiences predict future interest-rate expectations and the choice of fixed- vs. adjustable-rate mortgage financing (Botsch and Malmendier, 2019).

The rest of the paper proceeds as follows. Section 1 presents a simple theoretical framework demonstrating how inflation and house-price expectations can influence tenure choice. Section 2 describes the key data sets we employ. In Section 3, we present the analyses of the relationship between individual experiences of past (aggregate and house price) inflation and homeownership. Section 4 concludes.

1 Theoretical Framework

We present a stylized model of household tenure choice 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, for example, in the seminal Gordon growth model (1962). Our model embeds the possibility of experience-based belief formation into Gordon's theoretical setting to analyze the perceived attractiveness of real estate as a real asset, as well as the perceived attractiveness of fixed-rate mortgages.

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

1.1 Model Set-up

Housing Decision. Consider an agent born at time t who lives for one period. The agent is endowed with wealth w_t 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.

The decision of interest is the agent's choice between buying and renting a home to live in. Households maximize expected real terminal wealth subject to the constraint that they must either rent or own a home from t to $t+1$. Any wealth not spent on housing is invested in an alternative asset, which pays a nominal interest rate n_t. This assumption implies that housing is the only inflation-protected investment opportunity. We discuss below how our results differ in the presence of alternative inflation hedges. (See Appendix B for details on these and other results.)

Rent. If the agent decides to rent her home, her expected utility is

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

where h_t is the rental price at t and $w_{t+1}(R)$ is the expected nominal wealth in $t+1$ conditional on renting.

Buy. If the agent decides to buy a home, she pays the current house price M_t at time t, and sells the house at price M_{t+1} at time $t+1$. The change in house prices in each period can be decomposed into inflation in the price of consumption π and an exogenous housing-specific component g, $M_{t+1} = M_t(1+\pi_{t+1})(1+g_{t+1})$, where g_{t+1} is the real house-price growth between t and $t+1$.[10]

We assume the agent can finance a home purchase by borrowing amount $m_t \leq M_t$. Under a fixed-rate mortgage, she borrows at a nominal rate n_t^f, and then has to repay $(1+n_t^f)m_t$ in $t+1$. Under a variable-rate mortgage, she borrows at a real rate r_t^v (and thus nominal rate $(1+r_t^v)(1+\pi_{t+1})$), and has to repay $(1+r_t^v)(1+\pi_{t+1})m_t$.[11] We

[10] The exogenous process for home prices abstracts from house prices reacting to demand and supply. It allows us to illustrate the main effects of experience-based learning without complicating the model.
[11] In practice, variable-rate mortgages take many forms; here we assume the nominal rate adjusts

analyze each scenario separately.

Under fixed-rate financing, the expected utility of ownership is given by

$$E_t\left[U_{t+1}(FR)\right] = E_t\left[u\left(\frac{w_{t+1}(FR)}{1+\pi_{t+1}}\right)\right] \tag{2}$$
$$= E_t\left[\log\left(\frac{M_t(1+\pi_{t+1})(1+g_{t+1}) - m_t(1+n_t^f) + (w_t - (M_t - m_t))(1+n_t)}{1+\pi_{t+1}}\right)\right]$$

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

The equation highlights the two channels through which expected inflation affects the value of homeownership. The first is the classic real-asset motivation: If house prices move with inflation, investment in real estate protects households from high inflation in the future. As inflation rises, the real value of the alternative investment is reduced while the real value of the home stays constant. The second motivation comes from a desire to borrow at a fixed-rate when inflation is high. With a nominal fixed rate, the *real* mortgage rate, $(1+n_t^f)/(1+\pi_{t+1})$, is decreasing in inflation. Therefore, homeownership is attractive as it allows households to borrow "cheaply."

Under variable-rate financing, the corresponding expression for the expected utility of ownership (relegated to Appendix-Section B.1) reveals that the real-asset motivation remains the same, but that the variable rate removes the latter channel: households no longer benefit from fixed-rate borrowing at what they expect to be a low real rate.

In the Appendix, we extend the set-up to include a cost of ownership which captures, for example, maintenance costs or property taxes. We also explore a larger parameter space (see Appendix B.3), including "housing crisis" scenarios.[12] In the main text, we restrict the analysis to the simpler setting that assumes that the value of the house tomorrow is greater than the outstanding loan for all possible realizations of inflation and of house-price growth.

Household Beliefs. At time t, the agent observes rental price h_t, house price M_t, mortgage rate n_t^f or r_t^v, current inflation π_t, and current (real) house-price growth g_t.

one-for-one with inflation.

[12] In Appendix-Section B.3, we simulate the model to demonstrate the robustness of our predictions. We identify the bounds of the parameter space where each prediction holds, and then demonstrate the robustness of the predictions under a variety of alternative assumptions about the distribution of inflation beliefs and alternative levels of risk-aversion. We also use the simulations to demonstrate that these patterns do not hold if past inflation affects only the variance of inflation beliefs.

We allow beliefs to be influenced by agents' personal experiences: They believe that future inflation and (real) house-price growth will be more similar to what they have experienced in the past than rational learning implies. For our purposes, it suffices to assume that the inflation beliefs of an agent who has experienced high inflation at time t first-order stochastically dominate beliefs of an agent who has experienced lower inflation at time t. Similarly, an agent who has experienced higher real house-price growth at t has beliefs about g_{t+1} that first-order stochastically dominate the beliefs of an agent who has experienced lower g_t. (Beliefs about π and g are uncorrelated.) Agents take rent and mortgage rates as given and do not use them to draw inferences about future inflation or house-price growth.

Note that, in the empirical analysis, we will account for experiences over agents' actual lifetimes and for previously documented features of experience-based learning, including the weighting function used in experience-based learning models such Malmendier et al. (2016b). We will also allow all other historical data to matter; the key feature is that lifetime experiences receive some extra weight.

1.2 Experiences and the Buy vs. Rent Decision

Agents choose to buy or rent in order to maximize their expected utility, given their experience-based beliefs. We show how this decision is affected by past experiences.

Prediction 1. *Homeownership is increasing in experienced inflation.*

Proof. An increase in experienced inflation at time t shifts beliefs about $(t+1)$ inflation to a first-order stochastically dominant distribution. Hence, homeownership is increasing in experienced inflation if the expected utility difference between owning and renting is increasing in expected inflation. We check whether this difference is positive for any given realization of future inflation and future house-price growth, $\frac{\partial U(buy)-U(rent)}{\partial \pi_{t+1}} \geq 0 \ \forall \pi_{t+1}, g_{t+1}$, separately for each of the two mortgage types:

$$\frac{\partial}{\partial \pi_{t+1}} \left[U_{t+1}(FR) - U_{t+1}(R)\right]\Big|_{\pi,g} = \frac{M_t(1+g)}{w_{t+1}(FR|\pi,g)} \tag{3}$$
$$> 0 \quad \forall \pi, g.$$
$$\frac{\partial}{\partial \pi_{t+1}} \left[U_{t+1}(VR) - U_{t+1}(R)\right]\Big|_{\pi,g} = \frac{M_t(1+g) - m_t(1+r_t^v)}{w_{t+1}(VR|\pi,g)} \tag{4}$$
$$> 0 \quad \forall \pi, g \quad s.t. \quad M_t(1+g) > m_t(1+r_t^v).$$

where $w_{t+1}(FR|\pi, g)$ and $w_{t+1}(VR|\pi, g)$ is the wealth in $t+1$ under fixed- and variable-rate financing, respectively.

Under fixed-rate financing, the derivative is positive for all possible realizations of future inflation and future house-price growth. Under variable-rate financing, the derivative is positive under our assumption that $M_t(1+g) > m_t(1+r_t^v) \ \forall g$. Thus, the expected utility difference is also increasing in experienced inflation. We simulate the model in Appendix-Section B.3 to confirm that this prediction is robust to a broader parameter space. □

Our second prediction hones in on the difference between variable- and fixed rate financing, namely, that household no longer benefit from a perceive-to-be-low real rate under variable-rate mortgages:

Prediction 2. *Among households with comparable wealth, the effect of experienced inflation is weaker for households who only have access to variable-rate mortgages.*

Proof. We compare the magnitudes of the point-wise derivatives in equations (3) and (4). Assuming $(t+1)$-wealth is similar when financing with either mortgage ($w_{t+1}(FR) \approx w_{t+1}(VR)$ for any π and g), homeownership will react more to experienced inflation under fixed- than variable-rate financing as (3)-(4) $\approx m_t(1+r_t^v) > 0$. We show that this prediction also holds without the similar-wealth assumption using simulations under a broad range of conditions in Appendix-Section B.3. □

Thus far, we have focused on the effect of past periods of inflation on housing markets. Our model also makes a clear prediction about the effect of past house-price growth.

Prediction 3. *Homeownership is increasing in experienced real house-price growth.*

Proof. The utility of ownership is strictly increasing in g, while the utility of renting is independent of g (see Appendix B.2). Therefore, a first-order stochastic dominating shift in beliefs about g unambiguously increases homeownership. □

In Section 3, we test these three predictions, relaxing some of the theoretical simplifications of our model. For example, we control for household characteristics that may shift the relative utility of ownership (e. g., family structure) or ability to buy (e. g., income and wealth). We also control for factors that may shift the relative cost of ownership, c, including tax benefits and tenant protections. Controlling for

variation in homeownership rates due to these factors, we test whether prior macroeconomic realizations have a long-lasting effect on homeownership by exploiting variation in the exposure to past macroeconomic realizations and in access to different types of mortgages across cohorts and countries.

To capture households' access to variable- versus fixed-rate mortgages in Prediction 2, we would ideally measure the supply of different types of mortgages. Our empirical proxy will rely on the prevalence of variable-rate mortgages as measured by Andrews et al. (2011). We also note that, while variable-rate financing shuts down the cheap-borrowing motivation for ownership, we can further shut down the real-asset channel by allowing for inflation-protected non-housing investment. In Appendix-Section B.1, we show that, with an alternative inflation hedge, Prediction 1 continues to hold for fixed-rate financing, through the perceived cheap borrowing motivation, but there is no predicted relationship under variable-rate financing. Therefore, in the presence of alternative inflation hedges, Prediction 1 is weakened (homeownership is only weakly increasing in experienced inflation) while Prediction 2 remains robust.

This discussion implies yet another prediction of our model: the effect of experienced inflation should be weaker in markets with access to alternative inflation hedges. To empirically test this prediction, we would need a convincing measure of households' access to alternative inflation hedges. Lacking such a measure we leave further exploration of this prediction to future research.

2 Data and Empirical Measures

2.1 Data Sets

American Community Survey (ACS) Data. Before turning to our main within- and across-country analyses of tenure decisions in the HFCS data, we use data of households in the American Community Survey (ACS) as it allows holding the housing market constant while varying macroeconomic histories due to different countries of origin. We include all households who immigrated to the U.S. from one of the 20 HFCS countries and make tenure decisions in the U.S. housing market. This sample consists of 200,426 immigrants over a sample period from XXX and YYY. MORE DETAILS? For robustness, we replicate the results on the full sample of all households in the ACS data.

Household Finance and Consumption Survey (HFCS) Data. Our primary data source is the household-level microdata from the Eurosystem Household Finance and Consumption Network's Survey (HFCS). Conducted by the European Central Bank (ECB), 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 the individual country level.

The HFCS collects information on finances and consumption of almost 150,000 households across 20 countries, so far in two waves. The first wave was conducted in 2008-2011 (primarily in 2010) and includes 15 countries: Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Italy, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia, and Spain. The second wave of the survey was conducted in 2011-2015 (primarily in 2014) and, in addition to the 15 countries from the first wave, also includes Estonia, Ireland, Latvia, Hungary, and Poland.

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 use indicator variables for the following marital statuses: single/never married, married or consensual union on a legal basis, widowed, and divorced. Highest level of education attained by the household head is measured in the HFCS using the International Standard Classification of Education (ISCED-97). We represent the employment status of the household head with indicator variables for employed, unemployed, retired, and not in the workforce (not retired).

We measure net wealth and total gross income at the household level, converting 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, described in Appendix E.) We focus on HFCS household heads aged 20-80 at the time the surveys were conducted.[13] In our main analyses, we include all households surveyed, regardless of where the household head was born. Country of birth is missing in wave 1 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.[14]

[13] Ireland and Malta provide only 5-year age buckets, so we use the midpoint of the age bucket.

[14] The ECB does not provide the country of origin so we cannot infer what experiences non-natives have had. This data is available in the ACS, where we find that immigrants' experiences in their

We control for time effects using the year the individual interview was conducted if available, and otherwise the start year of the survey period for the country.

Table 1 shows, in the left column, homeownership rates across the 20 HFCS countries. As also shown graphically in Figure A.11, the summary statistics reveal a wide variation in homeownership rates. For example, less than half of households own their main residence in Austria and Germany, while homeownership rates are above 80% in Slovakia, Hungary, and Spain. Appendix-Table A1 provides more detail on real estate participation for each of the 35 country-waves in the HFCS.

In Table 2, we show summary statistics of the HFCS household characteristics. 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 the average household income is about 35,000. 55% of household heads are married, 23% are single, and the remaining heads are widowed or divorced. 26% of household heads are educated at the tertiary ISCED-97 level (college in the U.S.), 44% at the upper secondary level (high school in the U.S.), and the remaining 30% at the lower secondary level or below. 56% of household heads were employed at the time of the survey, 6% unemployed, and 27% retired.

Inflation Data. Our primary source of historical inflation data is Reinhart and Rogoff (2009), who provide time series of consumer price indices (CPI) for a large number of countries until 2010. We extend the data to 2015 using inflation data from the International Monetary Fund (IMF). We note that the calculation of the CPI by the Bureau of Labor Statistics is meant to capture housing costs (Greenlees and McClelland, 2008) and has historically included house prices, while its more recent design targets housing consumption rather than investment.

For several countries not included in the Reinhart and Rogoff data, we use alternative historical inflation data. 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 GFD 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

native countries predict homeownership in their new country.

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.

For countries with gaps in the inflation series (ranging from 1 to 8 years), we linearly interpolate missing values over the CPI index when possible and over inflation rates when an underlying consistent CPI is not available.

House Price Data We obtain our house-price indices from several sources.

Real house-price indices from 1975 onward are available from the Federal Reserve Bank of Dallas for 9 of the 20 ECB countries: Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, and Spain.[15] The house-price index for each country is chosen (by the Dallas Fed) 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. With this data, we cannot compare relative house prices across countries so, instead, we compare house-price growth. Using the fourth quarter index values, we calculate annual house-price growth in each country and construct a (partial) measure of experienced real house-price growth.

Using historical house-price index time series from Knoll et al. (2017) and Bordo and Landon-Lane (2014), we are able to complete the time series to full experience measures for 6 of the countries in our HFCS sample. From Knoll et al. (2017), we obtain nominal house-price indices for Belgium, Finland, France, Germany, and the Netherlands which we convert to real house-price growth using the inflation data described above. For Spain, we use the real house-price index data of Bordo and Landon-Lane (2014).

Housing Market We obtain country-level measures of housing-market characteristics as of approximately the time of the ECB surveys, summarized in Table 1. We normalize all continuous comparative housing market measures to have a mean of 0 and variance of 1 in our sample.

From Andrews et al. (2011), we obtain relative measures of tenant protection, rent control, tax benefits to homeowners, and transaction costs measure the average cost associated with purchasing a home.

[15] The authors acknowledge use of the dataset described in Mack et al. (2011).

We also obtain annual price-to-rent ratios from the OECD for 11 of the countries in our sample. It is an index with a baseline for each country equal to the long-run average price-to-rent ratio in 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.

To capture the availability of fixed and variable-rate mortgages, we would ideally measure mortgage supply. Practically, our proxy is an equilibrium measure of the prevalence of variable-rate mortgages in each country, obtained from Andrews et al. (2011). We define predominantly variable-rate mortgages (PVR) countries as those with variable-rate mortgages as the prevailing type of interest rate. We note the implicit assumption in the empirical analysis that variable-rate mortgages are linked to inflation in some way (e.g., targeting a real interest rate); we recognize that there are other forms of variable-rates.

2.2 Measures of Exposure to Past Inflation and House-Price Growth

As a measure of individual exposure to past price increases, we calculate a weighted average of the experienced annual inflation or experienced annual growth in (real) house prices over one's life.

While our analysis is not tied to a specific model nor a specific notion of inflation (or house-price) beliefs, we follow the specification in Malmendier and Nagel (2011), where experiences of past price changes in the most recent year are given the highest weight and weights decrease linearly down from the year before the survey to zero in the birth year. Alternatively, we implement the approach of Malmendier and Nagel (2015) who model individuals as using inflation experiences to recursively estimate an AR(1) model of inflation in order to generate one-year inflation forecasts.[16] That is, the experienced inflation history of household i as of year t is

$$\pi_{i,t} = \frac{\sum_{k=1}^{age_{i,t}-1} w_{i,t}(k)\pi_{t-k}}{\sum_{k=1}^{age_{i,t}-1} w_{i,t}(k)} \quad \text{with weights} \quad w_{i,t}(k) = \frac{age_{i,t}-k}{age_{i,t}}.$$

[16] While similar in spirit, 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 A5 and Section 3.3).

