Homeownership and the Cost of Living*

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Preliminary

Abstract

How should price indices account for durable goods like housing, which are debt-financed, held for years, and resold? This paper proposes a price index for shelter that addresses key limitations of owners' equivalent rent and the one-period user cost. We first show in a stylized model that preference heterogeneity between owning and renting can rationalize differences between rental rates and the user cost but also implicates the welfare impact of shelter inflation. We measure this heterogeneity using a custom survey and find that households' willingness-to-pay for homeownership is both large and heterogeneous. We extend the insights of our stylized model to a general dynamic setting and derive a price index that depends on the timing of changes to non-durable consumption to offset changes in shelter costs and of foregone utility by households induced to rent rather than own. We calibrate a quantitative version to the survey evidence and other moments and apply our results to measure the change in the cost-of-shelter when mortgage rates increase. In response to a permanent 2 percentage point increase in the mortgage rate, our shelter price index rises by 0.75 percentage point, primarily due to the lost surplus of would-be homeowners. We argue that this better captures the true welfare impact than owners' equivalent rent, which does not change by construction, or the one-period user cost, which increases 10%.

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1 Introduction

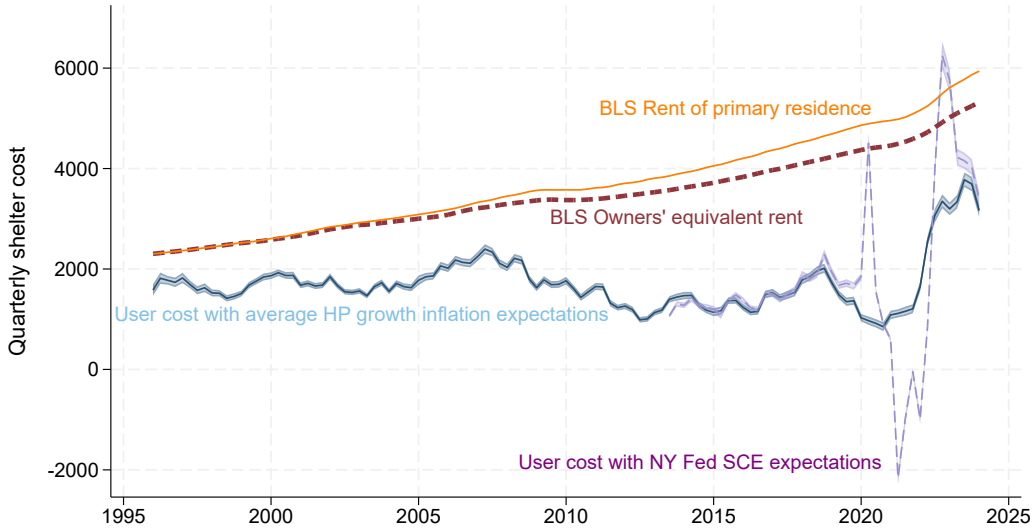
How should price indices treat durable goods, like housing, that are often debt-financed, owned for many years, and eventually resold? Standard indices follow the structure of a static expenditure function which assumes that all goods are rented. Yet correcting nominal incomes with a rent-based cost of living adjustment may badly mistate the true change in well-being for a population that contains large numbers of highly indebted owners. Adjusting pension or wage payments based on a rent-based inflation measure will introduce volatility to permanent income for a population that is largely living in owner-occupied housing.

This paper reconsiders how to incorporate shelter costs into a Consumer Price Index (CPI), taking into account the dynamic aspects of housing. Shelter is the largest expenditure item in the U.S. CPI. It comprises 32% percent of total costs, divided between a straightforward 7.5% of rental costs paid by renters and a far more complicated 25.1% of total spending associated with owners. Currently, the CPI measures shelter inflation for owners using the growth rate of actual rents reweighted to match the characteristics of owner-occupied properties, referred to as owners' equivalent rent (Poole, Ptacek and Verbrugge, 2005). Owners' equivalent rent may differ from the traditional concept of the one-period user cost, which combines maintenance costs, either interest costs or the opportunity cost of financial asset returns or both, and expected house price appreciation over the period (Steiner, 1961; Poterba, 1984). Consequently, the CPI does not capture any of the pain experienced by new home buyers when interest rates increase, even though those costs are seen by most economists as an important component of the cost of housing.

The conceptual case for using owners' equivalent rent is that standard models predict that in equilibrium the expected costs of renting should equal the expected costs of owning. Yet historical time series show that rents are far less volatile than user costs (Verbrugge, 2008). Furthermore, when transaction costs are substantial and people rarely buy and re-sell houses, the one-period user cost does not equal the cost of owning for incumbent owners.

Figure 1 shows rental rates and one-period user costs for the U.S. over 1995-2025 (see Appendix A for details of the data construction). The solid orange line shows rent of primary residence and the dashed red line shows owners' equivalent rent. Both series trend up relatively smoothly. The blue shows the one-period user costs of housing, where expected housing price

Figure 1: Rent, Owners' Equivalent Rent, and User Cost



Notes: We construct the user cost measures... See Appendix A for details.

growth is fixed at the average growth rate from 1995-2025. The dashed purple line gives user costs, where expected housing price growth is based on the Federal Reserve Bank of New York Survey of Consumer Expectations. These measures exhibit much more high frequency volatility and even have different low frequency trends than the rent series. Both user cost measures rise sharply in 2022 with the rise in mortgage interest rates. The user cost measures are also typically less than the rent costs, because of expected or realized housing price appreciation and the absence of transaction costs, and they are even negative during some periods.

Our paper first characterizes shelter inflation in Section 2 in a model with no transaction costs where households differ only in their non-pecuniary taste for owning, which we denote θ. These tastes may differ over the lifecycle and could reflect the desire for customization, or for idiosyncratic house or neighborhood characteristics that are associated with home ownership. The marginal buyer equates rental costs with her user cost minus her non-pecuniary utility from owning. Changes in homeownership rates therefore imply that the identity of the marginal home buyer changes, rationalizing a time-varying wedge between user costs and rents.

In this simple framework, changes in rents correctly characterize shelter inflation when homeownership and hence the θ of the marginal buyer remains fixed. But shelter inflation is not in general independent of changes in mortgage rates, unlike in the CPI. Higher rates directly in-

crease the cost of owning and also reduce the number of home buyers. Households that would have bought at lower rates have lost consumer surplus when they remain renters under the new rates. The loss in surplus depends on the change in homeownership and the distribution of tastes.

To assess the magnitude of this loss, we elicit preferences for homeownership in a customized survey. Our survey, which we describe in Section 3, provides respondents with a comparison of the cost of owning or renting over ten years and asks how much (if any) terminal wealth they would forgo to own rather than rent (where terminal wealth in the renting scenario fluctuates due to the returns on investment of their foregone downpayment). The distribution of elicited willingnes-to-pay (WTP) to own has a positive mean and is right skewed. As our model suggests, owners have higher average willingness-to-pay to own than renters. As validation, we re-surveyed respondents one month later and found that the preferences of individual respondents were relatively stable.

We then propose a price index for durable goods for settings with transaction costs and long-term contracts when there is no clear per-period price. As in Bajari, Benkard and Krainer (2005), the undisputed measure of intertemporal welfare is the value function consisting of the present value of the stream of nondurable consumption and utility from housing. In Section 4, we first characterize this value function in money-metric terms. We then calculate the transfer required to offset changes in nondurable consumption and housing utility each period due to changes in shelter costs. That transfer represents the cost of housing.

Intuitively, an increase in the cost of owning has two effects. First, from the intertemporal budget constraint, the change to the present value of spending on shelter requires a matching change in the present value of nondurable consumption. We allocate this present value across periods using agents' intertemporal marginal propensities to consume (Auclert, Rognlie and Straub, 2024), such that the price index path coincides with the timing of changes to utility from nondurable consumption. Second, housing utility falls if homeownership declines, as with the decline in consumer surplus in the simple model in Section 2.

In principle, measuring the empirical link between changes in shelter cost and and changes in nondurable consumption, homeownership, and the covariance of ownership with utility θ is sufficient to compute the price index. But these are complex empirical objects. We therefore build a quantitative model in which we can assess welfare and price indexes. Section 5 augments

Section 2 by including moving costs which generate long tenures, a heterogeneous propensity to make an exogenous move, and liquidity constraints. Owners finance their home purchase with 30 year fixed payment mortgages that include an option to refinance, while renters sign contracts with below-market rent growth that reset when they move. Both of these assumptions capture features of America's housing market. The decision to own a home reflects four forces: (i) preference for owning θ; (ii) the likelihood of an exogenous move (transaction costs are higher for owners), (iii) ability to make a down payment, and (iv) differences in rent paid between incumbents and new renters and (v) differences in mortgage costs for buyers relative to the steady state.

We calibrate the model to our survey results and to other moments of the data. We first set several parameters using external moments, including trend rent growth, transaction costs, discount and mortgage rates, and the supply curve for converting owner-occupied and rental housing. We introduce a stylized life-cycle process for the dynamics of the θ distribution that combines an upward drift with a periodic "reset" drawn from a normal distribution. This process generates an ergodic distribution that is approximately normal for lower values and exponential for higher values, which is consistent with our survey evidence on willingness-to-pay. With these parameters fixed, we calibrate the remaining parameters related to exogenous moves, the ability to make a down payment, and the flow cost of owning to match six moments in the model's steady state: the WTP premium for owners, four hazard rates for transitioning across owning and renting, and the share of renters with liquid assets below a minimum down payment threshold.

We apply our results to measure the change in the cost-of-shelter when mortgage rates increase, as occurred in the U.S. in 2022. We consider a permanent two percentage point increase in the mortgage rate with rents remaining fixed. As homeownership becomes more expensive, rent-to-own transitions decline and own-to-rent transitions rise. Due to "housing lock" (Liebersohn and Rothstein, 2025; Batzer et al., 2024; Fonseca and Liu, 2023), own-to-rent transitions remain elevated for several periods; households with low mortgage rates remain owners until they receive an exogenous moving shock. As a result, both house prices and homeownership drop in the first year of the rate increase and continue to decline thereafter. As homeownership falls, the average and marginal homeowners' taste for homeonwership (θ) rises.

Our shelter price index jumps about 0.75 percentage points when the mortgage rate increases.

Roughly 40 percent of this increase is due to higher lifetime shelter costs and 60 percent is due to the foregone utility of homeowners who have switched to renting. Other possible price indexes deliver a different message about the change in consumer welfare from the rate increase. By construction, a price index based on owners' occupied rent does not change since rents do not change. The one-period user cost increases more than 10% on impact, reflecting both the higher mortgage rate and the anticipated future house price decline due to the slow transition from owning to renting.

Section 7 concludes by summarizing directions for future research.

A Very Short History of Shelter Indices and Other Related Literature. Statistical agencies have debated for decades how to treat housing in the CPI. Prior to 1983, the U.S. measured shelter inflation for owners as a weighted average of the realized changes in house prices, mortgage interest costs, property taxes, insurance, and maintenance. Key papers in the debate over switching to owners' equivalent rent or the user cost include Dougherty and Order (1982) and Gillingham (1983), with Gillingham and Lane (1982) giving the official version for the BLS. These papers recognized but did not resolve the time series differences between the user cost and rent. Given the additional implementation issues required to compute the user cost, such as house price expectations and discount rate assumptions, BLS simply opted for owners' equivalent rent.

The debate among statistical agencies remains unresolved. The most recent *Consumer Price Index Manual* of the United Nations calls the treatment of owner-occupied housing "one of the most difficult issues faced by CPI compilers" (International Monetary Fund et al., 2020, p. 245) and outlines four approaches in use internationally: user costs, rental equivalence, a "payments" approach that includes all expenditure specific to owner-occupiers, and an "acquisitions" approach similar to the treatment of other durables that includes net purchases of dwellings and new construction. The *Manual* notes that many countries make *ad hoc* adjustments to these approaches, such as excluding the capital gain component of the user cost. Diewert and Shimizu (2021) advocate a fifth approach of using the maximum of owners' equivalent rent and the user cost. In our view, this debate remains unsettled because of the absence of a theoretical framework that reconciles the behavior of rents and user costs and, more deeply, that durable goods such as housing do not neatly fit into the standard theoretical framework underpinning consumer price indexes.

Indeed, International Monetary Fund et al. (2020, p.254) states that the rental equivalence approach "approximates the user cost approach" despite their very different time series behavior. Acknowledging that our full approach may pose implementation difficulties, we hope that the conceptual framework may stimulate new practical resolutions.

The academic literature has recognized the tension between an intertemporal world and static price indexes but reached different conclusions. Alchian and Klein (1973) argued that a price index used to measure inflation must include asset prices. Reis (2005) offers a modern treatment of what he calls "dynamic inflation" but retains the assumption for durable goods of zero transaction costs so that the one-period user cost applies. While we sympathize with the theoretical purity of including all asset prices in a dynamic world, we confine our measurement to shelter where these considerations are unavoidable while also incorporating realistic long-term contracts. Our approach of distributing the change in the value function across periods is in some ways the reverse of Baqaee, Burstein and Koike-Mori (2024), who derive a method to translate per-period price changes into changes in the value function. They allow for more flexibility in the consumption-savings problem but also restrict consideration of durables to the one-period user cost. Bolhuis et al. (2024) and Astin and Leyland (2023) argue that interest rates affect the cost of living, but differ in whether the CPI should incorporate them directly.

Academics and practitioners have also debated how to measure shelter costs for renters, since most rental contracts are long-term. Under current practice, the CPI measures average rent growth for all renters (with a lag structure for sampling reasons). **?** advocates for using rent growth of new tenants only. Our methodology can accommodate either extreme, depending on when agents change their nondurable consumption in response to a change in new tenant rent.

The link between the price index and the change in the intertemporal budget constraint builds on earlier results related to consumption out of housing wealth (Sinai and Souleles, 2005; Campbell and Cocco, 2007; Guren et al., 2020) or more general asset price fluctuations (Fagereng et al., 2024). Our measure accords with these papers in incorporating house price changes only insofar as agents will transact in the future and therefore adjust their consumption today. Relative to Berger et al. (2017) and Greaney, Parkhomenko and Van Nieuwerburgh (2025), our quantitative model simplifies aspects of the consumption-saving problem such as life cycle dynamics or unin-

surable idiosyncratic income risk in order to focus more sharply on housing dynamics in general equilibrium.

Like us, several articles have incorporated a preference for owning over renting into a tenure choice framework (Piazzesi and Schneider, 2016; Kaplan, Mitman and Violante, 2020). The closest treatment is in Greenwald and Guren (forthcoming), who also use heterogeneity in this parameter to generate a downward-sloping demand curve for owner-occupied housing. We contribute to this modeling framework by providing explicit discipline on the level of and heterogeneity in this preference using our survey evidence.

Last, given its weight in the CPI, the debate over measurement of shelter costs inevitably touches on the practice of monetary policy. Indeed, one motivation for the 1983 change to owner equivalent rent may have been to remove the direct feedback from higher interest rates into inflation. While our measure restores this link, we think the appropriate response involves changing the target rate of inflation for monetary policy rather than distorting measurement of the cost-of-living. Along these lines, Bianchi, McKay and Mehrotra (2025) argue that monetary policy should ignore housing inflation because housing is inelastically supplied.

2 Static Model with Preference Heterogeneity

This section presents an equilibrium model of house prices and homeownership where households have heterogeneous preferences for owning and renting. Our goal here is to examine the link between rents and the user cost of housing, and to develop formulas for measuring inflation when rent, interest rates, or other shelter-related variable change. To promote clarity, we omit elements such as moving costs, fixed rate mortgages, or liquidity constraints that we introduce in Section 5.

2.1 Setup

The economy consists of a continuum of agents indexed by their preference for owning θ, with $\theta \sim F_\theta(\theta)$. Each agent consumes one unit of housing and freely chooses whether to rent or own each period. We let $\mathcal{H}_t(\theta)$ denote an indicator function equal to 1 if an agent of type θ owns and 0 otherwise and $h_t = \int \mathcal{H}_t(\theta)\, dF_\theta(\theta)$ the homeownership rate.

Prices. We denote market rent by R_t. Since all housing units are identical, R_t also corresponds to owners' equivalent rent. Owners make a down payment $(1-\ell_t)\,P_t^H$, where ℓ_t is the loan-to-value ratio and P_t^H the price of a house, and then make interest payments given mortgage rate i_t of $i_t\ell_t P_t^H$, a payment $f_t P_t^H$ to cover property taxes, maintenance, and insurance. Owners then resell their house at the beginning of the next period, recouping $P_{t+1}^H - \ell_t P_t^H$. If agents discount the sale proceeds using a discount factor $\beta_{t,t+1}$, then the cost of owning can be written as the user cost $\rho_t P_t^H$, with:

$$\rho_t \equiv (1-\ell_t)\,(1-\beta_{t,t+1}) + \ell_t i_t + f_t - \beta_{t,t+1}\mathbb{E}_t\left[\frac{P_{t+1}^H - P_t^H}{P_t^H}\right]. \tag{1}$$

The user cost consists of a weighted average of the discount and mortgage rates, plus the flow maintenance cost, less the expected discounted house price appreciation, all scaled by the house price. The bundling of home-buying with mortgage financing makes mortgage costs an inextricable component of the cost of homeownership.

