Housing and the Heterogeneous Welfare Cost of Inflation *

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Abstract

Standard residential mortgages give rise to meaningful welfare costs of steady state inflation when consumers are borrowing constrained and mortgage refinancing is costly. Higher steady state inflation results in a more front loaded payments profile with fixed amortization mortgages, which impacts consumers' housing and consumption decisions. To quantify the welfare cost of inflation, we introduce nominal fixed amortization mortgages into a calibrated life-cycle housing tenure choice model. When house prices are held fixed, a one-percentage-point increase in inflation reduces welfare by about 0.05 percent of lifetime consumption, with larger costs for college-educated and middle and upper-income households. In general equilibrium, higher inflation lowers housing demand and reduces real house prices and rents, partially mitigating the tightening of borrowing constraints. As a result, the welfare cost of inflation is increasing in the housing supply elasticity and thus welfare costs of inflation is higher in cities with more elastic housing supply. We find that a permanent decline in steady inflation such as the Volcker disinflation can be welfare improving even accounting for the transition costs on existing mortgagors.

Keywords: Mortgage, Inflation, Welfare Cost, Heterogeneity

JEL: E21, E60, R21

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1 Introduction

A long standing question in economics is what are the costs of moderate steady state inflation. Behind this debate lies a divergence between survey evidence that find that many households strongly dislike inflation (e.g., Stantcheva (2024)) while economic analysis often points to modest welfare costs of moderate inflation.[1] This raises the question of whether others channels in the long taxonomy listed by Fischer and Modigliani (1978) could give rise to meaningful costs and help account for the widespread dislike of inflation.

In this paper, we focus on a channel which has been surprisingly understudied: the interaction between steady state inflation and nominal financial contracts. Specifically, we focus on one of the most used financial contracts: residential mortgages. With a standard fixed amortization (typically 30 years in the U.S.) and **constant nominal payments** mortgage, higher steady state inflation — which manifests as higher nominal interest rates via the Fisher equation — front-loads the profile of real mortgage payments (Kearl, 1979; Schwab, 1982; Lessard and Modigliani, 1975). With a long amortization, even modest inflation can lead to a significant increase in real payments in the early years of a mortgage (Section 2.1).

We show that when mortgages are costly to refinance that the front-loading of real mortgage payments tightens the borrowing constraints on lower wealth (typically younger) households. As a result, steady state inflation impacts life cycle consumption and homeownership decisions of borrowing constrained households. In our quantitative analysis, we show that this housing finance channel results in meaningful welfare costs for even modest levels of steady state inflation. Behind the aggregate welfare costs lie uneven impacts across people, as the welfare cost of inflation is much larger for middle and upper income households who start life with low wealth and are most likely to be borrowing constrained when purchasing a house. In turn, this leads to higher inflation lowering aggregate housing demand and thus real housing prices and rents. As a result, welfare costs can vary across cities due to differences in the elasticity of housing supply. When we examine transitions between steady states following an unexpected, permanent change in inflation, we find that the change in real house prices and rents have significant impacts on who wins and loses.

[1]The idea that inflation acts as a tax on real monetary balances is long standing (e.g.,Bailey (1956) and Friedman (1969)). The second channel focuses on how the inflation interacts with nominal rigidities that slow the adjustment of relative prices to result in shifts in relative prices that distort output (e.g., Burstein and Hellwig (2008), Blanco (2021)).

To illustrate the mechanism behind this housing finance channel, we develop a two-period model where households consume a non-storable good and housing financed by fixed amortization mortgages. We show that three features are necessary for steady state inflation to impact consumer's welfare via housing finance. First, (some) consumers must be borrowing constrained. The second two are features of standard fixed amortization mortgages: (i) Inflation tilts the profile of real mortgage payments over the amortization forward and (ii) mortgages are costly to refinance so households cannot offset higher nominal mortgage payments by costlessly extracting the rise in nominal house value that accompanies higher inflation. We show analytically that these features lead to larger welfare costs of inflation for borrowing constrained households with higher expected income growth. The housing finance channel also generates general equilibrium effects as the front-loading of real mortgage payments reduces demand for owner occupied housing of borrowing-constrained households. When housing supply is inelastic, a fall (rise) in demand translates into a decline (increase) in house prices which partially offsets the direct effects of inflation on housing affordability.

The quantitative model we develop incorporates nominal mortgages into a life-cycle housing tenure choice environment. Households face a life-cycle earnings profile and have preferences over a non-storable consumption good and housing services which are obtained by owning or renting. Since the welfare effects of inflation depends on whether households are borrowing constrained and their propensity to own, we introduce two household types—college and non-college. In our calibration, college households have higher homeownership rates, steeper life-cycle income growth, and lower idiosyncratic income risk than non-college households. The only debt instrument is a thirty-year amortization mortgage with fixed nominal payments which incurs a cost at origination. Borrowers face a maximum loan-to-value constraint and the buying and selling of houses incur transaction costs. The nominal mortgage interest rate varies proportionally with the (exogenous) rate of inflation. To avoid tracking the change of prices due to inflation, we map the household's nominal budget constraint into real terms so that mortgage payments depend on inflation and mortgage age.

We use the calibrated model to evaluate the welfare cost of steady state inflation between 0 and 10 percent. We calibrate to match homeownership, loan-to-value, debt-to-income, and payment-to-income ratios over the life-cycle in 2019 for college and non-college households. In our calibration, we assume the economy is in steady state with inflation at 2%. Our calibration implies that a number of households are borrowing constrained during the initial years of homeownership. This is consistent with the findings of Boar, Gorea, and Midrigan

(2022) who argue that liquidity constraints are severe in the housing market.[2]

To isolate the direct effect of inflation on borrowing constrained households, we examine the welfare costs of inflation when real house prices (and rents) are held fixed. We find that a 1 percentage point increase in inflation (i.e, from 2 % to 3 %) lowers welfare (in consumption equivalents) by roughly 0.05%. Since welfare primarily distorts housing and consumption choices of homeowners, one would expect that the welfare costs are larger for higher income households who typically own than for the lower income who typically rent. Comparing the college educated with the non-college, we find that the welfare costs of inflation for a new-born college educated consumer are nearly twice as large as for a non-college. Even conditional on education, we find that inflation has little impact on households born into the lowest income percentiles who are very likely to remain renter while top income earners face a welfare cost roughly twice as large as the economy-average.

Refinancing costs are a key determinant of the welfare cost since refinancing allows mortgagors to relax borrowing constraints by extracting inflation driven increases in home equity. We find that reducing refinancing costs from the benchmark 2.5% to 1% lowers the welfare cost of inflation by roughly one-third, while increasing refinancing costs to 4% only modestly amplifies welfare losses. Nevertheless, the qualitative pattern remains unchanged: inflation imposes larger welfare losses on college-educated and higher-income households.

In general equilibrium, higher inflation lowers the real price of houses. This fall in real prices partially mitigates the tighter borrowing constraints of younger homebuyers which reduces the welfare cost of inflation. With a price elasticity of 0.4 (roughly the estimate of Baum-Snow and Han (2024)), real house prices decrease by roughly 0.25 percentage points per percentage point increase in inflation. As a result, the welfare cost of inflation is roughly a third (0.015%) of the partial equilibrium estimate with fixed prices and rents. The smaller welfare costs are partly due to the pass through of higher house prices into rents, as higher real rents reduce the benefits to renters of lower inflation.

We decompose the differences in the partial and general equilibrium welfare cost estimates

[2]Chen, Michaux, and Roussanov (2020) find that liquidity playz an important role in refinancing decisions. Empirical studies of mortgage finance regulations also find that liquidity constraints are important. For example, Backman, Moran, and van santen (2024) find that a Swedish regulatory reform that eliminated interest only mortgages for mortgages with LTVs above 50% resulted in lower borrowing due to higher payments for newly originated mortgages above the LTV threshold. Similarly, policy reforms in the 1990s in the Netherlands and the 2000s in Denmark were followed by substantial take-up of interest only mortgages (Bäckman and Khorunzhina (2024), Rouwendal (2007)).

into the profile of real mortgage payments, the pass through of house prices into rents, and maintenance and property taxes. In our baseline, maintenance and property taxes are proportional to the house value. Mechanically, this means that the higher real house price in the low(er) inflation steady states pushes up ownership costs. This increase in ownership costs accounts for roughly a third of the lower welfare cost in GE compared to PE. When we hold real rents fixed, we find that the rise in rents in our baseline accounts for roughly a fifth of the smaller welfare cost of inflation. This then attributes less than half of the difference between the GE and PE welfare costs to the direct effect of higher prices offsetting the relaxation of borrowing constraints at lower inflation.

We use the calibrated model to quantify the steady state welfare gains from lowering inflation from 10 to 2 %, comparable to the early 1980s Volcker disinflation. For a housing supply elasticity of 1.7, steady state welfare is nearly 0.24 % higher at 2 % compared to 10 %.[3] These gains are mainly captured by the college educated and higher income households. Using the city level estimates of housing supply elasticities from Saiz (2010), we find large cross-city variation in the welfare gains. Cities with the lowest housing supply elasticity experience roughly half the welfare gains of cities with highly elastic housing supply.[4]

While our steady-state analysis finds that the structure of mortgage contracts results in welfare costs of steady state inflation, changing the target level of inflation leads to transitional winners and losers. To examine the implications for owners and renters, we introduce an unanticipated fall (increase) in inflation. Our transition experiments introduce two channels beyond the standard revaluation of real mortgage debt (Doepke and Schneider (2006)). First, changing inflation changes the real payment profile of new mortgages, which impacts households' subsequent housing and consumption decisions. Second, a permanent change in inflation leads to a one time shift in real house prices and rents. This leads to capital gains or losses for existing homeowners and impacts the real purchasing power of renters. We find that the change in real house price and rents mitigate the welfare effects associated

[3]We use the housing supply elasticity estimates from Saiz (2010), which are closer to the Volcker disinflation period. Housing supply has generally become less elastic over time which is reflected in the more recent estimates in Baum-Snow and Han (2024) for the post-2000 period.

[4]This paper complements recent work on the welfare consequences of the Volcker disinflation. Pugsley and Rubinton (2023) apply a HANK model to discuss the uneven distribution of welfare gains along the *transition* of the Volcker disinflation among borrowers and savers. Our analysis focuses on the steady state benefits, and highlights an additional source of welfare gains that is in addition to the costs associated with the inflation tax on real money balances.

with the unexpected revaluation of existing mortgage debt. We also find that the option to refinance limits the losses incurred by mortgagors following an unexpected fall in inflation. In contrast, an unanticipated increase in inflation results in large gains for mortgagors who lock-into mortgages contracted at lower nominal interest rates.

Our quantitative analysis shows that housing finance gives rise to meaningful welfare costs of moderate steady state inflation. While the tilt effect of inflation on mortgage payments is well known (e.g., see Lessard and Modigliani (1975), Fischer and Modigliani (1978), Kearl (1979), Schwab (1982) and Garriga, Kydland, and Šustek (2017)), little work has examined its implications for the welfare cost of inflation.[5] Closest in spirit to our work is a pioneering contribution by Schwab (1982), who showed theoretically that the tilt effect could impact consumers decisions. His simple numerical estimation of the welfare costs under the assumption of interest-only mortgages with fixed house prices found a very small cost. We show analytically the essential role of refinancing cost, as well as how even modest refinancing costs lead to meaningful welfare costs of moderate steady state inflation when consumers are borrowing constrained. Our quantitative analysis shows that this leads to meaningful welfare costs for moderate inflation rates that vary across income groups and housing markets. In complementary work, MacGee and Yao (2026) show that the interaction between inflation and housing finance can help account for historical episodes of increases in mortgage debt following a disinflation. Consistent with this channel, Hausman et al. (2026) show that nominal rather than real mortgage rates drive home-buying sentiment across US cities.

A commonly cited cost of anticipated inflation is the "shoe leather" cost resulting from inflation acting as a tax on money balances (e.g., Bailey (1956), Driffill, Mizon, and Ulph (1990), Schmitt-Grohe and Uribe (2011)). This has resulted in a range of estimates, including heavily cited work by Lucas (2000) who finds that reducing inflation from 10 to 0 percent would see a gain in income of roughly 1 % while Ireland (2009) reports a cost roughly a fourth as large. Our welfare costs estimates lie between those of Lucas and Ireland, and since our mechanism is independent from money demand, adds to the total cost of steady state inflation. The housing finance channel we examine also leads to different distributional effects as the inflation tax on non-interest bearing money disproportionately impacts lower income households (e.g., Erosa and Ventura (2002), Cao et al. (2021)), while we find that

[5]Despite some discussion about inflation-indexed mortgage contracts in the literature (e.g., see Campbell and Cocco (2003)), fixed payment mortgage contracts (including fixed-rate mortgage contracts and adjustable-rate mortgage contracts) are the most common contracts in the US.

the middle and upper income households bear the largest costs. Our channel thus offers a complementary explanation for why many people dislike steady state inflation.

Related work on the implications of nominal rigidities for the welfare cost of inflation finds a range of welfare costs. One branch of this work argues that the presence of nominal rigidities results in higher inflation increasing price dispersion. Nakamura et al. (2018) however argue that relative price dispersion during the U.S. great inflation was modest.[6] We show that the interaction between inflation and nominal mortgage contracts can distort the relative price of housing and non-housing consumption which leads to cross city differences in the welfare cost of inflation as a result of differences in housing supply elasticities.

Our paper is related to work on the transmission of cyclical monetary policy via mortgage rates (e.g., Garriga, Kydland, and Šustek (2017); Berger et al. (2021); Auclert (2019); McKay and Wolf (2023); Eichenbaum, Rebelo, and Wong (2022)). In contrast to these papers, which typically assume constant steady state inflation, we show that the level of inflation can have significant welfare costs. Other work argues that borrowing constraints impact the transmission of monetary-policy. McKay, Nakamura, and Steinsson (2016) show that uninsurable income risk and borrowing constraints can substantially alter households' responses to monetary policy relative to complete-markets models, while Kaplan, Moll, and Violante (2018) show the importance of household heterogeneity and general-equilibrium effects for monetary-policy transmission. Although household financial constraints are also central to our analysis, we differ in our focus on steady state inflation and the structure of long-term mortgage contracts rather than conventional monetary-policy shocks.

The rest of this paper is organized as follows. Section 2 uses a numerical example to show how inflation affects real mortgage payments over the amortization and a two-period model that illustrates the key mechanism. Section 3 outlines the quantitative model. Section 4 discusses the calibration strategy and results. Section 5 discusses the welfare implications of inflation across steady states. Section 6 examines welfare after an unexpected change in inflation, while Section 7 discusses alternative mortgage contracts and Section 8 concludes.

[6]Hahn (2022) and Afrouzi et al. (2024) show that in the standard New Keynesian model money is not superneutral as changes in steady state inflation affects real variables. Ascari, Phaneuf, and Sims (2018) examine a New Keynesian model with nominal rigidities, and report that a two percentage point rise in trend inflation (from 2 to 4 percent) implies a nearly 4 percent consumption-equivalent welfare loss.

2 The Mechanism: Inflation and Housing Finance

Although the implications of inflation for the profile of real mortgage payments are long established (e.g., Kearl, 1979; Schwab, 1982; Lessard and Modigliani, 1975), the tilt effect is not widely discussed in recent literature. We thus use a numerical example to illustrate how significant the effect the tilt effect can be for moderate inflation levels. We then develop a stylized two period model to analytically show how anticipated inflation can give rise to real effects when mortgagors are borrowing constrained and cannot freely refinance.

2.1 Inflation tilts real Mortgage Payments

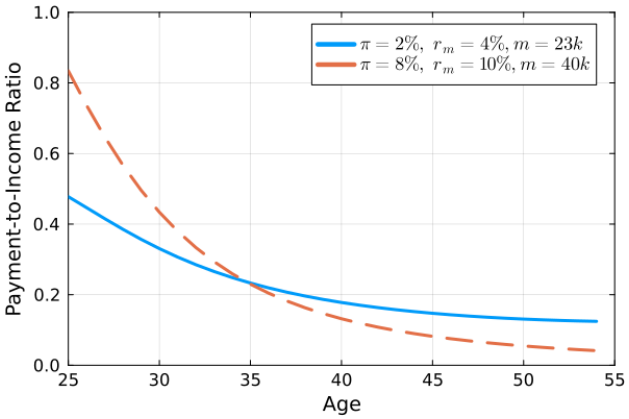
To provide some intuition on the significant impact of inflation on the path of mortgage payments, we use a numerical example (MacGee and Yao (2026)). We compare real payments on a $ 400,000 30-year amortization mortgage for inflation rates of two and eight percent where the Fisher equation links nominal interest rates and inflation (see Figure 1). For a $400,000 mortgage, the nominal annual payment mortgage nearly doubles from $ 23,244 at 2% inflation to $ 42,120 at 8% inflation. Higher inflation tilts the profile of real payments (adjusted for cumulative inflation since origination), as real payments with 8% inflation fall below those of 2% inflation by the twelfth year of the amortization. In Section 2.2 we show that this tilt in real payments can have real impacts on the consumption decisions of a borrowing constrained consumer and push non-housing consumption from the early to the later years of the amortization.