Experience-based belief formation has been successfully used to explain stated beliefs about future inflation and interest rates (Malmendier and Nagel (2015), Botsch and Malmendier (2019)), and we expand the concept to apply to beliefs about real-estate prices.

Table 3 shows the summary statistics of this measure of experienced inflation, calculated 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] The table reveals that both actual inflation and individuals' weighted lifetime inflation typically average in the single digits, with the exceptions of Estonia, Greece, Hungary, Italy, Poland, and Slovenia. Figure 3 shows the distribution of experienced inflation on the left. Roughly 6% of the sample make up the long right tail, with experienced inflation above 10%. To reduce the influence of these outliers, in our main analyses we apply a log transformation. We plot the distribution of log experienced inflation in the right graph of Figure 3. (See Appendix-Figure A.12 for histograms of experienced inflation by country.) We observe that, in some countries, inflation histories experienced by potential homeowners differ substantially from the actual, longer-term historical data. For example, while actual inflation is 11.4% on average in Italy over the last 90 years, the weighted lifetime experiences of Italians is only 5.4% on average. Vice versa, the lifetime experiences of people living in Poland or Estonia have been much higher (28.6% and 30.8%) than averaged historical inflation (16.4% and 19.5%). Across individuals in all countries, experienced inflation averages at 5.8%.

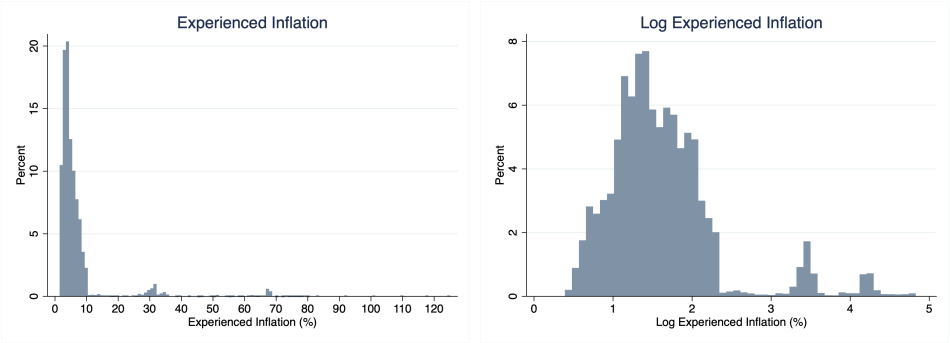


Figure 3. Distribution of experienced inflation

Histograms plot the distribution of experienced inflation (left) and log experienced inflation (right) in the HFCS sample.

For experienced real house-price growth, we construct two measures. In the first,

[17] Inflation data in Slovenia begins in 1929.

we use only the six countries for which we have a complete house-price history for the households in our sample (data from Knoll et al. (2017) and Bordo and Landon-Lane (2014)). For the second, we use real house-price data from the Federal Reserve, which covers more countries (nine sample countries) but is limited to house prices from 1975 onward. We construct this partial measure by re-scaling weights for the available data years. Here, the identifying variation does not utilize differences in experiences prior to 1975, but comes from the feature that recent years will matter more for younger than older households. Appendix-Figure A.13 shows the distribution of both measures of experienced house-price growth across countries.

A key assumption in our construction of the experience measures is that they include all experiences up to the survey year. This implies that households are continuously updating and re-evaluating their tenure status. An alternative assumption is that homeownership is sticky, and once a household decides to purchase a home, they will continue to be an owner. Using SHARE data, described in detail in D, we are able to identify when individuals first become homeowners and to test whether prior experiences predict when individuals first purchase their home.

Another assumption implicit in the construction of our measures is that the experiences of the household head are the relevant determinant. For single households and for married households with spouses from the same country and of similar age (or if the head primarily makes the financial decisions), this is likely to be a good proxy for the relevant macroeconomic experiences. However, we might expect to see a stronger response to experienced inflation among singles as our measure is likely a noisier proxy of the relevant household experiences for married households. Indeed, that appears to be the case (see Table 7).

3 Empirical Analysis

In this section, we test the predictions derived in Section 1. First, we demonstrate that households who have lived through periods of higher inflation are more likely to be homeowners (Prediction 1). To motivate our cross-country analysis, we begin with data from the cleanest setting. Leveraging variation in experiences of European immigrants to the U.S., we compare tenure choices of households in the same housing market. Expanding the analysis to many countries, we show that experienced inflation predicts homeownership both within and across countries. We find that the relationship is robust to controlling for a broad set of household and market characteristics. As

with any cross-country analysis, we cannot control for all differences between countries. However, we find suggestive evidence consistent with the mechanisms described in our model; the response to experienced inflation is weaker in countries with more variable-rate financing (Prediction 2) and among married household heads (i.e., households with mixed experiences). Finally, we test Prediction 3 by examining the relationship between experienced house-price growth and ownership.

3.1 Within the U.S. Housing Market (ACS)

We start by testing the first prediction: Is there is a positive relationship between past inflationary periods an individual has experienced and her homeownership decision?

To motivate our cross-country analysis, we first consider households with experiences who live in an *identical* housing market. To do this, we obtain the 2001-2015 American Community Surveys (ACS) data from IPUMS (2015) to examine homeownership choices of individuals who have immigrated to the United States from one of the 20 European countries we study in the HFCS. For each household head, we calculate the weighted average of inflation over their lifetime as described in Section 2.2, using inflation in their birth country from the year of birth to the year of immigration to the U.S., and U.S. inflation thereafter. The data are summarized in Appendix-Table A2.

While the vast majority of households have inflation under 15%, the distribution has a long right tail. To minimize the effect of outliers, in our analyses we use the log of experienced inflation with two exceptions. For the 55 households in Lativa and Estonia with negative experienced inflation, we set log experienced inflation to 0 and include an indicator. The data also includes 88 household heads aged 79 or 80 who lived through the German hyperinflation and thus have experienced inflation of 60M% or more. For these households, we also set log experienced inflation to 0 and include a separate indicator.

To analyze the relationship between experienced inflation and homeownership for these immigrants to the U.S., we first estimate Logit regressions of homeownership on our key measures of experienced inflation and household demographics. We control for age, gender, educational attainment (below high school, high school, and four or more years of college), employment status (employed, unemployed, and not in the labor force), marital status (single, married, widowed, or divorced), an indicator equal to 1 if the household head is married to a U.S. native, children living in the home, and decile of household income, where income is adjusted for inflation over the survey years

and deciles are calculated out of our entire ACS sample (including U.S. natives). In addition to the demographic controls, we control for years lived in the U.S. as a percent of the household head's life. In all regressions, we also control for survey year fixed effects. We weight the data using ACS provided representative weights and report heteroskedasticity-robust standard errors.

Table 4 reports the results of this analysis. For all of our Logit regressions, we report the results in odds ratios (exponentiated coefficients), so that a number above 1 is a positive relationship and a number below 1 is a negative relationship.

First, we focus on the sample of household heads born in one of the European HFCS countries. In column (1), we regress an indicator for homeownership on our measures of experienced inflation, demographic controls, length of time in the U.S., and survey year fixed effects. We find that a 1 log-point increase in experienced inflation predicts an 11pp increase in the odds of ownership. To understand the magnitude of this effect, for a household head with a baseline probability of ownership of 65% (roughly the average in our sample) our estimation predicts that increasing one log-point in experienced inflation (say from 2% to 5.4%), would increase the likelihood of ownership to 67%. Looking at the indicators for outliers in experienced inflation, we find no significant relationship between ownership and living through the German hyperinflation. We find that households with a negative average experienced inflation have lower experienced inflation, with marginal statistical significance.

In column (2), we include as an additional control the homeownership rate among other (non-immigrant) households in the same state and year. This estimation addresses the concern that the positive estimate of experienced inflation might be explained by immigrants with higher inflation experiences moving to higher homeownership states. We find that immigrants are indeed more likely to own a home if they move to a state with a higher homeownership rate. However, conditional on the homeownership rate in the state where they move, immigrants with higher experienced inflation are still more likely to own a home. The magnitude and statistical significance of the coefficient remain very similar. The estimates are also robust, though attenuated, to including country-of-birth fixed effects, as shown in column (3). While including country-of-birth fixed effects controls for many things we do not want to attribute to inflation experiences (e.g., cultural differences), it also takes out the average difference in experiences across countries. In these estimations, we are identifying the effect of experienced inflation off of differences across household heads born in the same coun-

try. The estimated coefficient remains statistically significant at the 5% level, but the magnitude of the effect is smaller. After controlling for country of birth fixed effects, a one log-point in experienced inflation (e.g., 2% to 5.4%), corresponds to a predicted increase in the likelihood of ownership from 65% to 66%.

Finally, we re-estimate the relation between experienced inflation and homeownership on a larger sample of households in the ACS, which includes those headed by a U.S. native. Here, we control for state and state-year fixed effects as well as an indicator for being born in the U.S. (column (4)) or even the full set of birth country fixed effects (column (5)). Similar to the results on the European-born sample, we find a positive significant effect of experienced inflation. Note that the magnitude of the coefficient estimate on inflation experiences increases quite dramatically when we include U.S. natives in the analysis, most of whom have experienced relatively low inflation compared to the immigrant population (see Appendix-Table A2). A one log-point in experienced inflation (e.g., 2% to 5.4%), corresponds to a predicted increase in the likelihood of ownership from 65% to 79-83%. While a one log-point change is well-within the distribution of experienced inflation among immigrants, the standard deviation of experiences among U.S. natives is only 0.5%.

From the ACS data, we find that variation in experienced inflation predicts variation in homeownership both among immigrants and U.S. natives. Building on this analysis, we expand to a cross-country analysis of homeownership in Europe using household survey data from 20 European countries.

3.2 Within and Across European Markets (HFCS)

Before leveraging the wealth of information in the household-level data, we examine whether this prediction holds in the aggregate: Does the population average of lifetime inflation experiences predict aggregate homeownership across countries? We collapse the HFCS data into country averages, using the survey weights representative of the population. We then weight countries by average population across survey years (from the World Bank).

Figure 4 shows this data graphically. The scatter diagram plots the relation between average experienced inflation (in percentage points) on the x-axis and the homeownership rate (percent of households living in owner-occupied housing) on the y-axis for each country in our analysis. The points are coded by the size of the population. The plot reveals a positive relationship between experienced inflation and homeownership.

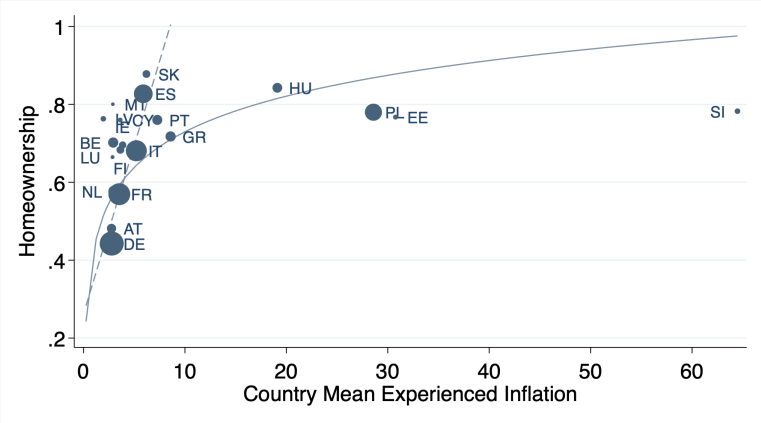


Figure 4. Homeownership rate by experienced inflation

Scatter plot of country average experienced inflation (x-axis) and homeownership rate (y-axis). Country abbreviations are in Table 1. Size indicates relative population. Dashed line shows the weighted linear fit excluding the high-inflation countries (column 2 of Table 5) and solid line shows the weighted log fit (column 3 of Table 5).

However, the relationship is clearly non-linear; there is a steep relationship between experienced inflation and homeownership among countries with average experienced inflation below 10% (the majority of the EU population) that flattens out at about 80% homeownership for countries with high average experienced inflation (about 12% of the EU population).

The results are shown formally using OLS regression in Table 5. We estimate 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 1 pp increase in a country's average experienced inflation corresponds to a 1 pp higher homeownership rate, significant at the 5% level. Excluding the high-inflation countries in column (2), the magnitude is much larger, with a 1 pp increase in average experienced inflation predicting a 9 pp increase in homeownership, significant at the 1% level.[18] In column (3), we address the non-linearity by including the log of each country's average experienced inflation, rather than estimating the linear effect. From this regression, we find that a one log-point change in average experienced inflation predicts a 13pp increase in homeownership. The fit is shown graphically in Figure 4 and reflects the non-linearity seen in the raw data.

Overall, the economic and statistical magnitude of the effects is striking, given that we are collapsing the data to the country level and are estimating off of 20 observations.

[18] High-inflation countries are those in which any household has a lifetime experienced inflation above 10%. These include Slovenia, Estonia, Poland, Hungary, and Greece.

We also infer from the country-level analysis that a linear model does not appear to best describe the data when including high-inflation countries. The different relationship among high-inflation countries likely reflects three forces. First, the high-inflation sample includes some very-high inflation years, e. g., 1900% inflation, which are prone to significant measurement error. In addition, the extreme outliers distort averages and are hard to fit into a model of experience-based learning (cf. the treatment of hyperinflation in Malmendier et al. (2016a)). Lastly, a given amount of variation is likely psychologically less meaningful at very high levels of inflation. For example, the difference between 0% and 10% inflation is unlikely to have the same impact on individuals' beliefs as the difference between 300% and 310%.

To address these differences and avoid model misspecification, our baseline regressions will use the log of experienced inflation. In the HFCS sample, we do not have any households who have a negative average experienced inflation nor any who lived through the German hyperinflation. Thus, with the log transformation we are able to include all households and significantly reduce the impact of high-experience outliers (See Figure 3 for the distribution).

Our main analyses exploit the detailed household-level data and test whether individual differences in experiences predict the likelihood of homeownership on top of a number of household characteristics. In these analyses, we have variation in experiences both across individuals in different countries and also across individuals within a country (by age and survey year).

We show estimates from logit regressions on the household-level data, and the results are robust to probit and OLS specifications. Our key dependent variable is a binary indicator of whether the household owns their primary residence (Own HMR).[19] The key independent variable is household experienced inflation, calculated using household heads' ages, countries, and survey years as described above.

Parallel to our analysis of the country-level data, we consider the relationship between homeownership and the log of a household head's lifetime average experienced inflation as described above and homeownership. Our Prediction 1 results are robust to alternative ways of handling households with high inflation experience, discussed in more detail in Section 3.3.)

In our main specifications, we control for household demographics that are likely to be related to homeownership: age, gender, having children, marital status, educational

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

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 and the corresponding estimation techniques from Rubin (2004) to include the full imputed sample in our analyses, despite some households having missing data.[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 analyses. Controlling for household demographics, we find that a one log-point increase in experienced inflation predicts a 174% increase in the odds of being a homeowner (i.e., $2.74 - 1 = 1.74$). This relationship is quite large. A household with a likelihood of ownership at 65% (the average homeownership rate in our sample) has an odds ratio of 1.86 ($= 0.65/(1 - 0.65)$). A 1 log-point increase in experienced inflation (e.g., from 2% to 5.4%) predicts an increase in the odds ratio to 5.06 ($274\% \times 1.86$) which corresponds to an 84% probability of ownership ($= 5.09/(1 + 5.09)$).

All of our baseline analyses control for the full array of household demographic variables, reported in more detail in Appendix-Table A3. We find that age has a slightly negative effect on the likelihood of homeownership. Married and widowed households are significantly more likely to own a home than single households. More educated households are less likely to own a home. Having a child is also a significant predictor of being a homeowner. Relative to being out of the workforce, employed, unemployed, and retired household heads are more likely to be homeowners. Homeownership is increasing in wealth, but conditional on wealth, is decreasing in income. We also find that homeownership is higher in the second wave of the survey.

One way to quantify the estimated effect is to calculate the implied counterfactual homeownership rate if a country had a different inflation history. The hypothetical counterfactual abstracts, of course, from general-equilibrium considerations and serves merely as a back-of-the envelope calculation. Figure 5 provides three examples. The left panel 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

[20] Wealth and income are converted to 2010 euros, and deciles are calculated across the entire sample.
[21] While few households are missing the family characteristic and employment variables, a substantial amount of wealth or income data is missing (about 40% of the overall sample). For robustness, we re-run all specifications on the subsample with complete data, cf. Appendix-Table A3.