Preferences. We normalize the consumption-equivalent utility benefit from renting to 0. Thus, flow net utility of renters is $U_t\left(\theta|\mathcal{H}_t\left(\theta\right)=0\right) = -R_t$. Agents differ in their non-pecuniary consumption-equivalent utility from owning. An agent of type θ receives utility $\theta\bar{R}_t$, where the scalar $\bar{R}_t$ denotes rent along the balanced growth path.[1] Thus, an agent with $\theta = 0$ receives no additional utility from owning relative to renting. Section 3 relates θ to preferences for owners' ability to customize their houses, for neighborhoods dominated by owner-occupied housing, or for privacy from landlord intrusion, among other factors. The net utility for an owner over the period is therefore $U_t\left(\theta|\mathcal{H}_t\left(\theta\right)=1\right) = \theta\bar{R}_t - \rho_t P_t^H$. Each agent draws a new θ with probability δ_θ each period.

Supply. The price of a rental unit depends on the gross inverse net "capitalization rate" c_t:

$$c_t = \frac{P_t^R}{R_t}. \tag{2}$$

"Private equity firms" can convert a rental to an owner-occupied unit at a cost $g(h)$ proportional to the value of a rental building, with $g'(h) > 0$. The function $g(h)$ may reflect the cost of literal

[1] We scale utility by trend rather than actual rent so that deviations of market rent do not mechanically affect utility from owning.

conversion from owner-occupied to rentals, or, in the presence of depreciation, the cost of changing the mix of new residential investment towards one of the categories.

2.2 Equilibrium

There are three equilibrium conditions. The first defines a cutoff value θ_t^* at which an agent is indifferent between renting and owning:

$$-R_t = \theta_t^* \bar{R}_t - \rho_t P_t^H \Longrightarrow \rho_t P_t^H = R_t + \theta_t^* \bar{R}_t. \tag{3}$$

According to equation (3), the user cost equals market rent shifted by $\theta_t^* \bar{R}_t$. With a degenerate distribution of θ and an interior value of the homeownership rate, this equation requires that market rent perfectly tracks the user cost.

With heterogeneity in θ, market rent can move differently from the user cost as the cutoff value θ^* varies. Thus, preference heterogeneity can resolve the dichotomy between the time series of rents and user costs. Section 5 will introduce additional sources of heterogeneity (in expected duration and liquidity) that will make the indifference condition multidimensional; at this point, the taste for homeownership (θ) provides the only of heterogeneity.

The second equilibrium condition requires landlords to be indifferent between operating a building as a rental and converting it to an owner-occupied unit:

$$c_t R_t = P_t^R = P_t^H - g\left(h_t\right) c_t R_t \Longrightarrow P_t^H = \left(1 + g\left(h_t\right)\right) c_t R_t. \tag{4}$$

Combining equations (3) and (4) relates θ^* to the homeownership rate:

$$\theta_t^* = \left(R_t / \bar{R}_t\right) \left(\left(1 + g\left(h_t\right)\right) c_t \rho_t - 1\right). \tag{5}$$

Market clearing gives the third equilibrium condition:

$$h_t = 1 - F_\theta\left(\theta_t^*\right). \tag{6}$$

Equations (5) and (6) determine θ^* and h as functions of the conversion cost function $g(h)$, the capitalization rate c, the user cost component r, and the preference distribution F_θ. In particular, we have the following result (see Appendix B.1):

Proposition 1 *There exists a balanced growth path with $c_t = c, \rho_t = \rho$, and $R_t = \bar{R}_t$. Along this balanced growth path, the cutoff θ^* and homeownership rate h are constant.*

2.3 Shelter Inflation

We now define the fixed-utility price index. Using equation (3), equilibrium utility is:

$$U_t(\theta) = \begin{cases} -R_t, & \theta < \theta_t^* \Rightarrow \mathcal{H}_t(\theta) = 0, \\ (\theta - \theta_t^*)\bar{R}_t - R_t, & \theta \geq \theta_t^* \Rightarrow \mathcal{H}_t(\theta) = 1. \end{cases} \tag{7}$$

Let $X_t(\theta)$ denote shelter expenditure, with $X_t(\theta|\theta < \theta_t^*) = R_t$, $X_t(\theta|\theta \geq \theta_t^*) = R_t + \theta_t^* \bar{R}_t$.

For an agent with $\theta_{t+1} = \theta_t$, the fixed-utility price index $dP_{t+1}(\theta)$ is defined as the fraction of initial expenditure required as a transfer to keep utility fixed when shelter costs change:

$$dP_{t+1}(\theta) = \frac{U_t(\theta) - U_{t+1}(\theta)}{X_t(\theta)}. \tag{8}$$

Using equations (3) and (7):

$$dP_{t+1}(\theta) = \begin{cases} \dfrac{R_{t+1} - R_t}{R_t}, & \mathcal{H}_t(\theta) = \mathcal{H}_{t+1}(\theta) = 0, \\ \dfrac{R_{t+1} - R_t + \left(\theta_{t+1}^* \bar{R}_{t+1} - \theta_t^* \bar{R}_t\right) - \theta\left(\bar{R}_{t+1} - \bar{R}_t\right)}{R_t + \theta_t^* \bar{R}_t}, & \mathcal{H}_t(\theta) = \mathcal{H}_{t+1}(\theta) = 1, \\ \dfrac{R_{t+1} - R_t + (\theta - \theta_t^*)\bar{R}_t}{R_t + \theta_t^* \bar{R}_t}, & \mathcal{H}_t(\theta) = 1, \mathcal{H}_{t+1}(\theta) = 0, \\ \dfrac{R_{t+1} - R_t - \left(\theta - \theta_{t+1}^*\right)\bar{R}_{t+1}}{R_{t+1}}, & \mathcal{H}_t(\theta) = 0, \mathcal{H}_{t+1}(\theta) = 1. \end{cases} \tag{9}$$

The first line gives the required transfer for types who rent in both periods, the second line the transfer for types who own in both periods, the third line is the transfer for types who own in t and rent in $t+1$, and the fourth line provides the transfer for types who rent in t and own in $t+1$.

The aggregate price change is the expenditure-weighted transfer:

$$dP_{t+1} = \int dP_{t+1}(\theta)\, dw_t(\theta), \tag{10}$$

where $dw_t(\theta) = X_t(\theta)dF(\theta) / \int X_t(\theta')dF(\theta')$ is the share of aggregate shelter expenditure by type θ. The reshuffling of θs as agents take new draws from $F_\theta(.)$ creates winners and losers but does not change the required aggregate transfer: equation (10) . Applying the expenditure weights for renters and owners to equation (9), we can now state the main results of this section concerning shelter inflation:

Proposition 2 *If there is a change so that $\theta^*_{t+1} \geq \theta^*_t$, thenthe aggregate transfer to keep utility fixed is:*

$$X_t dP_{t+1} = \overbrace{(R_{t+1} - R_t)}^{\text{Rent change}} + \overbrace{\left(h_{t+1}\theta^*_{t+1}\bar{R}_{t+1} - h_t\theta^*_t\bar{R}_t\right)}^{\text{Additional owner costs}} + \overbrace{\left(\mathbb{E}_\theta\left[\mathcal{H}_{t+1}(\theta)\,\theta\bar{R}_{t+1}\right] - \mathbb{E}_\theta\left[\mathcal{H}_t(\theta)\,\theta\bar{R}_t\right]\right)}^{\text{Utility change}},$$

where: $\mathcal{H}_t(\theta) = \mathbb{I}\{\theta \geq \theta^*_t\}$.

The first term in proposition 2 contains the change in market rent. The second term contains the change in the additional costs of owning, due to movements along the supply curve as θ^* changes or a user cost-rent ratio above one. The third term contains the change in utility for agents who previously owned and now rent. Lemma 1 elucidates the implications in three special cases.

Lemma 1 *(i) Suppose $\theta = \bar{\theta}$ for all agents. Then:*

$$X_t dP_{t+1} = R_{t+1} - R_t.$$

(ii) Suppose $R_{t+1} \geq R_t$, $g(.), \rho, \bar{R}$ do not change, and c adjusts such that $h_{t+1} = h_t$.[2] *Then:*

$$X_t dP_{t+1} = R_{t+1} - R_t.$$

(iii) Suppose $i_{t+1} > i_t$ unexpectedly and (in expectation) permanently and $g(.), c, R, \bar{R}$ do not change. Then:

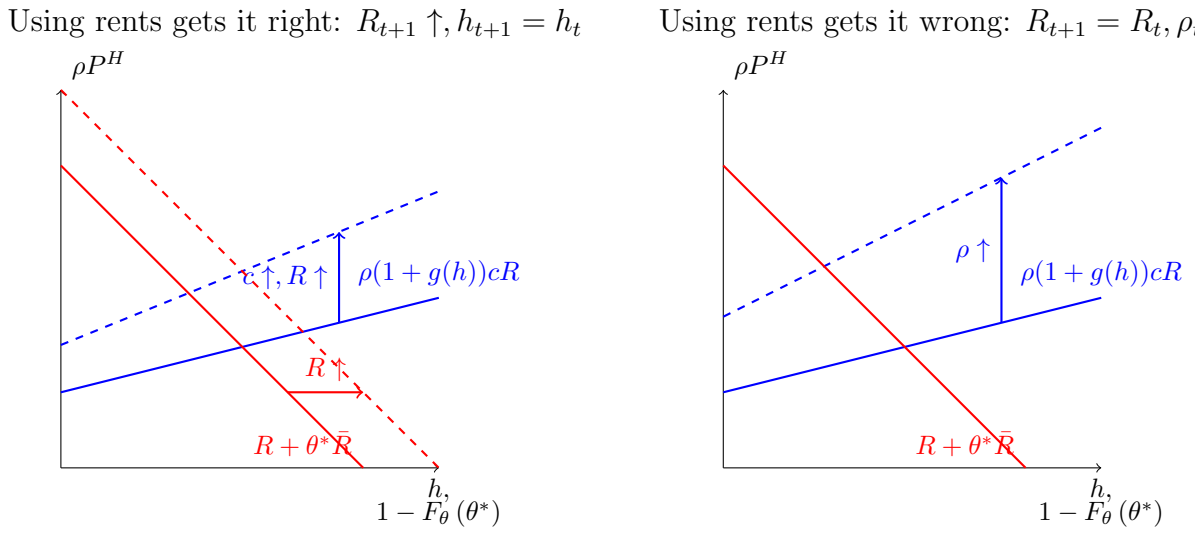
$$X_t dP_{t+1} = \overbrace{h_{t+1}\left(\theta^*_{t+1} - \theta^*_t\right)\bar{R}}^{\text{Owner costs}} + \overbrace{(h_t - h_{t+1})\,\mathbb{E}_\theta\left[\theta - \theta^*_t | \theta^*_t \leq \theta < \theta^*_{t+1}\right]\bar{R}}^{\text{Extensive margin consumer surplus}}.$$

Part (i) removes preference heterogeneity by fixing $\theta = \bar{\theta}$ for all agents. In this case, utility is $-R_t$ whether an agent owns or rents (see equation (7)) and using owners' equivalent rent gets shelter inflation right (the second and third terms in proposition 2 cancel). However, equation (3) shows that this case cannot reconcile the time series differences between rent and the user cost.

Heterogeneity in θ can reconcile the time series of user costs and rent, but that heterogeneity also introduces additional terms into the price index, which are captured by parts (ii) and (iii) of Lemma 1. Part (ii) considers a change in market rents with no change in homeownership and zero

[2] That is, given initial θ^*_t, h_t, $c_{t+1} = \frac{1+\theta^*_t\bar{R}_{t+1}/R_{t+1}}{(1+g(h_t))\rho_t}$.

Figure 2: Illustration of Lemma 1



trend rent growth. In this case, using owners' equivalent rent for owners still gets the contribution of shelter inflation right.[3] The left panel of Figure 2 demonstrates that when homeownership doesn't change, the shift right in the downward-sloping line exactly equals the change in the user cost.

Part (iii) of Lemma 1 and the right panel of Figure 2 consider a change in the user cost, due to an unexpected and (in expectation) permanent increase in the mortgage rate. Using owner-equivalent rent now gets shelter inflation wrong, since by assumption market rents have not changed. Intuitively, a slight rewriting of the latter two terms in proposition 2 shows two contributions: $h_{t+1}\left(\theta^*_{t+1} - \theta^*_t\right)$, the increase in the user cost for those that continue to own after the interest rate increase, and $(h_t - h_{t+1})\,\mathbb{E}_\theta\left[\theta - \theta^*_t | \theta^*_t \leq \theta < \theta^*_{t+1}\right]\bar{R}_t$, the foregone consumer surplus as agents who previously owned now rent.[4]

Having demonstrated why fixed-utility shelter inflation may depart from the growth of owner-equivalent rent, we now turn to measurement of θ.

[3] When $\bar{R}_{t+1} = \bar{R}_t$, rent change on the balanced growth path is zero, as is total shelter inflation. Non-zero trend rent growth introduces the additional term $\mathbb{E}_\theta\left[\theta \geq \theta^*_{t+1}\right]\left(\bar{R}_{t+1} - \bar{R}_t\right)$ coming from the change in non-pecuniary utility for owners. This term arises because trend growth implies rents grow faster than the rest of the economy (the numeraire) and a balanced growth path requires non-pecuniary utility from owning to be a fixed proportion of trend rent and hence a growing share of the total economy.

[4] That is, $\mathbb{E}_\theta\left[\mathcal{H}_t(\theta)\,\theta\right] = h_t \mathbb{E}_\theta\left[\theta | \theta \geq \theta^*_t\right]$, so $\mathbb{E}_\theta\left[\mathcal{H}_t(\theta)\,\theta\right] - \mathbb{E}_\theta\left[\mathcal{H}_{t+1}(\theta)\,\theta\right] = h_t \mathbb{E}_\theta\left[\theta | \theta \geq \theta^*_t\right] - h_{t+1}\mathbb{E}_\theta\left[\theta | \theta \geq \theta^*_{t+1}\right] = (h_t - h_{t+1})\,\mathbb{E}_\theta\left[\theta | \theta^*_t \leq \theta < \theta^*_{t+1}\right]$.

3 Survey Evidence on Preferences for Owning

This section presents our survey evidence on preferences for owning versus renting. We survey 1000 individuals using the online platform Prolific, selected to be nationally representative by age, gender, and race.[5]

3.1 Benchmarking

Tables B.1 and B.2 compares the demographics of our survey respondents to the general population of household heads and their partners in the Current Population Survey and Survey of Income and Program Participation. Our survey over-weights college-educated respondents, but otherwise contains reasonable balance over age, gender, marital status, and number of children. Crucially, our survey also contains a representative share of owners and renters. We do not re-weight along any dimension.

Table B.3 compares the rent and owner's equivalent rent reported in our survey to the values reported in the Consumer Expenditure Survey. The distribution of owner's equivalent rent is quite similar. Our survey contains a similar median but slightly less variance of rent than the CEX.

Appendix C.2 compares the reasons why people last moved reported in our survey to related questions asked in the Survey of Income Program and Participation (SIPP), American Housing Survey (AHS), and Current Population Survey Annual Social and Economic Supplements (CPS-ASEC). Our survey, the SIPP, and the CPS-ASEC offered the response "Wanted to own home, not rent" and in all three surveys this response was selected more than other by current owners. Of course, wanting to own does not distinguish financial from preference reasons, a task we turn to next. We also find suggestive evidence of preferences related to family structure as most important for changes from owning to renting.

3.2 Willingness-to-Pay to Own

We solicit respondents' willingness-to-pay (WTP) by asking them what additional financial windfall from not owning and investing in the market they would be willing to forgo in order to own.

[5]We require participants to own their property or live in privately rented accommodation. We exclude three individuals who restarted the survey after being screened out on this question. We also exclude an additional three renters who reported paying zero monthly rent and one owner who reported a value of zero for the rent if someone were to rent his/her home, leaving a maximum of 993 observations in what follows.

Appendix C provides screenshots of the relevant part of the survey. For current owners, we frame this scenario as a comparison between buying and renting and total wealth 10 years later, holding other aspects of life the same. For current renters, we add to the comparison a hypothetical inheritance of $25,000 to ensure that a down payment constraint does not prevent them from choosing to own. We show both groups a side-by-side comparison of living situation (own and pay down mortgage or rent), initial investment (down payment or invest in diversified portfolio), and terminal wealth composition (proceeds from sale net of mortgage repayment plus any additional savings or investment portfolio plus any additional savings). We then instruct the respondent to imagine that total wealth in both the owning and renting scenarios is the same after ten years and ask whether they would have chosen to buy or rent or are indifferent between the two options. For those opting to buy, we ask for the maximum additional wealth in the rental scenario at which they would still choose to buy (and symmetrically if they opted to rent).[6]

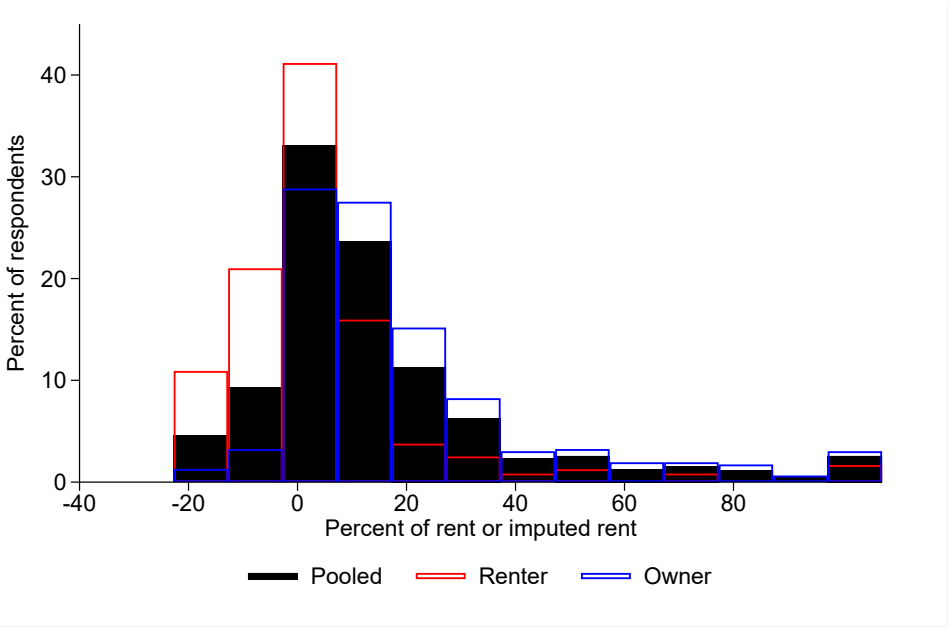
Three additional design details merit mention. First, we ask the WTP question after a series of questions about why the person last moved and why they currently own or rent. This sequencing may prime respondents to think about tenure choice. We think of such priming as an advantage in stimulating more accurate responses. Nonetheless, our follow-up validation did not first ask questions about reasons for tenure choice and we find our main results are robust in this sample. Second, we randomized two aspects of this procedure: (i) whether we specify that the respondent would buy or rent exactly the same property or not, (ii) whether the respondent enters the maximum WTP using a slider or via a repeated incrementing loop. We control below for these features and find neither has statistical power for predicting WTP, although the point estimate for being told it would be the identical house is consistently negative. Third, about 18% of respondents chose the maximum possible WTP on the slider or loop; for these respondents we implemented a short (2 minute) follow-up survey about one week later to solicit a numeric value. We obtained a response rate of 94% in this follow-up survey and use the reported values for these respondents.