2.2 Unpacking the Housing Finance Channel: Two Period Model

The welfare costs of trend inflation that we examine arise from the interaction between borrowing constrained consumers and two features of standard mortgage contracts: the tilt in the profile of real payments of fixed nominal amortization mortgages and costly refinancing. Since this mechanism is relatively novel, in this section we develop a simplified 2-period version of our quantitative model.[7] We show analytically that when a mortgagor cannot refinance, that the front loading of real mortgage payments that result from higher anticipated inflation distorts the intra-temporal and intertemporal consumption decisions of a borrowing

[7]Schwab (1982) and MacGee and Yao (2026) also present two period examples that illustrate this mechanism where real house prices are held fixed.

Figure 1: Inflation and the Profile of Real Mortgage Payments



(a) Inflation & Real Mortgage Payments

This figure presents the mortgage payment-to-income (PTI) ratio under different levels of trend inflation for a 25-year-old worker with an initial mortgage balance of $300,000 who earns the average income for his or her age over the subsequent 30 years. Nominal mortgage interest depends on inflation and a real rate of 2%.

constrained consumer. In addition, we show that by shifting housing demand, the level of inflation impacts real house prices. As a result, the welfare implications of inflation vary with the elasticity of housing supply.

The two-period model formalizes the intuition for why the structure of standard mortgages leads to the non-superneutrality of money when consumers are borrowing constrained. This intuition is clear for a Hand-to-mouth borrower as non-housing consumption is $1-PTI$. Our example shows this generalizes for any borrowing constrained household as, holding housing consumption fixed, higher inflation tilts their non-housing consumption profile.

2.2.1 Environment

The economy is populated by a two-period lived household with preferences defined over a non-durable consumption good and housing services. The flow of housing services is proportional to the house h. The only borrowing instrument is a standard fixed amortization mortgage. The real interest rate $\bar{r}$ is fixed exogenously, and inflation (which we vary exogenously) moves nominal wages, prices and interest rates by factor $1+\pi$. The price P denotes the price of a unit of housing in units of the non-durable good. We use the end of the first period (the beginning of the second period) as the base period for all real values.

Financial and Housing Markets: We examine a small open economy with exogenous

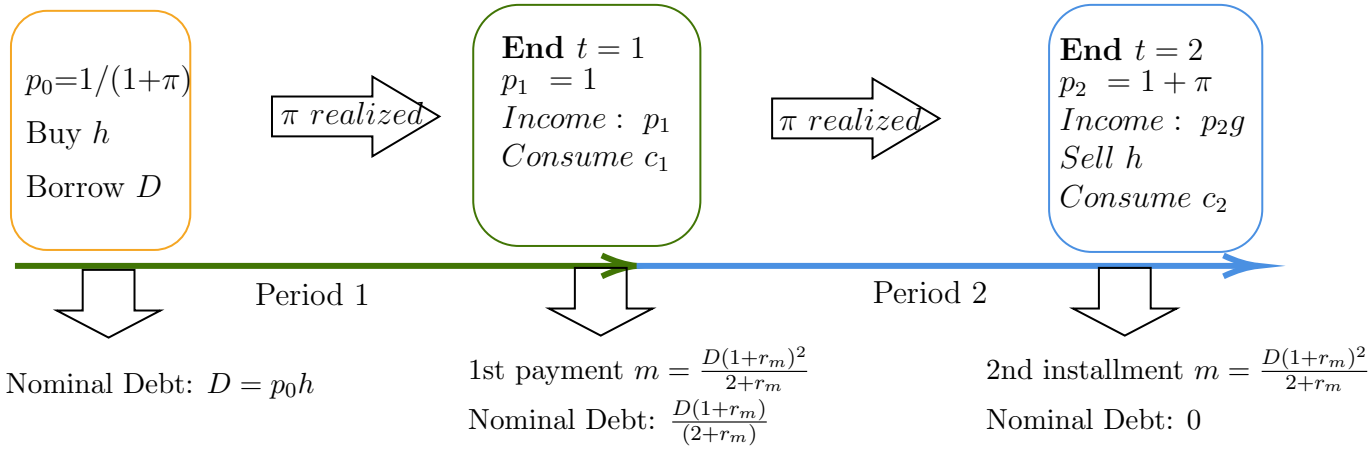
incomplete markets. Households can save S at nominal return $(1+\bar{r})(1+\pi)$. Fixed amortization mortgages D are secured against the house, and the nominal mortgage interest rate r_m is equal to the return on savings. Mortgages are originated at the beginning of the first period, and the scheduled nominal mortgage payments $\frac{(1+r_m)^2}{2+r_m}D$ are made at the end of the first and second periods. An owner incurs a maintenance cost δph at the end of each period.

Households: A mass 1 of two-period-lived households are born young. They receive an endowment of 1 when young and $g > 1$ units of the consumption good when old. Household preferences are represented by a separable utility function defined on consumption c_t and housing services h.

$$\max_{c_1,h,c_2,S} \ln(c_1) + \theta \ln(h) + \beta \ln(c_2) \tag{1}$$

Timing: At the beginning of the first period, the young choose the size of house h to buy at price $\frac{P}{1+\pi}$ which they finance with a mortgage $D = \frac{Ph}{1+\pi}$ that amortizes over two periods. At the end of the first period, households receive income 1, and make a mortgage payment consisting of interest and the first of two principal payments. Households enter the second period with housing (h) and the mortgage balance. At the end of the second period, households make their final mortgage interest and principal payments, sell the house, and consume their remaining wealth. The timing of transactions and the evolution of real and nominal mortgage debt are summarized in Figure 2.

Figure 2: Time Line and Debt Evolution



2.2.2 When does Anticipated Inflation have Real Effects?

What are the essential elements that lead to steady state inflation having real effects on consumers life-cycle consumption and housing decisions? Consistent with standard theory,

the nominal interest rate and the relative prices of goods are indexed to anticipated inflation. Thus, any real effects of inflation households' optimal choices arise via the household's budget constraints. We compare two household borrowing constraints in the presence of fixed amortization mortgages. In the first, we impose that households can only borrow using debt collateralized by the value of their house. In the second, the household can borrow up to their intertemporal budget constraint.

We start with the standard budget constraints of the young and old:

$$c_1 + \delta ph + \frac{(1+r_m)^2}{2+r_m} D + S = 1; \quad S \geq 0 \tag{2}$$

$$(1+\pi)c_2 + \frac{(1+r_m)^2}{2+r_m} D + (1+\pi)\delta ph = (1+\pi)ph + (1+\pi)g + (1+r)(1+\pi)S \tag{3}$$

The constraint $S \geq 0$ imposes that borrowing cannot exceed the value of the house (i.e., a LTV constraint of 1). The standard intertemporal budget constraint follows when we drop the $S \geq 0$ constraint. For any given housing choice h, the nominal mortgage payment $\frac{(1+r_m)^2}{2+r_m}\frac{ph}{(1+\pi)}$ is increasing in inflation since r_m increases with inflation. This also implies that the real balance after the first period payment decreases in inflation, which results in higher real home equity in the second period.

Corollary 2.0.1 *The first period real mortgage payment is* ***increasing*** *in inflation and the second period real mortgage payment is* ***decreasing*** *in inflation.*

We show that three ingredients are required for steady state inflation to have real effects via housing finance. First, (some) households must be borrowing constrained. In our example, borrowing constraints arise because all borrowing is collateralized by a mortgage with a maximum LTV constraint. When households can borrow at the risk-free nominal rate against their future income (i.e. $S \geq 0$ is dropped), inflation has no impact on household's decisions. Second, the "tilt" effect of higher rates of inflation front loads real payments which tightens the borrowing constraint on young households with fixed nominal payment mortgages. The third assumption is more subtle: we implicitly assume that households cannot refinance a mortgage at the end of period 1. This restriction is essential since if borrowers can costlessly refinance, then they can undo the tilt effect of inflation. These three elements lead to higher inflation decreasing steady state welfare.

Borrowing Constrained Allocation: To show the essential role of borrowing constrained consumers, we first characterize the conditions under which the LTV constraint

results in a household being borrowing constrained. We then show that higher inflation reduces consumer welfare when households are borrowing constrained.

A household is credit-constrained when $c_1^* + \delta p h^* + \frac{(1+r_m)^2}{2+r_m}\frac{Ph^*}{1+\pi} > 1$, where c_1^* and h^* denote the first-best consumption and housing allocations, respectively, obtained when no borrowing constraints are imposed. The inequality states that the household's desired first-period expenditures—including non-housing consumption, housing-related costs, and the mortgage payment—exceed its first-period income.

$$(\frac{1+\frac{g}{1+r}}{1+\beta+\theta})[1+(\delta+\frac{(1+r_m)(1+r)}{2+r_m})\frac{\theta}{\delta+\frac{\delta}{1+r}+\frac{r^2+2r}{1+r}}] > 1 \tag{4}$$

Equation 4 implies that for income growth g, there exists a level of inflation $\bar{\pi}(g)$ such that if inflation exceeds $\bar{\pi}(g)$, households are credit-constrained. Moreover, as g increases, $\bar{\pi}(g)$ decreases. To illustrate how inflation affects a credit constrained households' housing and non-housing consumption choices, we assume that $(\frac{1+\frac{g}{1+r}}{1+\beta+\theta})[1+(\delta+\frac{(1+r)^2}{2+r})\frac{\theta}{\delta+\frac{\delta}{1+r}+\frac{r^2+2r}{1+r}}]$ such that households are credit constrained at price stability (setting π to 0 in Equation 4).

Theorem 2.1 *An increase in inflation tightens the constraint in period 1 and leads to*

1. *a decrease in consumption and housing consumption in the first period:* $\frac{\partial h}{\partial \pi} < 0, \frac{\partial c_1}{\partial \pi} \leq 0$
2. *an increase in consumption in the second period* $\frac{\partial c_2}{\partial \pi} > 0$
3. *a decrease in welfare*

Proof. See Appendix

Intuitively, when the credit constraint binds in the first period, an increase in inflation shifts more of the cost of housing to the first period. This tightens the credit constraint and results in a decrease in h_1. This tightening of the borrowing distorts both the intra and inter temporal consumption allocations, and thus lowers welfare.

Unconstrained Lifetime Borrowing Constraint: To show that borrowing constrained consumers who cannot refinance their mortgage are essential, we show that when households can borrow up to their intertemporal budget constraint that anticipated inflation does not impact consumer consumption or housing choices.

Lemma 2.2 *If households can borrow up to their intertemporal budget constraint, their choice of non-durable consumption and housing is independent of inflation.*

Proof. Removing the saving constraint in Equation 2 and combining equations 2 with 3 yields the standard life-time budget constraint:

$$c_1 + \frac{c_2}{1+r} + \delta ph + \frac{\delta ph}{1+r} + \frac{(r+2r)ph}{1+r} = 1 + \frac{g}{1+r} \tag{5}$$

where $\delta ph + \frac{\delta ph}{1+r}$ is the total maintenance cost and $\frac{(r+2r)ph}{1+r}$ is the forgone interest on the house. Noticeably, the life-time budget constraint is independent of inflation (neither π or r_m appear). As a result, households' optimal consumption and housing consumption are independent of inflation as can be seen from the solution to the households' optimization problem: $c_1^* = \frac{1+\frac{g}{1+r}}{1+\beta+\theta}, c_2^* = \frac{\beta(1+r)(1+\frac{g}{1+r})}{1+\beta+\theta}$ and $h^* = \frac{\theta(1+\frac{g}{1+r})}{p(1+\beta+\theta)(\delta+\frac{\delta}{1+r}+\frac{(r+2r)}{1+r})}$. ■

Although consumption and housing is independent of inflation, nominal savings, S, varies with inflation. As the mortgage payment, $\frac{(1+r_m)^2}{2+r_m}\frac{p}{1+\pi}$ increases, savings S declines. This illustrates that an unconstrained mortgagor can respond to the tilt effect of inflation by adjusting their asset portfolio.

Free Refinancing: The essential role of not allowing refinancing is not obvious at first glance. However, the intuition for why costless refinancing undoes the real effect of inflation is straightforward: when households can costlessly refinance, they can extract the nominal increase in house value to pay the higher nominal interest payments. In the example, allowing households to refinance at the end of period 1 would allow them to extract the increase in nominal equity due to the inflation during the first period. So long as the LTV is one or less, the nominal increase in equity is at least as large as the higher nominal interest payments. As a result, extracting equity allows the mortgagor to effectively undo the tilt effect.[8]

2.2.3 General Equilibrium: Fixed Housing Supply

The analysis above imposed the assumption that anticipated inflation does not impact real relative prices. However, we showed that higher inflation lowers housing demand when households are credit-constrained with fixed nominal payment mortgages that cannot be (costlessly) refinanced. This shift in housing demand could impact equilibrium real house prices. Since a fall in real house prices would relax borrowing constraints, this implies that the partial equilibrium assumption of fixed real house prices could overstate the welfare costs of inflation.

[8]Many housing models effectively assume that households can costlessly refinance their debt positions each period. MacGee and Yao (2026) show that this results in the level of anticipated inflation not impacting steady states.

For analytical tractability, we consider the inelastic housing supply case where total housing is fixed at $\bar{H}$.

Theorem 2.3 *An increase in inflation tightens the constraint in period 1 and leads to*

1. *a decrease in equilibrium house prices* p^*
2. *a smaller decrease in consumption compared to the partial equilibrium case:* $\frac{\partial c_1}{\partial \pi} \leq 0$
3. *an increase in consumption in the second period* $\frac{\partial c_2}{\partial \pi} > 0$
4. *a small increase in welfare*

Proof. See Appendix

The price adjustments alleviate the welfare loss of higher inflation and results in a moderate welfare gain. Note that part of the welfare gain comes from the profit loss of the absentee landlord in economy.

To keep the model analytically tractable, the two-period model abstracts from several features that may affect the welfare consequences of trend inflation, including housing tenure choice, mortgage interest rate premia, and changes in house size over the life cycle. We therefore develop a quantitative life-cycle model with endogenous housing tenure, house size, and mortgage choices in Section 3 to assess the welfare costs of trend inflation.

3 Quantitative Model

To quantitatively evaluate the welfare cost of trend inflation arising from standard mortgages, we develop a life-cycle housing tenure choice model with 30 year amortization fixed nominal payment mortgages that are costly to refinance. The economy is populated by finitely lived households who are subject to stochastic earnings shocks. Households' preferences are defined over a perishable consumption good and housing services which can be obtained by owning or renting. The segregation between owner-occupied and rental housing is captured by an ownership premium calibrated to match homeownership rates.[9]

[9]The ownership premium captures features such as the ability to customize one's home and the additional space typically associated with owner-occupied housing. According to Yao (2019), 93% of homeowners live in detached houses, while 63% of renters live in apartments.

There are two types of households, college and non-college who differ in their life-cycle income profiles (real) and income volatility. In the calibrated economy, college households face a steeper life-cycle income growth and less income volatility than the non-college. Homeowners borrow via 30-year fixed-amortization mortgages with free prepayment.[10] Buyers and sellers of houses incur transaction costs which make adjusting housing costly for owners. When a mortgage is originated, borrowers incur a mortgage closing cost (for both a purchase or refinance). On the supply side, there is a competitive construction sector that combines final goods and land to produce houses. The land supply is exogenously determined.

To simplify our quantitative analysis, we embed the impact of inflation in the budget constraint via the path of real mortgage payments. Specifically, the real mortgage payment depends on inflation and the mortgage age. This is equivalent to expressing all payments in nominal terms when the price of the numeraire good, house prices, rents, and interest rates grow at the same rate as inflation while the nominal mortgage payments are constant.[11]

3.1 Households

The economy is populated by J period lived households who work from period 1 to Jr and then retire. There are two types of households e, college ($e = 1$) and non-college ($e = 0$) with fixed population share. The two groups differ in their life-cycle income profiles as well as in the volatility of their income shocks. Working age households face stochastic mortality risk and labor income uncertainty, while retired households only face mortality risk. At birth, households initial wealth is drawn from a type-specific distribution Γ^e.

Household preferences are defined over a non-durable good and housing service represented by $u = \frac{((1-\eta)C^{1-\xi}+\eta d^{1-\xi})^{\frac{1-\sigma}{1-\xi}}}{1-\sigma}$. The value function of an age-j household is:

$$V_j^e(\cdot) = \frac{((1-\eta)C^{1-\xi} + \eta d^{1-\xi})^{\frac{1-\sigma}{1-\xi}}}{1-\sigma} + \beta_j s_j V_{j+1}^e(\cdot) + \beta_j(1-s_j)B(W_{j+1}). \tag{6}$$

where β_j is the discount factor combined with the consumption expenditure equivalence scale which captures household size over the life cycle (Muellbauer, 1979), s_j is the probability a household survives from age j to $j+1$, c_j is consumption, and h_j is housing services. The ownership premium, θ, captures the value to a household between an owner-occupied house

[10] The 30-year fixed amortization (and fixed rate) is the most common mortgage contract in the US.

[11] In the steady state, what matters is the amortization period rather than the term since fixed rate mortgages are effectively the same as adjustable rate mortgages when inflation is constant. However, following a change in trend inflation the mortgage term also matters (see MacGee and Yao (2026)).

and a rental apartment. The elasticity of substitution between non-durable consumption and housing is determined by ξ, and σ is the elasticity of intertemporal substitution. $B(W)$ captures the bequest motive, and W_{j+1} is the wealth bequested by a household who dies at age $j+1$, which is the sum of savings a and home equity (net of any outstanding mortgage debt). Following Guren et al. (2021), the bequest function is $B(W) = \frac{B_0(B_1+W)^{1-\sigma}}{1-\sigma}$.