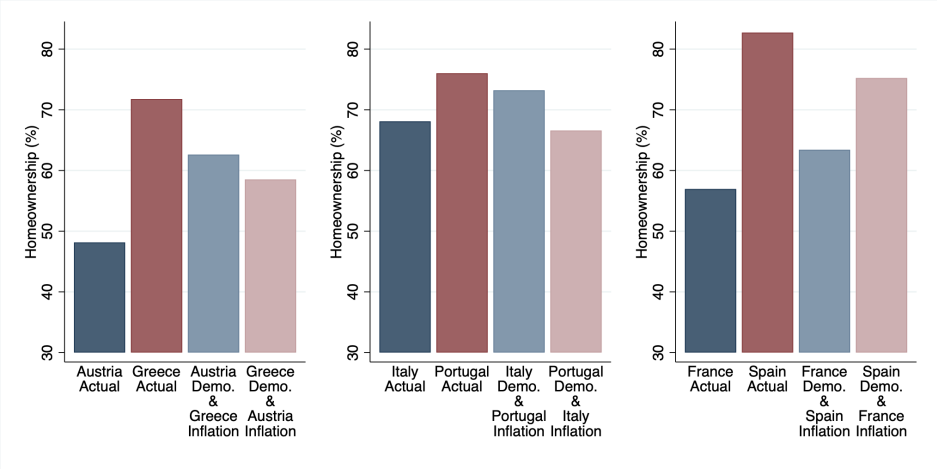


Figure 5. Hypothetical homeownership rates with alternate inflation histories

Actual homeownership from the HFCS data. Hypothetical homeownership rates calculated using the model estimated in Table 6, column (4), assuming another country's inflation history.

Austria having a homeownership rate under 50% (first bar) and a low inflation history, while Greece has a homeownership rate around 70% (second bar) and a high inflation history. Had Austrians experienced Greece's inflation history, our estimates would predict a substantial 14 pp increase in the homeownership rate for Austria (third bar). Likewise, if Greece had Austria's inflation history, we would predict a 13 pp drop in homeownership (fourth bar). As a second example, consider Italy and Portugal, shown in the middle. These countries have an 8 pp difference in homeownership. Our model predicts that the gap would almost completely close if these countries had the same inflation history. Finally, we pick an example where the hypothetical change in inflation histories would neither switch nor even out the cross-country differences in homeownership. The last panel on the right compares France and Spain, where the large gap in homeownership would be reduced by less than half if inflation histories were switched. Even in that case, our model predicts a substantial role of experienced inflation: the predicted change in homeownership for each country is over 5 pp.

In the cross-country analysis so far, we have abstracted from country differences when using macroeconomic experiences to predict homeownership. However, each country likely has differing housing regulations, supplies of homes available for purchase vs. renting, transaction costs, or distinct cultural features that make ownership more or less appealing. In the terminology of our theoretical framework, there are almost surely important differences in the cost of ownership, c, across countries.

In column (2) of Table 6, we include controls for housing market factors that we

expect to drive homeownership levels. In these analyses, we test the robustness of Prediction 1 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 2. Controlling for these housing market factors, the estimated magnitude remains similar: a one log-point in experienced inflation change predicts an increase in ownership from 65% to 87%. To benchmark the magnitude of this relationship, from a baseline of 65%, we find that a 1 SD increase tenant protection decreases predicted homeownership to 64%, a 1 SD increase in rent control reduces predicted homeownership to 61%, a 1 SD increase in tax benefits to homeowners increases predicted ownership to 71%, and a 1 SD increase in buyer transaction costs reduces predicted homeownership to 60%. The coefficient on the price-to-rent ratio is statistically insignificant and close to 1. While a high price-to-rent ratio is a signal of a high relative cost of ownership (lowering homeownership), it also may be related to expectations of future house price increases (and higher homeownership). We explore this relationship in Appendix-Table A4.

While we have demonstrated the robustness of our estimates to controlling for a number of differences across housing markets, we might still be concerned about unobserved differences. One way to control for any cross-country differences, and also for the average difference in experienced inflation across countries, is to include country fixed effects in the empirical model. This specification tests whether experienced inflation predicts homeownership *within* country. It controls for any historical differences not captured by our experience measures, e. g., former Soviet countries having different ownership structures. In our data, countries that were formerly in the Soviet sphere of influence have significantly higher homeownership when we exclude Germany (Estonia, Hungary, Latvia, Poland, Slovenia, Slovakia) and significantly lower average homeownership if we include Germany.

In columns (3) of Table 6, we add country fixed effects to the baseline specification from column (1). Our estimates reveal that, controlling for country fixed effects, a one log-point increase in experienced inflation predicts a 32% increase in the odds of homeownership (or for example, a change in probability of ownership from 65% to 71%). That is, even within country, the magnitude of the relationship between homeownership and experienced inflation is large.

While the time range of the HFCS surveys is relatively small, there may also be time-varying differences across countries and housing markets. To account for the

differences across countries and survey waves, in column (4) we include country-wave fixed effects and find a similar effect size. Our estimates imply that a one log-point increase in experienced inflation is associated with a change in likelihood of ownership from 65% to 74%.[22]

Heterogeneity in Experience Effects In this section, we explore heterogeneity in the effect of experienced inflation along two dimensions to provide further support for personal experiences as the mechanism driving the observed relationship between experienced inflation and homeownership.

First, if the relationship between past inflation histories and homeownership is indeed driven by personal experiences, we might expect that our measure of the household heads' experienced inflation would be noisier for couples compared to singles. However, if the correlation between experiences and homeownership is driven by unobserved correlations with market factors or financing opportunities, it is not clear why we should expect the relationship to vary across single and married household heads.

In columns (1) and (2) of Table 7, we test this hypothesis by interacting log experienced inflation with an indicator for being married. In these analysis we limit the sample to households heads who are either married or single, excluding those who are widowed or divorced. Consistent with experience effects as a mechanism, in column (1) of Table 7 we find that indeed the estimated odds ratio on the interaction between experienced inflation and married is less than 1, implying that the effect of experienced inflation is weaker among married household heads. In column (2), we include country-wave fixed-effects and confirm this result using only the within-country-wave variation in experiences.[23]

Second, as described in Section 1, a prediction of our framework is that the relationship between prior inflation histories and homeownership will not be as strong

[22] We also test the ability of contemporaneous and lagged macroeconomic conditions to explain cross-country-wave differences in homeownership, including inflation and other variables obtained from the World Bank (GDP per capita, unemployment, and household expenditure per capita). The results vary across specifications, likely as we try to fit homeownership from 20 countries (35 country-waves) with a handful of country-year measures. Thus we do not take much away from the estimated effects of macroeconomic conditions and defer to the specification with country-wave fixed effects to demonstrate the robustness of the estimated effect of experienced inflation to any cultural, market, or macroeconomic conditions.

[23] If we include experiences of both the household head and spouse in a regression, we find both coefficients positively predict ownership with similar magnitudes. The estimated coefficients remain similar but are not statistically significant after including country or country-wave fixed effects. This is perhaps not surprising given the high correlation in spouses' ages and thus experiences.

in countries with variable-rate mortgage financing. In that case, homeownership still provides an inflation hedge, but mortgage financing in and of itself is not perceived to be advantageous by those who have lived through periods of high inflation. Instead, all potential home buyers agree on the (real) cost of mortgage financing.

To proxy for the availability of fixed- versus variable-rate mortgages, we use the measure of "predominantly variable-rate mortgages" (PVR) from Andrews et al. (2011). To the extent that this measure reflects relative supply, rather than demand, of variable-rate mortgages (compared to fixed-rate), we predict that in PVR countries, prior inflation histories should have less predictive power (Prediction 2).

In column (3) of Table 7, we confirm this pattern. Our measure of experienced inflation predicts an increased likelihood of homeownership in general, but the effect is attenuated in countries with predominantly variable-rate mortgages (estimated odds ratio less than 1 for the interaction with PVR). In column (4), we also include country-wave fixed-effects. The estimated interaction effect remains negative, but is only marginally significant.

There are many possible channels for this relationship. 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). Unfortunately, the available data does not allow us to distinguish between them. Nevertheless, the results are consistent with and help corroborate the explanatory power of past inflation histories for the composition of real-estate markets within and across countries.

Our result confirming Prediction 2 is robust to many alternative specifications described in Section 3.3 (e.g., controlling for age, using an alternative dependent variable or measure of experienced inflation, and estimation using OLS or probit).

Testing Prediction 3: House-Price Histories and Homeownership In addition to experienced inflation, experienced house-price growth may also predict homeownership (Prediction 3). As outlined in Section 1, if people hold experience-biased beliefs, households that have lived through periods of high real house-price growth might 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.

As discussed in Section 2, historical data on house prices is much more scarce than historical data on inflation. Given the available data, we construct two measures of experienced real house-price growth. The first measure uses data from a full history of experiences over the lifetime while the second captures only a partial history. Unlike experienced inflation, a non-negligible fraction of households have negative experienced real house price growth (see Appendix-Figure A.13). Thus, we do not apply the log transformation to our measures of experienced real house price growth. In this analysis, we also standardize all experience measures within the sample so that we can easily compare magnitudes.

In columns (1) and (4) of Table 8, we replicate our main result, that experienced inflation predicts higher homeownership, on the subsample of countries with available house-price data. In these samples, a 1 standard-deviation increase in log experienced inflation predicts a 121% or 84% increase in the odds of ownership, or an increase in predicted ownership from 65% to 80% or 77%. In columns (2) and (5), we add the measures of past real house-price growth. We find that homeownership is significantly predicted by past house-price growth experiences. Surprisingly, the magnitudes of both measures of experienced house price growth are very similar, and smaller than that of experienced inflation. We find that a one standard deviation increase in experienced house-price growth predicts an increase in the probability of homeownership from 65% to about 68%. In both of these regressions, the effect of experienced inflation remains relatively stable and statistically significant. In columns (3) and (6), we add country-wave fixed effects, with differing results across the two measures. After controlling for country-wave, house price growth experiences are a large and significant predictor using the partial data and are small and statistically insignificant using the full data.[24]

There are several possible explanations for why the results on house-price experiences are less robust than those of experienced inflation. First, the house-price data is more limited. By limiting the analysis to a subset of countries or 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

[24] The 9 countries with data on historical house price growth do not include any of the high-inflation outliers that we see in the main sample. If we include linear (instead of log) experienced inflation in the analysis, the results are qualitatively similar. In the linear version, the effects of experienced inflation are more attenuated after controlling for country-wave fixed effects and become only marginally significant in the version with full inflation history.

purchased and pay relatively little attention to changes in house prices, cf. D'Acunto et al. (2019). (If anything they may be aware of the price appreciation of their prior home or a parent's home, both of which might be interesting avenues for future research.)

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 price 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 A4, 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 average price-to-rent ratios on average experiences. We find no statistically significant relationship between countries' inflation experiences (taking the log of the country average experience) and price-to-rent ratios, but find a strong positive relationship between past house-price growth experiences and price-to-rent ratios. Countries with a one standard deviation higher house-price growth measure (relative to other countries) have a 0.8 to 1 standard deviation higher price-to-rent ratio (relative to the country's long-run average). One possible interpretation, therefore, is as follows: while our model did not specify the process underlying changes in rental prices, they likely move with general inflation as well. In that case, the price-to-rent ratio will not respond (on average) to inflation, but will respond to house-price growth.

In summary, we identified two possible explanations for the weaker explanatory power of a country's and an individual's histories in terms of house-price growth, relative to the strong explanatory power of inflation histories. Either the weaker results reflect the lack of data on more direct, and possibly more frequent, house-price experiences or they reflect the indirect impact on affordability. Both explanations might be at work and would be interesting to explore if data becomes available. At the same time, inflation histories emerge as a strong influence on tenure decisions, even after taking house-price growth into account.

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

3.3 Robustness

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

Multiple Imputation Data. In Appendix-Table A3, we test the sensitivity of our main estimates to the use of the multiple-imputation data. In column (1), we report all of the coefficients from our benchmark estimation in Table 6. Using only the non-imputed data (column (2)), we limit the analysis to about 60% of the sample when we control for wealth and income. In column (3), we estimate the model on non-imputed data without including wealth and income controls. Across all three specifications, the magnitude of the coefficient on log experienced inflation is relatively similar, with a one log-point change in experienced inflation corresponding to an increase in the likelihood of homeownership from 65% to between 82% and 86%. While the coefficient on experienced inflation remains stable, 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 do not observe 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.

Alternative Measures of Inflation Experience. In Appendix-Table A5, we test several alternative methods of controlling for inflation experiences, described in detail in Appendix C. First, we demonstrate the robustness of our main result to the treatment of households with high inflation experience. We estimate coefficients of similar magnitude under several alternate specifications: estimating a linear effect of experienced inflation in all countries, limiting to the subsample of countries without high inflation, and winsorizing experienced inflation either before or after averaging to calculate the lifetime experience measure. Second we test several conceptually different measures of experienced inflation. We find that experienced inflation volatility also predicts homeownership, but with a smaller magnitude than the level. We also implement and extend the AR(1) model as described in Malmendier and Nagel (2015) to estimate households' one-year and five-year inflation forecasts from their lifetime experienced inflation. Higher estimated forecasts also significantly predict higher likelihoods of homeownership, but with smaller magnitudes than our main specification.

Accounting for Persistence in Homeownership. As discussed in Section 2.2, our main analysis tests the hypothesis that macroeconomic experiences predict homeownership *at the time of the survey*. Using retrospective data from the Survey of Health, Ageing and Retirement in Europe (SHARE), we zoom in on first home-ownership, eliminating the potential issue of persistence in ownership. We find that experienced inflation also predicts if and when an individual first purchases a home. The data and analysis are described in detail in Appendix-Section D with summary statistics and results reported in Appendix-Tables A6 and A7.

If moving was random, another way we could address the stickiness in tenure choice would be to focus on recent movers in the HFCS data, where we might expect to see stronger experience effects. If anything, we actually see weaker effects among recent movers, likely due to selection into moving frequently. The 25% of our sample who has moved in the last 5 years are younger, more employed, and significantly more likely to be renters with 32% ownership vs. 70% in the sample that has not moved recently. The benefit of the retrospective SHARE data is that it allows us to address the persistence in homeownership without the selection issues of the cross-sectional data.

Alternative Wealth Controls. In Appendix-Table A8, we test alternative methods for controlling for household wealth. In columns (1) and (2), we show that the predictive power of log 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 E). 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.

Additional Robustness. Our main result is robust to including age fixed effects or 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 log experienced inflation by a factor of 6, but the effect remain statistically significant at the 1% level. Because we have only 20 countries, we use the score bootstrap approach (Kline et al. (2012)): the average p-value for the coefficient on log

experienced inflation (across the 5 imputations) is 0.002. Again, inflation histories emerge as a robust determinant.

4 Conclusion

In this paper we present evidence that the macroeconomic histories individuals experience in their home countries have a long-lasting effect on the composition of and demand in the housing market. Households appear to overweight their own experiences when developing expectations about inflation and 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. Thus, we have identified a novel and economically meaningful factor explaining the large cross-country differences in housing markets and the variation in ownership within countries. We show that the relationship between prior inflation and tenure choices is not explained by housing market conditions. Further, we provide support for our hypothesis by showing that experienced inflation predicts homeownership among immigrants who move to the same housing market and that experiences throughout life predict the hazard of first homeownership.

The results of this paper tie into the literature on the long-run effects of macroeconomic events such as high inflation and economic crises addressed in DeLong and Summers (2012), Giuliano and Spilimbergo (2009), and Oreopoulos et al. (2012) among others. In this paper we formulate and address a housing-market participation puzzle by providing robust evidence for correlations between homeownership and experienced inflation.

References

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

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

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

H. S. Andersen. Motives for tenure choice during the life cycle: the importance of

non-economic factors and other housing preferences. *Housing, Theory and Society*, 28(2):183–207, 2011.

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

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

A. Apostolides. The growth of two small economies in the great depression: Gdp estimation for cyprus and malta during the interwar period (1921-1938). 2011.

M. D. Bordo and J. Landon-Lane. What explains house price booms?: History and empirical evidence. *Macroeconomic Analysis and International Finance*, 2014.

A. Börsch-Supan, M. Brandt, C. Hunkler, T. Kneip, J. Korbmacher, F. Malter, B. Schaan, S. Stuck, and S. Zuber. Data resource profile: the survey of health, ageing and retirement in europe (share). *International journal of epidemiology*, 42 (4):992–1001, 2013.

M. J. Botsch and U. Malmendier. Inflation experiences and contract choice – evidence from residential mortgages. 2019. Working paper, UC-Berkeley.

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

D. Brounen, P. Eichholtz, S. Staetmans, and M. Theebe. Inflation protection from homeownership: Long-run evidence, 1814–2008. *Real Estate Economics*, 42(3):662–689, 2014.

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

M. C. Chiuri and T. Jappelli. Financial market imperfections and home ownership: a comparative study. *European economic review*, 47(5):857–875, 2003.

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

P. Collin-Dufresne, M. Johannes, and L. A. Lochstoer. Asset pricing when'this time is different'. *Swiss Finance Institute Research Paper*, (13-73):14–8, 2016.

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

F. D'Acunto, U. Malmendier, J. Ospina, and M. Weber. Exposure to daily price changes and inflation expectations. 2019. Working paper, UC-Berkeley.

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

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

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

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

M. Ehrmann and P. Tzamourani. Memories of high inflation. *European Journal of*

Political Economy, 28(2):174–191, 2012.

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

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

L. M. Fisher and A. J. Jaffe. Determinants of international home ownership rates. *Housing finance international*, 18(1):34–37, 2003.

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

P. Giuliano and A. Spilimbergo. Growing up in a recession: Beliefs and the macroeconomy. *NBER Working Paper 15321*, 2009.