Figure 3 reports the distribution of annualized WTP as a fraction of rent or imputed rent. We scale by these values because our model does not have variation in rent across households.[7]

[6]The framing in terms of wealth after ten years is intended to focus the choice on non-pecuniary components. For example, in a different part of the survey some owners report that they prefer to own to avoid the uncertainty of rent fluctuations. A comparison of *ex post* terminal wealth should not reflect such *ex ante* uncertainty.

[7]Figure B.5 and Table B.4 repeat Figure 3 and Table 1 when scaling WTP by the sample average rent/equivalent

Figure 3: WTP Distribution



Notes: The figure reports the histogram of willingness-to-pay as a share of rent or equivalent rent. We winsorize the top and bottom 2.5% of observations.

Overall, WTP is right-skewed, with a modal value near zero but a tail extending to 80% of rent. Strikingly, current renters are much more likely to have negative or zero WTP while current owners account for most of the positive mass.

Table 1 reports regressions of WTP as a function of tenure, for various samples and weighting schemes. Column (1) includes all respondents except ten individuals who reported annualized WTP$\geq$ \$100k.[8] Owners exhibit a 15.4p.p. higher WTP/imputed rent than renters and this difference is highly statistically significant. Columns (2)-(5) instead winsorize WTP/imputed rent at the 2.5% and 97.5% level. Column (3) weights by respondents' self-reported confidence in their response (the observation difference reflects respondents who did not answer this question). Column (4) excludes respondents who fail the first attention check ("Type Attention is Key" into a text box), those who report in a follow-up screen that their selected WTP does not represent their true valuation (because either they clicked the wrong answer or were confused by the question), and those reporting rent or equivalent rent less than \$500 or greater than \$15,000. This is our

rent of \$2000 per month rather than the respondent's rent. The distribution of WTP and the owner premium are very similar.

[8]Of these ten individuals, seven own and three rent. Thus, including them only increases the coefficient multiplying Owner, but also substantially increases the standard errors.

Table 1: Normalized Willingness-to-pay to Own

Dep. var.:	WTP to Own				
	(1)	(2)	(3)	(4)	(5)
Owner	15.4**	14.1**	16.0**	15.9**	17.4**
	(1.8)	(1.5)	(2.1)	(1.7)	(2.0)
Identical house	-1.6	-2.0	-3.2	-2.4	-2.4
	(2.1)	(1.7)	(2.3)	(2.0)	(2.3)
Loop	-0.7	0.5	0.2	-0.8	-0.9
	(1.9)	(1.8)	(2.6)	(2.0)	(2.4)
Constant	3.0*	4.7**	7.4**	5.0**	5.0**
	(1.3)	(1.2)	(1.7)	(1.4)	(1.6)
WTP$< 100k$	✓				
Winsorized		✓	✓	✓	✓
Confidence weighted			✓		
Baseline sample				✓	✓
Addl. attention check					✓
WTP mean	12.2	13.3	17.6	14.8	15.4
WTP s.d.	31.4	24.4	30.4	24.1	25.0
WTP skewness	-0.91	1.92	2.20	1.77	1.78
WTP kurtosis	49.48	7.36	8.67	6.51	6.58
Observations	983	993	958	699	548

Notes: Column (2) excludes respondents who reported No (confused) or No (misclicked) to the question on valuation accuracy. Column (3) weights by confidence. The variable Identical house is an indicator for the hypothetical specifying an identical property in terms of location, size, quality, and features. Loop is an indicator for answering the WTP question using a loop instead of a slider.

preferred sample. Finally, column (5) also excludes respondents who failed a second attention check during the selection of their main reason for owning or renting. Reassuringly, the owner WTP premium remains of similar magnitude and highly statistically significant across all of these sample restrictions.

4 Price Index

Conventional price indexes arise from the problem of a static expenditure function as in Section 2. The analog in a dynamic setting is the change in the value function. However, this object is not directly observable, nor is it comparable to conventional price indexes, which measure the transfer required to hold period utility and not the present value of utility fixed when prices change.

This section has three objectives. First, we nest a dynamic tenure choice decision in a joint maximization problem with nondurable consumption in order to rigorously define consumption-

equivalent non-pecuniary utility from owning. Since our focus remains on tenure choice and the welfare implications of changes in shelter costs, we make assumptions to keep the choice of non-durable consumption relatively simple and standard. Second, we characterize the change in welfare when shelter costs change in terms of the paths of nondurable consumption expenditure and tenure choice and the distribution of θ as measured in the previous section. Third, we introduce a method to convert the value function change into a per-period price index impulse response comparable to the impulse response of a static price index. The price path depends on the change in lifetime expenditure on shelter, the intertemporal marginal propensities to consume out of non-housing wealth, the change in non-pecuniary utility due to any change to the overall homeownership rate, and changes to the efficiency of allocation of homeownership across individuals with varying preference for owning. The next sections implement these formulas using a quantitative model calibrated to the survey evidence and other moments of the data.

4.1 Adding Dynamics and Nondurable Goods

We enrich our tenure choice framework to incorporate dynamics and nondurable goods. Dynamics arise because in reality home buyers obtain long-term fixed rate mortgages, rent within a spell grows more slowly than market rent of new listings, and renters and owners face moving costs including broker fees for new renters and real estate commissions for home sellers. Our quantitative model in Section 5 will include all of these elements, which we track by denoting s as the time since the last move. We also generalize to additional dimensions of heterogeneity such as the expected duration before moving and liquidity constraints, which we write compactly as a vector of types denoted Θ. We let a bold vector $\mathbf{y}_t = (y_{t-\infty}, \ldots, y_t)$ denote the realizations of a variable y through date t. As in Section 2, $\beta_{t,t+j}$ denotes the inverse of the gross real interest rate. Then given a sequence of shelter costs and mortgage market parameters $\mathbf{W}_t$ (e.g. $\mathbf{W}_t = \left[\mathbf{R}_t, \mathbf{P}_t^H, \mathbf{i}_t, \ell_t, \beta_t\right]$), an agent with tenure path $\mathcal{H}_t$ and duration path $\mathbf{s}_t$ has net shelter outlays at date t of $X\left(\mathcal{H}_t, \mathbf{s}_t; \mathbf{W}_t\right)$.[9]

We start by setting up a general consumption-saving problem and subsequently make assumptions that simplify the consumption-saving component, allowing us to focus on shelter welfare.

[9]For example, $X_t = R_{t|t-s}$ for a renter who last moved s periods ago, the mortgage payment $d_{t|t-s}$ for an owner who obtained a mortgage s periods ago, $(1 - \ell_t + \psi_{1+})\, P_t^H + d_{t|t}$ for someone who transitions from renting to owning with closing costs ψ_{1+}, $M_{t|t-s} - (1 - \psi_{1-})\, P_t^H + (1 + \psi_{0+})\, R_t$ for someone who transitions from owning to renting with remaining mortgage balance $M_{t|t-s}$, real estate commission ψ_{1-}, and broker fee ψ_{0+}, etc.

Thus, agents also consume a composite non-durable good C with price normalized to one in all periods and have non-housing wealth (including discounted future income) A.[10] Period utility over the non-durable good is $u(C_t)$. Non-pecuniary utility from homeownership in utils is $v(\tilde{\theta})$ with $v'(.) > 0$; we will shortly derive consumption-equivalent utility from homeownership as used elsewhere in the paper. Agents discount future utility using the subjective discount factor $\tilde{\beta}_{t,t+j}$.

The maximization problem for an agent of current type Θ with tenure $\mathcal{H}$ of duration s is:

$$\tilde{V}_t(\Theta, \mathcal{H}, s) = \tilde{V}(\Theta, \mathcal{H}, s; \mathbf{W}_t) = \max_{\{C_{t+j}, \mathcal{H}_{t+j}, s_{t+j}\}_{j=0}^{\infty}} \mathbb{E}_t \left[\sum_{j=0}^{\infty} \tilde{\beta}_{t,t+j} \left(u(C_{t+j}) + \mathcal{H}_{t+j} v\left(\tilde{\theta}_{t+j}\right) \right) | \Theta, \mathcal{H}, s; \mathbf{W}_t \right]$$

$$\text{s.t. } A_t = \mathbb{E}_t \left[\sum_{j=0}^{\infty} \beta_{t,t+j} \left(C_{t+j} + X\left(\mathcal{H}_{t+j}, \mathbf{s}_{t+j}; \mathbf{W}_{t+j}\right) \right) | \Theta, \mathcal{H}, s; \mathbf{W}_t \right]. \tag{11}$$

The expectation operator incorporates uncertainty over both the agent's future idiosyncratic type Θ and expectations of future aggregate prices W_{t+j}.[11] With abuse of notation, let $\{C_{t+j}, \mathcal{H}_{t+j}, s_{t+j}\}_{j=0}^{\infty}$ now denote the sequences of optimal choices satisfying equation (11), so that:

$$\tilde{V}_t(\Theta, \mathcal{H}, s) = \tilde{V}_t^C(\Theta, \mathcal{H}, s) + \tilde{V}_t^{\theta}(\Theta, \mathcal{H}, s), \tag{12}$$

$$\text{where: } \tilde{V}_t^C(\Theta, \mathcal{H}, s) = \mathbb{E}_t \left[\sum_{j=0}^{\infty} \tilde{\beta}_{t,t+j} u(C_{t+j}) | \Theta, \mathcal{H}, s; \mathbf{W}_t \right], \tag{13}$$

$$\tilde{V}_t^{\theta}(\Theta, \mathcal{H}, s) \equiv \mathbb{E}_t \left[\sum_{j=0}^{\infty} \tilde{\beta}_{t,t+j} \mathcal{H}_{t+j} v\left(\tilde{\theta}_{t+j}\right) | \Theta, \mathcal{H}, s; \mathbf{W}_t \right]. \tag{14}$$

To separate the contribution of shelter to welfare from the more general consumption-savings problem, we rule out precautionary saving due to uncertainty over future shelter costs. For example, sufficient conditions are that agents can diversify idiosyncratic shelter risk from their type changing and have perfect foresight over aggregate prices (which we continue to denote using the expectations operator).[12] Using the budget constraint in (11), we can then write the expected present value of utility from nondurable consumption as a function of only initial assets A and the

[10] Setting the price of the non-durable good to one is without loss of generality since we do not place restrictions on the sequence of real interest rates $\beta_{t,t+j}$.

[11] The maximization problem contains an additional constraint that the sequences of $\mathcal{H}$ and s obey the law of motion that s increments when an agent does not move and resets to 0 when she does. Furthermore, our model in Section 5 contains idiosyncratic shocks that force an agent to move and liquidity constraints that prevent an agent from buying, in which case the expectation operator also incorporates uncertainty over these future forcing variables. We also require trend rent growth μ small enough that the right hand side of equation (11) is finite.

[12] That is, under perfect foresight $\mathbb{E}_t[C_{t+j}|\Theta, \mathcal{H}, s; \mathbf{W}_t]$ denotes deterministic consumption at date $t+j$ given current state variables and the future path of W.

expected present value of shelter costs (plus the discount rate):

$$\tilde{V}_t^C(\Theta, \mathcal{H}, s) = \tilde{V}_t^C\left(A_t - V_t^X(\Theta, \mathcal{H}, s)\right), \tag{15}$$

$$\text{where}: V_t^X(\Theta, \mathcal{H}, s) \equiv \mathbb{E}_t\left[\sum_{j=0}^{\infty} \beta_{t,t+j} X\left(H_{t+j}, \mathbf{s}_{t+j}; \mathbf{W}_{t+j}\right) | \Theta, \mathcal{H}, s; \mathbf{W}_t\right] \tag{16}$$

denotes the present value of shelter expenditure.

4.2 Changes in Welfare

Suppose at date t there is an unexpected change to the house price, mortgage rate, rent, or down payment requirement denoted by dW_t, with persistence encoded in the expectation operator.[13] Define $dY_t(\Theta, \mathcal{H}, s) = Y(\Theta, \mathcal{H}, s; \mathbf{W}_t + d\mathbf{W}_t) - Y(\Theta, \mathcal{H}, s; \mathbf{W}_t)$ as the (possibly discrete) change in any object Y. We assume the marginal utility of a dollar $\partial \tilde{V}_t^C(\Theta, \mathcal{H}, s)/\partial A_t$ remains fixed in the neighborhood of shelter cost changes that we consider.[14] Then applying the d operator to equations (12) and (15) and dividing through by $\partial \tilde{V}_t^C(.)/\partial A_t$, we arrive at the welfare change in potentially measurable consumption-equivalent terms:

Proposition 3 *The welfare change in consumption-equivalent units is:*

$$dV_t(\Theta, \mathcal{H}, s) = -dV_t^X(\Theta, \mathcal{H}, s) + dV_t^\theta(\Theta, \mathcal{H}, s), \tag{17}$$

where $dV_t(.) = d\tilde{V}_t(.)/\left(\partial \tilde{V}_t^C(.)/\partial A_t\right)$ *and* $dV_t^\theta(.) = d\tilde{V}_t^\theta(.)/\left(\partial \tilde{V}_t^C(.)/\partial A_t\right)$. *Furthermore, the contribution of consumption-equivalent utility from owning can be written:*

$$dV_t^\theta(\Theta, \mathcal{H}, s) = \sum_{j=0}^{\infty} d\mathbb{E}_t\left[\beta_{t,t+j} \mathcal{H}_{t+j}\left(\frac{v\left(\tilde{\theta}_{t+j}\right)}{u'\left(C_{t+j}\right)}\right) | \Theta, \mathcal{H}, s; \mathbf{W}_t\right]. \tag{18}$$

[13] We do not consider in this section changes to the interest path $\beta_{t,t+j}$. One can decompose the total welfare change from a change in interest rates into (i) the change in welfare from interest rates changing holding fixed allocations and other prices (e.g. house prices) and (ii) the change resulting from allocations and other prices endogenously changing. In our applications, when $\beta_{t,t+j}$ changes we report the welfare change from part (ii) only. While this split is not uncontroversial (Reis, 2005), it conforms to all modern price indexes and also simplifies some of the exposition. In addition, at the cost of additional notation, the results that follow also apply to anticipated future changes. Besides notational convenience, our focus on changes to current prices also conforms more closely to existing price index practice.

[14] In the case of infinitesimal perturbations dW_t, this assumption holds automatically if $V_t^X(.)$ and $\tilde{V}_t^\theta$ are differentiable. Continuity of the space of types θ or, as in our implementation in Section 5, discrete θ and pecuniary i.i.d. shocks that augment $X(\mathcal{H}_{t+j}, s_{t+j}; \mathbf{W}_t)$ guarantee differentiability.

Equation (17) shows the total change in money-metric welfare consists of two components. The first component, $-dV_t^X(\Theta, \mathcal{H}, s)$, is the change in the present value of shelter outlays. The second component, $dV_t^\theta(\Theta, \mathcal{H}, s)$, is the change in the consumption-equivalent non-pecuniary utility from owning. The second part of proposition 3 uses the consumption Euler equation and envelope condition to unpack the utility component into the discounted sum of changes to the non-pecuniary utility from homeownership, expressed in consumption-equivalent terms by dividing by the marginal utility of nondurable consumption.

4.3 Consumption-Equivalent Utility

The term $v\left(\tilde{\theta}_{t+j}\right)/u'(C_{t+j})$ in equation (18) maps naturally into the willingness-to-pay to own elicited in our survey. To make this connection explicit, we make functional form and parameter restrictions consistent with a balanced growth path. Let $u(C) = \log(C)$ and $\tilde{\beta}/\beta = 1 + \mu$ so that consumption grows at the same rate as trend real rent, $C_{t+1}/C_t = \bar{R}_{t+1}/\bar{R}_t = 1 + \mu$ for all types. Let $b(\Theta, \mathcal{H}, s) \equiv C(\Theta, \mathcal{H}, s)/\bar{R}$ denote the ratio of non-durable consumption to trend rent. Then consumption-equivalent utility from owning takes the form:

$$v\left(\tilde{\theta}\right)/u'(C_t) = v\left(\tilde{\theta}\right) b(\Theta, \mathcal{H}, s)\, \bar{R}_t = \theta \bar{R}_t, \tag{19}$$

where $\theta \equiv v\left(\tilde{\theta}\right) b(\Theta, \mathcal{H}, s)$ directly characterizes the non-pecuniary utility from owning.