3.1.1 Household Income

At the beginning of each period, working-age households receive exogenous real wage income that depends on their age and type $\bar{w}_j^e$, and a persistent idiosyncratic shock ϵ_{ij}:

$$w_{ij}(\epsilon)^e = \bar{w_j^e}\epsilon_{ij} \text{ if } j \leq Jr \tag{7}$$

The individual-level idiosyncratic shock follows an AR1 process which is type specific.

$$ln(\epsilon_{ij}) = \rho^e ln(\epsilon_{ij-1}) + \xi_i, \xi_i \sim N(0, \sigma_\epsilon^e) \tag{8}$$

Retired households earnings depend on their age and their income before retirement.

$$w_{ij}(\epsilon)^e = \bar{w_j^e}\epsilon_{iJr} \text{ if } j > Jr \tag{9}$$

Households are subject to a progressive income tax schedule $\tau(\bar{w_j}\epsilon_i)$. Following Kaplan, Mitman, and Violante (2020), we assume $\tau(\bar{w_j}\epsilon_i) = \tau_0(\bar{w_j}\epsilon_i)^{1-\tau_1}$, where τ_0 captures the average tax rate and τ_1 represents how taxes increase with income.

3.2 Assets

Households can accumulate wealth in housing equity or risk-free bonds which pays real interest rate r. The nominal return $(1+r)(1+\pi)$ varies with the inflation rate π.

A house provides housing services and is an asset. Owning is costly since housing depreciates at rate δ and owners incur a proportional property tax τ_h on the value Ph. Buying and selling housing is costly: A buyer incurs a transaction cost of $k_b Ph$ and a seller a cost of $k_s Ph$. There is a minimum size for an owner occupied house $\underline{h}$.

Households can (only) borrow via mortgages collateralized by housing. Mortgages take the form of a 30-year amortization fixed-interest rate mortgage. The nominal mortgage interest rate, r_m, equals the real interest rate r plus a spread ζ_m and the inflation rate π.

$$r_m = (1+r)(1+\zeta_m)(1+\pi). \tag{10}$$

The nominal mortgage annual payment schedule m of a mortgage of value L is given by:

$$m = \frac{r_m L}{1-(1+r_m)^{-30}}. \tag{11}$$

Consequently, the real mortgage payment for a loan L issued $n \in \{1, 2, ..., 30\}$ years previously is $\frac{r_m L}{(1-(1+r_m)^{-30})(1+r)^n}$. The evolution of the nominal balance of a mortgage contract issued n years ago, which specifies a nominal payment m, is described by:

$$\begin{aligned} D(m,0) &= \frac{m(1-(1+r_m)^{-30})}{r_m} \\ D(m,n) &= (1+r_m)D(m,n-1) - m, \quad n \in \{1,2,...,30\} \end{aligned} \tag{12}$$

Refinancing is costly: a closing cost k_m, proportional to the face value of the mortgage L, is incurred every time a mortgage is originated. While households can prepay their mortgage without penalty, it is costly to refinance as they are subject to the mortgage closing cost and the payment-to-income requirement.

3.3 Household's Recursive Problem

The state variables (Λ) of a household are their age j, housing asset h, saving a, mortgage with payment m issued n years previously, and income shock ϵ ($\Lambda = (a, h, m, n, \epsilon, j)$). At the beginning of each period j, a household receives wage income $y^e(\epsilon, j)$, chooses housing services by renting or purchasing, mortgage, saving, and consumption of non-durable good. We group households into three cases with respect to housing and mortgage status.

1. Households who rent: A renter ($h = 0$, $m = 0$ and $D = 0$) can costlessly adjust their rental. If the household owned in the previous period, choosing to rent requires selling the house and choosing rental unit size d, consumption c, and saving a' to maximize:

$$\begin{aligned} &V^{e,1}(a,h,m,n,\epsilon,j) = \max_{c,d,a'} \frac{((1-\eta)C^{1-\xi} + \eta d^{1-\xi})^{\frac{1-\sigma}{1-\xi}}}{1-\sigma} + \beta e_j s_j E_{\epsilon'|\epsilon}(V^e(a',0,0,0,\epsilon',j+1)) \\ &+ \beta e_j(1-s_j)B(a') \\ &s.t. \;\; c + a' + Rd = (1-\tau(w_j(\epsilon)^e)w_j^e(\epsilon) \\ &+ (1+r)a - (\delta+\tau_h)Ph - \frac{m}{(1+\pi)^n} + (1-k_s)Ph - \frac{D(m,n)}{(1+\pi)^n} \end{aligned} \tag{13}$$

where R is the rental rate and $(1-\tau(w_j(\epsilon))w_j(\epsilon)$ is the real after-tax household wage income. $(\delta+\tau_h)Ph$ is maintenance plus property tax of the house, $\frac{m}{(1+\pi)^n}$ the real mortgage payment,

and $(1-k_s)Ph - \frac{D(m,n)}{(1+\pi)^n}$ is the equity net of the selling cost k_sPh and debt $\frac{D(m,n)}{(1+\pi)^n}$.[12] $\beta e_j(1-s_j)B(a')$ captures the value of a bequest a' as savings are the only asset of renters.

2. A homeowner with mortgage payment m at mortgage age n, who chooses to remain in the current house $h > 0$ and retain the existing mortgage contract, chooses consumption c, savings a', and the amount of mortgage prepayment to maximize:

$$V^{e,2}(a,h,m,n,\epsilon,j) = \max_{c,a',m' \leq m} \frac{((1-\eta)C^{1-\xi} + \eta d^{1-\xi})^{\frac{1-\sigma}{1-\xi}}}{1-\sigma} + \beta e_j s_j E_{\epsilon'|\epsilon}(V^e(a',h,m',n+1,\epsilon',j+1)\mathbb{1}_{n<30}$$
$$+ V^e(a',h,0,0,\epsilon',j+1)\mathbb{1}_{n=30}) + \beta e_j(1-s_j)B(W_T)$$
$$s.t.\ \ c + a' = (1-\tau(w_j(\epsilon)^e))w_j(\epsilon)^e + (1+r)a - (\delta+\tau_h)Ph - \frac{m}{(1+\pi)^n} - (D(m,n) - D(m',n)). \tag{14}$$

where $(\delta+\tau_h)Ph$ is property tax and maintenance and $\frac{m}{(1+\pi)^n}$ is the real mortgage payment. Since $n = 30$ is the last period of the amortization, the mortgage balance is $m' = 0$ and $n' = 0$. W_T is the total wealth left by a household and equals the sum of saving and home equity.

We model prepayment as switching to a contract with the same remaining amortization period (n) but a lower mortgage payment. Specifically, the household chooses $m' \leq m$, where m' determines the mortgage contract carried into the next period. The amount $D(m,n) - D(m',n)$ represents the additional principal repaid in the current period. Prepayment is free in the sense that households face no penalty or transaction cost for reducing their mortgage balance. Thus, households may use their liquid assets to partially or fully prepay the mortgage whenever doing so is optimal.

Finally, W_T denotes the total wealth left by the household and equals the sum of liquid savings and home equity.

3. Households originate a new mortgage: This includes the case where a renter becomes an owner, an owner decides to change their house size, or an owner decides to refinance. In this case, a household chooses housing asset h', new mortgage contract m', saving a', and

[12] The budget constraints are specified in real terms. Therefore, we convert the nominal mortgage payments m and nominal debt outstanding D to real values by inflation $(1+\pi)^n$.

consumption c to maximize the current utility and expected future values.

$$V^{e,3}(a,h,m,n,\epsilon,j) = \max_{c,h',m',a'} \frac{((1-\eta)C^{1-\xi} + \eta(\theta h')^{1-\xi})^{\frac{1-\sigma}{1-\xi}}}{1-\sigma} + \beta e_j s_j E_{\epsilon'|\epsilon}(V^e(a',h',m',1,\epsilon',j+1))$$
$$+ \beta e_j(1-s_j)B(W_T)$$
$$s.t.\ \ c + a' + Ph' = (1-\tau(w_j(\epsilon)^e))w_j(\epsilon)^e + (1+r)a - (\delta+\tau_h)Ph - \frac{m}{(1+\pi)^n} - (k_s Ph + k_b Ph')\mathbb{1}_{h\neq h'}$$
$$+ Ph - \frac{D(m,n)}{(1+\pi)^n} + (1-\tau_m)\frac{m(1-(1+r_m)^{-30})}{r_m} \tag{15}$$

$$\frac{m'(1-(1+r_m)^{-30})}{r_m} \leq (1-\chi)Ph'$$
$$\frac{m'}{w_j(\epsilon)^e} \leq \varphi. \tag{16}$$

Equation 15 is the budget constraint. $(k_s Ph + k_b Ph')\mathbb{1}_{h\neq h'}$ is the buying and selling cost, where $\mathbb{1}_{h\neq h'}$ equals 1 if the household changes the house size ($h \neq h'$). For a household who refinances this term is 0 as $h = h'$. $Ph - \frac{D(m,n)}{(1+\pi)^n}$ is the real value of home equity which is the value of the house net of the mortgage balance. Recall $D(m,n)$ is the nominal value of the mortgage debt with a schedule mortgage payment m after n periods.

In Equation 12, $\frac{m'(1-(1+r_m)^{-30})}{r_m}$ is the real balance of a 30-year fixed-rate mortgage with annual payment m' and τ_m is the refinancing (closing) cost. Similar to Greenwald (2018), we allow for two constraints at origination: a maximum LTV and PTI. The first line in Equation 16 is the LTV constraint of a minimum downpayment of χ percent. The second specifies that payments must be lower than φ of the household income. In our experiments, we set $\varphi = 1$ so that the PTI constraint is not binding.

Finally, at the beginning of each period, households choose among the three options, base on the state variable $\Lambda = (a,h,m,n,\epsilon,j)$. That is

$$V^e(a,h,m,n,\epsilon,j) = max\{V^{e,1}(a,h,m,n,\epsilon,j), V^{e,2}(a,h,m,n,\epsilon,j), V^{e,3}(a,h,m,n,\epsilon,j)\} \tag{17}$$

3.4 Housing Supply

Following the recent literature (see e.g. Kaplan, Mitman, and Violante (2020) and Favilukis, Ludvigson, and Van Nieuwerburgh (2017)), we assume that a competitive construction sector

combines final goods K and land to produce houses. A government determines the number of new permits which affects the amount of land available for new construction, $\bar{L}$. Land is owned by an absentee landlord who lives outside of the economy and consumes the profit of selling the land. The construction sector earns zero profits in equilibrium

$$H = K^{\alpha} L^{1-\alpha} \tag{18}$$

Competitive developers maximize profit taking as given the equilibrium price of land q. The housing supply function:

$$H = (\alpha P)^{\frac{\alpha}{1-\alpha}} \bar{L} \tag{19}$$

where the supply elasticity of housing is $\frac{\alpha}{1-\alpha}$.

4 Parameterization

We calibrate the model to match key moments of the U.S. housing market in 2019, including the age profile of homeownership rates, loan-to-value, debt-to-income and payment-to-income ratios. A subset of the parameters are directly estimated or taken from the literature (see Table 1). The remaining parameters are estimated using the simulated method of moments.

4.1 Parameters Determined Outside of the Model

Each period in our model corresponds to one year.

Demographics: Households are born at age 25 (model period 1) and live up to age 83 (model period 59). Households retire at age 64 (model period 41). The survival probabilities are taken from the National Center for Health Statistics, United States Life Tables, 2016. Roughly a third (35%) of households are college educated and the remainder are non-college.

Preference: The intertemporal elasticity of substitution σ is set to 2. The discount factor is the product of the time discount factor and an adjustment for household size.[13]

Asset: The risk-free interest r is 1%. Annual inflation is 2%, similar to its average between 2015 and 2019. This implies a nominal return on the risk free asset of roughly 3%. The nominal mortgage rate is the risk free rate plus the mortgage spread $\zeta_m = 1\%$, which is

[13]See appendix for more details. This approach is quantitatively similar to assuming the discount factor does not vary with age, but instead, the ownership premium is age-specific, which is an alternative way to capture the impact of changes in household size over the life cycle on housing consumption.

the average difference between the contract mortgage interest rate reported by the Federal Housing Finance Agency (FHFA) and the 30-year treasury market yield.

Housing The property tax and maintenance cost are 1% and 2.5%, respectively, based on the average property taxes and owner costs, maintenance and insurance included, in the American Community Survey (2016). Transaction costs for buyers and sellers are $k_b = 6\%$ and $k_s = 2\%$ (see e.g. Sommer, Sullivan, and Verbrugge (2013)). The mortgage financing cost is $\tau_m = 2.5\%$, the average initial fees between 2010 and 2019 reported by the FHFA.

For the baseline calibration in 2019, we set the downpayment requirement χ to 15%, which is consistent with the distribution of loan-to-value ratio for mortgages issued in 2019. The initial wealth distribution is constructed using data from Survey of Consumer Finances (2019) for households aged from 20 to 22 for college and non-college households separately. We sum the value of all assets to construct the initial wealth distribution. The income process

Table 1: Directly Calibrated Parameters

Parameter	Value	Source
Maximum of life length J	59	
Working life Jr	41	
Intertemporal elasticity of substitution σ	2	Standard in the literature
Equivalence scale e_j		Square root of family size
Survival Probabilities s_j		National Center for Health Statistic
Annual risk free interest rate	1%	Standard in the literature
Annual inflation rate π	2%	Inflation target,
Mortgage spread ζ_m	1%	Federal Housing Finance Agency
Annual property tax	1%	American Community Survey
Annual maintenance cost & Insurance	2.5%	American Community Survey
Transaction cost for buyers	6%	Sommer, Sullivan, and Verbrugge (2013)
Mortgage closing cost	2.5%	Federal Housing Finance Agency
Annual auto correlation of earnings ρ	0.97	Kaplan, Mitman, and Violante (2020)
Standard deviation of earning $\sigma_\epsilon^0, \sigma_\epsilon^1$	0.25, 0.16	Exler et al. (2025)
Downpayment requirement χ	15%	LTV distribution
Tax schedule τ_0	4.787	Kaplan, Mitman, and Violante (2020)
Tax schedule τ_1	0.151	Kaplan, Mitman, and Violante (2020)
Income Profile $\bar{w}_j^e$		Survey of Consumer Finances
College Share of Households	35%	American Community Survey

is approximated by a nine-state Markov chain using the Tauchen (1986) methodology. The annual autocorrelation of earnings is set to 0.97 and the standard deviation of earning shocks is 0.25 for non-college and 0.16 for college graduates, following Kaplan, Mitman, and Violante

(2020) and Exler et al. (2025). Parameters in the tax schedule $\tau_0 = 4.787$ and $\tau_1 = 0.151$ come from Kaplan, Mitman, and Violante (2020). The retirement replacement rate is calibrated to match the average income of retired households. The deterministic age income profile $\bar{w}_j$ is calibrated to average household labor income in the Survey of Consumer Finances (2019).

The house price is the average house value reported by owners in the 2019 Survey of Consumer Finances and the rent is the median gross rent from the Census.

4.2 Calibration Strategy

We calibrate the ownership premium θ, discount factor β, minimum house size $\underline{h}$, housing share η, elasticity of substitution ξ, and the two parameters that shape the bequest motive, B_0 and B_1, to the age profile of homeownership rate, LTV ratios, DTI ratios and PTI ratios of owners for both college and non-college households using the Simulated Method of Moments.

Although we jointly calibrate seven parameters, each parameter is most closely related to one or two moments. The ownership premium θ mainly targets homeownership rates. Intuitively, a larger θ makes owning more attractive compared to renting, which pushes up ownership. The minimum house size, $\underline{h}$, is most sensitive to the homeownership rates of young and old households with low wealth who are more likely to be constrained by the minimum house size. The housing share in the utility function η, is most closely related to the payment to income ratio, which is mainly determined by the mortgage-to-income ratio of owners. The discount factor, β, influences the debt-to-income ratio and the loan-to-value ratio. The parameters of the bequest motive, B_0 and B_1, have the largest impact on ownership and mortgage debts of older households. A stronger bequest motive pushes up ownership of older households and lowers the use of mortgage refinancing to extract equity.

4.3 Calibration Results

The calibrated parameters are reported in Table 2. Consistent with market segregation between owner occupied and rental units, the ownership premium is greater than 1. As Yao (2019) points out, most owners live in detached homes while most renters live in apartments.[14] As the price and rent we observe in the data reflect the difference in owned and rented units, the estimated ownership premium, 1.7, captures the difference in the utility

[14]According to the American Housing Survey (2007), the average unit size for owner-occupied units is around 2262 square feet while the average unit size for rental units is 1209 square feet.

generated by owner-occupied and rental units. The calibrated annual discount factor is 0.9. The housing share in utility is 0.29, similar to other estimates in the literature (see e.g. Davis and Ortalo-Magné (2011)). The elasticity of substitution between housing and non-housing $\frac{1}{\xi}$ is 1.25, similar to Guren et al. (2021) and Kaplan, Mitman, and Violante (2020).