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

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

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

C. R. Gwin and S.-E. Ong. Do we really understand homeownership rates? an international study. *International Journal of Housing Markets and Analysis*, 1(1):52–67, 2008.

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

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

C. Hilber. The determinants of homeownership across europe: Panel data evidence. In *54th Annual North American Meetings of the Regional Science Association International Savannah*, volume 9, 2007.

International Monetary Fund. World economic outlook database, 2014.

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

P. Kline, A. Santos, et al. A score based approach to wild bootstrap inference. *Journal of Econometric Methods*, 1(1):23–41, 2012.

K. Knoll, M. Schularick, and T. Steger. No price like home: Global house prices, 1870-2012. *American Economic Review*, 107(2):331–53, 2017.

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

E. F. Luttmer and M. Singhal. Culture, context, and the taste for redistribution. *American Economic Journal: Economic Policy*, 3(1):157–179, 2011.

A. Mack, E. Martínez-García, et al. A cross-country quarterly database of real house prices: a methodological note. *Globalization and Monetary Policy Institute Working*

Paper, 99, 2011.

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

U. Malmendier and S. Nagel. Learning from inflation experiences. *The Quarterly Journal of Economics*, 131(1):53–87, 2015.

U. Malmendier and L. S. Shen. Scarred consumption. 2017. Working paper, UC-Berkeley.

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

U. Malmendier, D. Pouzo, and V. Vanasco. A theory of experience effects. *Working Paper*, 2016b.

J. M. Michal. *Central Planning in Czechoslovakia: Organization for growth in a mature economy*. Stanford University Press, 1960.

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

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

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

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

S. Ruggles, K. Genadek, R. Goeken, J. Grover, and M. Sobek. Integrated public use microdata series: Version 6.0 [dataset]. *University of Minnesota, Minneapolis*, 2015. doi: http://doi.org/10.18128/D010.V6.0.

S. Schraeder. Information processing and non-bayesian learning in financial markets. *Review of Finance*, pages 1–31, 2015.

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

Table 1. Summary of housing market measures

Country	Home-ownership	Households		Tenant Protection	Rent Control	Tax Benefits	Buyer Trans. Cost	Price-to-Rent Ratio	PVR
		Wave 1	Wave 2						
Slovakia	88%	2,056	2,030	-2.4			-2.6		1
Hungary	84%	-	5,810	-1.7	-0.6		-1.3		1
Spain	83%	5,717	5,600	0.9	-0.8	0.5	0.0	1.4	1
Malta	80%	801	938						
Slovenia	78%	327	2,411	-2.0	-1.7		-2.6		1
Poland	78%	-	3,274	-1.1	-1.3		-0.2		1
Estonia	77%	-	2,099				-2.3		1
Latvia	76%	-	1,155						
Portugal	76%	4,095	5,782	1.3	-0.3	-0.4	-0.9	-1.2	1
Cyprus	76%	1,202	1,248						
Greece	72%	2,860	2,859	1.8	-0.6	1.5	2.4	-0.5	1
Belgium	70%	2,164	2,030	-2.0	-0.8	1.0	2.7	1.6	0
Ireland	70%	-	5,194	-2.0	-1.2	-0.2	-1.3	-1.1	1
Finland	68%	10,046	10,073	-1.4	-1.7	1.5	-1.5	0.9	1
Italy	68%	7,243	7,249	-0.1	-0.8	-0.6	0.1	-0.5	0
Luxembourg	66%	922	1,565	-2.5	0.1	-0.5	0.5		1
Netherlands	58%	1,268	1,217	-1.9	1.6	2.9	-1.0	0.4	0
France	57%	13,817	11,167	0.9	-0.3	0.3	1.0	0.8	0
Austria	48%	2,249	2,818	1.1	0.2	-0.5	-0.8	-0.2	0
Germany	44%	3,388	4,264	-0.2	1.3	-0.9	-0.6	-0.9	0
Total	62%	58,155	78,783						

Notes: Table is sorted by the homeownership rate (the percent of households who own their main residence) in the HFCS sample. The summary statistics are weighted to be representative of the population within and across countries. Housing market variables are constructed using data from Andrews et al. (2011), Bloomberg, the World Bank, and the OECD. 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 measure 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. 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.

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
Marital 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 Experienced and Actual Annual Inflation by Country

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

Notes: Data is the HFCS non-imputed survey data and inflation as described in Section 2. Experienced-inflation summary statistics are weighted to be representative of the population within and across countries unless otherwise noted. "Countries equally weighted" indicates summary statistics are weighted to be representative within country, but equally weighted across countries. "Across Countries" 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 4. Inflation Experiences and Homeownership: Immigrants to the U.S.

Sample:	Immigrants from HFCS Countries			All	
Dep. Var.: Homeowner	(1)	(2)	(3)	(4)	(5)
Log Experienced Inflation	1.11***	1.08***	1.04**	1.99***	2.64***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)
Experienced German Hyperinflation	0.80	0.74	0.85	3.05***	5.02***
	(0.29)	(0.25)	(0.29)	(1.12)	(1.84)
Negative Experienced Inflation	0.56*	0.58*	0.62	2.14**	1.91*
	(0.18)	(0.18)	(0.20)	(0.65)	(0.64)
State-Year Homeownership Rate		1.07***	1.07***		
		(0.00)	(0.00)		
Years in U.S. (% of Life)	1.01***	1.01***	1.01***	1.02***	1.02***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
U.S. Native				0.58***	
				(0.01)	
Demographic Controls	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Country of Birth FE	No	No	Yes	No	Yes
State & 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	0.222	0.236	0.239	0.266	0.267

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

Notes: Table reports exponentiated coefficients (odds ratios) from logit regressions on the 2001-2015 ACS data, using representative weights, with robust standard errors in parentheses. The dependent variable is an indicator for homeownership. Log Experienced Inflation is the log of the weighted average of inflation over the household head's lifetime, with linearly declining weights from the 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. This variable is 0 for households who lived through the German hyperinflation and for those with negative experienced inflation with corresponding indicators. Demographic controls include household head age, gender, marital status, children in the home, education, employment status, and decile of total household income relative to the entire ACS population. All regressions also include survey-year fixed effects. State-year homeownership rate is the homeownership rate among other (non-immigrant) households calculated using the ACS from the same state and year. The sample in columns 1-3 are household heads born in one of the 20 ECB HFCS countries. In columns 4 and 5 we also include (and control for) households headed by a U.S. native.

Table 5. Inflation Experiences and Country-Level Homeownership

Sample:	All	Exclude High-Inflation Countries	All
Dependent Var: Homeownership	(1)	(2)	(3)
Average Experienced Inflation	0.01**	0.09***	
	(0.00)	(0.02)	
Log of Average Experienced Inflation			0.13***
			(0.04)
Constant	0.58***	0.26***	0.43***
	(0.06)	(0.08)	(0.09)
Observations	20	15	20
R^2	0.247	0.736	0.489

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

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. The dependent variable is the percent of households who own their main residence. High-inflation countries (where any household had a lifetime experienced inflation above 10%) 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 the year before the survey to birth year. The log of average experienced inflation is the log of the country average.

Table 6. Inflation Experiences and Homeownership, within and across Countries

Dep. Var: Own Main Residence	(1)	(2)	(3)	(4)
Log Exp. Inflation	2.74***	3.46***	1.32***	1.52***
	(0.10)	(0.32)	(0.13)	(0.16)
Tenant Protection		0.94***		
		(0.02)		
Rent Control		0.84***		
		(0.03)		
Tax Benefits to Homeowners		1.33***		
		(0.04)		
Buyer Trans. Cost		0.80***		
		(0.01)		
Price-to-Rent Ratio		0.95		
		(0.03)		
Demographic Controls	Yes	Yes	Yes	Yes
Wave FE	Yes	Yes	Yes	No
Country FE	No	No	Yes	No
Country-Wave FE	No	No	No	Yes
Observations	136,437	110,614	136,437	136,437
Countries	20	11	20	20
Pseudo R^2	0.512	0.534	0.536	0.537

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

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. The number of observations is the maximum N across the 5 imputations. Pseudo R^2 is the average across the 5 imputations. The dependent variable is an indicator for owning the household main residence (Own HMR). Log Experienced Inflation is the log of weighted average of inflation over the household head's lifetime, with linearly declining weights from the year before the survey to birth year. Demographic controls include age, gender, marital status, children, education, employment status, and deciles of net wealth and household income. Tenant protection is a comparative measure of tenant-landlord regulations. Rent control is a composite indicator increasing in the extent of controls of rents. Tax benefits is a comparative measure of the tax relief on debt financing of homeownership. Transaction costs measure 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 7. Heterogeneity in the Relationship between Inflation Experiences and Homeownership

Dependent Var:	Married vs. Single		Primarily Variable vs. Fixed-Rate Financing	
Own Main Residence	(1)	(2)	(3)	(4)
Log Exp. Inflation	3.57***	1.96***	2.29***	1.86***
	(0.23)	(0.26)	(0.20)	(0.30)
Log Exp. Inflation X Married	0.69***	0.71***		
	(0.05)	(0.05)		
Log Exp. Inflation X PVR			0.60***	0.77*
			(0.06)	(0.12)
Primarily Variable Rate (PVR)			7.65***	
			(1.15)	
Demographic Controls	Yes	Yes	Yes	Yes
Wave FE	Yes	Yes	Yes	Yes
Country-Wave FE	No	Yes	No	Yes
Observations	109,244	109,244	131,100	131,100
Countries	20	20	17	17
Pseudo R^2	0.475	0.501	0.499	0.515

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

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. The number of observations is the maximum N across the 5 imputations. Pseudo R^2 is the average across the 5 imputations. The dependent variable is an indicator for owning the household main residence (Own HMR). Log experienced inflation is the log of the weighted average of inflation over the household head's lifetime, with linearly declining weights from the year before the survey to birth year. Demographic controls include age, gender, marital status, children, education level, employment status, and deciles of net wealth and household income. Columns 1 and 2 exclude widowed and divorced household heads. PVR is an indicator for having predominantly variable-rate mortgages in the country.

Table 8. Experiences of Real House-Price Growth and Homeownership: Testing Prediction 3

Dependent Var: Own Main Residence	(1)	(2)	(3)	(4)	(5)	(6)
Experienced Log Inflation (std.)	2.21*** (0.10)	1.99*** (0.10)	1.98*** (0.24)	1.84*** (0.07)	1.72*** (0.06)	1.79*** (0.20)
Experienced Real House Price Growth (Full History, std.)		1.12*** (0.04)	1.09 (0.19)			
Experienced Real House Price Growth (Partial History from 1975, std.)					1.16*** (0.03)	1.56*** (0.24)
Demographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Wave FE	Yes	Yes	No	Yes	Yes	No
Country-Wave 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	0.516	0.517	0.524	0.532	0.534	0.543

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

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. The number of observations is the maximum N across the five imputations. Pseudo R^2 is the average across the 5 imputations. The 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 the year before the survey to birth year (re-scaling the weights for partial history). Note that all countries in this analysis have average experienced inflation under 10%. Full history of experienced real house-price growth obtained from Knoll et al. (2017) for Belgium, Finland, France, Germany, and the Netherlands. Full history of experienced real house-price growth obtained from Bordo and Landon-Lane (2014) 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 age, gender, marital status, children, education, employment status, log net wealth, and log income. All regressions also include a fixed effect for survey wave.

APPENDIX (For Online Publication)

A Survey of Homeowners

Recruitment We conducted a survey of 700 homeowners in six HFCS countries: Austria, Germany, Ireland, Italy, Portugal, and Spain. We recruited 100 participants from each country to our survey from Dynata's market research panel. We also recruited 100 participants through Amazon's Mechanical Turk (MTurk).[26] The results are similar across samples, so we combine them in the results below.

Participants recruited though Dynata were compensated for completing the survey using a combination of incentives including cash, gift cards, airline points, sweepstakes entries, and charity donations. Participants recruited from MTurk were paid $1 to complete our 3-minute survey.[27]

The survey was initially written in English, translated using translation services, and then edited by native speakers. The survey took place from March 5th to May 12th, 2020 for MTurk participants and from May 13 to May 15, 2020 for Dynata.

Survey Questions and Results After providing informed consent, participants were asked the following questions. Below we provide the exact question text and summary of responses from those who completed our survey.

1. In which country do you currently reside?
   →Screened out 9 participants not from the target countries.

Country	N	Percent
Austria	100	14
Germany	116	17
Ireland	105	15
Italy	150	21
Portugal	105	15
Spain	124	18
Total	700	100

2. Do you rent or own your home?
   →Screened out 55 participants who did not select "Own."

Response	N	Percent
Rent	0	0
Own	700	100
Other	0	0
Total	700	100

[26] We initially intended to recruit 100 participants from each country through MTurk, but were unable to recruit a sufficient sample during the COVID-19 crisis.

[27] Several participants were paid $0.50 before we increased the fee in an attempt to recruit more participants.

3. Why did you decide to buy rather than rent your home?
Text box, free fill in.

4. What do you think are good reasons for buying a home? Please select all that apply. *Order of options was randomized across participants, with "None of the Above" at the end.*

Response	Percent Selected
Ownership provides peace of mind.	65%
Better selection of homes to buy than to rent.	19%
More flexibility to redecorate or remodel.	41%
House prices are likely to increase over time.	37%
Rent prices are likely to increase over time.	47%
Real estate is a good investment if there is inflation.	50%
Mortgage rates are low.	27%
Ownership provides tax benefits.	18%
Mortgage payments force me to save money.	15%
Mortgage payments are more predictable than rent prices.	31%
None of the above.	3%

5. Did concerns about inflation impact your decision to buy a home?[28]

Response	N	Percent
Yes	228	34
No	380	56
I am not sure	66	10
Total who know what inflation is	674	100

6. Have you personally experienced high inflation? *[Asked only if know what inflation is.]*

Response	N	Percent
Yes	283	42
No	391	58
Total who know what inflation is	674	100

7. Do you worry about inflation in the future? *[Asked only if know what inflation is.]*

Response	N	Percent
Yes	460	68
No	214	32
Total who know what inflation is	674	100

[28] "I don't know what inflation is." was not available to the MTurk sample.

8. What do you think inflation will be next year? *[Asked only if know what inflation is.]*

Mean	38
25th percentile	2
Median	3
75th percentile	10
SD	770
N who know what inflation is	674

9. Were you born in *[Country from Q1]*?

Response	N	Percent
Yes	634	91
No	66	9
Total	700	100

10. In which country were you born?*[Asked only if Q9=no.]*

11. What is your age?

Mean	44
25th percentile	34
Median	43
75th percentile	54
SD	13
N	700

Results by Experience In addition to the results shown in the main section of the paper, we analyze the key results by those who indicated that they have vs. have not personally experienced high inflation.

We find no difference between the two groups in their evaluation of real estate as an inflation hedge. Figure A.1 shows that about half of respondents indicated that real estate is a good investment if there is inflation regardless of whether they personally lived through high inflation. However, the figure also shows that those with high inflation experience were more likely to say that their own homeownership decisions were impacted by inflation (45% vs. 26%) and more likely to be worried about inflation in the future (76% vs. 63%).

We also find that respondents who personally experienced high inflation have significantly higher expectations of next year's inflation. Excluding one outlier at 20,000%, expected inflation is 6.9% among those that did not experience high inflation and 11.3% among those who did. If we instead winsorize expected inflation at 20%, the 90th percentile, those with high inflation experiences have expected inflation about 1pp higher than those who did not (means of 5.7% vs. 6.7%).

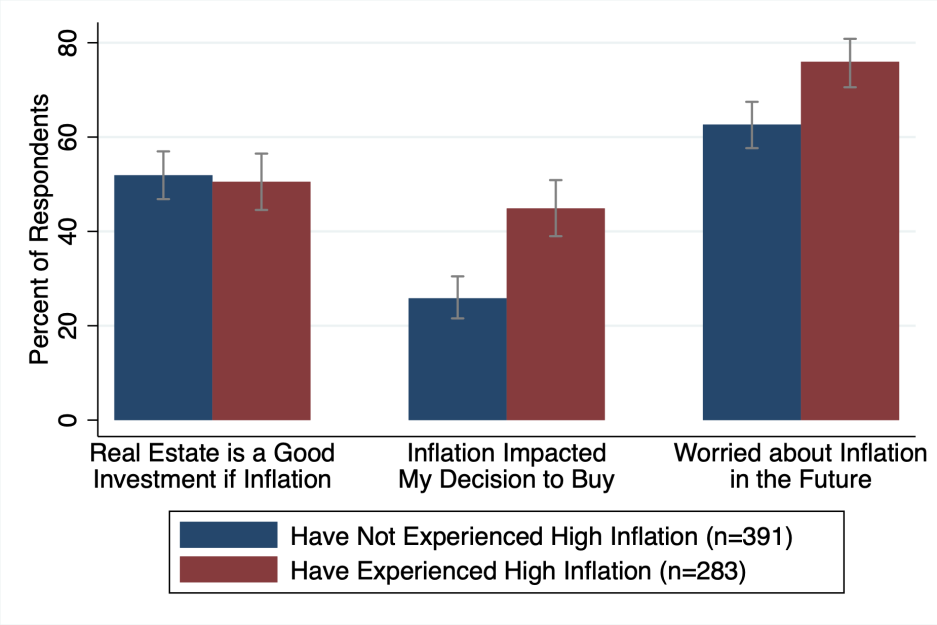


Figure A.1. Inflation results by inflation experience.