Using equation (19), we could in principle use repeated surveys of willingness-to-pay together with the path of homeownership and shelter outlays to directly evaluate equations (17) and (18). In practice, we do this exercise in the context of a quantitative calibrated model in the next sections.

4.4 Price Index

Translating the change in the value function into contributions to a per-period price index requires distributing $dV_t(\Theta, \mathcal{H}, s)$ across periods. Many possible paths of offsetting transfers exist. One feasible path would use the timing of the agent's change in shelter outlays. This implementation would imply for example that after a rise in house prices a homebuyer paying all cash would experience a spike in her price level only in the period of the home purchase. We propose instead to smooth the effect of the change on the price index using the agent's own impulse response of

nondurable consumption expenditure plus changes to consumption-equivalent utility from homeownership changes. That way, the price index moves exactly when the agent's period utility changes, just as in the static case.

To characterize the impulse response of nondurable consumption expenditure, note that the intertemporal budget constraint (11) requires a change in the path of nondurable consumption expenditure equal in present value to $-dV_t^X(\Theta, \mathcal{H}, s)$. In particular:

$$\mathbb{E}_t\left[dC_{t+j}|\Theta, \mathcal{H}, s\right] = -\left(\frac{\partial \mathbb{E}_t\left[C_{t+j}|\Theta, \mathcal{H}, s; \mathbf{W}_t\right]}{\partial A_t}\right) dV_t^X(\Theta, \mathcal{H}, s) = db_t(\Theta, \mathcal{H}, s; dW_t)\,\bar{R}_{t+j}. \quad (20)$$

The term in parentheses is simply the horizon j intertemporal marginal propensity to consume out of non-housing wealth. As in Auclert, Rognlie and Straub (2024), it depends on the details of the utility function over consumption and the interest rate available to the agent.[15] The second equality imposes balanced growth path consumption growth of μ and uses the identity $dC_t(\Theta, \mathcal{H}, s) = db_t(\Theta, \mathcal{H}, s; dW_t)\,\bar{R}_t$. We can now define the impulse response of the price index.

Proposition 4 *Let $\bar{R}_{t+j}dP_{t+j}(\Theta, \mathcal{H}, s; dW_t)$ denote the $t+j$ transfer equal to the utility change due to dW_t, scaled by annuitized initial shelter expenditure $mV_t^X(\Theta, \mathcal{H}, s)$, where $m = \left(\sum_{j=0}^{\infty}\beta_{t,t+j}\right)^{-1}$.*[16] *Then:*

$$dP_{t+j}(\Theta, \mathcal{H}, s; dW_t) = -\frac{\overbrace{db_t(\Theta, \mathcal{H}, s; dW_t)}^{\text{Nondurable consumption change}} + \overbrace{d\mathbb{E}_t\left[\mathcal{H}_{t+j}\theta_{t+j}|\Theta, \mathcal{H}, s\right]}^{\text{Housing utility change}}}{mV_t^X(\Theta, \mathcal{H}, s)}. \quad (21)$$

Let $G_t(\Theta, \mathcal{H}, s)$ denote the (endogenous) date t distribution of types, $V_t^X(G_t(.)) = \int_{\Theta,\mathcal{H},s} V_t^X(\Theta, \mathcal{H}, s)\,dG_t(.)$ the present value of aggregate shelter expenditure, and $dG_t(\Theta, \mathcal{H}, s)\,V_t^X(\Theta, \mathcal{H}, s)/V_t^X(G_t(\Theta, \mathcal{H}, s))$ the expenditure weight. Let $\mathbb{E}_{\{\Theta,\mathcal{H},s\}}$ denote the cross-sectional average using the measure $G_t(\Theta, \mathcal{H}, s)$. Then the expenditure-weighted average price change is:

$$dP_{t+j}(dW_t) = -\frac{\mathbb{E}_{\{\Theta,\mathcal{H},s\}}\left[db_t(\Theta, \mathcal{H}, s; dW_t) + d\mathbb{E}_t\left[\mathcal{H}_{t+j}\theta_{t+j}|\Theta, \mathcal{H}, s\right]\right]}{mV_t^X(G_t(\Theta, \mathcal{H}, s))}, \quad (22)$$

$$\text{where: } \mathbb{E}_{\{\Theta,\mathcal{H},s\}}\left[d\mathbb{E}_t\left[\mathcal{H}_{t+j}\theta_{t+j}|\Theta, \mathcal{H}, s\right]\right] = dh_{t+j}\mathbb{E}_\theta[\theta] + dCov_t(\mathcal{H}_{t+j}, \theta_{t+j}). \quad (23)$$

[15] The appearance of the marginal propensity to consume out of non-housing wealth echoes Proposition 1 in Berger et al. (2017). Equation (20) differs in that it applies to the present value of shelter outlays rather than the house price and in a setting with non-convex moving costs.

[16] For example, if $\beta_{t,t+j} = \beta^h\ \forall j$, then $m = 1 - \beta$.

Equation (21) characterizes the price path for a single *ex ante* type. By construction, the present value of the path of price changes equals the change in the value function as a share of annuitized expenditure: $\sum_{j=0}^{\infty} \beta_{t,t+j} \bar{R}_{t+j} dP_{t+j} (\Theta, \mathcal{H}, s; dW_t) = -dV_t (\Theta, \mathcal{H}, s) / mV_t^X (\Theta, \mathcal{H}, s)$.

Equation (22) characterizes the expenditure-weighted average price path. The first term contains the average change in expenditure on the nondurable good due to the shelter price change at date t. The second term contains the average change in consumption-equivalent utility. Equation (22) mirrors proposition 2 but applies to price paths rather than the static change in the price.

Equation (23) applies the law of iterated expectations and the definition of covariance to further split the non-pecuniary utility term in equation (22) into two parts. The first term on the right hand side of equation (23), $dh_{t+j} \mathbb{E}_\theta [\theta]$, is the change in utility due to the overall change in the homeownership rate dh_{t+j} evaluated at the population-average θ. This component captures the change in consumer surplus resulting from the change in the homeownership rate, as in Section 2. The second term, $d\text{Cov}_t (\mathcal{H}_{t+j}, \theta_{t+j})$, contains changes in the allocative efficiency of homeownership due to long-term contracts. This component affects shelter inflation if the average θ of those whom the cost change induces to rent rather than own differs from the average θ of those induced to own rather than rent.

4.5 Remarks

We make four remarks. First, the formulation in equation (21) correctly nests the case of an agent who owns their home and never expects to move. This agent has a change $dV_t (\Theta, \mathcal{H}, s) = dV_t^X (\Theta, \mathcal{H}, s) = 0$. Since this agent does not change her nondurable consumption expenditure, she experiences zero inflation despite the change in house prices, as in Sinai and Souleles (2005); Fagereng et al. (2024).

Second, at the cost of additional notation, the interest rates $\{\beta_{t,t+j}\}$ and hence intertemporal marginal propensities to consume could differ across types due to incomplete insurance markets. The deviation in the path of nondurable consumption expenditure to make equation (11) hold provides a sufficient statistic for distributing the change in shelter prices across time.

Third, the shelter price index in equation (22) differs from a static price index in that it can depend on expected future price changes. A renter expecting to purchase in the future and there-

fore affected by future house prices or mortgage rates provides one example. Likewise, unexpected house price appreciation enters into equation (21), while the traditional CPI excludes asset price changes. Such intertemporal dependence is unavoidable in a dynamic setting with a durable good. Of course, if every sale by a household with an unexpected capital gain also involves a purchase by a household at an unexpectedly high price, then unexpected price appreciation washes out in the aggregate index in equation (22) (as in Bajari, Benkard and Krainer, 2005). This condition will not hold exactly for consumer inflation along a transition path with changing homeownership, in which case one side of the transaction may be a "private equity" agent converting between owner-occupied housing and rental housing.

Fourth, equation (22) defines the impulse response of the shelter price index to changes in shelter cost parameters. Shelter inflation, which is the growth rate of the price index, therefore can depend on the base period. The balanced growth path assumption solves this issue since (de-trended) consumption jumps only at date t. We can thus rewrite equation (22) as:

$$\bar{R}_{t+j} dP_{t+j}\left(\Theta, \mathcal{H}, s; dW_t\right) = \frac{dV_t^X\left(\Theta, \mathcal{H}, s\right)}{V_t^X\left(\Theta, \mathcal{H}, s\right)} - \frac{\mathbb{E}_t\left[d\mathcal{H}_{t+j}\theta_{t+j} | \Theta, \mathcal{H}, s\right]}{mV_t^X\left(\Theta, \mathcal{H}, s\right)}. \tag{24}$$

In particular, date t shelter inflation $dP_t\left(dW_t\right)$ contains the growth rate of the present value of shelter expenditure less changes in utility coming from changes in the homeownership rate or the distributional efficiency into owners and renters. Thereafter, the change $dP_{t+j+1}\left(dW_t\right) - dP_{t+j}\left(dW_t\right)$ contains only changes to the utility term.

5 Quantitative Model

While the results in the previous section in principle allow for measuring welfare changes directly in the data, measuring the associated expenditure and tenure changes and covariances with utility from owning involve extremely high information requirements. In this section, we develop a quantitative model to generate these patterns and calibrate it using the survey evidence from Section 3 and other moments of the data.

5.1 Additional Elements

We extend the model in Section 2 to incorporate long-term rental and mortgage contracts, moving costs, liquidity constraints, and additional sources of heterogeneity.

Home buyers obtain fixed payment amortizing 30-year mortgages with loan-to-value at origination of ℓ_t. The fixed payment for a homeowner who bought at date $t-s$ with mortgage interest rate i_{t-s} is $d_{t|t-s}$, with original mortgage balance $M_{t|t} = \ell_t P_t^H$. The mortgage balance evolves recursively until payoff:

$$M_{t+1|t-s} = M_{t|t-s} - (d_{t|t-s} - i_{t-s}M_{t|t-s}) = (1+i_{t-s})M_{t|t-s} - d_{t|t-s}, \tag{25}$$

with $M_{t|t-s} = d_{t|t-s} = 0$ for $s \geq 30$ years.[17] A fraction ξ of owners receive the option to refinance each period, which if exercised resets the interest rate and loan-to-value, with the agent paying in or cashing out the difference from their current mortgage. Owning also involves a flow cost fP_t^H to cover maintenance, taxes, and insurance. Rental contracts fix the rent until a move.

Agents incur fixed costs when moving; moving into a new rental requires a "broker fee" of $\psi_{0+}R_t$, selling a home involves a "real estate commission" of $\psi_{1-}P_t^H$, and buying a home involves "closing and renovation costs" of $\psi_{1+}P_t^H$. Moving also involves one-time idiosyncratic realizations of taste shocks, described further below. While all agents have the option to move each period, some agents are forced to move. These forced moves reflect job changes or other life events that require relocation independent of the preference for owning or renting. The probability of a forced move differs across agents, with an agent of type $\lambda \sim F_\lambda(\lambda)$ forced to move with probability λ. Forced moves also require paying the moving cost. Fixing θ, higher λ therefore pushes agents toward renting since in equilibrium $(\psi_{1-}+\psi_{1+})P_t^H > \psi_{0+}R_t$ and homeowners who move frequently must amortize the fixed cost of selling over fewer periods. Agents change their type λ stochastically.

Agents also differ in their ability to buy. An agent with $\zeta = 1$ cannot make a down payment or qualify for a mortgage and hence cannot buy. Agents change their type ζ stochastically; someone who bought when $\zeta = 0$ and subsequently changes to $\zeta = 1$ can continue to live in their home.

Summarizing, agents differ along three dimensions that affect the homeownership decision: their preference for owning θ, which we generalize to allow for an arbitrary transition matrix across periods, their moving probability λ, and their ability to make a down payment ζ. In addition, once an agent has decided to move, she learns the values of i.i.d. Type 1 EV(σ_ε) shocks, $\bar{R}_t\varepsilon^0$ and $\bar{R}_t\varepsilon^1$, associated with renting and buying. These shocks may reflect the inherent randomness

[17] Iterating : $M_{t|t-s} = (1+i_{t-s})^s M_{t|t-s} - \sum_{j=0}^{s-1}(1+i_{t-s})^j d_{t|t-s} = (1+i_{t-s})^s M_{t|t-s} - \frac{d_{t|t-s}((1+i_{t-s})^s-1)}{i_{t-s}}$. Using the boundary condition $M_{t|t-120} = 0$, $d_{t|t-s} = \frac{i_t(1+i_{t-s})^{120}M_{t,t-s}}{(1+i_{t-s})^{120}-1}$.

of housing search (e.g. in the negotiated broker fee or closing costs) and also add computational tractability by making the value functions differentiable even when θ takes discretized values. The supply side remains the same as in Section 2, with the capitalization of rentals giving $P_t^R = c_t R_t$ and a conversion cost $g(h)$.

The timing within a period is as follows. Refinances and moves occur at the beginning of the period. Renters then pay rental costs and owners pay their mortgage and realize utility. Finally, agents draw new values of θ, λ, ζ.

5.2 Value Functions

Let $\Theta = \{\theta, \lambda, \zeta\}$ denote the vector of types and $\mathbf{W}_t$ continue to denote the path of aggregate prices and mortgage market parameters. We work directly with value functions in dollars and non-pecuniary utility $\theta \bar{R}_t$. This choice fully separates the housing tenure decision from the consumption-savings problem and avoids the complication of calibrating and jointly solving the consumption-saving process. We denote by $V_t^{\mathcal{H}}(\Theta, s) = V(\Theta, \mathcal{H}, s; \mathbf{W}_t)$ the value function (in dollars and evaluated at the time of rent/mortgage payments) for an agent of type Θ with tenure $\mathcal{H}$ who last moved s periods ago, where $V(\Theta, \mathcal{H}, s; \mathbf{W}_t)$ continues to satisfy equation (17).

We start by defining the value when acquiring a new residence. Let $V_t^{0+}(\Theta, \varepsilon^0)$ and $V_t^{1+}(\Theta, \varepsilon^1)$ denote the values when moving to a rental or owned home, respectively, given the idiosyncratic shocks ε^0 and ε^1:

$$\overbrace{V_t^{0+}\left(\Theta, \varepsilon^0\right)}^{\text{Move to rent}} = \overbrace{-\psi_{0+} R_t}^{\text{Broker fee}} + \overbrace{V_t^0(\Theta, 0)}^{\text{New rental value}} + \bar{R}_t \varepsilon^0, \tag{26}$$

$$\underbrace{V_t^{1+}\left(\Theta, \varepsilon^1\right)}_{\text{Move to own}} = \underbrace{-\left(1 - \ell_t - \psi_{1+}\right) P_t^H}_{\text{Down pay.+closing/renov.}} - \underbrace{\infty \times \zeta}_{\text{Liquidity restriction}} + \underbrace{V_t^1(\Theta, 0)}_{\text{New owner value}} + \bar{R}_t \varepsilon^1. \tag{27}$$

The value of moving, $V_t^+(\Theta)$, is the expected maximum over renting and buying:

$$V_t^+(\Theta) = \mathbb{E}_{\{\varepsilon^0, \varepsilon^1\}}\left[\max\left\{V_t^{0+}\left(\Theta, \varepsilon^0\right), V_t^{1+}\left(\Theta, \varepsilon^1\right)\right\}\right], \tag{28}$$

implying a fraction $\exp\left(V_t^{1+}(\Theta, 0)/\bar{R}_t\sigma\right) / \left(\exp\left(V_t^{0+}(\Theta, 0)/\bar{R}_t\sigma\right) + \exp\left(V_t^{1+}(\Theta, 0)/\bar{R}_t\sigma\right)\right)$ of movers of type Θ choose to buy if $\zeta = 0$.

We next define the value of a refinance option as the maximum over refinancing and declining the refinancing option, where refinancing pays out (or in) the change in the mortgage balance net

of the refinancing fee and resets the effective tenure in the house s to 0:

$$V_t^{\text{refi}}(\Theta, s) = \max\left\{(1-\psi_r)\,\ell_t P_t^H - M_{t|t-s} + V_t^1(\Theta, 0), V_t^1(\Theta, s)\right\}. \tag{29}$$

The value functions encompass utility net of costs at date t plus the expected discounted continuation value:

$$\text{Rent:}\quad V_t^0(\Theta, s) = -R_{t-s} + \beta_{t,t+1}\mathbb{E}_{\Theta'|\Theta}\left[\lambda' V_{t+1}^+(\Theta') + (1-\lambda')\max\left\{V_{t+1}^+(\Theta'), V_{t+1}^0(\Theta', s+1)\right\}\right], \tag{30}$$

$$\begin{aligned}\text{Own:}\quad V_t^1(\Theta, s) = \theta\bar{R}_t - d_{t|t-s} - f_t P_t^H + \beta_{t,t+1}\mathbb{E}_{\Theta'|\Theta}\Big[&\lambda'\left((1-\psi_{1-})\,P_{t+1}^H - M_{t+1|t-s} + V_{t+1}^+(\Theta')\right)\\ &+ (1-\lambda')\,\xi\max\left\{(1-\psi_{1-})\,P_{t+1}^H - M_{t+1|t-s} + V_{t+1}^+(\Theta'), V_{t+1}^{\text{refi}}(\Theta', s+1)\right\}\\ &+ (1-\lambda')(1-\xi)\max\left\{(1-\psi_{1-})\,P_{t+1}^H - M_{t+1|t-s} + V_{t+1}^+(\Theta'), V_{t+1}^1(\Theta', s+1)\right\}\Big]\end{aligned}$$

, (31)

For renters, flow utility is the cost of rent and the continuation value is V_{t+1}^+ if forced to move and the maximum over the moving value and remaining in the same unit for an additional period otherwise. For owners, flow utility is the non-pecuniary component less the mortgage payment and flow cost and the continuation value is a weighted average of the sum of net sale proceeds $(1-\psi_{1-})\,P_{t+1}^H - M_{t+1|t-s}$ and V_{t+1}^+ if forced to move, the maximum over moving and V_{t+1}^{refi} if given the option to refinance, and the maximum over moving and remaining in the same unit for an additional period otherwise.