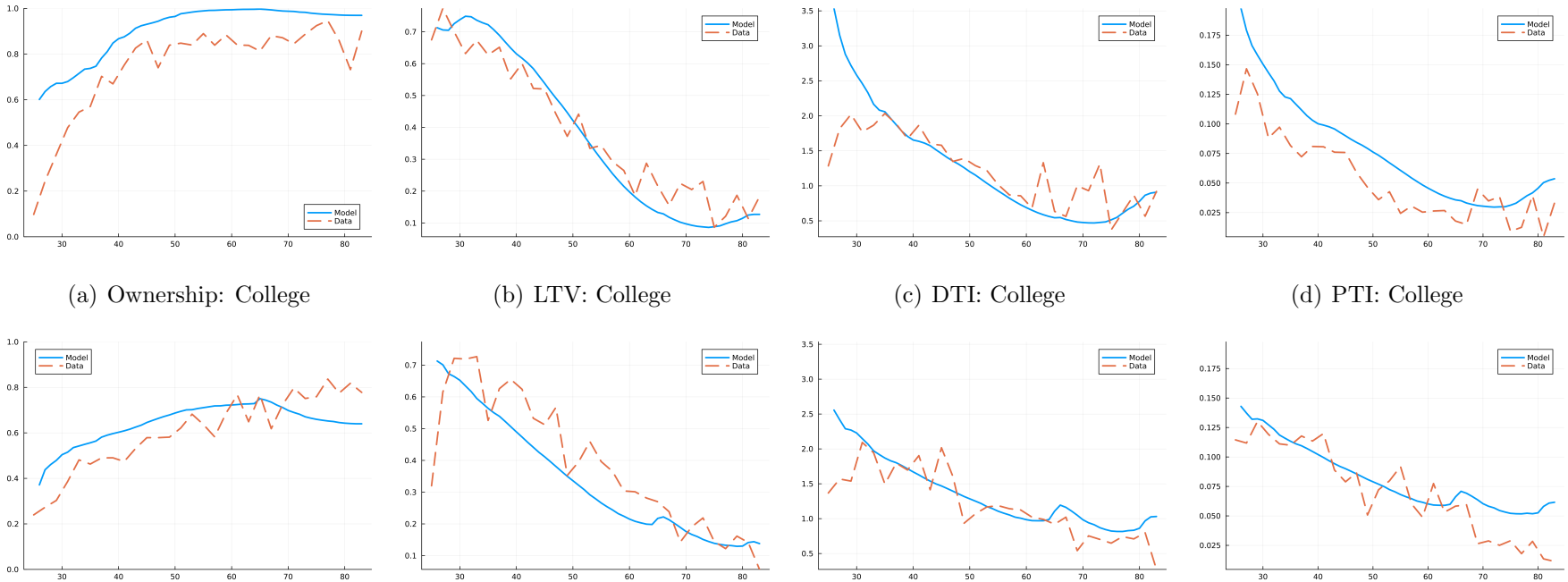
Table 2: Calibration Results

Parameter		Value	Target
β	Discount Factor	0.9	DTI and LTV
η	Housing Share	0.29	DTI
θ	Ownership Premium	1.7	Homeownership Rate
ξ	Elasticity of substitution	0.8	DTI & PTI
$\underline{h}$	Minimum House Size	1.0	Homeownership Rate
B_0	Bequest Motive	100	Homeownership Rate & Mortgage Loan
B_1	Bequest Motive	0.8	of Senior Households

Figure 3 plots the model generated moments and the data. Our model matches the homeownership rates, average Loan-to-Value ratios and average Debt-to-Income ratios by age and education reasonably well. It captures the increase in homeownership rate and decreasing mortgage balances by age. This pattern plays an important role in our welfare analysis as we focus on how inflation distorts life-cycle housing and non-housing consumption through the front-loading of real mortgage payments.

Beyond the targeted age profiles, the model also performs well in matching untargeted aggregate moments. For example, the model generates a housing stock value-to-income ratio of 2.45, which is very close to the housing wealth-to-disposable-income ratio of 2.50 reported by Zillow. In addition, the model produces an aggregate mortgage debt to aggregate labor income ratio of 0.936, closely matching the corresponding mortgage debt outstanding-to-disposable-income ratio of 0.86 in the data. These results provide additional validation that the model captures key aggregate features of the U.S. housing and mortgage markets despite being calibrated primarily to match life-cycle patterns.

Figure 3: Benchmark Calibration



(a) Ownership: College (b) LTV: College (c) DTI: College (d) PTI: College

(e) Ownership: Non-College (f) LTV: Non-College (g) DTI: Non-College (h) PTI: Non-College

Note: This figure presents the calibration results. One model period is equivalent to 1 year. Loan-to-value is the ratio of total outstanding mortgage debt to total housing value of owners. Debt-to-income ratio is total outstanding mortgage debt divided by total household income of owners. Payment-to-income ratio is total mortgage payments divided by total household income of owners. Data moments are constructed using the SCF (2019).

5 Welfare Cost of Inflation

We use the calibrated model to quantify the welfare cost of inflation. In the counterfactual experiments, we vary steady state inflation while holding fixed the calibrated parameters. Since inflation changes life-cycle housing and consumption of (some) households, steady state homeownership and consumption decisions vary with inflation. Our welfare measure compares the expected utility of a newborn across economies with different levels of inflation.

To isolate the direct effect of inflation via housing finance, we start with partial equilibrium counterfactuals where real house prices and rents are held fixed across inflation steady states. Since tighter borrowing constraints weaken housing demand, higher inflation puts downward pressure on (real) house prices and rents. This leads us to examine welfare costs in general equilibrium when real house prices and rents (relative to non-housing consumption) adjust in response to changes in housing demand.[15]

We find that even moderate levels of steady state inflation entails meaningful welfare costs. In partial equilibrium (when real house prices are held fixed), a one percentage point increase in trend inflation lowers welfare (lifetime consumption) by 0.05% for a newborn household. There is substantial heterogeneity across households: a one percentage point increase in inflation lowers welfare by 0.08% of lifetime consumption for a newborn college household and by 0.035% for non-college. The welfare costs are larger for middle and higher income households who are more likely to see the timing and size of house they buy impacted by higher PTI in the early years of an amortization. In contrast, lower income households — who generally chose to rent an (small) apartment — are not directly impacted by changes in the timing of real mortgage payments. Our experiments show that even modest refinancing costs leads to meaningful welfare costs by making frequent equity extraction a costly way to relax borrowing constraints. At a 1 % refinancing cost, the welfare costs of inflation are roughly two-thirds as large as the benchmark costs of 2.5 %.

In general equilibrium, the welfare cost varies with the elasticity of housing supply, since a lower real house price partially mitigates the tightening of borrowing constraints induced by higher inflation. In economies with a low housing supply elasticity, where house prices decline more in response to lower housing demand, higher inflation reduces welfare by less. The endogenous steady state response of the relative price of houses to non-housing consumption

[15] Guren et al. (2021) and Coven et al. (2024) find that changes in real house prices as a result of changes in access to credit only partially pass through into real rents.

leads to real effects on renters when house prices pass through into rents. As a result, renters are negatively impacted by lower inflation as higher steady state real house prices lead to higher real rents. We show that the extent to which house prices pass through into rents (i.e. the degree of segmentation between owner-occupied and rental markets) has a significant impact on the welfare costs of inflation. A higher pass-through implies that higher inflation translates into a larger reduction in rents, which decreases the welfare loss of inflation.

This implies that the welfare cost of inflation can vary across cities due to differences in the elasticity of housing supply.

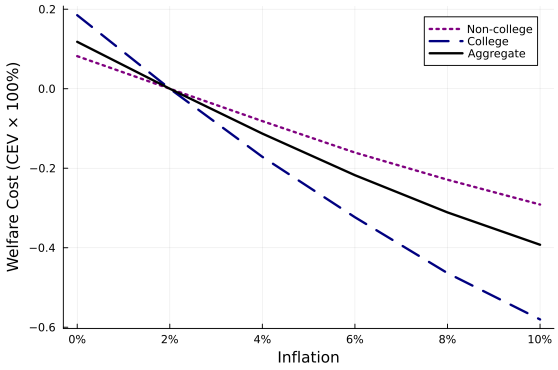
5.1 Welfare Cost of Inflation: Constant Real House Prices

To isolate the direct effect of inflation via costly to refinance fixed amortization mortgages, we compare steady state welfare with annual inflation between 0 and 10 % when the relative price of housing and non-housing goods is held constant. In each experiment, we compute the expected lifetime utility of a new born (conditional on education and initial income realization) and report the consumption equivalent variation, which is the (expected) share of consumption and housing consumption required to leave a new born indifferent between the benchmark and counterfactual economy. The benchmark economy has 2% inflation, consistent with the inflation target in the US and many advanced economies.

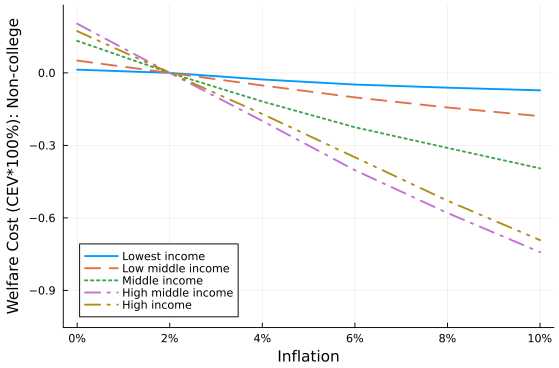
On average, a 1 percentage point increase in steady state inflation leads to a welfare cost of 0.05% of life-time consumption (see Figure 4.a). Consistent with the intuition that shifting real mortgage payments forward has a larger impact on households with higher expected income growth, our experiments find large differences in the welfare costs of inflation across education and income groups. The welfare cost per percentage point increase in inflation of 0.08% for the college-educated is twice as large as that of the non-college of 0.035% (see Figure 4.b). The higher cost of inflation of the college educated is due to both steeper life-cycle income growth and homeownership rates 20 to 30 p.p. higher than the non-college educated. These forces result in a larger fraction of college-educated households being squeezed by higher steady state inflation front-loading the real profile of mortgage payments.

A similar pattern of larger welfare costs for higher-income households holds conditional on education. For reporting purposes, we group the perstistent income realizations into five income groups and calculate the value of a newborn household for each income realization

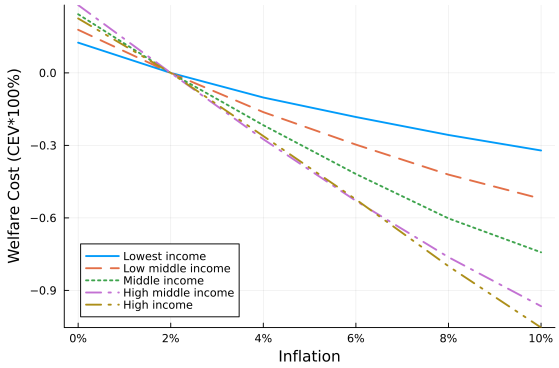
Figure 4: Welfare Cost of Inflation: Fixed Real House Prices



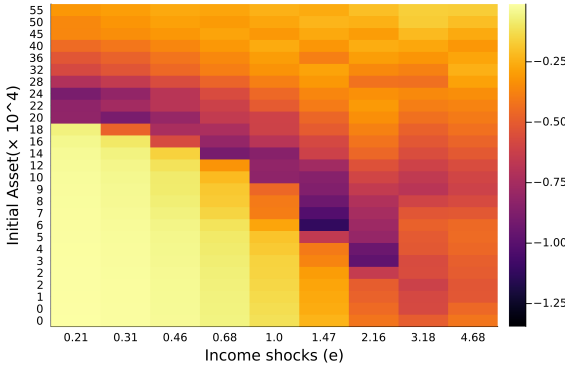
(a) Welfare Cost by Education



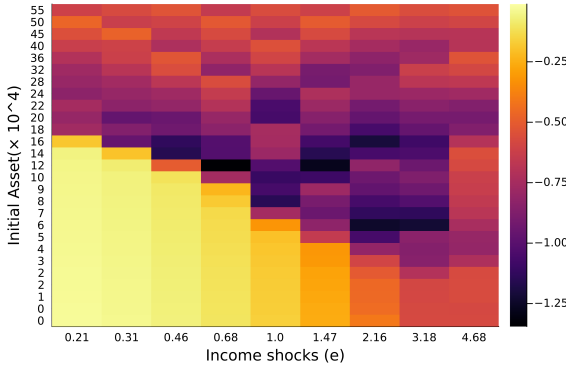
(b) Welfare Cost by Income: Non-college



(c) Welfare Cost by Income: College



(d) Welfare Cost by Income and Initial Wealth: Non-college



(e) Welfare by Initial Income and Wealth: College

Notes: Welfare costs are measured as consumption-equivalent variation (CEV) relative to the 2% inflation benchmark. Panels (a)–(c) report welfare costs by education and income, while panels (d)–(e) report welfare costs by initial income and wealth.

by type (see Panels b and c of Figure 4).[16] An interesting insight is that the welfare cost of inflation need not be monotonically increasing in initial realized income. The expected impact of inflation on a household is driven by the tightness of borrowing constraints and the likelihood of purchasing a home. Because income is persistent, households that begin with low income realizations are (more) likely to rent throughout their lives and are less exposed to higher inflation front loading real mortgage payments. Conversely, households with high income realizations are very likely to become homeowners, but may be less likely to be constrained when purchasing a home due to their higher income. This mechanism is particularly evident among non-college households, for whom the upper-middle-income experiences the largest welfare losses. For college, the effect of higher inflation remains significant even at the top of the income distribution, so the highest-income group experiences the largest welfare loss.

The likelihood of being borrowing constrained varies with initial wealth since initial assets affect down payments and the desire to borrow against future income. For both newborn college and non-college households, the welfare cost of inflation generally increases with initial assets before peaking at intermediate asset levels (see Panels (d) and (e) of Figure 4 which compares the 2 and 8% inflation steady states). The effect peaks because inflation alters the homeownership decision through the extensive margin. Beyond this point, inflation continues to have a significant but smaller impact on welfare, primarily operating through the intensive margin of housing consumption and life-cycle non-housing consumption.

Housing finance results in meaningful but uneven welfare costs of inflation. We find that middle and upper middle income households are the most impacted. These effects are larger for those with lower initial wealth, as people from "wealthy" families are less likely to be borrowing constrained thanks to bequests. As a result, inflation most adversely impacts middle and upper middle class earners with low(er) wealth.

5.1.1 Refinance Costs and the Welfare Costs of Inflation

The two-period example in Section 2.2 showed analytically that costly refinancing of mortgages is essential for the tilt effect of inflation on mortgage payments to have a real impact

[16] We have nine evenly spaced grids for the persistent income process: $\epsilon \in \{0.22, 0.31, 0.46, 0.68, 1.0, 1.47, 2.16, 3.18, 4.68\}$. We label the first two $\{0.22, 0.31\}$ as "lowest income", $\{0.46, 0.68\}$ as "low middle income", $\{1.0\}$ as "middle income", $\{1.47, 2.16\}$ as "high middle income", and $\{3.18, 4.68\}$ as "high income".

via household decisions. In this section, we examine the quantitative effect of refinancing costs on the welfare cost of inflation. We find — consistent with intuition — that the welfare costs vary with refinancing costs. However, even at a lower bound estimate of 1 %, the welfare costs remain significant and are over 2/3 as large as our 2.5 % benchmark.

We replicate our baseline experiment (holding fixed the calibrated parameters) with a conservative lower and upper bound estimate of US refinancing costs. Our lower bound value is 1 %, similar to that of Boar, Gorea, and Midrigan (2022) who calibrate a fixed cost of mortgage refinancing of $1,330$ in 2016 dollars and a variable cost of 0.5%. [17] Our upper bound estimate of 4 % is arguably conservative, as Chen, Michaux, and Roussanov (2020) calibrate a fixed cost of mortgage origination of 3.9 % of the average house (15.4 % of mean income) and a proportional cost of 1.4 %.[18]

Refinancing costs matter quantitatively for the welfare cost estimates (see Figure 5 a,b). The welfare costs of inflation at 1% refinancing costs are roughly two-thirds as large as in the 2.5% baseline.[19] For a college educated household, the welfare cost per percentage point increase in inflation is roughly 0.06%, versus 0.08% in the benchmark. In contrast, 4% refinancing costs modestly increase the welfare costs of inflation. As a result, while costly refinancing is essential, welfare costs remain significant for a reasonable range of costs.[20]

To unpack how refinancing costs shape the impact of inflation, we plot ownership and refinancing rates for college and non-college against inflation in panels c-f of Figure 5. For a given inflation rate, higher refinancing costs reduce both the fraction of households that refinance to extract equity and homeownership. The negative relationship between refinancing costs and the frequency of refinancing is straightforward, although it impacts homeownership via two channels. First, a higher refinancing cost increases the total purchase costs for a homebuyer. Second, it makes it more costly for a borrowing constrained owner to extract equity to finance non-housing consumption. Both of these channels push down ownership (MacGee and Yao (2026)). However, what drives the welfare cost is how ownership and refinancing vary with inflation. When refinancing costs are low (1 %), the impact of higher inflation is muted by an increase in refinancing to extract equity to mitigate the front loading

[17] According to Single Family Loan, the average balance at origination in 2016 was $239,717, so $1,330$ is roughly 0.55 %. Adding this to the variable cost yields a proportional cost near 1.05%.

[18] Chen, Michaux, and Roussanov (2020) argue most US refinancing is not interest rate driven.