Figure shows means and 95% confidence intervals, separately for respondents who reported that they have (or have not) personally experience high inflation. Total sample includes 674 respondents who know what inflation is.

B Theoretical Framework

B.1 Expected Utility from Renting and Buying

In this section, we derive the utilities of renting and owning under fixed- and variable-rate financing in market with and without an alternative inflation hedge. To distinguish between the markets with and without an alternative inflation hedge, we introduce additional notation. $U_{t+1}(\cdot, \cdot, n_t)$ indicates utility when the alternative asset pays a nominal rate of n_t and $U_{t+1}(\cdot, \cdot, r_t)$ indicates utility when the alternative asset pays a real rate of r_t.

In addition, we expand the model to allow for a (known) cost of ownership c that is proportional to the value of housing and payable at $t+1$, amounting to cM_{t+1}.[29] The cost could include maintenance costs, property taxes, and costs of being a landlord (e.g., tenant protection, regulations, and rent control). We will assume that initial wealth is sufficiently high relative to housing costs to be positive under any realization, to accommodate the log utility specification.

Housing as the only inflation hedge In this scenario, the alternative asset pays a nominal rate n_t between t and $t+1$, known to households at time t. Under this

[29] The results are qualitatively unchanged if c grows with inflation instead of house prices.

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

$$E_t\left[U_{t+1}(R,h_t,n_t)\right] = E_t\left[u\left(\frac{w_{t+1}(R,h_t,n_t)}{1+\pi_{t+1}}\right)\right] \\ = \log\left((w_t-h_t)(1+n_t)\right) - E_t[\log(1+\pi_{t+1})], \tag{5}$$

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

Households' expected utility conditional on buying with a fixed-rate mortgage is

$$E_t\left[U_{t+1}(FR,m_t,n_t)\right] = E_t\left[u\left(\frac{w_{t+1}(FR,m_t,n_t)}{1+\pi_{t+1}}\right)\right] \\ = E_t[\log(M_t(1+\pi_{t+1})(1+g_{t+1})(1-c) - m_t(1+n_t^f) \\ + (w_t-(M_t-m_t))(1+n_t)) - \log(1+\pi_{t+1})], \tag{6}$$

where $w_{t+1}(FR,m_t,n_t)$ 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 yields

$$E_t\left[U_{t+1}(VR,m_t,n_t)\right] = E_t\left[u\left(\frac{w_{t+1}(VR,m_t,n_t)}{1+\pi_{t+1}}\right)\right] \\ = E_t[\log(M_t(1+\pi_{t+1})(1+g_{t+1})(1-c) - m_t(1+r_t^v)(1+\pi_{t+1}) \\ + (w_t-(M_t-m_t))(1+n_t)) - \log(1+\pi_{t+1})], \tag{7}$$

where $w_{t+1}(VR,m_t,n_t)$ 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 scenario, the alternative asset is inflation-protected and pays a *real* rate r_t between t and $t+1$, known to households at time t. Here, the expected utility conditional on renting is

$$E_t\left[U_{t+1}(R,h_t,r_t)\right] = E_t\left[u\left(\frac{w_{t+1}(R,h_t,r_t)}{1+\pi_{t+1}}\right)\right] \\ = E_t\left[\log\left((w_t-h_t)(1+r_t)(1+\pi_{t+1})\right) - \log(1+\pi_{t+1})\right] \\ = E_t\left[\log\left((w_t-h_t)(1+r_t)\right)\right], \tag{8}$$

where $w_{t+1}(R,h_t,r_t)$ is the expected 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

is

$$
\begin{aligned}
E_t\left[U_{t+1}(FR, m_t, r_t)\right] &= E_t\left[u\left(\frac{w_{t+1}(FR, m_t, r_t)}{1+\pi_{t+1}}\right)\right] \qquad (9)\\
&= E_t[\log(M_t(1+\pi_{t+1})(1+g_{t+1})(1-c) - m_t(1+n_t^f)\\
&\quad + (w_t - (M_t - m_t))(1+r_t)(1+\pi_{t+1})) - \log(1+\pi_{t+1})]\\
&= E_t\left[\log(M_t(1+g_{t+1})(1-c) - \frac{m_t(1+n_t^f)}{1+\pi_{t+1}} + (w_t - (M_t - m_t))(1+r_t))\right],
\end{aligned}
$$

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

The expected utility conditional on buying with a variable-rate mortgage of value m_t is

$$
\begin{aligned}
E_t\left[U_{t+1}(VR, m_t, r_t)\right] &= E_t\left[u\left(\frac{w_{t+1}(VR, m_t, r_t)}{1+\pi_{t+1}}\right)\right] \qquad (10)\\
&= E_t[\log(M_t(1+\pi_{t+1})(1+g_{t+1})(1-c) - m_t(1+r_t^v)(1+\pi_{t+1})\\
&\quad + (w_t - (M_t - m_t))(1+r_t)(1+\pi_{t+1})) - \log(1+\pi_{t+1})]\\
&= E_t[\log(M_t(1+g_{t+1})(1-c) - m_t(1+r_t^v) + (w_t - (M_t - m_t))(1+r_t))],
\end{aligned}
$$

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

B.2 Sensitivity of Utility to Experiences

Below we present the pointwise derivatives of the utility difference between buying and renting with respect to inflation and house price growth, separately for each of the two mortgage types and alternative assets.

With equation (13)>0, we confirm Prediction 1 under fixed-rate financing in a market with alternative inflation hedges. Here, the benefit of homeownership among households who have experienced higher inflation is that they can borrow at what they perceive to be a low real rate. In equation (14), we find no response of homeownership to experienced inflation in a market with an alternative inflation hedge (and thus no real-asset motivation) and variable-rate financing (and thus no cheap borrowing motivation).

Because the partial derivatives are weakly positive in all four cases, our model predicts that homeownership will be increasing in experienced inflation in any market with a mix of funding opportunities and access to inflation hedges.

We also find that Prediction 2 is robust to the existence of alternative inflation hedges. Because (13)-(14)=(13)>0, we also expect the effect of experienced inflation to be stronger with fixed-rate financing in a market with alternative inflation hedges.

Finally, we confirm that the results of Prediction 3 are robust to the availability of

inflation hedges. Because the relationship between house price growth and the benefit of homeownership is independent of the type of financing and availability of inflation hedges, equations (13) and (14) are also positive.

Inflation.

$$\frac{\partial}{\partial \pi_{t+1}} \left[U_{t+1}(FR, m_t, n_t) - U_{t+1}(R, h_t, n_t)\right]\Big|_{\pi,g} = \frac{M_t(1+g)(1-c)}{w_{t+1}(FR, m_t, n_t|\pi, g)} > 0 \tag{11}$$

$$\frac{\partial}{\partial \pi_{t+1}} \left[U_{t+1}(\,VR, m_t, n_t) - U_{t+1}(R, h_t, n_t)\right]\Big|_{\pi,g} = \frac{M_t(1+g)(1-c) - m_t(1+r_t^v)}{w_{t+1}(\,VR, m_t, n_t|\pi, g)} > 0 \tag{12}$$

$$\frac{\partial}{\partial \pi_{t+1}} \left[U_{t+1}(FR, m_t, r_t) - U_{t+1}(R, h_t, r_t)\right]\Big|_{\pi,g} = \frac{m_t(1+n_t^f)}{w_{t+1}(FR, m_t, r_t|\pi, g)(1+\pi)} > 0 \tag{13}$$

$$\frac{\partial}{\partial \pi_{t+1}} \left[U_{t+1}(\,VR, m_t, r_t) - U_{t+1}(R, h_t, r_t)\right]\Big|_{\pi,g} = 0 \tag{14}$$

House Price Growth.

$$\frac{\partial}{\partial g_{t+1}} \left[U_{t+1}(FR, m_t, n_t) - U_{t+1}(R, h_t, n_t)\right]\Big|_{\pi,g} = \frac{M_t(1+\pi)(1-c)}{w_{t+1}(FR, m_t, n_t|\pi, g)} > 0 \tag{15}$$

$$\frac{\partial}{\partial g_{t+1}} \left[U_{t+1}(\,VR, m_t, n_t) - U_{t+1}(R, h_t, n_t)\right]\Big|_{\pi,g} = \frac{M_t(1+\pi)(1-c)}{w_{t+1}(\,VR, m_t, n_t|\pi, g)} > 0 \tag{16}$$

$$\frac{\partial}{\partial g_{t+1}} \left[U_{t+1}(FR, m_t, r_t) - U_{t+1}(R, h_t, r_t)\right]\Big|_{\pi,g} = \frac{M_t(1+\pi)(1-c)}{w_{t+1}(FR, m_t, r_t|\pi, g)} > 0 \tag{17}$$

$$\frac{\partial}{\partial g_{t+1}} \left[U_{t+1}(\,VR, m_t, r_t) - U_{t+1}(R, h_t, r_t)\right]\Big|_{\pi,g} = \frac{M_t(1+\pi)(1-c)}{w_{t+1}(\,VR, m_t, r_t|\pi, g)} > 0 \tag{18}$$

B.3 Simulations of the Model

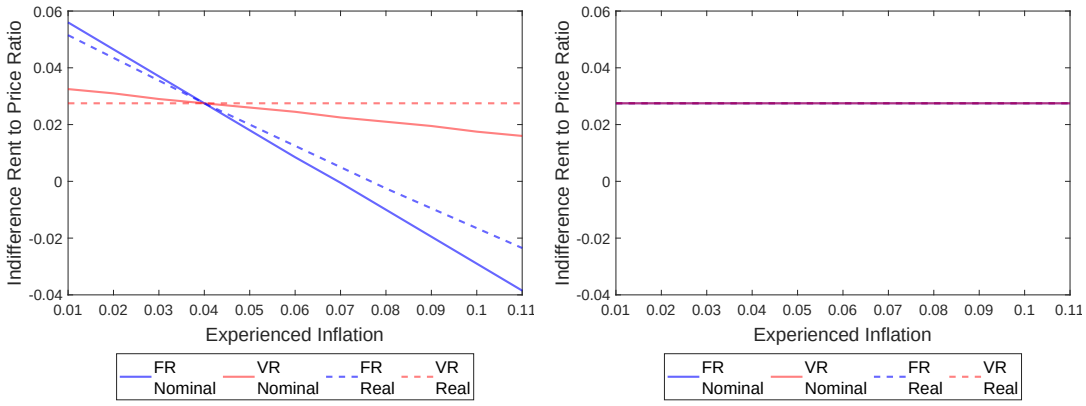
In this Appendix-Section, we simulate the theoretical model in a wider parameter space than considered in Section 1.2 and under alternative assumptions.

B.3.i Baseline

To simulate the model, we parametrize beliefs of agents who are influenced by past macro histories and, for comparison, of agents with rational beliefs. We start with the most simplistic version, by assuming that past macro histories induce deterministic beliefs that are exactly the same as what they observed in the past. For example, a household who sees 5% inflation in t would expect 5% inflation in $t+1$.

We explore the influence of past realizations of inflation on agents' tenure decisions under this parametrization in Figure A.2(a). For each historical inflation level, 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, separately for each the four markets: fixed- vs. variable-rate mortgage and with an alternative asset that pays a known nominal or real return. A lower h_t/M_t indicates a higher value of ownership relative to renting.[30]



(a) Experienced-Based Beliefs (b) Rational Beliefs

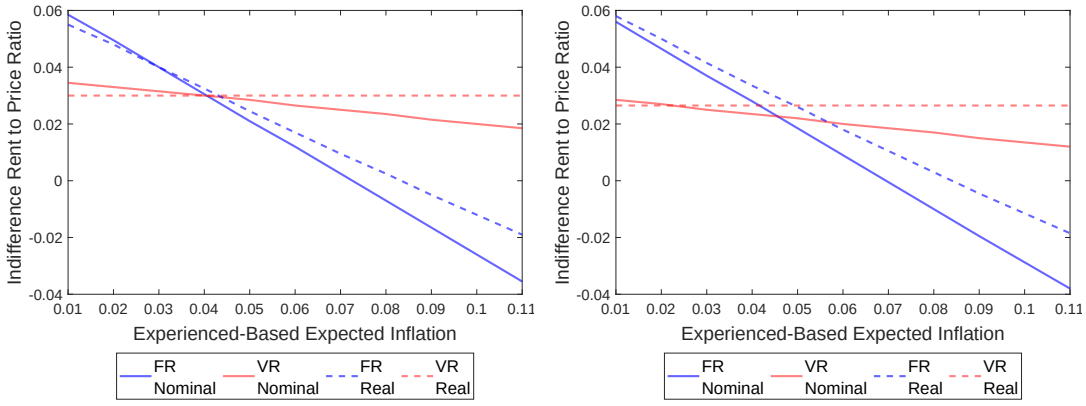
Figure A.2. Simple simulation of the model

Figure A.2(a) shows that, in all four markets, the slope is (weakly) negative, indicating that all else equal, higher past inflation increases the willingness to pay for ownership. Second, the effect of past inflation experiences on ownership is stronger when households have access to fixed- rather than variable-rate mortgages, evidenced by the steeper slope of the blue (darker) relative to the corresponding red (lighter) lines. Third, the graph shows that the effect of experienced inflation will be stronger in a market without alternative inflation hedges as the solid lines (for markets without inflation hedges) are steeper than the corresponding dashed lines (for markets with alternative hedging opportunities).

For comparison, in Figure A.2(b), we plot the corresponding graph for a household who has rational beliefs. In this case, past realizations of inflation have no bearing on inflation expectations and therefore do not impact the relative value of ownership. All lines overlap.

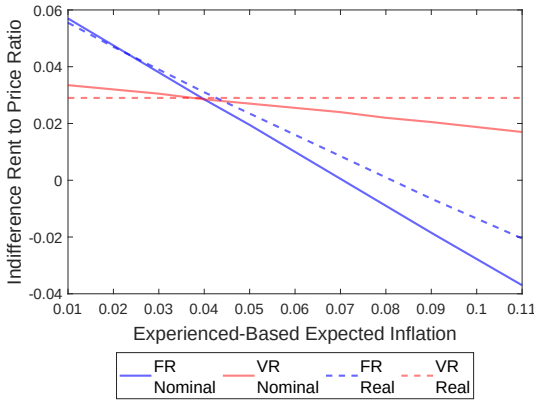
Note that there is a level of experienced inflation (in this case, 4%), at which the experienced-based household has the same beliefs as the rational household. If the experienced-based household lives through higher inflation, she is willing to pay more than the rational household for ownership. If she lives through lower inflation, she is willing to pay less.

[30] We also assume the household expects real house-price growth $g_{t+1} = 2\%$, has log utility over real wealth, initial wealth $w_t = 200,000$, house price $M_t = 100,000$, loan-to-value ratio $m_t/M_t = 0.8$, ownership costs $c = 2\%$, the alternative asset offers either a real return $r_t = 2\%$ or a nominal return $n_t = 6.1\%$ (corresponding to 4% anticipated inflation), and we assume mortgage rates carry a 1% premium relative to the alternative asset (i.e.,$n_t^f = 7.1\%$ and $r_t^v = 3\%$).



(a) Lognormal Distributions

(b) Uniform Distributions



(c) Normal Distributions

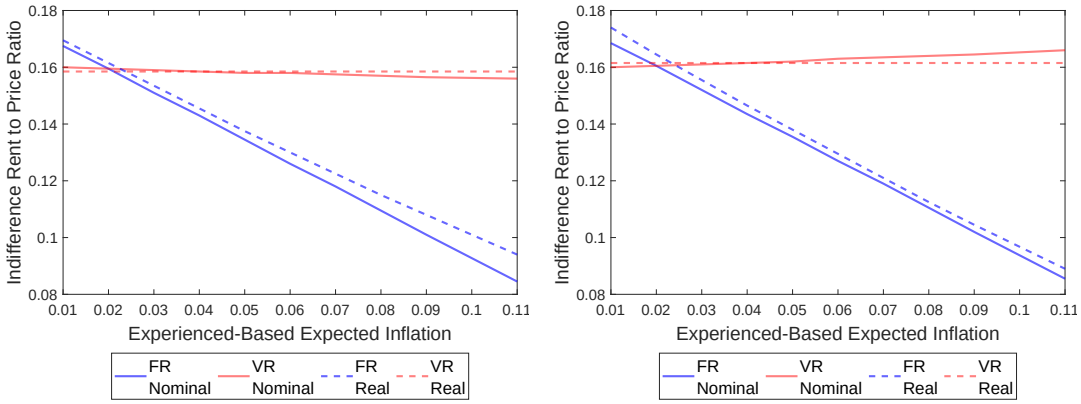
Figure A.3. Simulation with alternative distributions of beliefs

In Figure A.3, we present results under less simplistic parametrizations of experiences, namely, assuming instead that experienced-based households are uncertain about future inflation and real house-price growth. Specifically, we model households as having lognormal, uniform, or normally distributed beliefs about inflation and house-price growth. Along the x-axis we vary the mean of the experienced-based inflation belief distribution, fixing the standard deviation of beliefs about inflation and beliefs about house-price growth. 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 a mean of 2% and a standard deviation of 7%. Under all three distributional assumptions, the theoretical predictions hold.