5.3 Parameters

Table 2 lists the parameters. We report relevant parameters on an annualized basis with a period length of Δ of a year (i.e. $\Delta = 1$ for annual calibration.) We treat 2019 as the model steady state. We set several parameters externally and the remainder to match key moments of the data.

We externally set the growth rate of rents to 1% at an annualized rate, the value of real (deflated by the non-shelter CPI) rent growth over 2000-2019. The values for ψ_{0+} and ψ_{1-} correspond to a broker fee of 1 month rent when moving into a new rental and a sales commission of 5% when selling a house. We set the value of ψ_{1+} to match the additional spending on home improvement and durable goods after a home purchase found in Benmelech, Guren and Melzer (2022). We

Table 2: Parameters

Name	Description	Value	Source
	Panel A: Externally calibrated		
μ	Growth rate of rents	0.01Δ	2000-2019 real rent growth
χ	Relative rent growth in spell	0	
ψ_{0+}	Fee for new rental	$R/(12\Delta)$	1 month rent
ψ_{1+}	Home purchase costs	$0.055P^H$	Benmelech, Guren and Melzer (2022)
ψ_{1-}	Fee for selling home	$0.05P^H$	Broker fee
ℓ	Loan-to-value at origination	0.87	Adelino, Schoar and Severino (2018)
$1/\beta-1$	Discount rate	0.02Δ	Conventional
i	Mortgage rate	$.025\Delta$	Freddie Mac
ξ	Refinance opportunity	$1-(1-.166)^{\Delta}$	Berger et al. (2021)
0.012Δ	BEA FAA 5.1, 5.4		
o^R	Rental operating cost	0.242	BEA I-O Use
c	Rental inverse cap. rate	15.16	Net cap. rate 0.05
γ_1	Slope of conversion supply curve	1.98	Greenwald and Guren (forthcoming) + c
γ_0	Intercept of conversion cost	$P^H/P^R-\gamma_1 h$	$P^H/R=14.6/\Delta$ (CEX)
δ_θ	Redraw probability	$1-(1-.02)^{\Delta}$	Life cycle
σ_ε	Scale of idiosyncratic moving cost	$(2/12)(6/\sqrt{\pi})\Delta$	SD equal to two months rent
	Panel B: Internally estimated with θ process		
$\Delta_\theta/\delta_\theta$	Expected step/redraw prob.	.215	
m_θ	Redraw mean	-.0417	
σ_θ	Redraw standard deviation	.0467	
	Panel C: Internally estimated with full model		
λ	Forced moving hazard	$1-(1-.185)^{\Delta}$	
$p_{\lambda+}$	No forced mobility to forced mobility transition probability	$1-(1-.033)^{\Delta}$	
$p_{\lambda-}$	Forced mobility to no forced mobility transition probability	$1-(1-.035)^{\Delta}$	
$p_{\zeta+}$	Liquidity unconstrained to constrained hazard	$1-(1-.024)^{\Delta}$	
$p_{\zeta-}$	Constrained to unconstrained transition probability	$1-(1-.065)^{\Delta}$	
f	Owning flow cost	0.043Δ	

set the loan-to-value at origination to 0.87, which Adelino, Schoar and Severino (2018) show has remained about the median value throughout the 2000s. We set the discount rate to 2% and the mortgage rate to 2.5%. A fraction $\xi = 1/6$ of owners have the opportunity to refinance each year (Berger et al., 2021). The idiosyncratic moving cost has a standard deviation σ_ε equal to two months of trend rent.

For the supply side, we assume $P_t^H/P_t^R = 1 + g(h_t) = \gamma_0 + \gamma_1 h_t$. Thus, $\partial\left(P_t^H/R_t\right)/\partial h_t = \gamma_1 c_t$. We set the net capitalization rate to 0.05 and $1-o^R = 75.8\%$ as the ratio of gross operating surplus to gross output in the tenant occupied housing sector (U.S. Bureau of Economic Analysis, 2025, 2017 detailed Use table), giving a gross inverse capitalization rate of $c = P^R/R = (1-o^R)/0.05 = 15.16$.[18] Greenwald and Guren (forthcoming) estimate $\partial\left(P_t^H/R_t\right)/\partial h_t$ (for annual rent) following shocks to mortgage availability that plausibly keep c_t fixed.[19] Using a value of 30 together with $c = 15.16$ implies $\gamma_1 = 1.98$.

We incorporate life-cycle-type dynamics into the transition matrix for θ and parameterize them to match our survey evidence. Specifically, an agent's θ in the next period can be either her current θ, a discrete increase, or a draw from a normal distribution. Thus, $\mathbb{E}\left[\theta'|\theta\right] = (1-\delta_\theta)(\theta + \Delta_\theta) + \delta_\theta N(m_\theta, \sigma_\theta)$, where δ_θ is the probability of a re-draw and Δ_θ is the product of the probability of θ otherwise increasing and the step size. When $\Delta_\theta = 0$, this process becomes one where agents redraw θ from a fixed distribution as in Section 2. When $\sigma_\theta = 0$, this process generates (approximately) an exponential distribution with minimum value m_θ and rate parameter $\Delta_\theta/\delta_\theta$. The life-cycle flavor arises because agents expect their θ to grow on average, but face a "downsizing" risk of redrawing θ from a "starter" distribution.[20] The ratio $\Delta_\theta/\delta_\theta$ and the mean and standard deviation of the re-draw distribution m_θ, σ_θ uniquely determine the overall distribution $F_\theta(\theta)$.[21] We

[18] Standard practice in the commercial real estate sector is to quote a capitalization rate as net operating income divided by market value, or $(1-o^R)R/P^R$ in our notation. The value of 0.05 comes from Costar for highly related rental properties.

[19] Greenwald and Guren (forthcoming) report estimates using two separate measures of homeownership. Using the Home Vacancy Survey they find coefficients in the range of 6 to 12 across horizons while using their own measure constructed by merging deeds records with occupancy they find coefficients of 30 or higher. We are grateful to Adam Guren for providing us the precise values plotted in figures 3(c) and 3(d) of Greenwald and Guren (forthcoming).

[20] This process also helps with matching other moments of the data. For example, without the growth component, agents who transition from high to low θ may not sell because they prefer the option value of waiting for another re-draw than to pay the transaction cost to transition to rent and then buy again when their θ jumps back up.

[21] To see this fact, let θ_0 denote an initial draw. For $a > \theta_0$, it takes in expectation $(a-\theta_0)/\Delta_\theta$ periods to reach $\theta = a$. Thus: $\mathbb{P}(\theta > a|\theta_0 \leq a) = (1-\delta_\theta)^{\frac{a-\theta_0}{\Delta_\theta}} \approx \exp\left(-\left(\delta_\theta/\Delta_\theta\right)(a-\theta_0)\right)$. Then for any re-draw distribution $G(\theta_0)$, $\mathbb{P}(\theta > a) = G_\theta(a)\int(1-\delta_\theta)^{\frac{a-\theta_0}{\Delta_\theta}} dG_\theta(\theta_0) + (1-G_\theta(a)) \approx G_\theta(a)\int\exp\left(-\left(\delta_\theta/\Delta_\theta\right)(a-\theta_0)\right)dG_\theta(\theta_0) + (1-G_\theta(a))$.

Table 3: Moments

Moment	Description	Source	Data	Model
$\mathbb{E}_\Theta[\theta\|\mathcal{H}=1]-\mathbb{E}_\Theta[\theta\|\mathcal{H}=0]$	WTP premium for owners	Survey	15.9	13.3
$\mathbb{P}_\Theta[\mathcal{H}'=0,s=0\|\mathcal{H}=0]$	Rent-to-rent	SIPP	15.1	14.7
$\mathbb{P}_\Theta[\mathcal{H}'=1,s=0\|\mathcal{H}=0]$	Rent-to-own	SIPP	4.6	5.5
$\mathbb{P}_\Theta[\mathcal{H}'=0,s=0\|\mathcal{H}=1]$	Own-to-rent	SIPP	2.3	2.8
$\mathbb{P}_\Theta[\mathcal{H}'=1,s=0\|\mathcal{H}=1]$	Own-to-own	SIPP	3.1	4
$\mathbb{E}_\Theta[\zeta\|\mathcal{H}=0]$	Constrained renters share	SCF	45	44.8

choose values for these objects to best match the first four moments of the empirical willingness-to-pay distribution from our survey. We externally set $\delta_\theta = 0.02$ per year to roughly match a life cycle of 50 years.

The remaining parameters are the forced moving hazard λ, the transition rates across being vulnerable to a λ shock or not, which we denote $p_{\lambda+}$ and $p_{\lambda-}$, the transition rates across being liquidity constrained, which we denote $p_{\zeta+}$ and $p_{\zeta-}$, and the flow cost of owning f. Table 3 lists the moments targeted. The first moment is the difference in the mean θ of owners and renters from column (4) of Table 1. The next four moments characterize overall mobility rates by pre-and-post move ownership status and come from the Survey of Income and Program Participation (SIPP). The SIPP is a panel survey that follows households when they move (see Appendix D for details). The final moment is the fraction of renters who cannot make a down payment. We target a value of 45% using the 2019 Survey of Consumer Finances distribution of liquid assets of renters, adjusted to account for the reality that purchasers with low wealth can obtain FHA mortgages with 3.5% down payment.[22]

The intuition for the identification from these moments is as follows. The rent-to-rent and own-to-own hazard rates directly inform λ and the population share subject to λ shocks $p_{\lambda+}/(p_{\lambda+}+p_{\lambda-})$, since moves without a tenure change can come only from these households. Conditional on the θ process, the rent-to-own and own-to-rent hazard rates inform the parameter transition probabilities $p_{\lambda+}, p_{\lambda-}, p_{\zeta+}, p_{\zeta-}$, since in steady state agents change tenure only when their type changes. The difference in mean θ indicates the degree of sorting. In addition to the transaction costs, imperfect

[22]Since little else in our model depends on heterogeneity in the down payment, we choose to model all purchasers as starting with a single loan-to-value ℓ. However, the proper comparison to the liquid asset distribution is the minimum down payment in the data of 3.5%. This implies the right comparison for making a down payment is whether liquid assets exceed $0.035P_t^H$ or equivalently whether $(1-\ell_t)/0.035$ of liquid assets exceed $(1-\ell_t)P_t^H$.

sorting arises because heterogeneity in λ and ζ also determine homeownership. The value of λ, the population share subject to λ shocks, and the constrained population share $p_{\zeta+}/(p_{\zeta+}+p_{\zeta-})$ govern the strength of these other dimensions. The share of renters constrained additionally disciplines the liquidity constraint transition probabilities. Finally, the steady state homeownership rate obeys the stock/flow identity $h = \mathbb{P}_\Theta\left[\mathcal{H}'=1, s=0|\mathcal{H}=0\right]/(\mathbb{P}_\Theta\left[\mathcal{H}'=1, s=0|\mathcal{H}=0\right] + \mathbb{P}_\Theta\left[\mathcal{H}'=0, s=0|\mathcal{H}=1\right])$. The homeownership rate changes with the flow cost of ownership f.

We obtain seemingly reasonable values. A share of 9.4% of households receive forced move shocks each year, the product of an exposed share of 52% and a value of λ of 18%. Approximately 3.5% of agents change their type λ each year. A share 27% of households are liquidity constrained and 6.5% of these become unconstrained each year. The value of $f = 4.3\%$ of the house price is close to the annual flow cost of maintenance, property taxes, and insurance of 3.5% in the CEX.

5.4 Steady State Homeownership

Figure 4 illustrates the sorting into homeownership in steady state. The left part of Panel (a) contains unconstrained agents ($\zeta = 0$) with no immediate risk of a forced move ($\lambda = 0$). Essentially all of these agents own if their θ is positive. Some agents with $\theta < 0$ also own. Typically, these agents recently redrew their θ but due to transaction costs remain owners while they wait for their θ to grow.

The right part of Panel (a) contains unconstrained agents at risk of a forced move. These agents value homeownership less because transaction costs of owners exceed those of renters. High θ agents with $\lambda > 0$ still own, but those with lower θ rent.

Panel (b) contains liquidity constrained agents. These agents can own only if they bought at a time they were unconstrained. Thus, overall most constrained agents rent, especially so if they face λ shocks and hence likely moved relatively recently.

6 Short-run Implications: Mortgage Rate Hikes

Our first application is to increases in the mortgage rate such as occurred in 2022 in the U.S. For this exercise, we model an unexpected, permanent 2p.p. increase in the mortgage rate and report the de-trended impulse responses along the transition path.

Figure 4: Steady State Heat Map

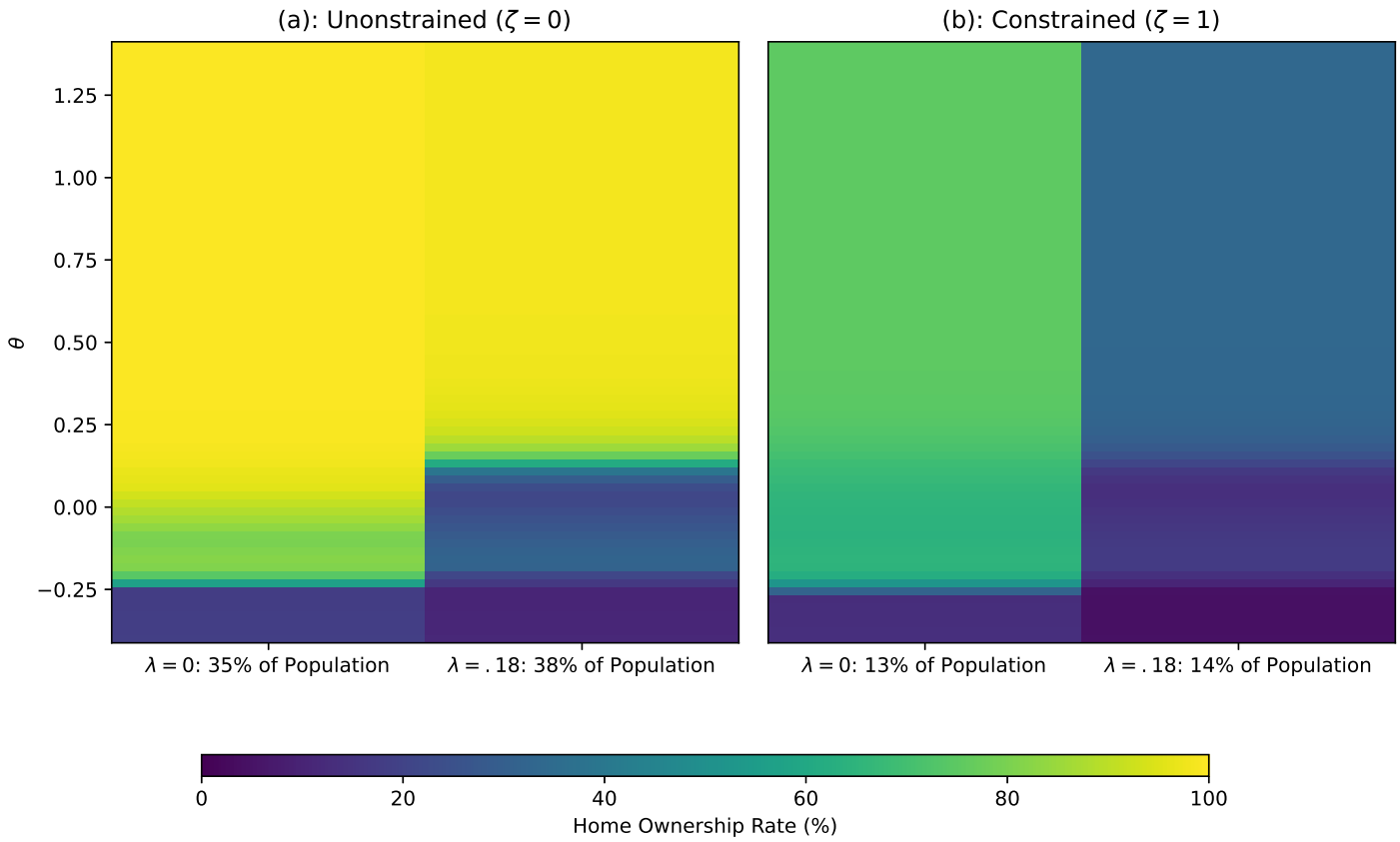
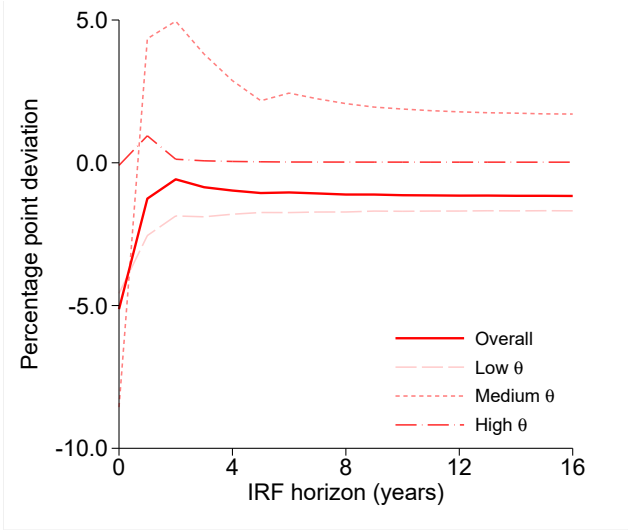


Figure 5 shows the responses of transition rates across tenure status, separately for low, medium, and high θ agents as well as overall. With homeownership more expensive, rent-to-own transitions fall and own-to-rent transitions rise. The decline in rent-to-own rates reflects the higher carrying cost of owning when mortgage rates increase. The increase in own-to-rent mostly occurs among owners receiving λ shocks, who now face the higher mortgage rate. The non-instantaneous adjustment of these flows reflects housing lock (Liebersohn and Rothstein, 2025; Batzer et al., 2024; Fonseca and Liu, 2023); agents with low mortgage rates happily remain in their own homes until they receive a λ shock and have to move.