[19] Figure 5 a,b shows how inflation impacts consumer welfare for a given refinancing cost. For any given level of inflation, consumer welfare is decreasing in refinancing costs.

[20] This is important since refinancing costs have varied over time (e.g., see MacGee and Yao (2026)).

of inflation. When refinancing costs are higher, the mitigation strategy becomes more costly so that the refinancing rate increases less with inflation, and the decline in the ownership rate becomes steeper (but similar) for 2.5% and 4% refinancing costs.

5.2 Welfare Costs of Inflation and Endogenous House Prices

Since steady state inflation influences housing demand, if housing supply is not perfectly elastic, it can shift the (real) price of housing relative to non-housing.[21] Intuitively, since higher inflation tightens borrowing constraints and lowers housing demand, it should result in lower real house prices. This shift in relative prices (which we refer to as the general equilibrium effect of inflation) dampens the welfare effects of higher inflation since lower real house prices relaxes the borrowing constraint of first time home buyers.

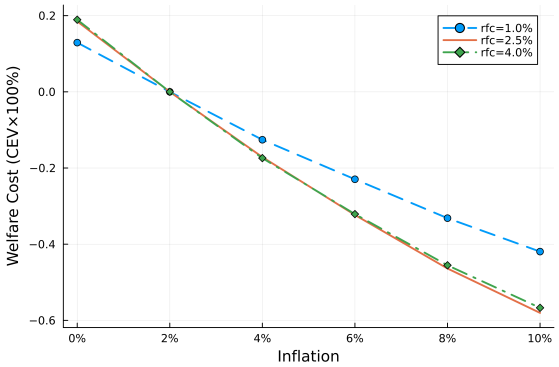
To quantify the general equilibrium effect of inflation, we repeat our counterfactuals where we endogenize the relative price of housing. In our baseline we assume a housing supply elasticity of 0.4, following Baum-Snow and Han (2024), although we also report the results for when the supply of housing is fixed (i.e., completely inelastic supply).[22] We hold fixed the college population share at 35% when aggregating housing demand. There is a growing view in the literature (e.g., Greenwald and Guren (2025)) that a change in real house prices driven by changes in access to credit of homebuyers is only partially pass through into (real) rents. In our benchmark, we assume that 20% of the change in real house prices (relative to our 2 % inflation benchmark) is passed through to rents.[23] In our sensitivity analysis we show that the extent to which changes in house prices are pass through into real rents is

[21]The implicit assumption is that non-housing production is elastic. So long as non-housing consumption is more elastic, the real relative price shift that we document will hold.

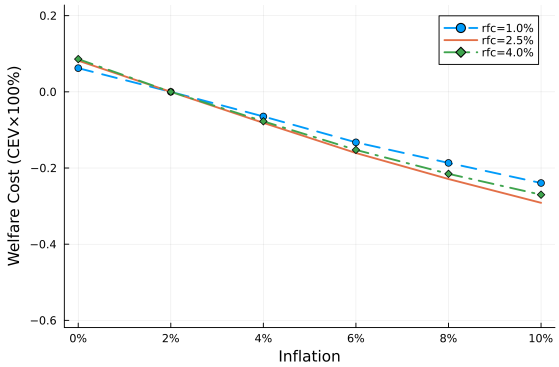
[22]According to Baum-Snow and Han (2024) the housing units supply elasticity ranges from 0.14 to 0.44 in the 25th and 75th percentile neighborhoods with a mean of 0.29. Estimates by Saiz (2010) are on the higher end. The supply elasticity in metropolitan areas with population over 500,000 in 2000 ranges from 0.6 in Miami Florida to 5.45 in Wichita, Kansas.

[23]Following Greenwald and Guren (2025), we assume partial market segmentation where 20% of house price growth is passed through to rents. This specification recognizes that owner-occupied and rental housing are imperfect substitutes: changes in the demand for owner-occupied housing affect rents, but the pass-through need not be one-for-one because the two markets differ in their housing stock and clientele. To aggregate housing demand across the two markets, we scale the demand for owner-occupied units by the ownership premium and combine it with the demand for rental units. The ownership premium captures systematic differences between owner-occupied and rental units, such as size, quality, and other housing characteristics, and therefore provides a common-unit conversion when aggregating demand across the two segments.

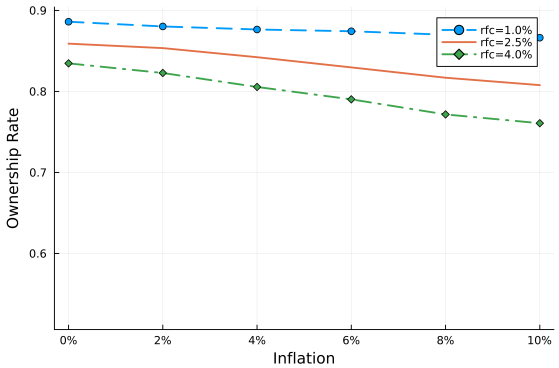
Figure 5: Welfare Cost of Inflation with Fixed Price: Refinancing Costs



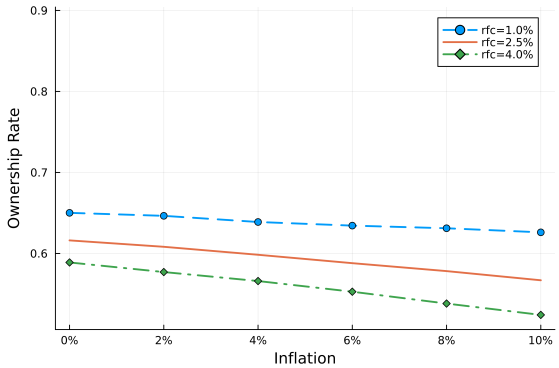
(a) Welfare Cost: College



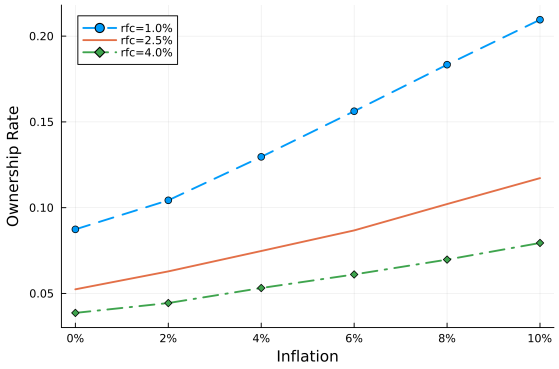
(b) Welfare Cost: Non-College



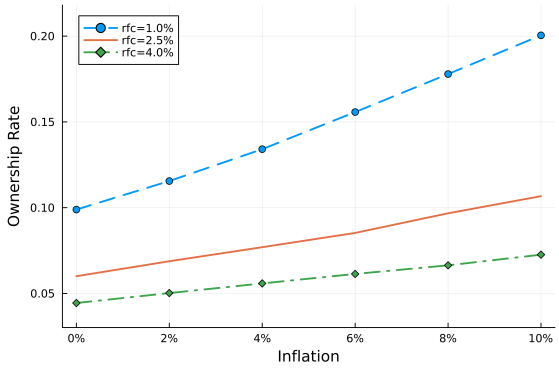
(c) Ownership: College



(d) Ownership: Non-College



(e) Refinancing: College



(f) Refinancing: Non-College

Notes: Panels (a)–(b) show the welfare cost of inflation measured as consumption-equivalent variation (CEV) relative to the 2% inflation benchmark. Panels (c)–(d) show the homeownership rate, and panels (e)–(f) show the refinancing rate, defined as the fraction of mortgagors taking out a new mortgage and increasing debt (equity extraction). Results are shown for three refinancing costs (1.0%, 2.5%, and 4.0%) and are reported separately for college and non-college households.

important for the welfare costs, especially for lower income households.

The general equilibrium effects of inflation via house prices are significant. By shifting real mortgage payments forward, higher inflation reduces housing demand and thus lowers steady state real house prices. With a supply elasticity of 0.4, a one percentage increase in inflation lowers steady state house prices (relative to the non-durable good) by roughly 0.25% (see panel a of Figure 6). The effect of inflation with fixed housing supply is roughly 50% higher: a one percentage increase in inflation lowers equilibrium house prices by 0.4%.[24]

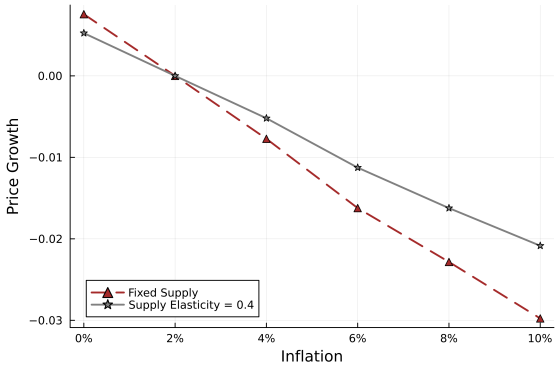
The endogenous decline in real house prices at higher steady state inflation ameliorates the welfare costs. With a housing supply elasticity of 0.4, the welfare cost of moderate levels of inflation is reduced by more than half compared to when the relative price of housing is fixed: A one percentage point increase in inflation reduces welfare by only 0.015%. With fixed housing supply, higher inflation further reduces house prices. As a result, the user cost of housing and rents can sometimes make higher inflation slightly welfare enhancing.

The effects on welfare arise from how the relative price of housing services affect homebuyers *and* renters. For homebuyers, lower house prices (partially) offset the front loading of real mortgage payments on borrowing-constrained households. In addition, lower house prices reduce both the user cost of housing and the transaction costs associated with home purchases. What is perhaps less obvious is the impact on renters. When house prices pass through into real rental rates, renters gain from lower real rents. In our baseline (see Figure 6), a fifth of the change in house prices passes through. Since household income is held fixed in units of the non-housing good, a fall in real rents increases the real income of renters.

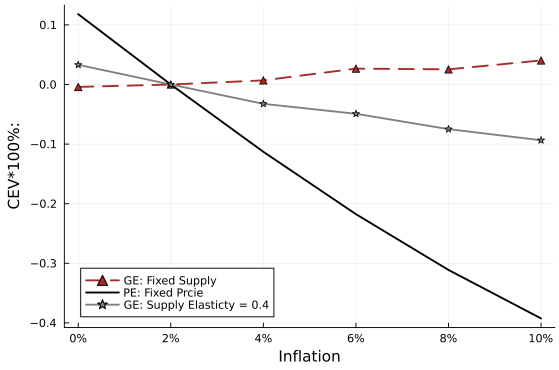
Lower real rents play a significant role in lowering the cost from higher inflation, particularly for lower income households. In panels c-f of Figure 6 we plot the CEV (relative to 2% inflation) for newborn households by initial income realization. Non-college households with low initial income see their welfare increase with inflation: since they are unlikely to purchase a house over their lifetime, tighter borrowing constraints have little cost while lower rents increase their purchasing power. In contrast, a new-born lower income college household has a higher probability of becoming a home owner. With a supply elasticity of 0.4, the tighter borrowing constraints from the forward tilt in real mortgage payments offsets the gains from lower rents. However, the lower real house prices and rents with fixed supply results in even low income college households gaining from higher inflation.

[24]Real house prices (and rents) shift relative to the price of non-housing consumption. In steady state, the change (between period t and t+1) the nominal price of housing and non-housing equals the inflation rate.

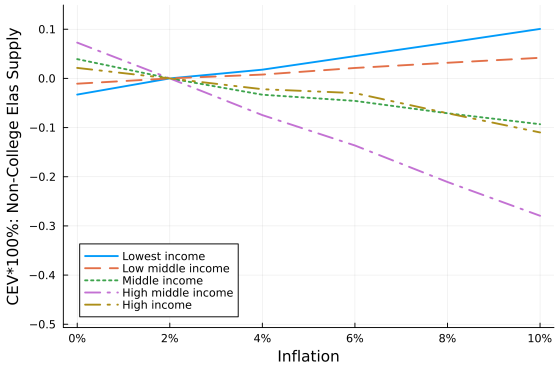
Figure 6: Welfare Cost of Inflation: Endogenous Real House Prices



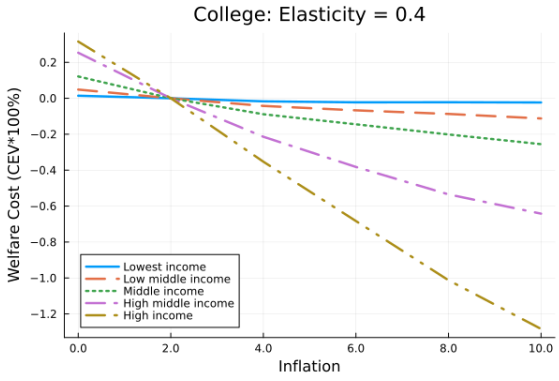
(a) Equilibrium House Prices



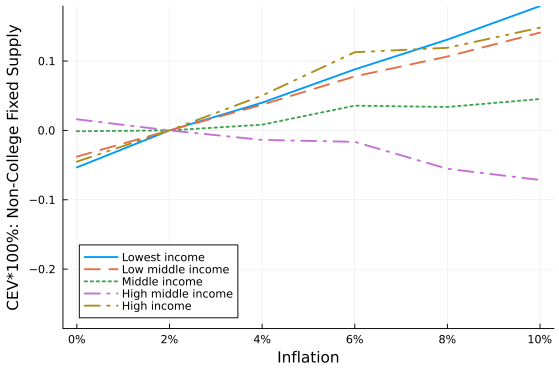
(b) Aggregate Welfare



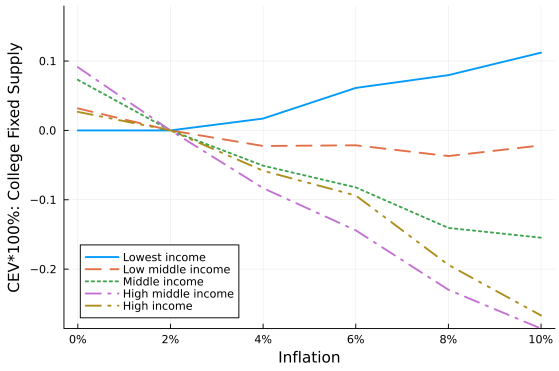
(c) Welfare Non-college: Supply Elasticity 0.4



(d) Welfare College: Supply Elasticity 0.4



(e) Welfare Non-college: Fixed Supply



(f) Welfare College: Fixed Supply

Notes: Panel (a) shows the equilibrium response of real house prices to inflation under fixed housing supply and a housing supply elasticity of 0.4. Panel (b) reports the corresponding aggregate welfare effects, along with the benchmark case in which real house prices are held fixed. Panels (c)–(d) show welfare effects by income and education when the housing supply elasticity is 0.4, while panels (e)–(f) report the corresponding results under fixed housing supply. Welfare effects are measured as consumption-equivalent variation (CEV) relative to the 2% inflation benchmark.

Since higher income new-borns have higher expected life-cycle ownership rates, the tilt effect dominates the gains from lower real house prices and rents. As a result, the qualitative pattern of higher welfare costs for inflation for middle and upper middle households of the partial equilibrium case continues to hold. However, for the top income earners, the costs of inflation are relatively smaller since the highest initial income earners are less borrowing constrained (on average) than middle and upper income earners as a result of higher incomes and initial endowments.[25] As a result, the highest income groups see much smaller welfare costs from inflation when real house prices adjust across steady states.

The general equilibrium effect of inflation on house prices and rents amplifies the uneven impact of inflation across households. Higher trend inflation acts as an adverse change in access to housing credit which lowers housing demand and thus real house prices. When house price decline passes through into the real (relative) rents, lower real rents increases the real purchasing power of renters. For low income households who are very likely to remain renters, this can result in welfare increasing with trend inflation. In contrast, for middle- and upper-income households, particularly the college educated, the relaxation of borrowing constraints associated with lower inflation generates welfare gains. This pattern provides a rationale for middle- and upper-income households to prefer lower trend inflation.

5.2.1 Decomposition

The GE effects of inflation on house prices and rents impacts both the average welfare cost of steady state inflation and its uneven impact across households. Our GE analysis includes three main channels via which real house prices impacts welfare. The first channel is the impact on borrowing constrained consumers. The second is via the user cost of ownership. In the benchmark analysis, we adopt the common assumption that user costs such as maintenance and property taxes are proportional to house prices. However, one could plausibly argue that the real costs of repairs or the cost of public services do not vary one for one with real house prices. Third, there is debate over the extent to which owner occupied and rental markets are segmented and thus the pass through of real house price changes into the price to rent ratio.

To decompose the contribution of these channels, we compare our PE and GE benchmarks with counterfactuals where we hold fixed maintenance, insurance and property taxes per

[25]This pattern is already present when house prices and rents are held fixed, suggesting that the highest-income households are less borrowing constrained.

house and vary how real house prices impact real rents. Our experiments compare the welfare costs of inflation 2% and 8% inflation for college and non-college households.