B.3.ii Robustness of Prediction 1

In the main text, we restrict the parameter space by requiring $M_t(1+g_{t+1})(1-c) > m_t(1+r_t^v)$. This condition fails when expected house-price growth is low, costs are

high, LTV is high, and variable mortgage rates are high. Most predictions hold more generally, but, as we show in Section 1.2, the positive influence of past inflation on the value of ownership under variable-rate financing depends on this restriction in the scenario without an alternative inflation hedge. Assuming beliefs are normally distributed, in Figure A.4(a) we show that Prediction 1 is robust to low beliefs about future house-price growth ($g_{t+1} \sim N(-2\%, 1\%)$), high costs of ownership ($c = 10\%$), and high variable mortgage rates ($r_t^v = 5\%$ compared to 3% in the benchmark simulations). In Figure A.4(b), we increase LTV all the way to 90% and find a slightly upward slope. That is, experiencing higher inflation predicts *lower* value of ownership for households who can finance with a variable-rate mortgage in a market with no alternative inflation hedges. However, the response remains strong in the predicted direction for households with access to fixed-rate financing. Assuming a mix of financing opportunities, the simulations imply that Prediction 1 should still hold in the aggregate.



(a) Low g, high c, high variable-rate (b) Low g, high c, high variable-rate, high LTV

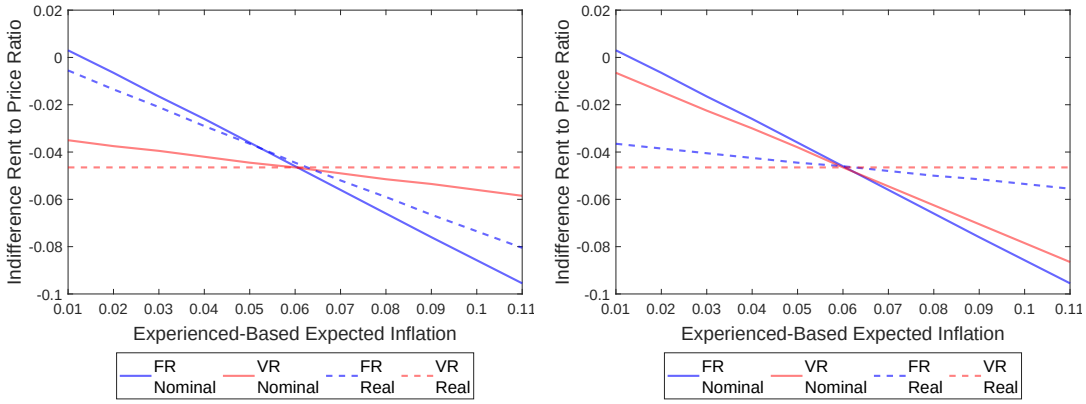
Figure A.4. Stress test of Prediction 1

B.3.iii Robustness of Prediction 2

In a market with alternative inflation hedges, our model predicts an unambiguously stronger response to experienced inflation for households with access to fixed-rate compared to variable-rate financing. We argued in Section 1.2 that this is likely also the case in a market without alternative inflation hedges. In the simulations thus far, we have seen this evidenced by the fact that the solid blue line is steeper than the solid red line. In Figure A.5, we test the robustness by simulating conditions least favorable to Prediction 2. Specifically, this prediction may fail when 1) $m_t(1 + r_t^v)$ is small and 2)

$$\frac{M_t(1 + g_{t+1})(1 - c)}{w_{t+1}(FR, m_t, n_t)} << \frac{M_t(1 + g_{t+1})(1 - c)}{w_{t+1}(VR, m_t, n_t)}.$$

In Figure A.5(a) we show that, although the magnitude drops, the prediction holds with low real rates relative to the nominal ($r_t = r_t^v = 1\%$, $n_t = n_t^f = 7\%$), a higher expected real house-price growth of 6%, and a 0% cost of ownership.[31] Lowering LTV to 20% (Figure A.5(b)) greatly reduces the magnitude, however Prediction 2 still holds.



(a) Low real rates, high g, and low c (b) Low real rates, high g, low c, and low LTV

Figure A.5. Stress tests of Prediction 2

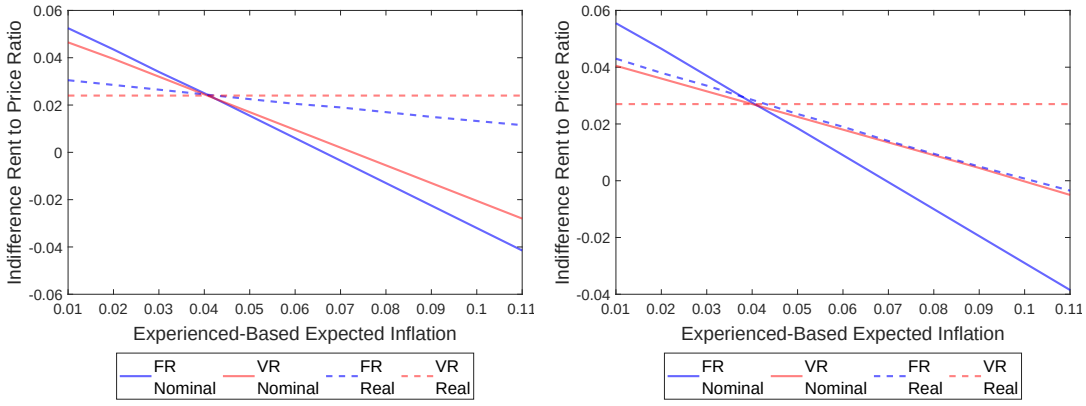
B.3.iv Loan-to-Value

In the baseline simulation, we assume the mortgage value is 80% of the value of the home. As discussed above, our predictions in Section 1 appear to be sensitive to loan-to-value ratios. Maintaining the benchmark parameters and varying only loan-to-value ratios, we find that the key predictions of our model hold except at LTVs above 90%, as demonstrated in Figure A.6.

B.3.v Housing Booms and Crises

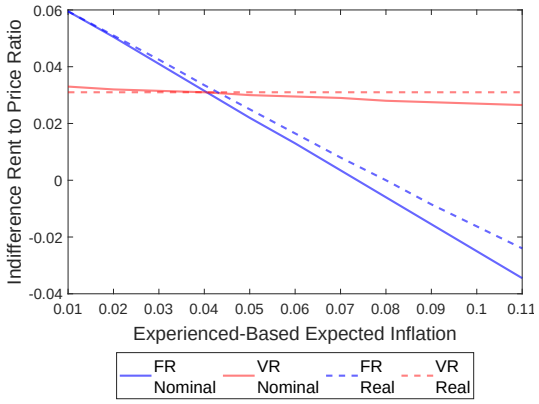
In this section, we explore the robustness of our predictions to more extreme changes in real house-price growth, as they may occur during housing booms or crises. To do this, we vary the assumptions about the mean real house-price growth, assuming beliefs about future inflation and house-price growth are normally distributed. Consistent with Prediction 3, we see in Figures A.7(a) and (b) that higher mean g (i. e., a housing boom) increases the valuation of ownership overall, but does not meaningfully change Predictions 1 and 2. Similarly, a low mean $g = -2\%$ (i. e., a housing crisis) lowers overall ownership but does not affect our predictions, as demonstrated in Figure A.7(c). Even in the case of an extreme housing crisis with mean $g = -20\%$ (Figure A.7(d)), when mortgages would be underwater in the majority of the parameter space, Predictions 1 and 2 appear largely robust. At this very low g, we do see a reversal of

[31] We assume beliefs are lognormally distributed but results are similar for other distributions.

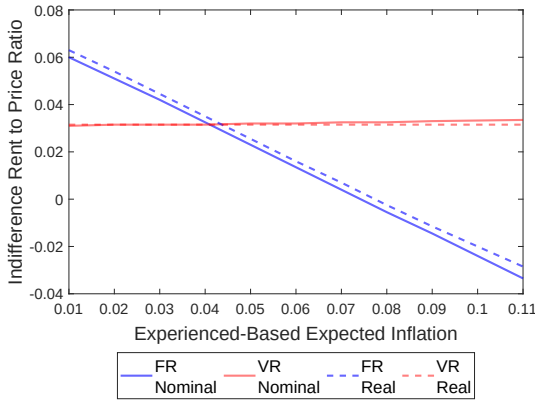


(a) 20% LTV.

(b) 50% LTV.



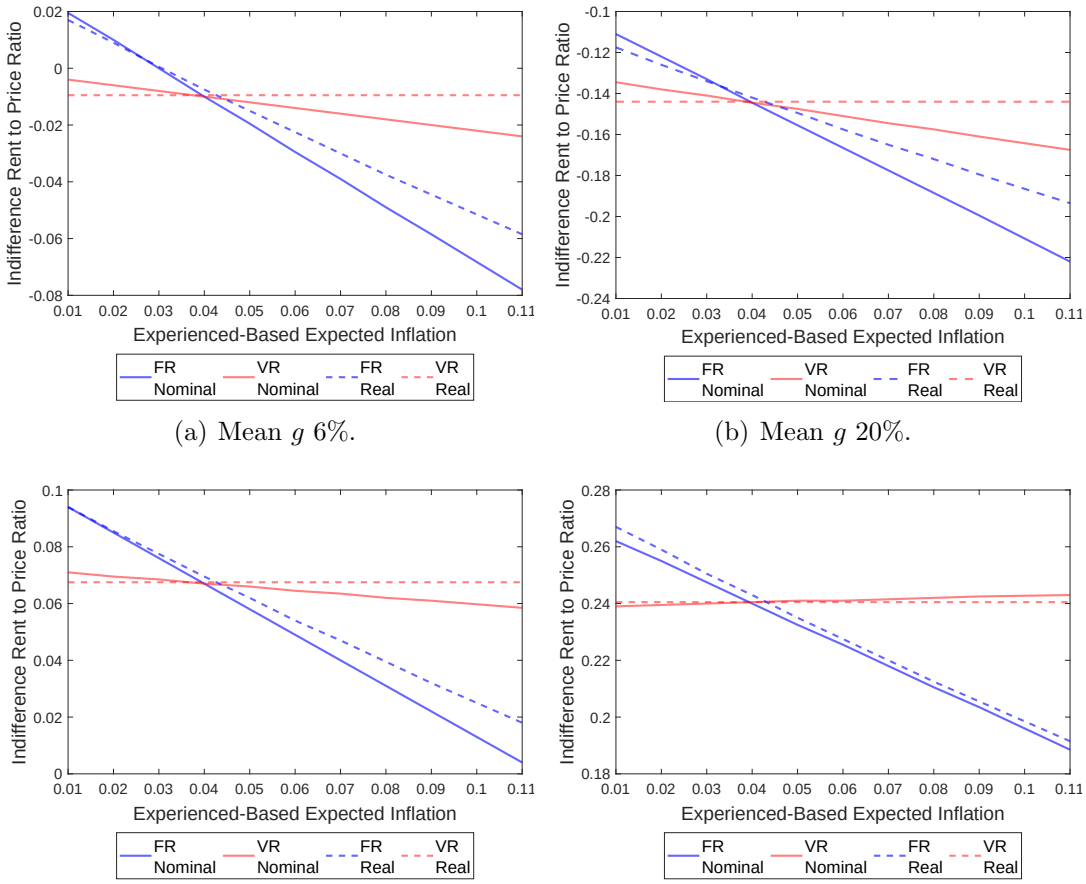
(c) 90% LTV.



(d) 99% LTV.

Figure A.6. Simulation with alternative loan-to-value ratios

Prediction 1 (though small in magnitude) in markets with variable-rate mortgages and no alternative inflation hedges.



(a) Mean g 6%.

(b) Mean g 20%.

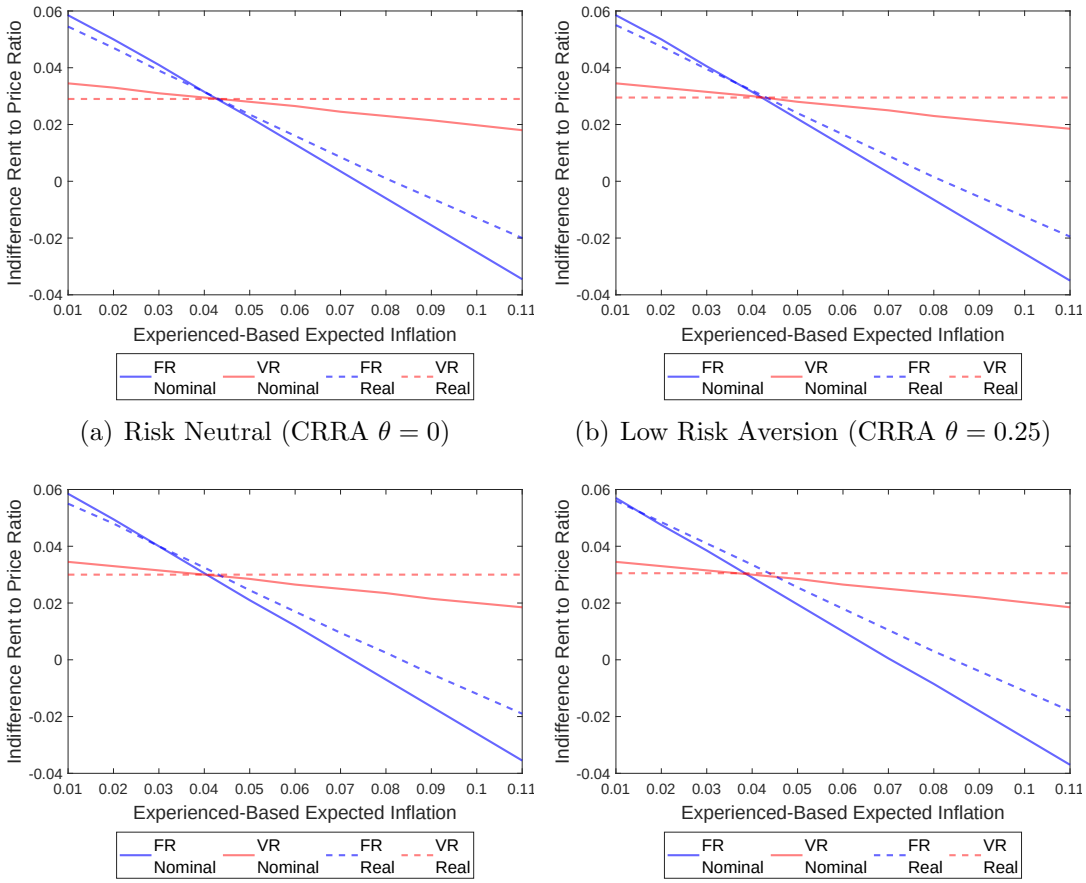
(c) Mean g -2%.

(d) Mean g -20%.

Figure A.7. Simulation of extreme real house price growth

B.3.vi Risk Aversion

The theoretical model assumes log utility. Here, we show that the results are robust to agents having more or less risk-averse preferences. We assume constant relative risk aversion and show that the predictions hold for a range of possible risk aversions in Figure A.8.



(a) Risk Neutral (CRRA $\theta = 0$)

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

(c) Log Utility (CRRA $\theta = 1$), benchmark

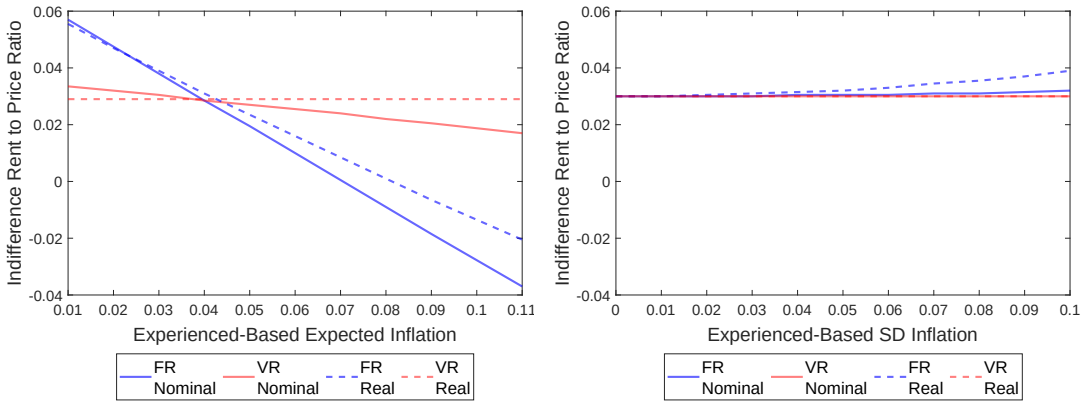
(d) High Risk Aversion (CRRA $\theta = 2$)

Figure A.8. Simulation with alternative levels of risk aversion

B.3.vii Inflation Variance

In the theoretical framework, and in our empirical analysis, we model the level of experienced inflation as affecting the level of beliefs about future inflation. However, we can also think of the variance in experiences as affecting the variance of the belief distribution. In Figure A.9(a), we replicate the benchmark graph with normally distributed beliefs, varying the mean of the distribution and holding the standard deviation at 6%. In Figure A.9(b), we instead hold the mean of inflation beliefs fixed at 4% and vary the standard deviation of inflation beliefs across the x-axis. Compared to changes in the means, we see very little movement in the value of ownership as we vary the standard deviation of beliefs.