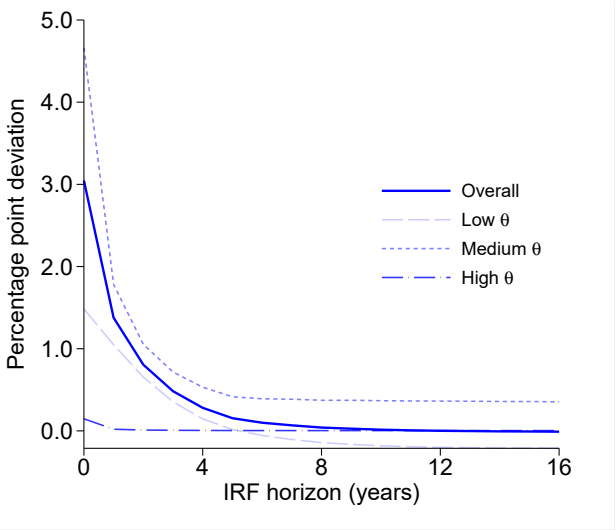
Figure 6 show the resulting paths of house prices and homeownership. Given our relatively simple supply side, these are tightly linked. Both house prices and homeownership fall on impact and continue to decline over several years. The non-instantaneous adjustment occurs because the own-to-rent flows remain elevated for several periods as agents with low mortgage rates wait for

Figure 5: Mobility Rates

(a) Rent-to-Own



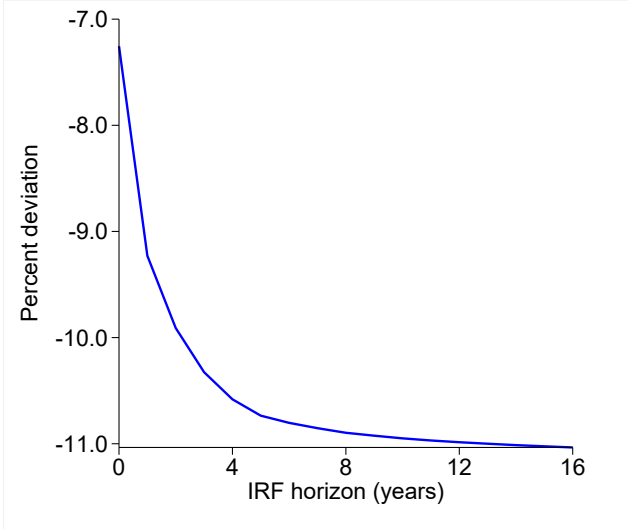
(b) Own-to-Rent



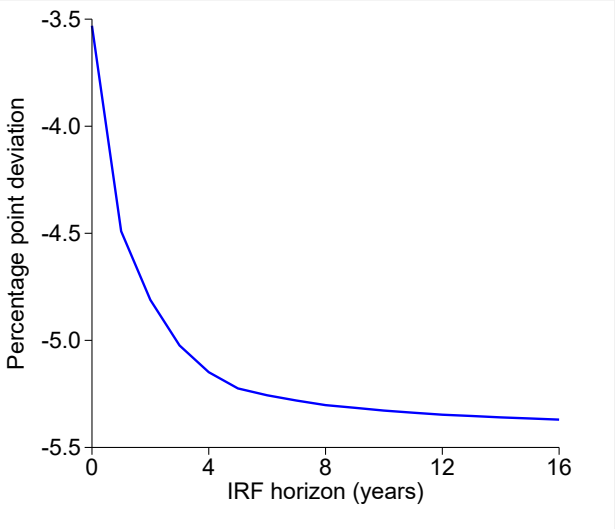
Notes:

Figure 6: House Price and Homeownership

(a) House Price



(b) Homeownership

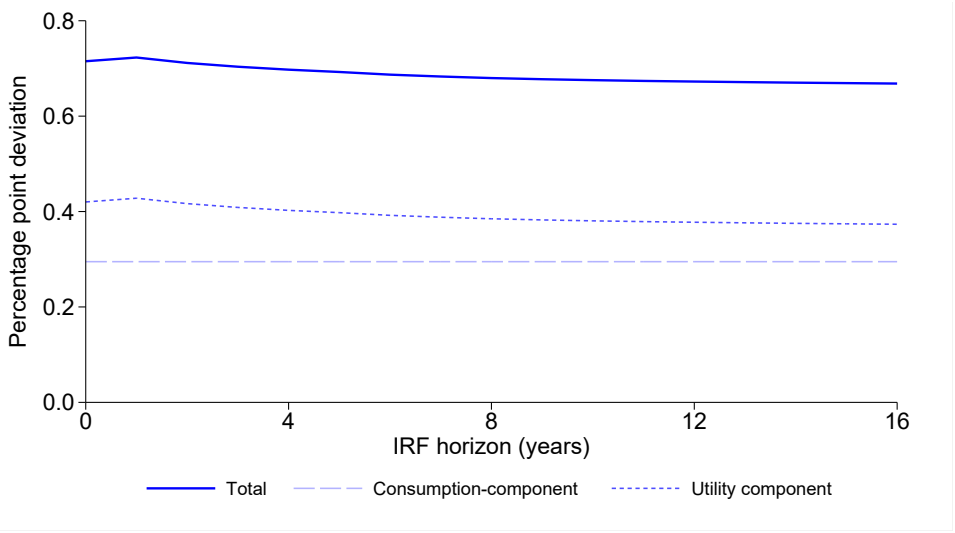


Notes:

λ shocks to force them to move. Of course, these agents also anticipate the falling house prices. The reason they do not all sell ahead of the decline is that they have higher θ; put differently, the average θ of homeowners increases to offset the expected capital loss.

The solid blue line in Figure 7 shows the overall price index. Prices jump 0.75p.p. on impact, which would contribute to an increase in the CPI of about 0.25p.p. using an expenditure weight

Figure 7: Shelter Price Index

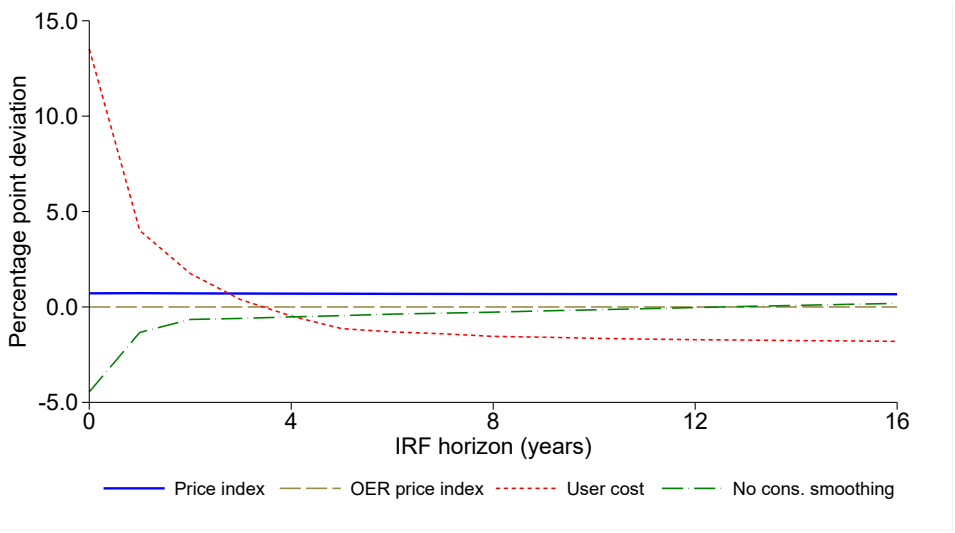


Notes:

of 1/3. The dashed and dotted lines decompose the index into the part coming from changes in nondurable consumption (the first term in the numerator of equation (10)) and the part coming from foregone utility due to changes in homeownership (the second term). The change in nondurable consumption contributes about 40% to the impact rise in the price index and the foregone utility contributes about 60%.

Figure 8 compares our price index response to several alternatives. The dashed brown line shows shelter costs using owners' equivalent rent, which does not change since rents remain unchanged by construction. The dotted orange line shows the one period user cost. The user cost rises sharply on onset, reflecting both the higher interest payment and anticipated further house price declines. It eventually turns negative as the lower house price outweighs the higher mortgage cost. The dotted green line shows the price index if we had not imposed consumption smoothing and instead allocated changes in spending to the period in which they occur. The impact decline reflects the liquidation of housing wealth as some sellers transact with "private equity" who turn the houses into rentals.

Figure 8: Alternative Shelter Price Indexes



Notes:

7 Conclusion

We have argued that a proper cost-of-living price index should account for the costs associated with owning a home and peoples' preferences for owning instead of renting. Furthermore, it should reflect the inherently dynamic considerations involved in shelter payments when transaction costs, fixed rate mortgages, and sticky rents link costs over time. In response to an increase in mortgage rates, our shelter price index departs from both owners' equivalent rent, which does not directly respond by construction, and the one-period user cost, which is highly volatile.

Our analysis deliberately abstracted from uncertainty in order to deliver an analytic price index formula with minimal measurement requirements. Future work could relax this assumption in quantitative applications and introduce idiosyncratic income risk and borrowing constraints into the consumption-saving problem as well as aggregate risk of rents or other elements of shelter costs changing.

Our price index could create difficulties for central banks insofar as it creates a direct transmission from higher interest rates into higher inflation. We think this concern does not survive scrutiny, for two reasons. First, our analysis connects higher interest rates to a higher cost-of-living, whether or not the official CPI acknowledges this fact. Second, central banks need not target a comprehensive cost-of-living index, just as they already focus on core measures that ex-

clude food and energy. Bianchi, McKay and Mehrotra (2025) make this argument and future work could extend their results to a setting that contains dynamic contracts and preference heterogeneity such as ours. A question of particular interest is how optimal monetary policy should change with prevalent features of the mortgage contract such as a fixed or variable rate.

Finally, a reconsideration of shelter inflation opens many questions beyond those pursued here. What happens when the population distribution of tastes change, for example due to population aging or the advent of work-from-home? What are the welfare consequences of the upward trend in the age of first-time home-buying in the U.S.? We leave these applications to future work.

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A Construction of the User Cost

B Model Appendix

B.1 Proof of proposition 1

We need to verify that equations (3), (4) and (6) hold with $h_t = h, \theta_t^* = \theta$. Dividing both sides of equation (3) by $R_t = \bar{R}_t$ and imposing constant r gives:

$$\frac{rP_t^H}{\bar{R}_t} = 1 + (\theta_t^* - 1)\,. \tag{32}$$

From equation (4), constant c and $g(h)$ imply a constant ratio P_t^H/R_t and hence the left hand side of equation (32) is constant. From equation (5), constant h also implies constant θ^* and hence the right hand side of equation (32) is also constant.

B.2 Proof of proposition 2

The price index multiplied by expenditure is given by the sum of the terms in the numerators in equation (9) multiplied by their respective population shares. Thus:

$$\begin{aligned}
X_t dP_{t+1} &= (R_{t+1} - R_t) + h_{t+1}\left(\theta_{t+1}^* \bar{R}_{t+1} - \theta_t^* \bar{R}_t\right) - (h_t - h_{t+1})\,\theta_t^* \bar{R}_t \\
&\quad - h_{t+1}\mathbb{E}_\theta\left[\theta|\theta \geq \theta_{t+1}^*\right]\left(\bar{R}_{t+1} - \bar{R}_t\right) + (h_t - h_{t+1})\,\mathbb{E}_\theta\left[\theta|\theta_t^* \leq \theta < \theta_{t+1}^*\right]\bar{R}_t \\
&= (R_{t+1} - R_t) + \left(h_{t+1}\theta_{t+1}^* \bar{R}_{t+1} - h_t \theta_t^* \bar{R}_t\right) \\
&\quad - h_{t+1}\mathbb{E}_\theta\left[\theta|\theta \geq \theta_{t+1}^*\right]\bar{R}_{t+1} + \left((h_t - h_{t+1})\,\mathbb{E}_\theta\left[\theta|\theta_t^* \leq \theta < \theta_{t+1}^*\right] + h_{t+1}\mathbb{E}_\theta\left[\theta|\theta \geq \theta_{t+1}^*\right]\right)\bar{R}_t.
\end{aligned}$$

The second term in the last line can be written:

$$\begin{aligned}
\left((h_t - h_{t+1})\,\mathbb{E}_\theta\left[\theta|\theta_t^* \leq \theta < \theta_{t+1}^*\right] + h_{t+1}\mathbb{E}_\theta\left[\theta|\theta \geq \theta_{t+1}^*\right]\right)\bar{R}_t &= \left(\int_{\theta_t^*}^{\theta_{t+1}^*} \theta dF(\theta) + \int_{\theta_{t+1}^*}^{\infty} \theta dF(\theta)\right)\bar{R}_t \\
&= h_t \mathbb{E}_\theta\left[\theta|\theta \geq \theta_t^*\right]\bar{R}_t.
\end{aligned}$$

Finally,

$$h_t \mathbb{E}_\theta\left[\theta|\theta \geq \theta_t^*\right]\bar{R}_t = \int_{\theta_t^*}^{\infty} \theta dF(\theta) = \int_{-\infty}^{\infty} \mathcal{H}_t(\theta)\,\theta dF(\theta) = \mathbb{E}_\theta\left[\mathcal{H}_t(\theta)\,\theta\right],$$

giving the formulation in proposition 2.

B.3 Proof of proposition 3

The application of the definition of dY to equations (12) and (15) gives:

$$d\tilde{V}_t\left(\Theta,\mathcal{H},s\right)=d\tilde{V}_t^{\theta}\left(\Theta,\mathcal{H},s\right)-\left(\frac{\partial\tilde{V}_t^{C}\left(\Theta,\mathcal{H},s\right)}{\partial A_t}\right)dV_t^{X}\left(\Theta,\mathcal{H},s\right).$$

Dividing this equation through by the marginal utility of a dollar $\partial\tilde{V}_t^{C}\left(.\right)/\partial A_t$ gives equation (17) in the main text. To arrive at equation (18), we use from the consumption-savings problem the envelope condition $\partial\tilde{V}_t^{C}\left(\Theta,\mathcal{H},s\right)/\partial A_t=u'\left(C_t\left(\Theta,\mathcal{H},s;\mathbf{W}_t\right)\right)$ and the Euler equation $u'\left(C_t\left(\Theta,\mathcal{H},s;\mathbf{W}_t\right)\right)=\mathbb{E}_t\left[\tilde{\beta}_{t,t+j}\beta_{t,t+j}^{-1}u'\left(C_{t+j}\right)|\Theta,\mathcal{H},s;\mathbf{W}_t\right]$, which together give:

$$\frac{\tilde{\beta}_{t,t+j}v\left(\theta_{t+j}\right)}{\partial\tilde{V}_t^{C}\left(.\right)/\partial A_t}=\frac{\beta_{t,t+j}v\left(\theta_{t+j}\right)}{u'\left(C_{t+j}\right)}.$$

Note that we have used here the certainty-equivalence property assumed in Section 4.1. Using this condition and the definition of $\tilde{V}_t^{\theta}\left(\Theta,\mathcal{H},s\right)$ in equation (14) gives the first equality in equation (18). The second equality follows from the definition of the covariance.

B.4 Proof of proposition 4

On the balanced growth path, $V_{t+1}^{X}\left(\Theta,\mathcal{H},s\right)/V_t^{X}\left(\Theta,\mathcal{H},s\right)=1+\mu$.

C Additional Survey Material

C.1 Demographic and Financial Benchmarking

Table B.1 compares demographic characteristics of our sample to the population as reported in the CPS. Table B.3 compares the distribution of rent and owners' equivalent rent in our sample to the population as reported in the CEX.

Table B.1: Demographic Characteristics Comparison to Current Population Survey

	Percent of household heads or spouses		
Sample:	CPS	Full survey	Baseline sample
18-24 years old	3.6	8.6	6.3
25-34 years old	15.7	17.2	15.9
35-44 years old	18.8	18.0	19.7
45-54 years old	17.2	17.8	19.0
55-64 years old	17.9	24.6	25.0
65+ years old	26.7	13.9	14.0
Female	52.1	50.8	51.6
Married	61.4	52.2	53.8
No children	60.4	67.4	69.0
1 child	17.0	15.6	15.5
2 children	14.5	12.3	11.7
3+ children	8.2	4.6	3.9
No college	32.5	9.5	9.7
Some college	25.2	27.9	28.6
BA	25.8	41.1	41.5
Graduate or professional	16.5	21.4	20.0

Notes: the table compares demographics in our survey to reference persons and their partners in the December 2024 Current Population Survey.