Table 3: Decomposition of Welfare Costs of Inflation: 2% vs 8%

Experiments	College	Non-college
1: PE: Constant real house price and rent	-0.46	-0.23
2: GE Baseline: Partial segmentation	-0.18	-0.01
3: Fixed user costs & Partial segmentation	-0.29	-0.08
4: Full segmentation, rent constant	-0.23	-0.09
5: Fixed user costs & rent constant	-0.34	-0.16
6: GE: No segmentation, Price-Rent ratio constant	0.03	0.30
7: Fixed user costs + No segmentation	-0.08	0.24

Notes: The table reports the welfare effects of an increase in steady-state inflation from 2% to 8%, expressed as consumption-equivalent variation (in percent) under different model specifications. Negative values indicate welfare losses from higher inflation, while positive values indicate welfare gains. In Cases 2,4, and 6, user costs are proportional to house prices. In Cases 3, 5 and 7, user costs are held fixed as house prices adjust. Partial, no, and full segmentation correspond to 20%, 100%, and 0% pass-through, respectively, from house prices to rents.

The first two rows of Table 3 report the benchmark welfare costs from our partial and general equilibrium experiments. The PE experiment gives the direct welfare cost of how inflation front loads real mortgage payments. In the GE baseline, the welfare costs of 8 % compared to 2 % inflation are about 0.28 (0.22) smaller for college (non-college) than the PE estimate. The third row reports the welfare cost where we hold fixed the maintenance and property tax per house rather than allowing the total payment to decrease with real house prices.[26] This user cost channel accounts for roughly a third (0.11 of 0.28) of the difference in welfare between the PE and GE experiments for college and (0.07 of 0.22) for non-college, which suggests that our GE welfare costs are conservative. The fourth row of Table 3 reports the GE welfare costs when real rents are held fixed (and user costs are proportional). Lower real rents account for roughly a fifth (0.05 of 0.28) of the difference in welfare between the PE and GE experiments for college and a third (0.08 of 0.22) for non-college. When we hold both the user cost and rents constant (row 5), we find that there is little interaction

[26]To the extent that lower real house prices lead to lower debt, mortgagors also gain from lower mortgage interest payments. The nominal mortgage rate includes a real rate as well as a mortgage spread.

between these two channels. As a result, only about half of the smaller GE welfare costs can be attributed to lower house prices relaxing financing constraints.

The final two rows illustrate the implications if house prices pass through into rents one for one. Row 6 shows that higher inflation increases welfare in our GE baseline when the price to rent ratio is constant. The benefits are concentrated among the non-college due to their higher probability of renting. The final experiment in row 7 holds fixed both the real user cost payments and the price to rent ratio. In this case, the college educated prefer lower inflation, while the non-college prefer higher inflation. This implies that a large spill over from housing demand to rents could support the case for a higher inflation target. However, the literature (e.g., Yao (2019) and Greenwald and Guren (2025)) point to substantial segmentation between owner occupied and rental markets. This supports our baseline of only partial pass through of real house prices into rents.

5.3 Cross-city Variation in the Welfare Costs of Inflation

Our analysis in Section 5.2 showed that the elasticity of supply has a significant impact on the welfare cost of inflation. To quantify the implications of cross city differences in supply elasticities (e.g., Saiz (2010), Baum-Snow and Han (2024)), we repeat our steady state analysis for US cities. We find that cross-city differences in the elasticity of housing supply leads to cross city differences in the welfare cost of inflation comparable to that between education groups. We argue that this implies that the gains from the Volcker disinflation were unequally distributed across cities.

Our experiments use estimates of housing supply elasticities at the US metropolitan-level reported in Saiz (2010) which capture how geographic and regulatory constraints limit housing construction. To focus on the implications of cross-city variations in elasticities we keep all other calibrated parameters fixed, including the population shares of college (35%) and non-college households across cities.[27] Given that we are interested in cross-city variation, we compare two steady state inflation rates: 10 % and 2 %. This comparison also provides a rough estimate of the cross-city variation in the steady state welfare gains following the early 1980s Volcker disinflation.

Cross city differences in welfare costs are nearly as large as the differences between the college and non-college (see Table 4). The difference in the cost of inflation between the

[27]Our baseline also sees 20 % of house price differences pass through into rents.

most (Pine Buff) and least (San Diego) elastic housing supply is 0.22 (0.36 vs 0.14), while the difference between college and non-college for the median city is 0.2 (0.36 vs 0.16). In Figure 7 we plot the welfare costs (for 10% relative to 2% inflation) for all cities reported by Saiz (2010). The darker colors indicate cities with higher supply elasticities and larger welfare costs. Since coastal cities tend to have less elastic housing supply than cities in the interior, this leads to substantial variation in the welfare costs of inflation across US states.[28]

Our estimates suggest that the steady state welfare gains from the Volcker disinflation were unevenly distributed across cities, with cities with higher supply elasticities seeing larger benefits than cities with less elastic supply. In cities with high housing supply elasticities, the increase in housing demand results in a small difference in steady state real house prices and a larger change in housing stocks. Conversely, in cities where housing supply was constrained, real house prices rose by more, resulting in smaller steady state welfare gains.[29] As a result, the Volcker disinflation should have contributed to increased dispersion in real house prices and rents across cities.

Our analysis points to uneven welfare costs of trend inflation across cities as a result of cross-city variation in housing supply elasticities. Since this analysis is steady state, it does not offer insight into how these shifts in real house prices and rents following a change in trend inflation impact net redistribution along the transition between steady states. We explore this question in Section 6.

5.4 Discussion

In a classic contribution, Fischer and Modigliani (1978) set out a taxonomy of channels via which anticipated inflation impacts the economy. They concluded that the case that inflation was a serious economic problem was not convincing. Our paper adds support to the case that even moderate steady state inflation results in meaningful economic distortions. In this section, we briefly discuss how the mechanism we examine relates to the broader taxonomy, with a focus on how our estimates compare to those based on how inflation distorts money demand or relative prices due to nominal rigidities (Schmitt-Grohe and Uribe, 2011).

[28]This cross city variation in the welfare cost of inflation is consistent with the findings in Hausman et al. (2026) of differences across US cities in the impact of changes in nominal mortgage rates.

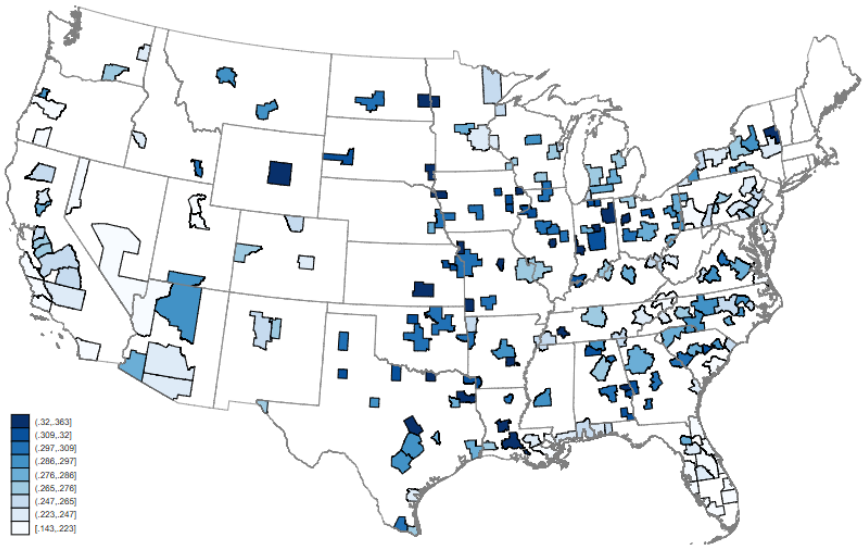
[29]Our analysis also implies that the shift towards lower housing supply elasticities in many US cities documented by Baum-Snow and Han (2024) would imply a lower welfare cost of inflation today than in the 1980s.

Table 4: Welfare Effects under Alternative Housing Supply Elasticities

	Welfare		
Elasticity	Aggregate	College	Non-college
Fixed Price	0.39	0.58	0.29
12.14 (Pine Bluff, AR)	0.36	0.55	0.26
1.7 (Avg)	0.24	0.36	0.16
0.67 (San Diego, CA)	0.14	0.29	0.07
Fixed Supply	-0.003	0.27	-0.15

Notes: The table reports welfare effects under alternative housing supply elasticities taken from Saiz (2010). Welfare effects are reported for the aggregate population and separately for college and non-college households.

Figure 7: Welfare Gains from 2 vs 8 % Disinflation across cities



Notes: This figure presents the welfare gain from a disinflation from 10% to 2% across steady states. Welfare gains are measured as the consumption equivalent variation (CEV) for a newborn household entering the economy. Cities have the same share of college-educated households but differ in housing supply elasticity. Consequently, when inflation declines, welfare gains vary with the response of house prices across cities. Housing supply elasticity is taken from Saiz (2010).

The taxonomy in Fischer and Modigliani (1978) briefly mentions the front loading effect of real mortgage payments from higher steady state inflation. Although they do not offer an estimate of the cost, Schwab (1982) builds on Kearl (1979) and Lessard and Modigliani (1975) and argues that the cost was negligible. Our work both implies a much larger estimate and shows that the impact is uneven across households. Our work also shows that the shifts in steady state demand for owner occupied homes can spill over into rental markets and impact renters.

There are a range of welfare cost estimates that build on the Bailey (1956) insight that inflation acts as a tax on money holdings (e.g., see (Benati and Nicolini, 2025; Serletis and Xu, 2025)). Our estimates of the welfare cost of inflation from housing finance are of a similar order of magnitude. In a heavily cited paper, Lucas (2000) reports that moving inflation from 0 to 10 % would decrease income by roughly 1 %.[30] In contrast, Ireland (2009) finds that the cost of 10% inflation is roughly 0.25% of income, and that two percent inflation has a welfare cost of under 0.04%. In recent work, Benati and Nicolini (2025) use long run data to estimate money demand equations and find that the US welfare costs are roughly a half as large as Lucas (2000). Our estimates of the cost of moderate inflation point towards a similar additional cost resulting from housing finance.

Although our housing finance channel implies a similar average welfare cost, it has very different implications for the uneven impact of inflation across households. A common view is that cash holdings result in inflation imposing a larger tax on lower income households since non-interest bearing cash is a larger share of their asset portfolios (e.g., Cao et al. (2021) , Erosa and Ventura (2002)). Our steady state analysis points to a very different pattern, with anticipated inflation having the largest impact on middle and upper income households with low(er) wealth. This indicates the importance of taking into account the various channels via which inflation has real economic impacts.

A common view is that inflation leads to distortions in relative prices. In standard New Keynesian models, nominal price and wage rigidities imply that higher inflation increases price dispersion and lowers aggregate productivity. There remains an active debate over the quantitative importance of this channel (Nakamura et al. (2018); Burstein and Hellwig (2008); Hahn (2022)). The mechanism we emphasize is distinct. We show that the typical

[30]Silva (2012) finds that when portfolio rebalancing between money and bond holdings is endogenous, that the welfare cost of 10 % inflation is roughly 1% of GDP. Serletis and Xu (2021) finds a welfare cost of 0.3 % of output of increasing inflation from 2 to 4%.

design of long-term nominal mortgage contracts can result in inflation distorting the relative price of housing and non-housing consumption through two channels. First, higher inflation front-loads real mortgage payments, tightening borrowing constraints for young households and thereby raising the shadow price of owner-occupied housing relative to non-durable consumption. Second, in general equilibrium, the housing demand affect steady state house prices and rents. The magnitude of these real price responses depends on local housing supply elasticities, generating variation across cities in the relative price of housing and, consequently, in the welfare costs of inflation.

The magnitude of welfare costs of inflation have implications for the debate over the appropriate level of inflation for central banks to target. Several authors have argued that the risk of ELB episodes provides a rationale for a higher inflation target (e.g., Ball (2013), Blanchard, Dell'Ariccia, and Mauro (2010),Krugman (2014)). This conclusion generally rests on two pillars. First, that a higher inflation target would make ELB episodes less likely. Second, that moderate inflation results in small welfare costs.[31] Our findings challenge the second pillar, as we show that housing finance leads to meaningful welfare costs.

6 An Unexpected Permanent Change in Inflation

Our benchmark steady state analysis finds that housing finance leads to higher welfare at lower inflation. However, a monetary policy decision to change the inflation target results in additional costs and redistibution along the transition between steady states. In this section, we examine the implications of housing finance for who wins and loses following an unanticipated permanent change in steady state inflation. We show — solely from a housing market finance channel perspective — that the early 1980s Volcker disinflation would have been chosen by a reasonably patient social planner even if no weight was placed upon the gains received by lenders from higher real interest rates.

Our analysis builds on work that quantifies the redistribution between borrowers with fixed rate debt contracts and savers (lenders) following an unexpected change in inflation (e.g., Doepke and Schneider (2006)). Our framework incorporates two additional channels. First, a permanent change in inflation impacts households' welfare since it alters the profile of payments on new mortgages and thus households' future housing and consumption decisions.

[31] Blanco (2021) finds that taking the ELB into account in a menu cost model results in an optimal inflation rate of 3.5%.

Second, a permanent changes in steady state inflation shifts housing demand, which generates a permanent change in the level of real house prices and rents. As a result, an unexpected change in inflation can create capital gains or losses for homeowners and impact renters via a change in real rents. In other words, the welfare consequences of an unexpected change in inflation depend not only on households' initial nominal balance sheet, but also on their future financing plans, housing tenure, and exposure to changes in house prices and rents.

Our experiments compare a decline from 8 % to 2 % inflation, and an increase from 2 % to 8 %. In each experiment, the economy begins in steady state when an unexpected, permanent change in the steady state level of inflation over 1 period is announced. Mortgagors can refinance at a cost of 2.5% of the refinanced balance, but only after paying the interest on their existing mortgage during the period when inflation changes.

We compute the welfare effects for each age group, measured as the consumption-equivalent gain/loss *over their remaining lifetime* compared to households of the same age in the initial steady state.[32] We compare the welfare gains (losses) between partial and general equilibrium. The partial equilibrium welfare holds house prices and rents fixed, which isolates the direct effects of inflation changes through outstanding mortgage debt and the profile of real mortgage payments on newly originated mortgages. In the general equilibrium experiments, we assume that real house prices and rents adjust to their new steady-state levels in the period following the change in inflation.[33] We also report the welfare from the perspective of a social planner that weights the utility of each generation.

We find that the impact of an unexpected permanent change in inflation differs by age and education. A key insight from our partial equilibrium experiments is that a change in trend inflation has a significant impact on welfare via the profile of mortgage payments. Following a fall (increase) in trend inflation, young and middle aged renters see a sizable welfare gain (loss). This is driven by the relaxation (tightening) imposed by a fall (rise) in nominal mortgage rates on renters who transition to becoming an owner in the future. The

[32]This has the benefit of showing the cost/benefit relative to the expected path. However, the loss/gain for older workers as a percentage of total lifetime utility can appear large given the short remaining life.

[33]This provides a tractable approximation to the general equilibrium valuation effects associated with the transition. Computing the full transition path of equilibrium house prices would require solving for the sequence of market-clearing prices as the cross-sectional distribution of households evolves, which is computationally demanding in our overlapping-generations model. Our exercise captures the capital gains/loses accruing to existing homeowners from the change in real house prices while abstracting from the timing along the transition.

PE experiment also highlights the role of asymmetric refinancing incentives. When inflation falls, most mortgagors incur the refinancing cost to obtain lower nominal rates. In contrast, when inflation rises, mortgages lock-into what is now a low real interest rate. The change in the level of real house prices and rents in the GE analysis also has a significant impact on welfare along the transition. Homeowners with no or modest mortgage balances benefit (lose) from a fall (rise) in inflation, while the change in house prices reduce the losses (gains) of owners with large mortgages. Taking into account the change in real rents has an even larger impact on the welfare gains (losses) of young and middle aged renters. This shows a novel channel via which a monetary policy change in the inflation target can impact renters.

6.1 Welfare following an Unexpected Decline in Inflation

We examine the welfare implications for owners and renters of an unexpected, permanent *decline* in inflation from 8% to 2 %. The change in expected welfare we report is relative to the initial steady state with 8% inflation. We find that the flattening of the profile of real payments results in welfare gains that primarily impact renter households when inflation falls. Taking the GE impact on real house prices and rents has a significant impact on who wins and loses following an unexpected, permanent fall in inflation. An increase in real house prices provides a gain for owners with low or no debt while mitigating the higher real interest payments of mortgagors. In contrast, the rise in real rents reduces the gains for renters from a decline in trend inflation.

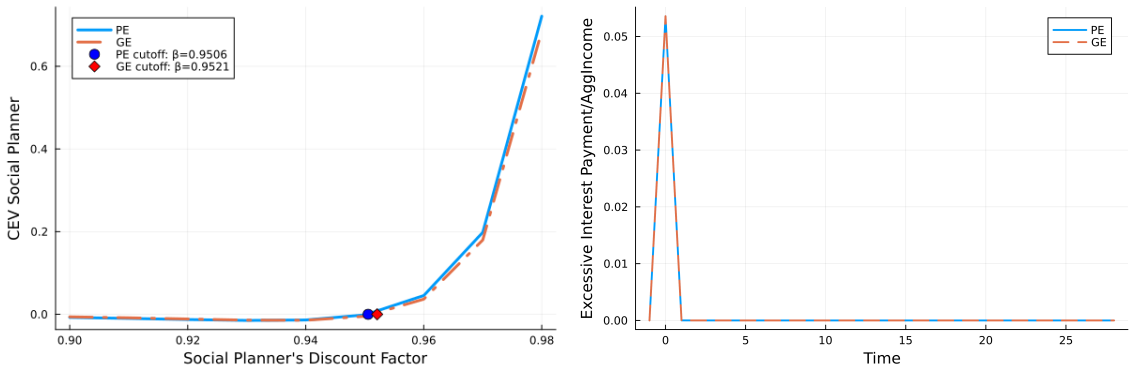
Aggregate Welfare Analysis: The transition to lower steady state inflation results in both redistribution from borrowers to savers as well costs due to refinancing. We ask whether the steady state gains are larger than the transitional costs on existing homeowners and renters. To answer this question, we use the objective function of a social planner who weights the lifetime welfare of current and future cohorts using a social discount factor β^{SP}: $W^{SP} = \sum_{t=-J+1}^{\infty} V_t$. In calculating this, we assume that that the higher real rates and refinancing costs are a deadweight loss. This means that our estimates are a lower bound.