The only effect we can see is a slight lowering in the value of ownership under fixed-rate financing in a market with alternative inflation hedges. By financing at a fixed-rate, the household gives up the inflation-hedging benefits of the alternative asset.



(a) Vary Mean Inflation (b) Vary SD Inflation

Figure A.9. Simulations of experiences affecting the mean and variance of beliefs, normally distributed beliefs

C Alternative Measures of Inflation Experience.

In Appendix-Table A5, we test several alternative methods of controlling for inflation experiences. In this table, we standardize all continuous experience measures to facilitate comparisons of the magnitudes.

First, we demonstrate the robustness of our main result to the treatment of households with high inflation experience. In our baseline analyses, we apply a log transform to average experienced inflation over the lifetime to account for non-linearity in the effects and to limit the impact of high-experience outliers. In column (1), we report the coefficient on the standardized measure. We find that a 1 standard deviation increase in the log of experienced inflation predicts a 93% increase in the odds of homeownership, or an increase from 65% to 78%.

In column (2), we estimate a linear effect of experienced inflation for the entire sample. As in our main specification, we find a significant positive effect of experiences. A 1 standard deviation increase in experienced inflation predicts a 58% increase in the odds of homeownership, or an increase in the probability of ownership from 65% to 75%.

In column (3), we estimate the linear effect of experienced inflation only for the subset of countries that do not have any high-inflation outliers (or households with lifetime experienced inflation above 10%). High-inflation countries include Slovenia, Estonia, Poland, Hungary, and Greece. Within this subsample, the predicted relationship between experienced inflation and homeownership is slightly stronger: a 1SD increase in experienced inflation predicts an 87% increase in the odds of homeownership, or an increase in the probability of ownership from 65% to 78%.

In column (4), we return to the full sample, but winsorize lifetime experienced inflation at 10%. We also include an indicator for any household above the threshold. This allows us to estimate effects on the entire sample, while accounting for the non-linearity we observed in the aggregate data. In this specification, we find that a 1SD increase in winsorized experienced inflation is associated with a 118% increase in the odds of homeownership, or an increase in the predicted probability of ownership from 65% to 80%. Interestingly, we estimate a negative effect of being above the 10% threshold, indicating that the predicted probability of homeownership is lower for high-inflation households compared to those at 10%. We chose a 10% threshold to winsorize the data as it is a clear break in the distribution of lifetime experiences and, coincidentally, corresponds to the visual trend break in the aggregate data. We find qualitatively similar results if we winsorize instead at 40% or 70%, which correspond to other natural breaks in the distribution.

In column (5), rather than winsorizing the lifetime average of experienced inflation, we cap each year's inflation at 25% before calculating a weighted average over the lifetime. In this way, 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 the threshold (i. e., whether any year in their experienced inflation measure was above 25%). We find that the measure of capped experienced

inflation positively and significantly predicts higher homeownership, with a 1SD increase predicting an increase in the probability of ownership from 65% to 77%. In this specification, households who ever lived through inflation above 25% have an even higher likelihood of ownership. Using alternative annual thresholds of 50% and 100%, we continue to find a positive significant effect of the winsorized experience measure, but mixed effects of ever experiencing inflation above the cap.

In columns (6) through (8), we test several conceptually different measures of experienced inflation. First, we test the hypothesis that inflation volatility predicts individual homeownership. We calculate individual experienced inflation volatility as the standard deviation of inflation over the lifetime. We find that a 1SD increase in inflation volatility predicts a 27% increase in the odds of homeownership, or an increase in the predicted probability from 65% to 70%. While still sizeable, the magnitude of the effect is smaller than the level of experienced inflation. As we show in Appendix B, this weaker result is consistent with our model simulations.

We have also implemented the AR(1) model as described in Malmendier and Nagel (2015) to estimate households' one-year inflation prediction from their lifetime experienced inflation. Extending the AR(1) model to our context is not straightforward as one-year inflation is unlikely to be relevant for homeownership decisions, which are long-term investments. Hence, we have to take a stance on the relevant forecast period for homeownership decisions as well as how individuals make long-term forecasts and iterate the one-year belief formation process forward.

Before we choose a set of assumptions, we start from simply relating homeownership to the original Malmendier-Nagel one-year forecast, despite the mismatch in horizon. We use their estimate of 3.044 for the gain parameter, and implement their AR(1) model to estimate households' one-year inflation prediction from their lifetime experienced inflation. In column (7), we find that the predicted inflation measure over the next-year significantly predicts the likelihood of being a homeowner.[32]

Turning to the more relevant long-term horizon, we take the approach to let 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. As shown in column (8), we find that the five-year aggregate inflation forecast significantly predicts ownership. We also find significant relationships using the predicted two-, ten-, and twenty-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 choose to use the lifetime weighted average approach of measuring macroeconomic experiences in our main analyses.

[32] The results are robust to using alternative gain parameters ranging from 2 to 5.

D Accounting for Persistence in Homeownership Using SHARE Data

Our main analysis tests the hypothesis that macroeconomic experiences predict homeownership *at the time of the survey*. However, homeownership is persistent and therefore the relevant experience measure may be experiences at the point of first homeownership. With retrospective data from the SHARE, we are able to zoom in on the first home purchase and ask whether macroeconomic experiences throughout life predict if and when an individual first purchases a home.

The SHARE microdata consists of a panel following elderly individuals (above age 50) in countries across Europe, starting with the first wave in 2004 to the most recent wave in 2015. We use data collected primarily in 2008-2009 from the SHARELIFE wave of the study for 14 countries in Europe.[33] 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 2.2. In addition to the data used in our main analyses, we also use historical inflation from Reinhart and Rogoff for Denmark, Sweden, and Switzerland (extended to 2015 using the IMF data). We obtain historical inflation for the Czech Republic from GFD and Michal (1960).[34]

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 A6 displays the summary statistics.

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

[33] This paper uses data from SHARE Wave 3 (DOI: 10.6103/SHARE.w3.700, see Börsch-Supan et al. (2013) for methodological details). The SHARE data collection has been funded by the European Commission through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005-028857, SHARELIFE: CIT4-CT-2006-028812), FP7 (SHARE-PREP: GA N°211909, SHARE-LEAP: GA N°227822, SHARE M4: GA N°261982) and Horizon 2020 (SHARE-DEV3: GA N°676536, SERISS: GA N°654221) and by DG Employment, Social Affairs & Inclusion. Additional funding from the German Ministry of Education and Research, the Max Planck Society for the Advancement of Science, the U.S. National Institute on Aging (U01_AG09740-13S2, P01_AG005842, P01_AG08291, P30_AG12815, R21_AG025169, Y1-AG-4553-01, IAG_BSR06-11, OGHA_04-064, HHSN271201300071C) and from various national funding sources is gratefully acknowledged (see www.share-project.org).

[34] 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.

household. We allow for a flexible baseline hazard over age. The key independent variable is log experienced inflation, which we adjust for individual-years who have experienced the German hyperinflation or have a negative lifetime average as described in Section 3.1. In all analyses, we control for the year, gender, and several time-varying demographics: whether the individual is married, has a child under the age of 18, and is employed. The results are in Appendix-Table A7. 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).[35]

The estimated hazard ratios in columns (1) and (3) indicate that a one log-point increase in experienced inflation predicts an 8-13% increase in the hazard of becoming a homeowner. The results are robust to controlling for country fixed effects in columns (2) and (4), where a 1 log-point increase in experienced inflation predicts a 7% increase in the hazard of homeownership. Hence, we confirm a significant role of past exposure to inflation on the decision to become a first-time homeowner and its timing.

[35] Our main results are unweighted as it is not clear that the SHARE survey weights are appropriate for the retrospective data. The results are mixed if we instead use the calibrated cross-sectional individual weights.

E Endogeneity of Household Wealth

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 A8 we try to address this endogeneity by removing home equity from net wealth. We calculate a homeowner's current home equity as the current value of their main residence minus current mortgages with household main residence as collateral. 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 0.21 compared to 0.51 in our baseline model, Table 6, column (1)).

One concern with this analysis is that we are overcorrecting. With this definition of wealth, a household suffers a large drop in wealth immediately after purchasing a home, when instead we should view those households as having the same wealth. As a way to try to improve upon the measure of wealth, we use the current value of the household's main residence and its value at the time of purchase to calculate a real gain from homeownership due to house-price appreciation. We then subtract this gain from wealth to calculate wealth net the gain from owning the main residence. 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 the price of the current home and not any previously owned property. Inertial effects in homeownership are likely to be problematic – if the household currently owns a home, they may be more likely to have owned a home 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 be subtracting more than just asset accumulation from being a homeowner. An additional concern is that for homeowners, this measure does not represent their counterfactual choice 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.

F Additional Figures and Tables

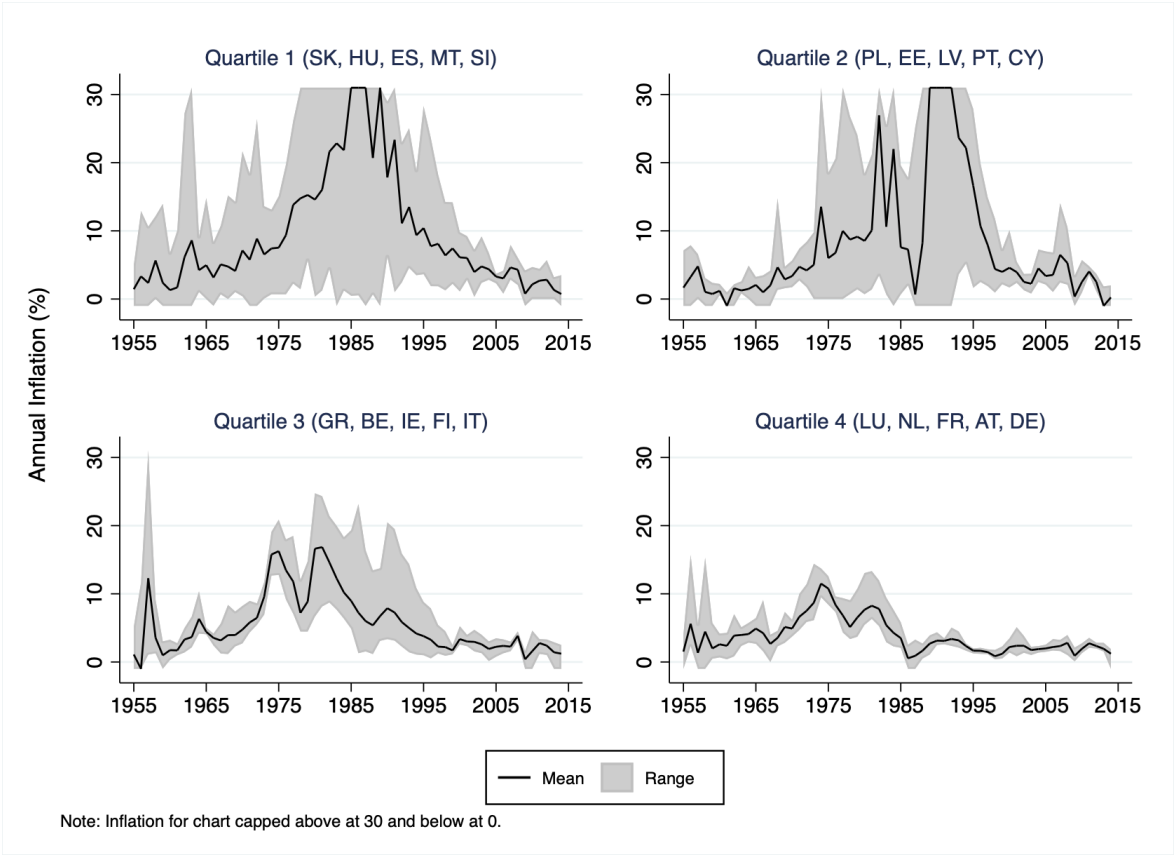


Figure A.10. Inflation history, stratified by quartile of homeownership rate

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

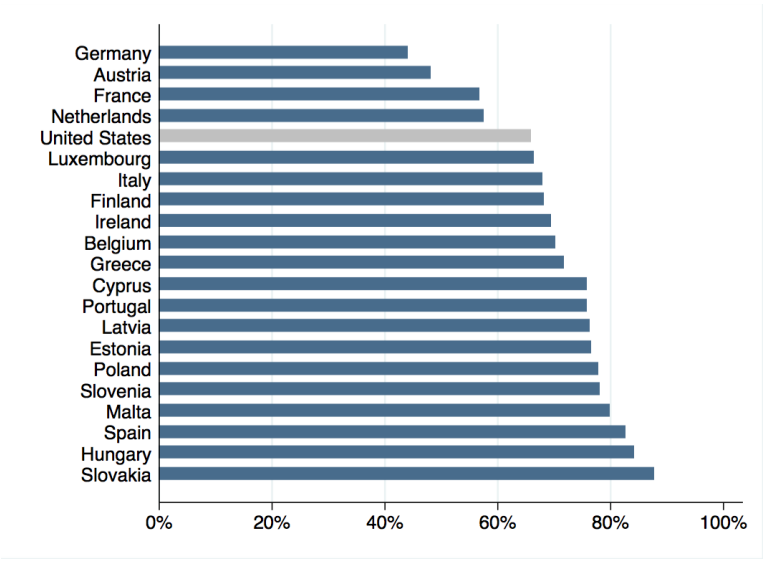


Figure A.11. Homeownership rates in Europe and the United States (2008-2015)

European data is from the 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.

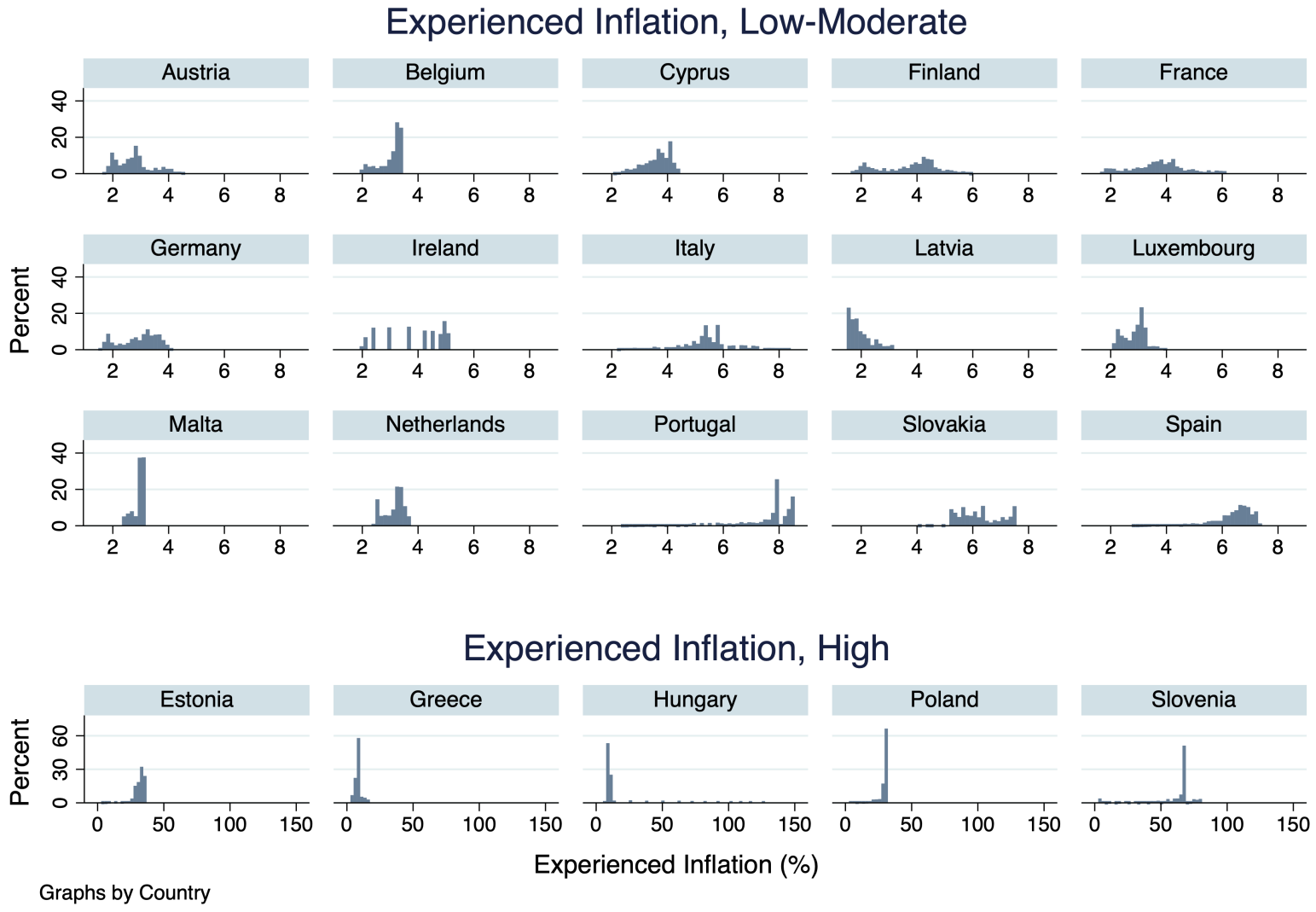


Figure A.12. Distribution of Experienced Inflation, by Country

Note: Inflation data sources described in the text.