Table B.2: Demographic Characteristics Comparison to SIPP

	Percent of household heads or spouses								
	Pooled			Owners			Renters		
Sample:	SIPP	Full survey	Baseline sample	SIPP	Full survey	Baseline sample	SIPP	Full survey	Baseline sample
Owner	68.4	63.9	66.0						
18-24 years old	2.8	8.6	6.3	6.4	15.6	10.1	1.1	4.7	4.3
25-34 years old	14.4	17.2	15.9	25.3	25.6	24.4	9.4	12.4	11.5
35-44 years old	18.5	18.0	19.7	21.3	17.2	18.1	17.3	18.4	20.6
45-54 years old	17.5	17.8	19.0	16.1	15.8	18.1	18.1	18.8	19.5
55-64 years old	19.1	24.6	25.0	13.9	17.8	20.2	21.4	28.4	27.5
65+ years old	27.7	13.9	14.0	16.9	8.1	9.2	32.7	17.3	16.5
Female	52.5	50.8	51.6	54.4	50.4	49.2	53.0	50.9	52.8
Married	60.2	52.2	53.8	36.5	30.3	30.3	69.0	64.5	65.9
No children	61.6	67.4	69.0	64.2	73.3	76.5	60.4	64.1	65.1
1 child	17.0	15.6	15.5	15.3	15.3	13.9	17.8	15.9	16.3
2 children	13.9	12.3	11.7	11.9	8.9	8.4	14.9	14.3	13.4
3+ children	7.4	4.6	3.9	8.6	2.5	1.3	6.8	5.8	5.2
No college	31.0	9.5	9.7	39.2	11.1	11.8	27.2	8.6	8.7
Some college	25.8	27.9	28.6	25.6	30.0	27.3	25.8	26.7	29.3
BA	25.3	41.1	41.5	22.3	41.4	42.4	26.8	41.0	41.0
Graduate or professional	17.9	21.4	20.0	12.9	17.5	18.5	20.2	23.5	20.8

Notes: the table compares demographics in our survey to reference persons and their partners in the 2023 SIPP.

Table B.3: Shelter Cost Comparison to Consumer Expenditure Survey

	Statistic				
Statistic:	P10	P25	P50	P75	P90
Owner equivalent rent					
CEX	1000	1500	2100	3000	3803
Full survey	800	1250	2000	3000	4000
Baseline sample	800	1300	2000	2800	3500
Rent					
CEX	400	853	1594	2433	4100
Full survey	562.5	910	1400	1900	2750
Baseline sample	675	960	1400	1900	2800

C.2 Reasons for Moving

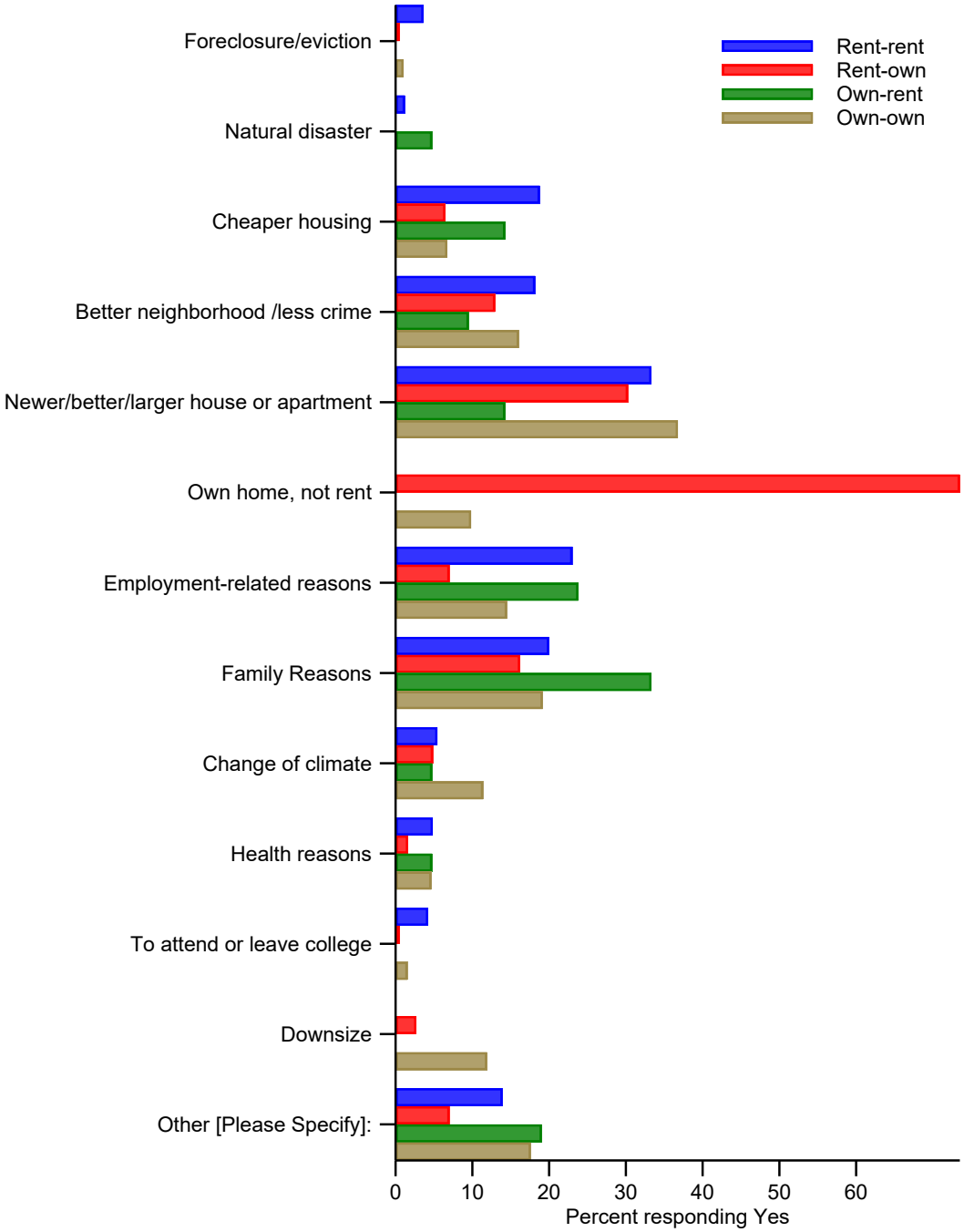
This appendix presents evidence on reasons for moving from our survey and from the SIPP, American Housing Survey (AHS), and Current Population Survey Annual Social and Economic Supplements (CPS ASEC).

Figure B.2 presents results from the SIPP question "What was the main reason you moved to this address?" (`EEHC_WHY`). The sample for this analysis coincides with Appendix D. Respondents can choose one answer.

Figure B.3 presents results from a similar question asked of recent (last two years) movers in the AHS (`RM*`). The sample for this is the AHS waves in 2015, 2017, and 2019. Unlike the SIPP, the AHS prefaces a series of questions with "People choose to move for a variety of reasons, either voluntary or non-voluntary" and respondents can choose multiple reasons.

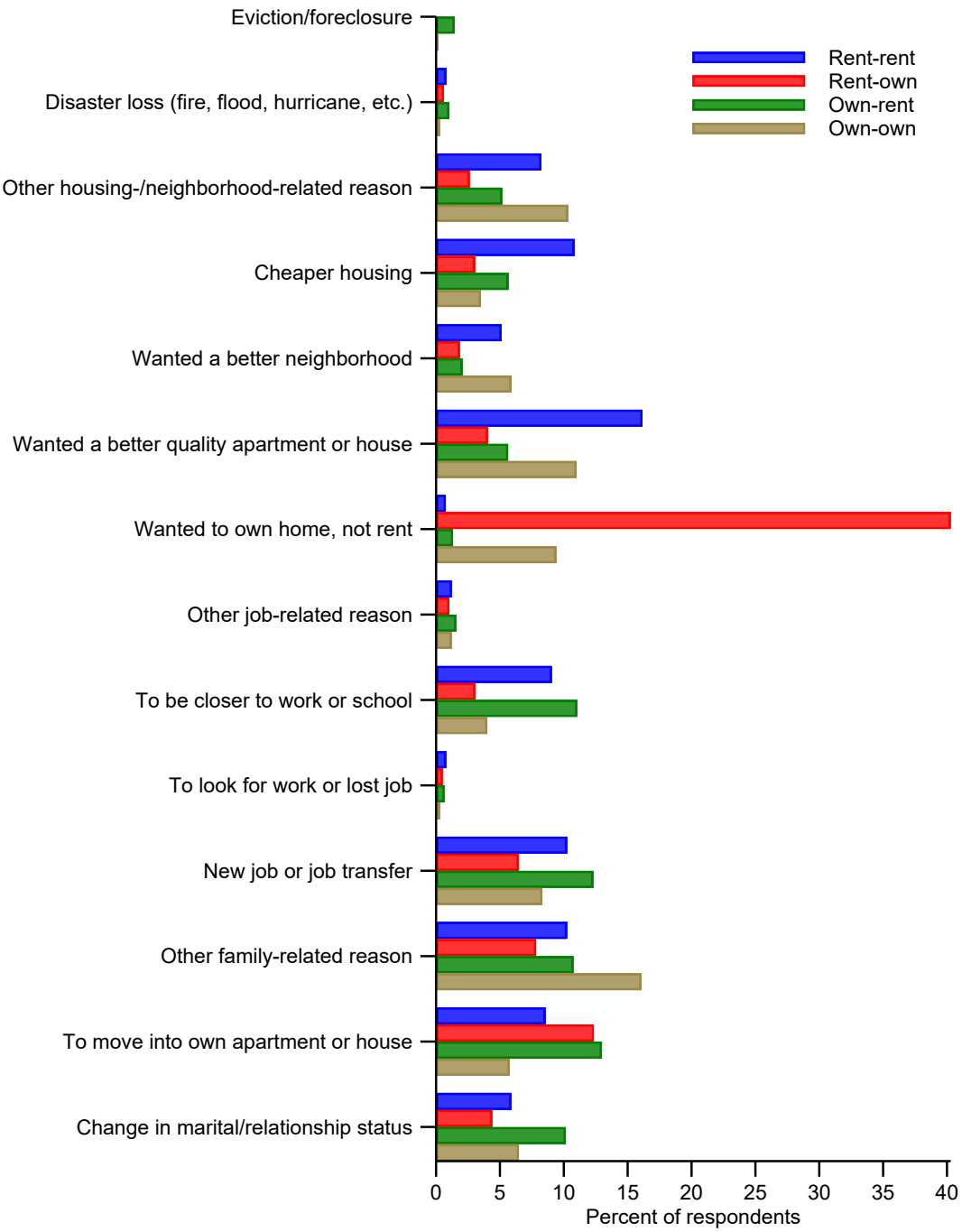
Figure B.4 presents results from a similar question asked of movers (in the previous year) in the CPS ASEC: "What was your main reason for moving?" (`NXTRES`). The sample for this is the 2015-2018 ASECs. Like the SIPP, respondents may choose only one answer. Unlike the SIPP and AHS, we cannot split respondents by whether they change tenure status as the CPS does not ask about the tenure of the previous residence.

Figure B.1: Reason for Moving: Our Survey



Notes: Due to a survey module error, we did not offer current renters the option to select "downsize".

Figure B.2: Reason for Moving: SIPP



Notes:

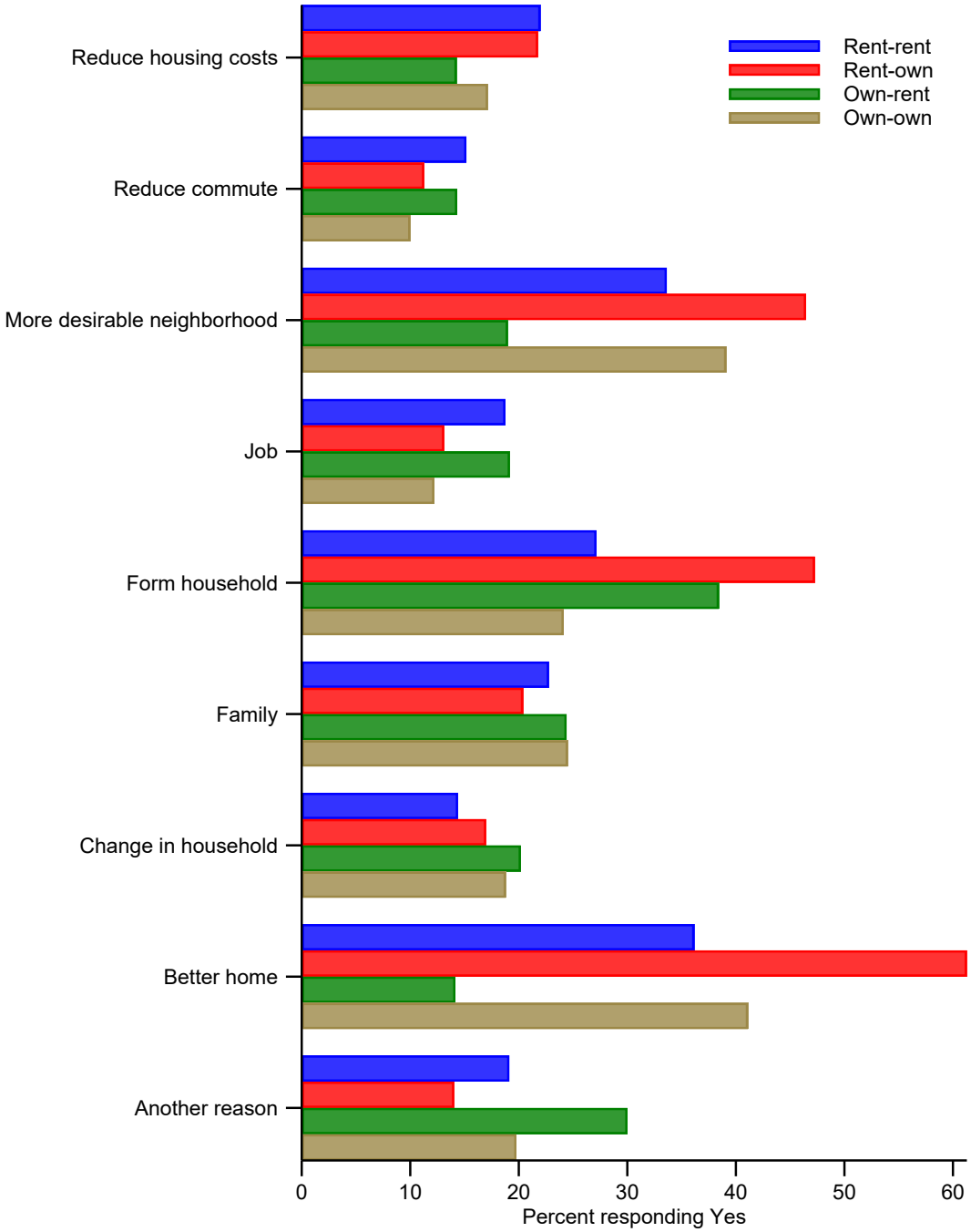
C.3 Willingness-to-pay Questions

Imagine the following scenario: When you bought your home, you also considered renting. Let's compare the outcome of your choice to buy a home with a hypothetical alternative where you chose to rent instead.

The Decision Point

When you bought your home, you faced a choice about where to

Figure B.3: Reason for Moving: AHS



Notes:

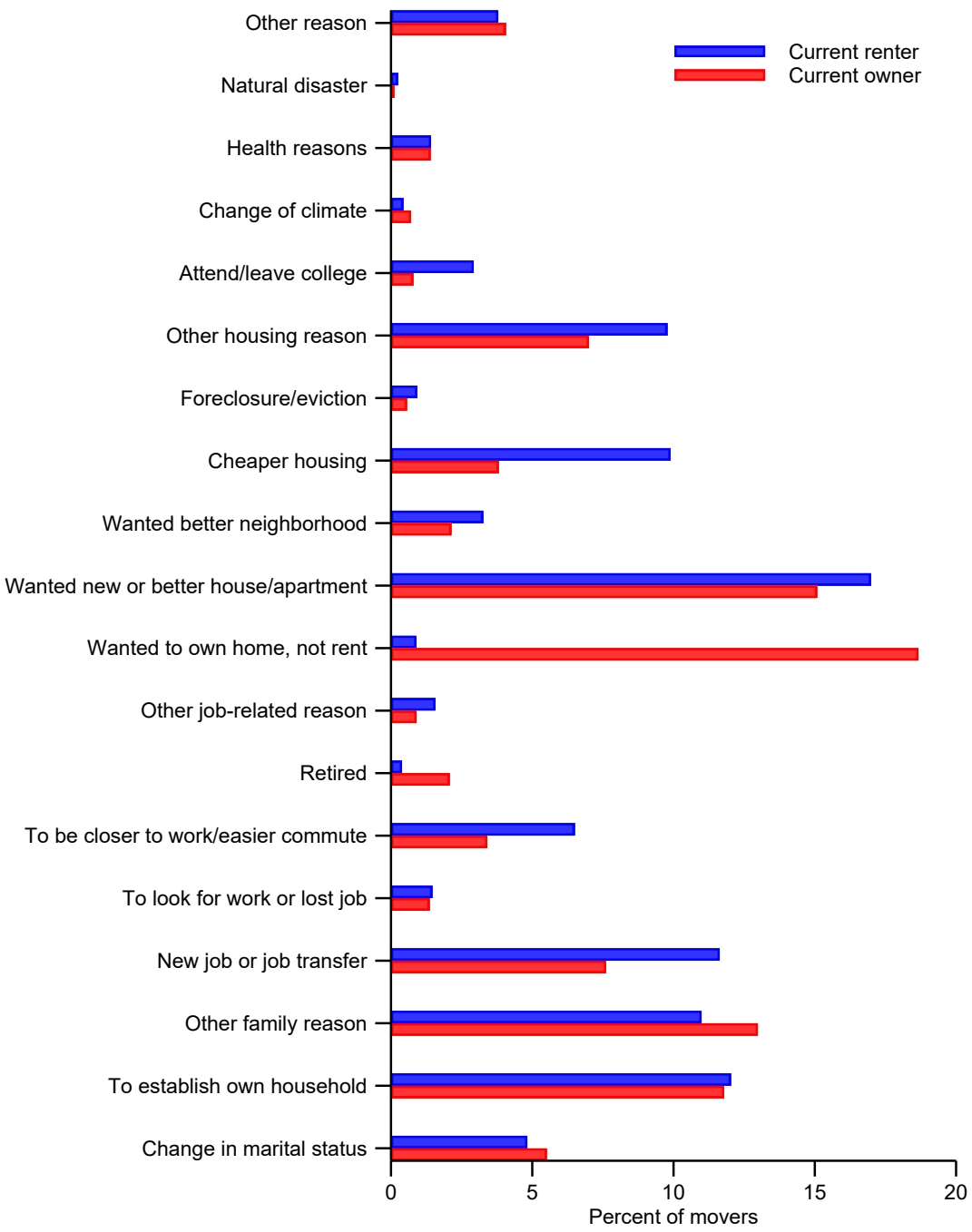
Imagine this hypothetical scenario: You've just inherited $25,000 from a distant relative. This amount is enough to cover a down payment on a home you might like to buy. You now face a significant financial decision.