A permanent decline in inflation entails both direct costs for mortgagors and indirect costs as households adjust their housing and consumption mix. Since existing fixed-rate mortgages were originated under the higher steady state inflation regime, the fall in inflation results in higher than expected real mortgage interest payments. Since the proportional cost of refinancing is less than the decline in inflation, all mortgagors refinance in the period

following the unexpected fall in inflation (See 8). As a result, mortgagors incur both the refinancing cost and one period of high real interest rates.

Given these costs for mortgagors, would a social planner view the steady gains welfare as large enough to offset the cost to current mortgagors? We find that for a reasonable range of social discount factors that the answer is yes. Figure 8 plots the discounted value of intergenerational welfare for a range of social discount factors. For discount factors above $\beta^{SP} = 0.9506$ in partial equilibrium and 0.9521 in general equilibrium, the long run steady gains of future generations outweigh the transitional costs of current generations.[34] What is striking is that this result holds even when we assume that the higher real interest payments of existing mortgagors are treated as a deadweight cost.

Figure 8: Aggregate Welfare and Excessive Mortgage Interest Payment Along Downward Transition



(a) Social Planner's Aggregate Welfare

(b) Excessive Mortgage Interest Payment

This has implications for evaluating the Volcker disinflation — which saw U.S. inflation drop from near double-digits to near 3% — and has been termed "the most widely discussed and visible macroeconomic event" in recent US history (Goodfriend and King (2005)). Houtz, Pugsley, and Rubinton (2025) examine the welfare implications of the Volcker disinflation in a model where the real steady state effects of inflation come from distorting consumer's cash holdings and how inflation interacts with sticky wages. They conclude that the net welfare gains were positive, although highly uneven. Our results add two key points beyond an additional rise in steady state welfare from lower inflation. First, we show that the option to refinance mortgages effectively reduces the average duration of mortgage debt, which lowers

[34]While there is debate around the appropriate scope for weighting generations, this discount factor is conservative compared to the values argued for by Arrow et al. (2013).

redistribution from mortgagors to savers. Second, as we discuss below, our findings point to a more uneven impact via housing markets.

Welfare Impacts Across Households: Behind the aggregate welfare effects lie highly uneven effects by age, education and ownership status. To isolate how these vary, we plot the change in (remaining) lifetime utility by age cohort as a result of the unexpected fall in inflation in Figure 9.a.b. At first glance, the welfare losses by age in partial equilibrium appear largely consistent with standard intuition.[35] On average, middle-aged households (ages 45–60) experience larger welfare losses than younger (ages 25–45) households. Middle-aged households have higher ownership rates and high debt and therefore are impacted more by the rise in the real value of nominal mortgage debt following an unexpected decline in inflation. With house prices and rents held fixed, the welfare effect initially increases with age for older households (60+) and then decreases. This non-monotonic pattern reflects two forces. On the one hand, the declines in average debt with age reduces the exposure of older households to the unexpected rise in real debt. On the other hand, older households have a shorter remaining lifespan to absorb the increase in real debt.

To disentangle the front-loading of real mortgage payments from the unexpected rise in the real value of mortgage debt and home equity, we classify households as owners or renters based on their status the period before inflation declines (Figure 9 panels (c) to (f)). In partial equilibrium, the welfare losses are accounted for by homeowners as renters benefit. Since real rents and house prices are fixed, renters benefits from the relaxation of borrowing constraints which increases steady state homeownership and thus expected welfare from future transitions to ownership (see Section 5.1). Since the college ownership rate is higher than the non-college, this gain is larger for college renters. The option to refinance (at a cost of 2.5% of the new loan) at the new, lower nominal mortgage rate limits the welfare losses of mortgagors (MacGee and Yao (2026)). While borrowing constrained owners benefit from less front loaded mortgage payments, they (and non-constrained mortgagors) lose from higher real interest payments in the period that inflation falls and the cost of refinancing.

Taking into account the GE effects on real house prices and rents has a significant impact on welfare across age and education groups. A 6 percentage point decline in inflation raises the real value of nominal debt by approximately 6%, while equilibrium house prices increase by about 1.7%. For existing homeowners, the increase in housing wealth offsets the higher

[35] In our welfare discussion, we assume that the gains from lenders accrue to an offshore lender and are not rebated to domestic savers.

real mortgage burden for households with a $LTV \leq 27\%$. The effect on college households is larger since they have higher homeownership rates and larger homes. Since older households have lower debt, the capital gain effect leads to college cohorts over age 70 benefiting from the decline in inflation. In sharp contrast to when house prices and rents are held fixed, renters, particularly college renters, see little benefit (or, small losses). The pass through of house prices into rents means that non-college renters face higher real rents that reduce their purchasing power while the low probability of transitioning to ownership means they see little benefit from the lower front loading of mortgages. In contrast, younger college renters still see small gains from lower inflation, while older college renters lose from higher rents as they are unlikely to become owners.

6.2 Transition to Higher Trend inflation

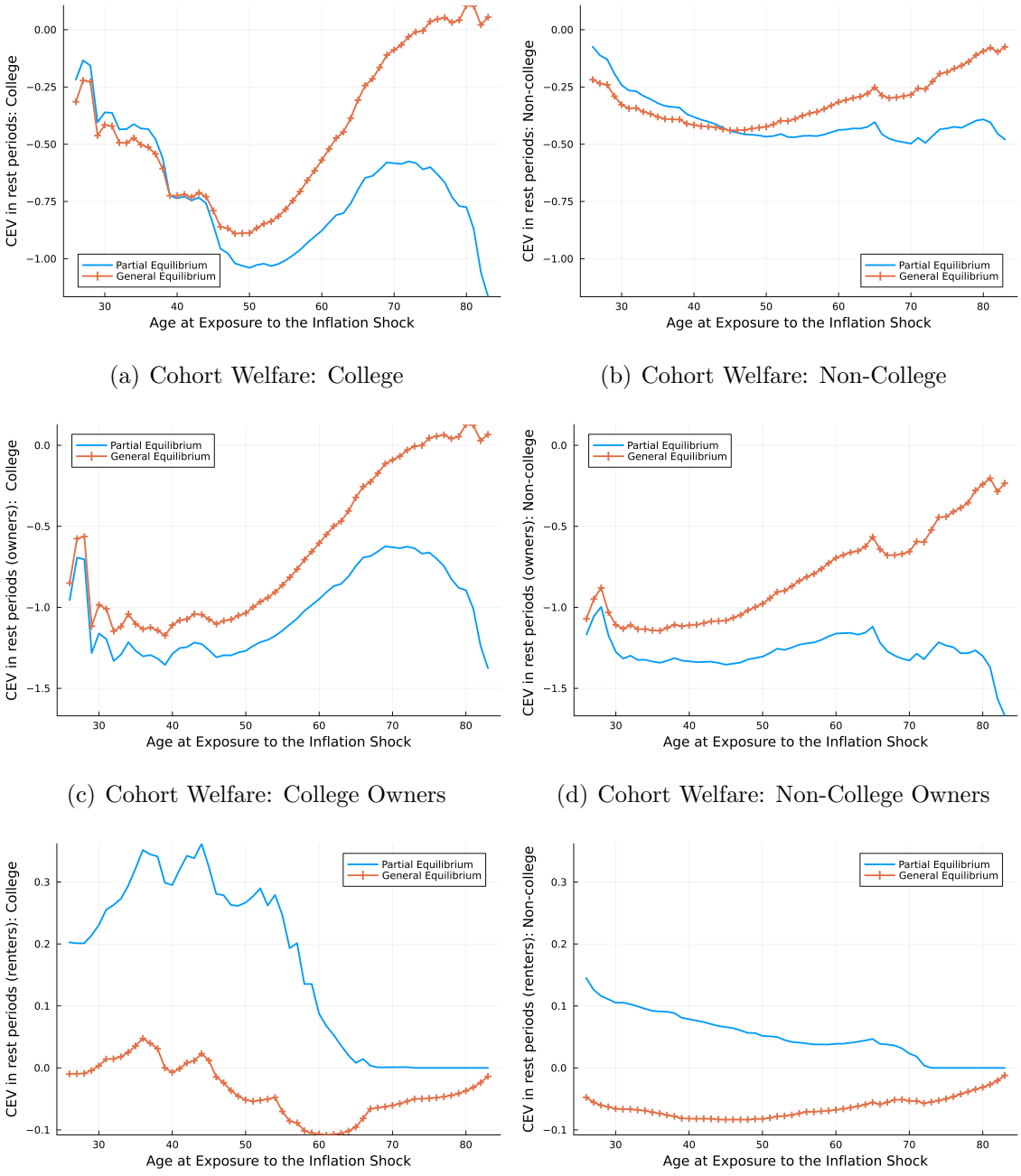
Some economists have argued for higher inflation targets to mitigate the risk of ELB episodes (e.g., Blanchard, Dell'Ariccia, and Mauro, 2010; Ball, 2013). In this subsection, we evaluate the welfare effects of an unexpected increase in inflation from 2 % to 8 % in 1 period. We find that the welfare impacts on households (excluding the losses to lenders) are much larger than following a disinflation. This is largely due to the well known asymmetric refinancing incentives of mortgagors (e.g., Eichenbaum, Rebelo, and Wong (2022),Berger et al. (2021)), which leads to mortgagors delaying refinancing and prepayments so as to benefit from low real interest rates. Our analysis shows that the GE channel of a decline in the real price of housing partially offsets this gain for owners, while renters gain from the fall in real rents.

The welfare effects on owners of an unexpected increase in inflation are substantial, with magnitudes roughly four to five times larger than the downward transition (Figure 10).[36] This asymmetry is mainly due to mortgage lock-in: following an unexpected increase in inflation, households with pre-existing fixed-rate mortgages retain their lower nominal rate mortgage. Following a 6 percentage point increase in inflation, the average welfare gain for a 50-year-old is approximately 4.5% for college and 2% for non-college. These gains accrue primarily to existing mortgagors. In contrast, a 6 percentage point decline in inflation sees a 1% decline in remaining lifetime consumption for a 50-year-old college household and a 0.5% reduction for a 50-year-old non-college (see Figure 9).

Renters do not benefit from the erosion in the real value of outstanding nominal mortgage

[36]The welfare implication is computed relative to the 2% steady state.

Figure 9: Welfare by Cohort along Transition: 8% to 2%



(a) Cohort Welfare: College

(b) Cohort Welfare: Non-College

(c) Cohort Welfare: College Owners

(d) Cohort Welfare: Non-College Owners

(e) Cohort Welfare: College Renters

(f) Cohort Welfare: Non-College Renters

Notes: The figure reports welfare effects of an unexpected drop in inflation from 8% to 2% by age at the time of the inflation shock. Panels (a)–(b) show welfare effects for all households, panels (c)–(d) for homeowners, and panels (e)–(f) for renters, separately for college and non-college households. Welfare effects are measured as consumption-equivalent variation (CEV) over the household's remaining lifetime relative to households of the same age in the initial steady state. The partial-equilibrium case holds real house prices and rents fixed, while the general-equilibrium case allows house prices and rents to adjust following the change in inflation.

debt or from mortgage lock-in. As a result, the magnitude of the welfare loss from a 6 percentage point increase in inflation is similar to that generated by a 6 percentage point decline in inflation. Thus, the pronounced asymmetry in the aggregate welfare effects of upward and downward inflation transitions is driven primarily by the exposure of existing homeowners to fixed-rate mortgage contracts. Noticeably, the gap between the fixed-price and price-adjustment cases shows that price adjustment moderates the welfare effects of an unexpected, sudden change in inflation.

7 Alternative Mortgage Contracts and Inflation

When households are borrowing constrained and mortgages are costly to refinance, steady state inflation has real effects on household consumption and housing decisions. One critique is that financial contracts could be changed to mitigate the impact of inflation.[37] In this section, we briefly argue that the structure of housing finance systems complicates the widespread roll out of inflation indexed mortgages along the lines suggested by Lessard and Modigliani (1975), while modifications such as extending the amortization are ineffective.

Fixed nominal payment mortgages have remained dominent in advanced economies, even during the 1970s and 1980s when inflation approached (or exceeded) 10%. One explanation is that the mortgage finance system is heavily regulated and shaped by industry practices. For example, in the US, the Truth in Lending Act defines a qualified mortgage and specifies the legal disclosures required (including features such as APR) as well as the extent to which complying with these disclosures could limit (or lead to) legal liability of a lender (Griffith (2003)), while investors use historical data to guide pricing.[38] These forces create considerable inertia against a widespread change of mortgage contracts.

An alternative is to lengthen the amortization. A longer amortization spreads mortgage payments over a longer horizon and reduces the annual (nominal) payments so as to relax borrowing constraints. We compare the welfare difference between 2 and 8 % inflation

[37]Since the front loading effect is a feature of a fixed amortization and fixed nominal payments, it holds across FRM and ARM mortgages as well as for an interest only mortgage (MacGee and Yao (2026)). An ARM with a lower rate than a FRM will have lower nominal payments. However, the level of trend inflation which is passed through into the risk free nominal rate will front load real payments for ARMs and FRMs.

[38]In some countries, mortgage insurance regulations also specify the features of insurable mortgages. For example, in Canada mortgage insurance (which is required for all high LTV mortgages originated by federally regulated intermediaries) specifies the maximum amortization of standard mortgage contracts.

Figure 10: Welfare by Cohort along Transition: 2% to 8%



(a) Cohort Welfare: College

(b) Cohort Welfare: Non-College

(c) Cohort Welfare: College Owners

(d) Cohort Welfare: Non-College Owners

(e) Cohort Welfare:College Renters

(f) Cohort Welfare: Non-College Renters

Notes: The figure reports welfare effects by age at the time of an unexpected permanent increase in inflation from 2% to 8%. Panels (a)–(b) show welfare effects for all households, panels (c)–(d) for homeowners, and panels (e)–(f) for renters, separately for college and non-college households. Welfare effects are measured as consumption-equivalent variation (CEV) over the household's remaining lifetime relative to households of the same age in the initial steady state. The partial-equilibrium case holds real house prices and rents fixed, while the general-equilibrium case allows house prices and rents to adjust following the inflation shock.

with our benchmark 30 year amortizations and 35 and 40 year amortizations in Table 5.[39] Extending the amortization to 35 or 40 years (from 30) has a small impact on the welfare cost of higher inflation, as the welfare loss declines from 0.31% in the benchmark to 0.30% (0.29 %) with 35 (40) year amortization. These small changes in welfare indicate that amortization extension is not effective in offsetting higher inflation.[40]

Table 5: Welfare Cost of a Rise in Inflation from 2% to 8%: Amortization Extension

	Aggregate	College	Non-college
30-year amortization	-0.31%	-0.46%	-0.23%
35-year amortization	-0.30%	-0.44%	-0.22%
40-year amortization	-0.29%	-0.43%	-0.21%

Notes: The table reports the welfare effects of an increase in inflation from 2% to 8% under alternative mortgage amortization periods. Welfare effects are measured as consumption-equivalent variation (CEV) in lifetime consumption relative to the 2% inflation steady state. All other model parameters are held at their benchmark values.

A different question is whether — if the regulatory and practical issues were to be overcome — inflation indexed mortgages would dominate standard mortgage contracts. On the one hand, Campbell and Cocco (2003) argue that inflation indexed mortgages have some attractive properties in dealing with the risk of transitory changes in inflation. On the other hand, while inflation indexed mortgages have been adopted in some developing countries, these experiments have unraveled during economic crises (e.g., see Buckley, Lipman, and Persaud (1989)). This leaves the question of whether inflation indexed mortgages would be a suitable innovation to address the welfare cost of inflation we document as an open question for future research.[41]

[39]Throughout these experiments, we hold house prices and rents fixed to isolate the effects operating through mortgage payments and borrowing constraints. Extending amortization in our model is costless for mortgagors as we allow free early repayments. As a result, extending the amortization gives borrowers additional flexibility but they can replicate the payment schedule under the original amortization at no cost.

[40]These estimates are arguably an upper bound as we hold fixed the pricing of mortgages. In practice, longer-amortization mortgages are associated with higher closing costs or an interest-rate premium, and accounting for these costs would reduce the benefits of extending amortization.

[41]There are several potentially important channels. First, does indexing to the inflation rate creates additional risk for households since wage growth for some workers may lag (or, lead) inflation, particularly when inflation is driven by relative price shocks. In addition, the details around refinancing options and

8 Conclusion

We examine a novel housing market finance channel via which anticipated inflation has real effects on household housing and consumption. We show that when refinancing is costly, higher anticipated inflation front-loads real mortgage payments and tightens the credit constraints for young households. To quantify the importance of this channel, we develop and calibrate a life-cycle housing tenure choice model with fixed-amortization mortgages. Our results show that anticipated and stable inflation generates meaningful welfare losses. When house prices are held fixed, a one percentage point increase in inflation lowers welfare by roughly 0.5 % of lifetime consumption for a newborn household. The welfare costs are heterogeneous across households and are larger for college-educated and higher-income households, who are more likely to become homeowners and therefore more exposed to mortgage borrowing constraints.