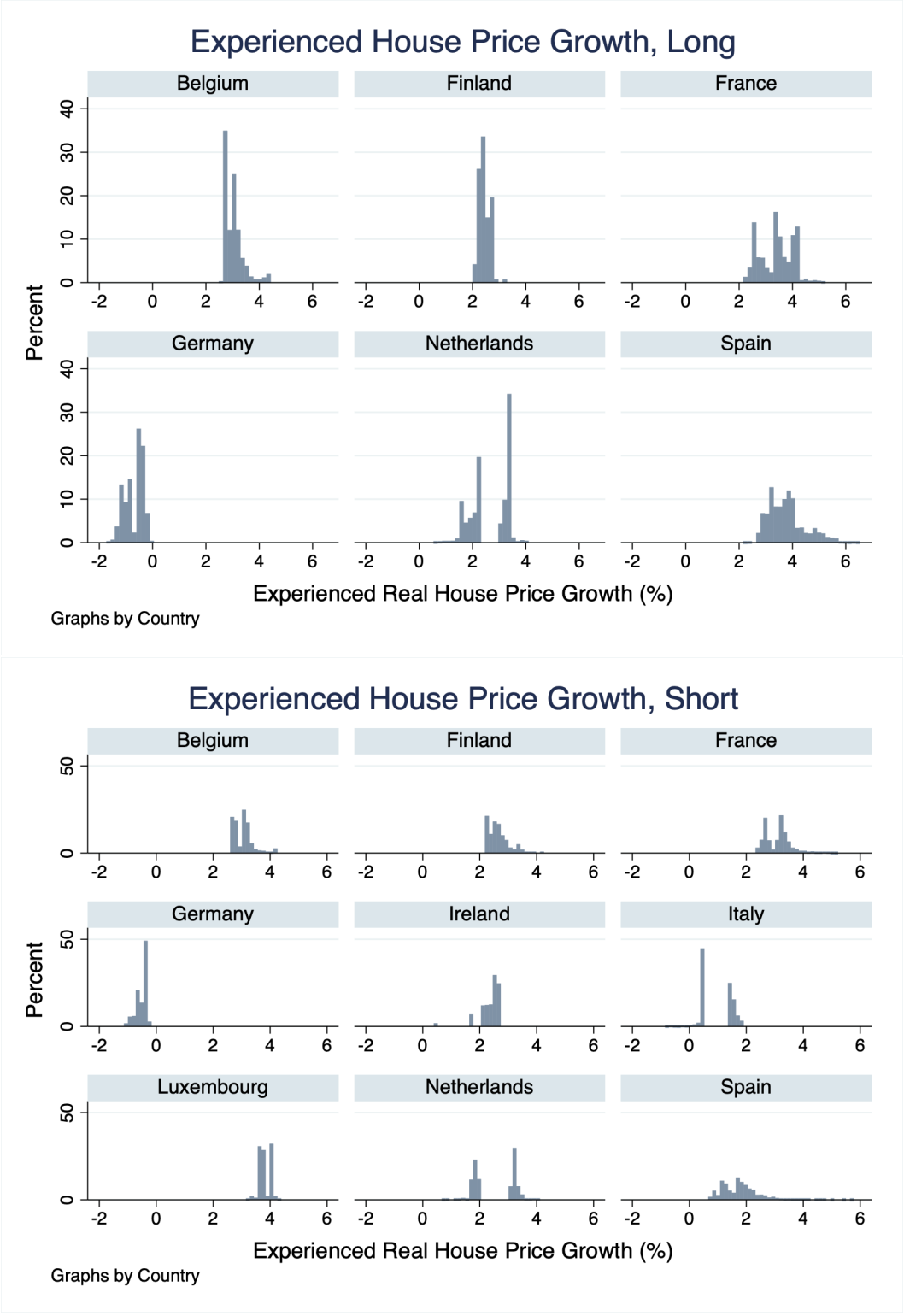


Figure A.13. Distribution of Experienced House Price Growth, by Country

Note: House price data sources described in the text.

Table A1. Summary of Real Estate Participation Rates in HFCS Countries

Country	Wave	HH in	Actual Pop. sample	Year of Survey (M)	Home-ownership 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 A2. Summary of ACS Data – Household Heads Born in U.S. and HFCS Countries

Country	Households	Experienced Inflation (%)			Homeownership	Married	Mean	Mean Percent of
		Mean	Median	Std. Dev.			Age	Life in U.S.
Austria	3,605	4.1	4.1	0.9	77%	53%	58	70%
Belgium	2,375	3.6	3.7	0.6	66%	54%	51	60%
Cyprus	302	3.9	3.8	0.5	75%	65%	50	56%
Estonia	355	18.8	4.3	20.7	60%	50%	55	54%
Finland	1,230	4.3	4.3	0.9	66%	53%	52	49%
France	12,108	4.0	4.0	1.0	62%	51%	49	58%
Germany	65,887	$2.1\text{x}10^5$	3.9	$4.7\text{x}10^6$	68%	50%	50	76%
Greece	10,328	6.6	5.1	3.2	74%	64%	56	62%
Hungary	4,955	59.5	11.2	70.7	69%	54%	59	59%
Ireland	9,222	4.4	4.2	0.8	70%	53%	54	55%
Italy	25,288	4.9	4.5	1.3	80%	62%	58	68%
Latvia	1,319	3.1	3.7	1.4	69%	51%	58	61%
Netherlands	6,416	3.7	3.8	0.6	74%	61%	55	61%
Poland	22,733	19.2	10.3	15.9	68%	62%	50	46%
Portugal	11,737	4.9	4.2	1.7	73%	68%	52	63%
Slovakia	4,030	4.6	4.2	1.7	66%	53%	53	50%
Slovenia	12,535	52.4	63.6	39.5	63%	67%	49	42%
Spain	6,001	4.5	4.4	1.1	60%	54%	47	59%
United States	12,267,948	3.7	3.8	0.5	68%	51%	49	100%
Total European	200,426	66,864	4.21	2,617,757	69%	57%	52	63%
Total with U.S.	12,468,374	1,137	3.78	340,935	68%	51%	49	

Notes: Summary of experienced inflation and homeownership in the ACS sample of households with household head born in one of 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 the 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 A3. Inflation Experiences and Homeownership: Imputed and Non-Imputed Data

Dep. Var: Own Main Residence	(1)	(2)	(3)
Log Exp. Inflation	2.745***	3.389***	2.477***
	(0.095)	(0.191)	(0.074)
Age	0.992***	0.989***	1.031***
	(0.002)	(0.003)	(0.002)
Male	0.933	0.890**	1.099***
	(0.042)	(0.052)	(0.033)
Married	1.791***	1.699***	2.381***
	(0.107)	(0.138)	(0.092)
Widow	1.576***	1.479***	1.198***
	(0.144)	(0.174)	(0.074)
Divorced	1.061	1.061	0.765***
	(0.079)	(0.108)	(0.039)
Educ:2 (middle school)	0.795***	0.754***	0.960
	(0.052)	(0.058)	(0.043)
Educ:3 (high school)	0.832***	0.829**	1.263***
	(0.053)	(0.065)	(0.050)
Educ:5 (college)	0.660***	0.662***	1.913***
	(0.049)	(0.061)	(0.086)
Has Child	1.420***	1.401***	1.494***
	(0.069)	(0.090)	(0.047)
Employed	1.448***	1.330***	1.637***
	(0.099)	(0.112)	(0.075)
Unemployed	1.390***	1.343**	0.842***
	(0.121)	(0.159)	(0.052)
Retired	1.475***	1.553***	1.171***
	(0.109)	(0.149)	(0.061)
Second Wave	1.409***	1.420***	1.074**
	(0.061)	(0.084)	(0.030)

See notes on next page.

Table A3. Inflation Experiences and Homeownership: Imputed and Non-Imputed Data (*cont'd.*)

Dependent Variable: Own Main Residence	(1)	(2)	(3)
Wealth Decile 1	0.003***	0.002***	
	(0.000)	(0.000)	
Wealth Decile 2	0.003***	0.002***	
	(0.000)	(0.000)	
Wealth Decile 3	0.020***	0.010***	
	(0.003)	(0.002)	
Wealth Decile 4	0.076***	0.051***	
	(0.010)	(0.008)	
Wealth Decile 5	0.200***	0.152***	
	(0.027)	(0.026)	
Wealth Decile 6	0.382***	0.288***	
	(0.056)	(0.050)	
Wealth Decile 7	0.569***	0.522***	
	(0.089)	(0.098)	
Wealth Decile 8	0.790*	0.677**	
	(0.111)	(0.132)	
Wealth Decile 9	0.813	0.701**	
	(0.110)	(0.123)	
Income Decile 1	2.891***	3.954***	
	(0.463)	(0.807)	
Income Decile 2	2.034***	2.516***	
	(0.326)	(0.505)	
Income Decile 3	1.896***	2.247***	
	(0.279)	(0.419)	
Income Decile 4	1.660***	1.836***	
	(0.234)	(0.335)	
Income Decile 5	1.608***	1.890***	
	(0.226)	(0.344)	
Income Decile 6	1.461***	1.746***	
	(0.203)	(0.318)	
Income Decile 7	1.481***	1.650***	
	(0.194)	(0.306)	
Income Decile 8	1.706***	1.980***	
	(0.240)	(0.367)	
Income Decile 9	1.558***	1.782***	
	(0.233)	(0.347)	
Imputed Data?	Yes	No	No
Observations	136,437	80,389	136,164
Countries	20	20	20
Pseudo R^2	0.512	0.548	0.150

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

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 the imputed data, the number of observations is the maximum N across the five imputations and the Pseudo R^2 is the average across the five imputations. Observations are weighted using the HFCS representative weights. The dependent variable is an indicator for owning the household main residence (Own HMR). Log experienced inflation is the log of weighted average of inflation over the household head's lifetime, with linearly declining weights from the year before the survey to birth year. 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 workforce (not retired), and the highest deciles of wealth and income.

Table A4. Using Experiences to Predict Price-to-Rent Ratio

Dependent Var: Price-to-Rent Ratio (Std.)	(1)	(2)	(3)	(4)	(5)
Log of Avg. Experienced Inflation (Std.)	0.41		0.09		0.18
	(0.82)		(0.19)		(0.31)
Avg. Experienced House Price Growth (Full History, Std.)		1.04***	0.97**		
		(0.07)	(0.20)		
Avg. Experienced House Price Growth (Partial History, Std.)				0.83***	0.78***
				(0.13)	(0.16)
Constant	0.18	0.30**	0.30**	0.11	0.11
	(0.46)	(0.09)	(0.09)	(0.21)	(0.22)
Observations	11	6	6	8	8
R^2	0.041	0.950	0.952	0.711	0.741

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

Notes: OLS regression coefficients with robust standard errors in parentheses. The data is the HFCS non-imputed data, averaged using representative weights. Countries weighted by population from the World Bank. The dependent variable is the price-to-rent ratio relative to the country long-run average across survey years. Experience measures are calculated as the weighted average over the household head's lifetime, with linearly declining weights from the 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. Dependent variable and all experience measures are standardized.

Table A5. Alternative Measures of Inflation Experiences and Household-Level Homeownership, Standardized Coefficients

Dependent Var: Own Main Residence	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log Exp. Inflation (std.)	1.93***							
	(0.04)							
Exp. Inflation (std.)		1.58***						
		(0.03)						
Exp. Inflation (Exclude High-Infl. Countries, std.)			1.87***					
			(0.05)					
Exp. Inflation (Wins. at 10, std.)				2.18***				
				(0.06)				
High-Inflation Exp. (Above 10)				0.69***				
				(0.05)				
Exp. Inflation (Wins. at 25 in Each Year, std.)					1.76***			
					(0.04)			
Any Year High-Inflation Exp. (Above 25)					1.74***			
					(0.10)			
Standard Deviation of Exp. Inflation (std.)						1.27***		
						(0.04)		
Pred. AR(1) 1-Year Infl. Forecast (std.)							1.28***	
							(0.04)	
Pred. AR(1) 5-Year Infl. Forecast (std.)								1.18***
								(0.04)
Observations	136,437	136,437	116,807	136,437	136,437	136,437	136,437	136,437
Countries	20	20	15	20	20	20	20	20
Pseudo R^2	0.512	0.501	0.520	0.516	0.516	0.493	0.492	0.491

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

Notes: The table reports exponentiated coefficients (odds ratios) from logit regressions with robust standard errors in parentheses. Continuous experience measures are standardized within sample. The data is the HFCS multiple-imputation data, using representative weights. The number of observations is the maximum N across the five imputations. The pseudo R^2 is the average across the five imputations. The 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 the year before the survey to birth year. High-inflation countries (where any household had a lifetime experienced inflation above 10%) include Slovenia, Estonia, Poland, Hungary, and Greece. In column (4), experienced inflation is winsorized at 10% and we include an indicator for having experienced inflation about 10%. In column (5), each year's experienced inflation is winsorized at 25% prior to averaging and we include an indicator for ever living through a year of inflation above 25%. Volatility is measured as the standard deviation of annual experienced inflation over the lifetime so far. 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. All regressions include demographic controls (age, gender, marital status, children, education, employment status, and deciles of wealth and income) and a fixed effect for survey wave.

Table A6. Summary of SHARE Data

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

Notes: Summary statistics of microdata obtained from Wave 3 of the SHARE. Homeownership variables are on the individual level and 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 A7. Inflation Experiences and First Year of Homeownership (SHARE)

	(1)	(2)	(3)	(4)
Log Experienced Inflation	1.08***	1.07***	1.13***	1.07***
	(0.01)	(0.02)	(0.01)	(0.02)
Experienced German Hyperinflation	1.20	1.72**	0.94	1.39
	(0.28)	(0.41)	(0.22)	(0.34)
Negative Experienced Inflation	0.95	0.92	1.03	1.22
	(0.17)	(0.16)	(0.17)	(0.21)
Male	0.97**	0.96**	1.04***	1.04***
	(0.01)	(0.02)	(0.01)	(0.01)
Married	11.26***	11.63***	9.51***	10.06***
	(0.37)	(0.38)	(0.30)	(0.32)
Has Child under 18	0.49***	0.49***	0.53***	0.54***
	(0.01)	(0.01)	(0.01)	(0.01)
Employed	1.59***	1.61***	1.10***	1.20***
	(0.04)	(0.05)	(0.03)	(0.03)
Sample	Complete Covariates		All Available Data	
Indicators for Missing Covariates			Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Country Fixed Effects	No	Yes	No	Yes
Observations	237,291	237,291	522,200	522,200
Individuals	17,412	17,412	26,691	26,691
Countries	14	14	14	14
Pseudo R^2	0.040	0.043	0.028	0.032

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

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. We include time-varying indicators for being married, having children under the age of 18, and being employed. Columns 1 and 2 include only individuals with complete demographic data from age 20 to the 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. Log experienced inflation is the log of weighted average of inflation over the household head's lifetime, with linearly declining weights from year before the observation year to birth year. This variable is 0 for households who lived through the German hyperinflation and for those with negative experienced inflation with corresponding indicators.

Table A8. Inflation Experiences and Homeownership (Alternative Wealth Measures)

Dependent Variable: Own Main Residence	(1)	(2)	(3)	(4)	(5)
Log Experienced Inflation	3.42***	2.75***	2.72***	3.08***	2.80***
	(0.12)	(0.09)	(0.09)	(0.11)	(0.10)
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	136,436	98,433	136,437	136,437	136,437
Countries	20	20	20	20	20
Pseudo R^2	0.213	0.408	0.512	0.507	0.463

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

Notes: The table reports exponentiated coefficients (odds ratios) from logit regressions with robust standard errors in parentheses. The data is the HFCS multiple-imputation data. With imputed data, the number of observations is the maximum N across the five imputations, and the pseudo R^2 is the average across the five imputations. Observations are weighted using the HFCS representative weights. The dependent variable is an indicator for owning the household main residence (Own HMR). Log experienced inflation is the log of weighted average of inflation over the household head's lifetime, with linearly declining weights from the year before the survey to birth year. Demographic controls include age, gender, marital status, children, education, employment, and deciles of wealth and income. All regressions also include a fixed effect for survey wave. In column 1, wealth is calculated as net home equity for owners with available price data. Column 2 excludes homeowners who do not report the purchase price of their home and uses Wealth net HMR gain, i. e., net wealth minus the gain from price appreciation of a 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.