The Decision Point

With this unexpected inheritance, you have two options:

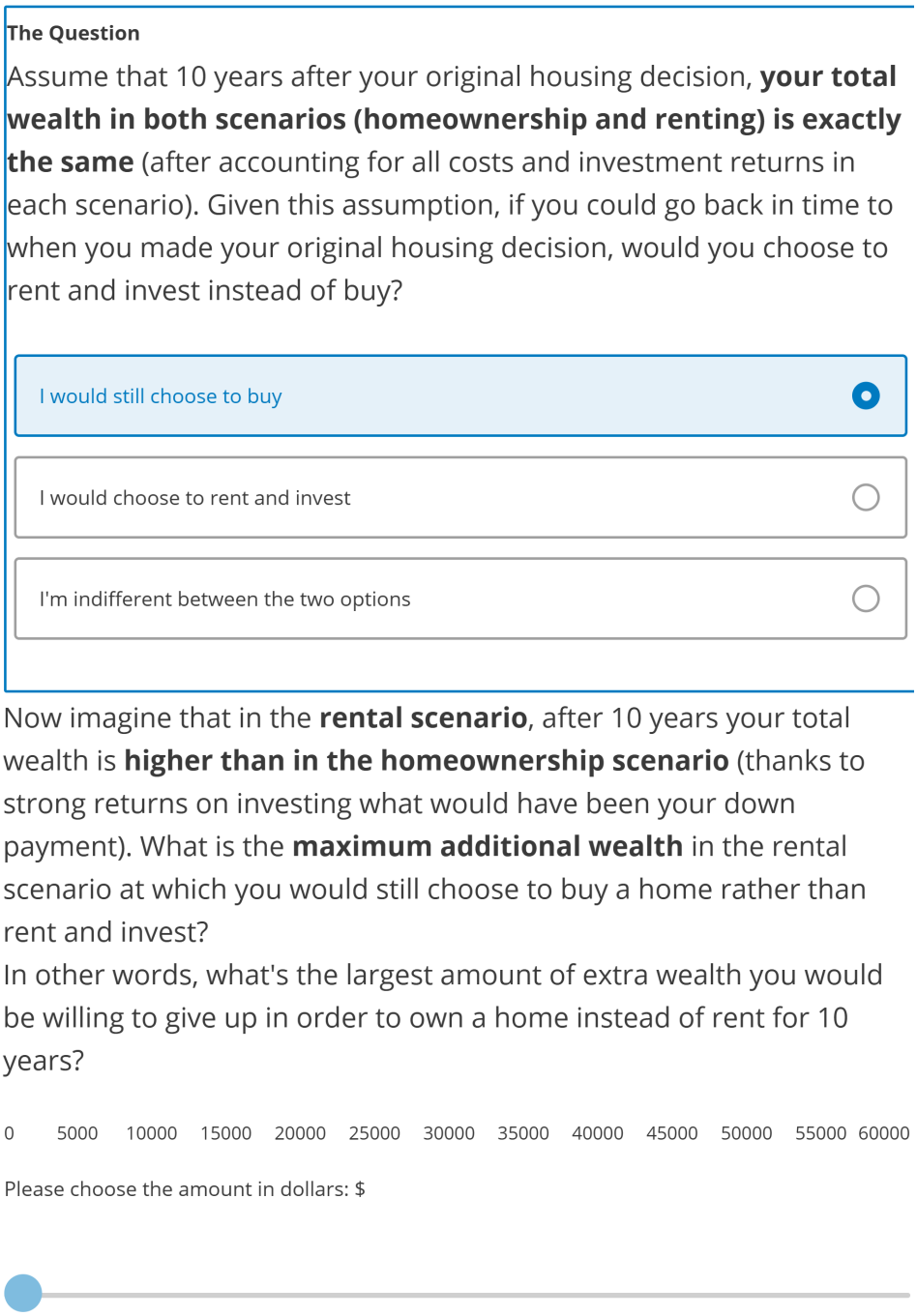
1. **Buy a Home:** Use the inheritance as a down payment to

Figure B.4: Reason for Moving: CPS ASEC



Notes:

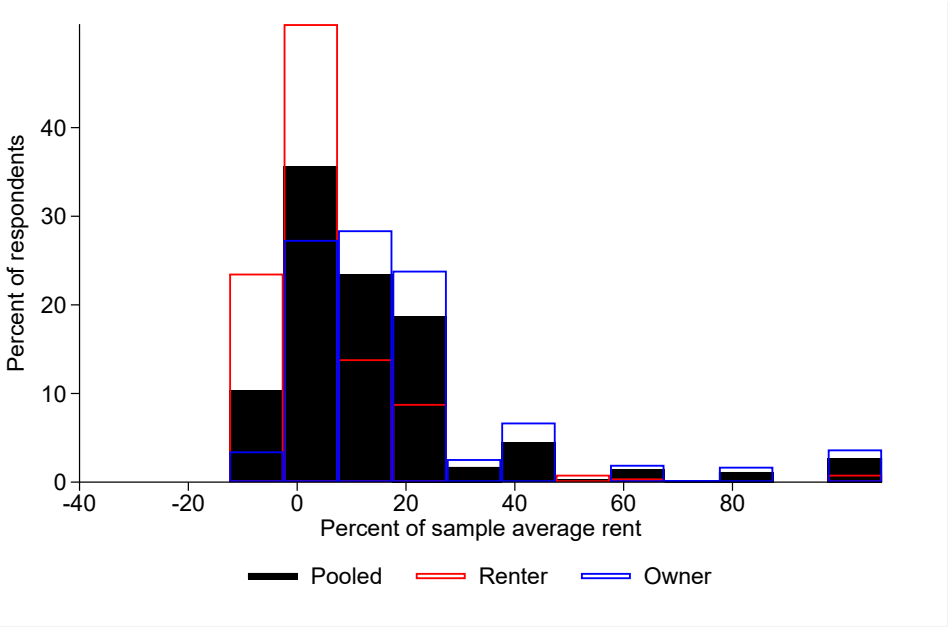
Homeownership (Your Actual Choice)	Rental Scenario (Hypothetical)
Living Situation: You lived in a home you owned for 10 years, paying off part of your mortgage	**Living Situation:** You would have been continuously living in a rented home for 10 years



C.4 Results With WTP Scaled by Sample-Average Rent

Figure B.5 reports the histogram of WTP as a share of sample-average rent. Table B.4 reports regressions of WTP scaled by sample-average rent on homeownership.

Figure B.5: WTP Distribution



Notes: The figure reports the histogram of willingness-to-pay as a share of the sample average rent or imputed rent. We winsorize the top and bottom 2.5% of observations.

C.5 Mis-reporting and Results From Follow-up Survey

C.5.1 Follow-up Survey

We launched an approximately 15 minute follow-up survey five weeks after the main survey.[23] We made the follow-up survey available to a randomly-selected 300 respondents of the main survey, excluding respondents who reported their WTP did not reflect their true valuation (whom we exclude from our baseline sample) and 89 respondents newly ineligible to participate in Prolific surveys because they are not U.S. nationals. We received 230 responses, for an overall response rate of 77%. We exclude one respondent who finished the survey in less than one minute (the next shortest response time is 00:03:40) and six respondents who did not complete the WTP portion, leaving 223 responses, or 74% of the potential sample.

The selected respondents were not told this survey was related to our earlier survey. To mask any connection, the follow-up survey asked a series of questions about different trade-offs around living arrangements. For example, homeowners were asked in order: (i) their typical commute time; (ii) open-ended question about their decision to live with that commute; (iii) a WTP for a

[23]Specifically, we collected the main survey on January 9, 2025, the short follow-up to obtain numeric values for those who chose the slider or loop maximum over January 16-22, 2025, and launched the main follow-up on February 21, 2025.

Table B.4: Willingness-to-pay to Own

Dep. var.:	WTP to Own				
	(1)	(2)	(3)	(4)	(5)
Owner	14.3**	13.1**	15.5**	15.2**	16.7**
	(1.1)	(1.0)	(1.6)	(1.4)	(1.7)
Identical house	-0.9	-2.3+	-2.4	-3.4*	-2.9
	(1.6)	(1.2)	(2.0)	(1.6)	(2.0)
Loop	0.6	1.3	1.5	1.4	1.5
	(1.6)	(1.4)	(2.1)	(1.9)	(2.3)
Constant	2.1**	3.3**	4.9**	4.1**	4.0**
	(0.8)	(0.8)	(1.2)	(1.1)	(1.3)
WTP$< 100k$	✓				
Winsorized		✓	✓	✓	✓
Confidence weighted			✓		
Baseline sample				✓	✓
Addl. attention check					✓
WTP mean	11.2	11.5	15.3	13.8	14.6
WTP s.d.	21.1	19.1	24.0	22.0	22.9
WTP skewness	3.44	2.04	2.16	2.37	2.30
WTP kurtosis	23.60	7.97	8.12	9.61	8.98
Observations	987	997	959	699	548

Notes: Column (2) excludes respondents who reported No (confused) or No (misclicked) to the question on valuation accuracy. Column (3) weights by confidence. The variable Identical house is an indicator for the hypothetical specifying an identical property in terms of location, size, quality, and features. Loop is an indicator for answering the WTP question using a loop instead of a slider.

10 minute reduction in commute time; (iv) an explanation of that amount; (v) the WTP to own question shown below including related open-ended questions; (vi) to select and explain household tasks done by a paid employee versus self; (vii) hobbies; (viii) outdoor space; (ix) number of bedrooms; a trade-off between indoor and outdoor space.

To assess whether interviewer bias might contaminate the follow-up, we asked respondents about what they thought was the purpose of the survey...

The WTP to own question was similar to but simpler than the version shown on the original survey. Figure B.6 shows the question for owners. We followed this question with a slider from $0 to $100,000 for the additional wealth required to induce the respondent to switch tenure.

The correlation coefficient between the WTP in the original survey (in dollars) and in the follow-up is 0.50. Restricting the sample to respondents who did not answer the short survey in the interim results in a correlation coefficient of 0.48. Thus, we find a meaningful correlation of

Figure B.6: Survey Follow-up WTP Text

*Think back to when you bought your home. Imagine that at the time, you ha
options:

1. **Buy a Home:**
    - Make down payment
    - Take out a mortgage
    - *Live there for 10 years, then sell*
2. **Keep Renting:**
    - Invest the down payment in a diversified portfolio
    - *Rent for 10 years*

Suppose after 10 years, **your total wealth would be exactly the same in scenarios** (accounting for all costs, home sale proceeds, and investment returns).
Which would you choose?

- ◯ Buy a home
- ◯ Keep renting and invest
- ◯ I would be indifferent

responses across surveys.

C.5.2 Interpretation

To interpret the differences across the original and follow-up surveys, we provide the following cognitive uncertainty framework. An individual with a true value $\theta_i \sim N(\mu_\theta, \sigma_\theta^2)$ receives a signal of her true preference of $\theta_i + e_i$, with $e_i \sim N(0, \sigma_e^2)$ drawn independent of θ_i. The signal-to-noise ratio is:

$$b = \frac{\sigma_\theta^2}{\sigma_\theta^2 + \sigma_e^2}.$$

We consider two cases.

Case 1: naive. Individuals who do not recognize their cognitive uncertainty simply report $\hat{\theta}_i = \theta_i + e_i$. Then:

1. A regression of $\hat{\theta}$ on homeownership yields an unbiased coefficient of the true relationship. This result follows because e_i adds classical left hand side measurement error.

2. The cross-sectional variance is $Var\left(\hat{\theta}_i\right) = \sigma_\theta^2 + \sigma_e^2 = \sigma_\theta^2/b$. Thus, measurement error causes the cross-sectional variance to be inflated by a factor $1/b$.

3. If we elicit two values $\hat{\theta}_i^1$ and $\hat{\theta}_i^2$ for each individual with independent measurement error, then $Corr\left(\hat{\theta}_i^1, \hat{\theta}_i^2\right) = b$.

Case 2: sophisticate. An individual aware of her cognitive uncertainty shrinks her signal toward the mean and reports $\hat{\theta}_i = \mu_\theta + b(\theta_i + e_i - \mu_\theta)$. Then:

1. A regression of $\hat{\theta}$ on homeownership yields a coefficient attenuated by a factor b.

2. The cross-sectional variance is $Var\left(\hat{\theta}_i\right) = b^2\sigma_\theta^2 + \sigma_e^2 = b\sigma_\theta^2$. Thus, measurement error causes the cross-sectional variance to be attenuated by a factor b.

3. If we elicit two values $\hat{\theta}_i^1$ and $\hat{\theta}_i^2$ for each individual with independent measurement error, then $Corr\left(\hat{\theta}_i^1, \hat{\theta}_i^2\right) = b$.

Comparing across both cases, we have the following conclusions:

1. A regression of $\hat{\theta}$ on homeownership yields a weakly attenuated coefficient.

2. The cross-sectional variance $Var\left(\hat{\theta}_i\right)$ maybe larger or smaller than the true variance but is bounded (in the case of uncorrelated measurement error) by b and $1/b$.

3. $Corr\left(\hat{\theta}_i^1, \hat{\theta}_i^2\right) = b$. Using our survey, we thus have $b \approx 0.5$.

D SIPP Mover Analysis

This appendix describes our analysis of the SIPP. Unlike most government surveys (including the CPS, ACS, and AHS), the SIPP follows individuals who move from the originally-sampled address.

We use the 2014-2021 panels, which cover the years 2013-2020. We use 2020 only to compute moving rates for the last few months of 2019.

We define a move as a change in residence (variable `ERESIDENCEID`). The SIPP contains its own edited mover variable (`TMOVER`). In nearly all cases, `TMOVER` coincides with a change in residence. U.S. Census Bureau (2021, p. 64) explains the discrepancies: "However, in a small number of cases a change in `ERESIDENCEID` from one month to another may not be reflected on `TMOVER` and `TRESDUR`. In these instances, a respondent has changed residences from one month to another but reports always living at the residence he or she has moved to on the reason for move variable (`EEHC_WHY`). Because respondents' own definitions of what constitutes a move may differ from how the SIPP survey identifies a move, we have chosen to leave these apparent inconsistencies in the data." We use changes in residence directly in order to compute moving rates across horizons greater than 1 month. The variable `EEHC_TEN` determines whether a residence is owned or rented.

To focus on moves likely to involve a change in title or lease contract at the original residence, we restrict the sample to reference persons (`ERELRPE`=1,2), which U.S. Census Bureau (2021, p. 161) defines as "an owner or renter of record." If a household splits into multiple residences (for example, a child moves into her own apartment), we keep only the reference person in the original unit. We further restrict the sample to residences defined as houses or apartments (`TPRVLVQRT`=1). We compute statistics weighted by the monthly sample weight (`WPFINWGT`).

The size of the SIPP sample varies over time. There also is seasonality in moving hazards. To address these issues, we compute population shares and moving hazards by month, take averages

Table B.5: Moving Rates

	Population share			Hazard rate		
	1 month	3 month	12 month	1 month	3 month	12 month
Rent stayer	34.30	32.84	26.46	98.41	95.09	80.97
Rent-to-rent	0.43	1.30	4.74	1.23	3.77	14.50
Rent-to-own	0.13	0.39	1.48	0.36	1.14	4.53
Own stayer	64.86	64.59	64.29	99.57	98.65	95.49
Own-to-rent	0.12	0.38	1.23	0.19	0.58	1.82
Own-to-own	0.16	0.50	1.81	0.24	0.77	2.68

Notes: the table shows the population share and hazard rates for 1-month, 3-month, and 6-month moves. The sample consists of household reference persons in the SIPP panels covering 2013-2019. For households with multiple residences and reference persons in a reference year, we keep only the original reference person. We construct population shares and hazard rates by month, take averages for each of the 12 calendar months, and finally take averages over the calendar months to account for uneven sample sizes and seasonality.

for each of the 12 calendar months, and finally take averages over the calendar months.

Table B.5 reports population shares and moving hazards by whether the move involves a change in tenure.