Allowing house prices to adjust in general equilibrium partially mitigates these welfare losses. Higher inflation reduces housing demand and lowers equilibrium house prices, which relaxes borrowing constraints for some households. As a result, the welfare cost of inflation depends on housing supply conditions and varies systematically across cities. Consistent with this mechanism, we find that the welfare gains from the Volcker disinflation are substantially larger in cities with elastic housing supply than in cities where supply is constrained.

The welfare costs in this paper arise from distortions associated with housing finance, rather than from the traditional monetary channels emphasized in much of the literature. Thus, our findings point to an additional source of welfare loss from inflation that, when combined with traditional monetary distortions, could imply a larger overall welfare cost of inflation and help account for why many households report disliking inflation. Our findings suggest that future work on how inflation interacts with other long-term nominal debt contracts, such as auto loans, could be useful.

costs could be important for both the pricing by lenders and the attractiveness to households. Second, the implications for a lender's risk profile could influence pricing as inflation indexed mortgages could create a mismatch between the timing of cash flow for lenders.

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Appendix

A Proof of Theorem 2.1: Partial Equilibrium Analysis

Lemma A.1 *When households are borrowing constrained at any positive inflation level, an increase in the steady-state inflation reduces the housing value ph.*

Household's problem in real terms

$$\begin{aligned} &\max_{c_1,h,c_2} \ln(c_1) + \theta \ln(h) + \beta \ln(c_2) \\ s.t.\ \ & c_1 + (\delta + \frac{(1+r_m)(1+r)}{2+r_m})ph + S = 1 \\ & c_2 + \delta ph + \frac{(1+r)^2}{2+r_m} ph = g + ph + (1+r)S \\ & S \geq 0 \end{aligned} \tag{20}$$

Denote $x = \delta + \frac{(1+r_m)(1+r)}{2+r_m}$ as the effective housing cost and $y = (1 - \delta - \frac{(1+r)^2}{2+r_m})$ as the return to housing asset in the first period. Both x and y are increasing in inflation π as $(1+r_m) = (1+\pi)(1+r)$. Specifically

$$\begin{aligned} \frac{\partial x}{\partial \pi} &= \frac{(1+r)^2}{(2+r_m)^2} \\ \frac{\partial y}{\partial \pi} &= \frac{(1+r)^3}{(2+r_m)^2} \end{aligned} \tag{21}$$

Effectively, higher inflation forces households to save though home equity in the first period which gets a return rate of $1+r$.

When borrowing constraint binds, household's optimal choice is characterized by:

$$\begin{aligned} \hat{c}_1 &= 1 - xP\hat{h} \\ \hat{c}_2 &= g + yP\hat{h} \end{aligned} \tag{22}$$

where $\hat{h}$, the optimal housing consumption is given by

$$\frac{\theta}{\hat{h}} + \frac{\beta yp}{g + yp\hat{h}} = \frac{xp}{1 - xp\hat{h}} \tag{23}$$

Rewriting equation 23

$$(1+\beta+\theta)xyp^2\hat{h}^2 + [(1+\theta)xg - (\beta+\theta)y]p\hat{h} - \theta g = 0 \tag{24}$$

Solving Equation 24, we get

$$p\hat{h} = \frac{[(\beta+\theta)y - (1+\theta)xg] + \sqrt{[(1+\theta)xg - (\beta+\theta)y]^2 + 4(1+\beta+\theta)xy\theta g}}{2(1+\beta+\theta)xy} \tag{25}$$

Taking the total differentiation of equation 24 :

$$\frac{\partial p\hat{h}}{\partial \pi} = -\frac{(1+\beta+\theta)(p^2\hat{h}^2)[x\frac{\partial y}{\partial \pi} + y\frac{\partial x}{\partial \pi}] + (1+\theta)gp\hat{h}\frac{\partial x}{\partial \pi} - (\beta+\theta)p\hat{h}\frac{\partial y}{\partial \pi}}{2(1+\beta+\theta)xyp\hat{h} + (1+\theta)xg - (\beta+\theta)y} \tag{26}$$

The denominator

$$\begin{aligned}
&2(1+\beta+\theta)xyp\hat{h} + (1+\theta)xg - (\beta+\theta)y \\
&= 2(1+\beta+\theta)xyp\hat{h} + (1+\theta)xg - [(1+\beta+\theta)xyp\hat{h} + (1+\theta)xg - \frac{\theta g}{p\hat{h}}] \\
&= (1+\beta+\theta)xyp\hat{h} + \frac{\theta g}{p\hat{h}} > 0
\end{aligned}$$

The numerator

$$\begin{aligned}
&(1+\beta+\theta)(p^2\hat{h}^2)[x\frac{\partial y}{\partial \pi} + y\frac{\partial x}{\partial \pi}] + (1+\theta)gp\hat{h}\frac{\partial x}{\partial \pi} - (\beta+\theta)p\hat{h}\frac{\partial y}{\partial \pi} \\
&= [(1+\beta+\theta)(xp\hat{h}(1+r) + yp\hat{h}) + (1+\theta)g - (\beta+\theta)(1+r)]p\hat{h}\frac{\partial x}{\partial \pi} \\
&= [-(\beta+\theta)(1+r)(1-xp\hat{h}) + (1+\theta)(g+yp\hat{h}) + xp\hat{h}(1+r) + \beta yp\hat{h}]p\hat{h}\frac{\partial x}{\partial \pi}
\end{aligned}$$

When borrowing constraint binds $S > 0$, Kuhn-Tucker implies

$\frac{1}{\hat{c}_1} > \frac{\beta(1+r)}{\hat{c}_2}$ or $\frac{1}{1-xp\hat{h}} > \frac{\beta(1+r)}{g+yp\hat{h}}$

Therefore, $[-(\beta+\theta)(1+r)(1-xp\hat{h}) + (1+\theta)(g+yp\hat{h}) + xp\hat{h}(1+r) + \beta yp\hat{h}]p\hat{h}\frac{\partial x}{\partial \pi}$

$\geq [-\theta(1+r)(1-xp\hat{h}) + \theta(g+yp\hat{h}) + xp\hat{h}(1+r) + \beta yp\hat{h}]p\hat{h}\frac{\partial x}{\partial \pi}$

According to Equation 23 $xp\hat{h} = (\theta + \frac{\beta yp\hat{h}}{g+yp\hat{h}})(1-xp\hat{h})$

$[-\theta(1+r)(1-xp\hat{h}) + \theta(g+yp\hat{h}) + xp\hat{h}(1+r) + \beta yp\hat{h}]p\hat{h}\frac{\partial x}{\partial \pi}$

$\geq [\theta(1+r)xp\hat{h} + \theta(g+yp\hat{h}) + \beta yp\hat{h}]p\hat{h}\frac{\partial x}{\partial \pi} > 0$

Thus $\frac{\partial ph}{\partial \pi} < 0$: Housing value decreases in inflation. In the partial equilibrium model where housing price is fixed, housing consumption decreases in inflation.

Lemma A.2 *When households are borrowing constrained at any positive inflation level, an increase in the steady-state inflation reduces consumption in the first period and increases consumption in the second period.*

$$\frac{\partial \hat{c}_1}{\partial \pi} = \frac{\partial (1 - x\hat{ph})}{\partial \pi} = -\frac{\partial x\hat{ph}}{\partial \pi} \tag{27}$$

$$\begin{aligned}
\frac{\partial x\hat{ph}}{\partial \pi} &= \hat{ph}\frac{\partial x}{\partial \pi} + x\frac{\partial \hat{ph}}{\partial \pi} \\
&= \hat{ph}\frac{\partial x}{\partial \pi} - \frac{x(1+\beta+\theta)(p^2\hat{h}^2)[x\frac{\partial y}{\partial \pi} + y\frac{\partial x}{\partial \pi}] + (1+\theta)gx\hat{ph}\frac{\partial x}{\partial \pi} - (\beta+\theta)x\hat{ph}\frac{\partial y}{\partial \pi}}{2(1+\beta+\theta)xy\hat{ph} + (1+\theta)xg - (\beta+\theta)y} \\
&= \frac{[x(1+r)-y][(\beta+\theta) - (1+\beta+\theta)x\hat{ph}]}{2(1+\beta+\theta)xy\hat{ph} + (1+\theta)xg - (\beta+\theta)y}\hat{ph}\frac{\partial x}{\partial \pi}
\end{aligned} \tag{28}$$

According to Equation 25

$$\begin{aligned}
\hat{ph} &= \frac{[(\beta+\theta)y - (1+\theta)xg] + \sqrt{[(1+\theta)xg - (\beta+\theta)y]^2 + 4(1+\beta+\theta)xy\theta g}}{2(1+\beta+\theta)xy} \\
&< \frac{[(\beta+\theta)y - (1+\theta)xg] + \sqrt{[(1+\theta)xg - (\beta+\theta)y]^2 + 4(1+\theta)(\beta+\theta)xy\theta g}}{2(1+\beta+\theta)xy} \\
&= \frac{[(\beta+\theta)y - (1+\theta)xg] + \sqrt{[(1+\theta)xg + (\beta+\theta)y]^2}}{2(1+\beta+\theta)xy} \\
&= \frac{\beta+\theta}{(1+\beta+\theta)x}
\end{aligned}$$

i.e. $x\hat{ph} < \frac{\beta+\theta}{(1+\beta+\theta)}$ which implies $\frac{[x(1+r)-y][(\beta+\theta) - (1+\beta+\theta)x\hat{ph}]}{2(1+\beta+\theta)xy\hat{ph} + (1+\theta)xg - (\beta+\theta)y}\hat{ph}\frac{\partial x}{\partial \pi} > 0$

Therefore $\frac{\partial x\hat{ph}}{\partial \pi} > 0$ and $\frac{\partial \hat{c}_1}{\partial \pi} < 0$

Similarly

$$\begin{aligned}
\frac{\partial \hat{c}_2}{\partial \pi} = \frac{\partial (g + y\hat{ph})}{\partial \pi} &= \hat{ph}\frac{\partial y}{\partial \pi} + y\frac{\partial \hat{ph}}{\partial \pi} \\
&> \hat{ph}\frac{\partial x}{\partial \pi} + x\frac{\partial \hat{ph}}{\partial \pi} > 0
\end{aligned} \tag{29}$$

as $\frac{\partial y}{\partial \pi} = (1+r)\frac{\partial x}{\partial \pi} > \frac{\partial x}{\partial \pi}$, $x > y$, and $\frac{\partial \hat{ph}}{\partial \pi} < 0$

Lemma A.3 *When households are borrowing constrained at any positive inflation level, an increase in the steady-state inflation reduces households' welfare.*

$$V = \ln(\hat{c}_1) + \theta \ln(\hat{h}) + \beta \ln(\hat{c}_2) \tag{30}$$

Envelope theorem implies that

$$\begin{aligned}\frac{\partial V}{\partial \pi} &= -\frac{p\hat{h}}{1-xp\hat{h}}\frac{\partial x}{\partial \pi}+\frac{\beta p\hat{h}}{g+yp\hat{h}}\frac{\partial y}{\partial \pi}\\ &= [-\frac{p\hat{h}}{1-xp\hat{h}}+\frac{(1+r)\beta p\hat{h}}{g+yp\hat{h}}]\frac{\partial x}{\partial \pi}\end{aligned}$$

When borrowing constraint binds $S>0$, Kuhn-Tucker implies (31)

$$\frac{1}{\hat{c}_1}>\frac{\beta(1+r)}{\hat{c}_2} \text{ or } \frac{1}{1-xp\hat{h}}>\frac{\beta(1+r)}{g+yp\hat{h}}$$

which implies $[-\frac{p\hat{h}}{1-xp\hat{h}}+\frac{(1+r)\beta p\hat{h}}{g+yp\hat{h}}]\frac{\partial x}{\partial \pi}<0$

When borrowing constraint binds, an increase in steady-state inflation further tightens the borrowing constraint, distorts consumption allocation over time, reduces housing consumption and households' welfare.

B Proof of Theorem 2.3: General Equilibrium Analysis

In the partial equilibrium analysis, we assume that house price p is fixed at $\bar{H}$. In this general equilibrium analysis, we focus on the other extreme case where housing supply is fixed. When inflation changes, housing price will adjust to clear the housing market.

Lemma B.1 *Suppose we are at a steady state of which households are borrowing constrained at any positive inflation level, an increase in the steady-state inflation reduces equilibrium house price p^*, consumption in the first period c_1^* while increases consumption in the second period c_2^*.*

The competitive equilibrium is defined as equilibrium housing price p^* and allocation of households $\{c_1^*, c_2^*, h^*, S^*\}$ such that given p^*, $\{c_1^*, c_2^*, h^*, S^*\}$ solves

$$\begin{aligned}&\max_{c_1,h,c_2} \ln(c_1)+\theta\ln(h)+\beta\ln(c_2)\\ s.t.\ \ &c_1+(\delta+\frac{(1+r_m)(1+r)}{2+r_m})ph+S=1\\ &c_2+\delta ph+\frac{(1+r)^2}{2+r_m}ph=g+ph+(1+r)S\\ &S\geq 0\end{aligned} \tag{32}$$

Housing market clears:

$$h^* = \bar{H} \tag{33}$$

Combining households' constrained optimal housing consumption 26 with the housing market market clearing condition yields

$$\begin{aligned} &\frac{\partial p^* h^*}{\partial \pi} < 0 \\ &p^* \frac{\partial h^*}{\partial \pi} + h^* \frac{\partial p^*}{\partial \pi} < 0 \\ &h^* \frac{\partial p^*}{\partial \pi} < 0 \end{aligned} \tag{34}$$

Following the same logic as in 28 and 29, we still have

$$\frac{\partial c_1^*}{\partial \pi} < 0, \frac{\partial c_2^*}{\partial \pi} > 0 \tag{35}$$

Lemma B.2 *Suppose we are at a steady state of which households are borrowing constrained at any positive inflation level, an increase in the steady-state inflation leads to an increase in welfare.*

$$V = ln(c_1^*) + \beta ln(c_2^*) + \theta ln(\bar{H}) \tag{36}$$

$$\begin{aligned} \frac{\partial V}{\partial \pi} &= -\frac{1}{1 - xp^*h^*} \frac{\partial xp^*h^*}{\partial \pi} + \frac{\beta}{g + yp^*h^*} \frac{\partial yp^*h^*}{\partial \pi} \\ &= -\frac{1}{1 - xp^*h^*} [p^*h^* \frac{\partial x}{\partial \pi} + x \frac{\partial p^*h^*}{\partial \pi}] + \frac{\beta}{g + yp^*h^*} [p^*h^* \frac{\partial y}{\partial \pi} + y \frac{\partial p^*h^*}{\partial \pi}] \\ &= -\frac{1}{1 - xp^*h^*} \frac{[x(1+r) - y][(\beta + \theta) - (1 + \beta + \theta)xp^*h^*]}{2(1 + \beta + \theta)xyp^*h^* + (1 + \theta)xg - (\beta + \theta)y} p^*h^* \frac{\partial x}{\partial \pi} \\ &+ \frac{\beta}{g + yp^*h^*} \frac{[x(1+r) - y][(1 + \beta + \theta)yp^*h^* + (1 + \theta)g]}{2(1 + \beta + \theta)xyp^*h^* + (1 + \theta)xg - (\beta + \theta)y} p^*h^* \frac{\partial x}{\partial \pi} \\ &= \frac{[x(1+r) - y]p^*h^* \frac{\partial x}{\partial \pi}}{2(1 + \beta + \theta)xyp^*h^* + (1 + \theta)xg - (\beta + \theta)y} \{ \frac{\beta[(1 + \beta + \theta)yp^*h^* + (1 + \theta)g]}{g + yp^*h^*} - \frac{(\beta + \theta) - (1 + \beta + \theta)xp^*h^*}{1 - xp^*h^*} \} \\ &> \frac{[x(1+r) - y]p^*h^* \frac{\partial x}{\partial \pi}}{2(1 + \beta + \theta)xyp^*h^* + (1 + \theta)xg - (\beta + \theta)y} \{ \beta(1 + \theta) - \frac{(\beta + \theta) - (1 + \beta + \theta)xp^*h^*}{1 - xp^*h^*} \} \\ &= \frac{[x(1+r) - y]p^*h^* \frac{\partial x}{\partial \pi}}{2(1 + \beta + \theta)xyp^*h^* + (1 + \theta)xg - (\beta + \theta)y} \frac{(1 + \theta(1 - \beta))xp^*h^* - \theta(1 - \beta)}{1 - xp^*h^*} \\ &= \frac{[x(1+r) - y]p^*h^* \frac{\partial x}{\partial \pi}}{2(1 + \beta + \theta)xyp^*h^* + (1 + \theta)xg - (\beta + \theta)y} \frac{xp^*h^* - \theta(1 - \beta)(1 - xp^*h^*)}{1 - xp^*h^*} > 0 \end{aligned}$$

as $\frac{xp^*h^*}{1 - xp^*h^*} > \theta > \theta(1 - \beta)$according to households' optimal decision described in Equation 24

(37)