Housing and the Heterogeneous Welfare Cost of Inflation *

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Abstract

When consumers are borrowing constrained, the "tilt" induced by higher trend inflation front loading the profile of real payments of fixed amortization mortgages impacts consumer's life cycle housing and consumption. To quantify the steady state welfare costs of anticipated inflation, we introduce nominal mortgage contracts into a calibrated life-cycle housing tenure choice model. We find that even moderate levels of anticipated inflation generate meaningful welfare costs by distorting life-cycle housing and consumption decisions. When house prices are held fixed, a one-percentage-point increase in inflation reduces welfare by about 0.08 percent of lifetime consumption. The welfare cost is substantially larger for college-educated and higher-income households, who are more likely to be homeowners. In general equilibrium, inflation lowers housing demand and reduces real house prices, partially mitigating the tightening of borrowing constraints. As a result, the welfare cost of inflation falls as the housing supply elasticity declines and is roughly a third as large with a fixed supply of housing. We find that the Volcker disinflation increased steady state welfare by nearly 0.05 %, and that housheolds in cities with low housing supply elasticity saw roughly half the welfare gains of cities with the most elastic supply.

Keywords: Mortgage Debt, Debt-to-income, Inflation, Homeownership rate, Life-cycle
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1 Introduction

The rapid rise of inflation since 2021 following a period of below target inflation has rekindled debate over the appropriate target level of inflation (e.g., see Blanchard, Dell'Ariccia, and Mauro (2010), Gagnon and Collins (2019)). Proponents of increasing inflation targets often argue that the welfare cost of sustained but moderate inflation is small, and thus there is little reason to not increase targets to reduce the likelihood of ELB episodes. This view typically cites estimates of the welfare costs of inflation resulting from holding (non-interest) bearing money or distortions in relative prices.[1]

The debate over the welfare costs of inflation has surprisingly ignored how the interaction between inflation and the structure of financial contracts can lead to moderate anticipated and stable inflation distorting economic decisions. In this paper, we focus on the implications of inflation for one of the most used financial contracts: residential mortgages. With fixed amortization mortgages, higher trend inflation — which leads to higher nominal interest rates via the Fisher equation — front-loads the profile of real mortgage payments. By front-loading real payments, higher inflation tightens the borrowing constraints on lower wealth (typically younger) households. As a result, the level of trend inflation impacts the life cycle consumption and homeownership decisions of borrowing constrained households. Moreover, we show that this results in trend inflation impacting aggregate housing demand, and thus real house prices. By distorting consumption and housing decisions, as well as shifting real house prices, the level of anticipated inflation impacts the welfare of consumers.

To quantitify the welfare cost of (steady state) inflation arising from standard fixed amortization mortgages and borrowing constraints, we develop an incomplete market life cycle tenure choice model with nominal mortgages.[2] We show, for reasonable parameter values, that these distortions result in meaningful welfare losses for even modest levels of inflation. We also find that the magnitude of the welfare costs varies with the elasticity of housing

[1] Following the seminal framework proposed Bailey (1956) and Friedman (1969) where higher rates of inflation increase the cost of holding real monetary balances, welfare loss are measured under money demand curve (see e.g. Lucas (2000)). 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)).

[2] Despite the extensive discussions 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.

supply. Economies with elastic housing supply see little change in equilibrium housing prices as housing demand changes with steady-state inflation. As a result, lower inflation acts to alleviate borrowing constraints. In an economy with inelastic housing supply, the higher demand for housing at lower inflation pushes up steady state house prices which partially offsets how lower inflation relaxes borrowing constraints.[3]

Our focus on the interplay between inflation, borrowing constraints and mortgage contracts reflects the fact that mortgage debt accounts for the bulk of consumer debt while housing is the most important asset of most households and accounts for a large share of consumption. Residential mortgages generally specify a fixed amortization period (typically 30 years in the U.S. and 25-30 years in Canada and UK) with **constant nominal payments**. As we show in Section 2.1, a long amortization means that even modest differences in inflation have a large impact on the profile of real payments. Using data from the Census and American Community Survey, we document that the mortgage payments to income ratio declined faster with borrower's age in 1980 when inflation was high than in 2000 or 2016 when inflation was lower.[4] Our focus on inflation and mortgages also reflects the fact that almost all first-time buyers finance their home purchase with mortgage loans. As most buyers are in their 30s and 40s, they face an earning profile that features real income growth. More broadly, there is growing evidence that many homeowners face significant liquidity constraints (e.g., see Boar, Gorea, and Midrigan (2022)).

To illustrate the key mechanism via which inflation distorts the intra-temporal and inter-temporal allocation of consumption and housing services, we develop a two-period model where households consume a non-storable good and housing financed by fixed amortization mortgages. We show that when consumers are not borrowing constraints that anticipated inflation has no impact on consumption, housing demand or welfare. However, when consumers are borrowing constraints, higher inflation lowers the welfare of consumer and that the welfare costs of inflation are increasing in the growth rate of real lifetime income. We also show that higher inflation reduces aggregate housing demand, resulting in real house prices deceasing in inflation.

To quantitatively evaluate the welfare cost of inflation, we develop a general equilibrium life-cycle housing tenure choice model where households choose whether to rent or purchase a home and the amount of mortgage debt. Households face a life-cycle earnings profile

[3]We abstract from the welfare gains and losses on absentee landowners in our analysis.

[4]See MacGee and Yao (2026a) for further empirical evidence supporting the key channels in our model

and stochastic shocks to income, and have preferences over a non-storable consumption good as well as housing services. Since homeownership rates are much higher for college educated than the non-college, we introduce college and non-college households with different income processes. In our calibration, college households have steeper life-cycle income growth and face lower idiosyncratic income risk than the non-college. Households choose between owning and renting different size houses. The only credit contract in the model is a standard thirty-year amortization mortgage with fixed nominal payments which incurs a fixed cost at origination. Borrowers face both 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 rate of inflation. To avoid tracking the change of prices and interest rates due to inflation, we map the household's nominal budget constraint into real terms so that real mortgage payments depend on inflation and mortgage age.

We calibrate the baseline model to match homeownership rates, loan-to-value ratios, debt-to-income ratios, and payment-to-income ratios over the life-cycle in 2019 for both college and non-college households. In our baseline calibration, we assume the economy is in steady state with inflation at 2%. We use the calibrated model to evaluate the welfare cost of steady state inflation between 0 and 10 percent. In our experiments, we consider both a partial equilibrium setting where house prices do not adjust and a general equilibrium setting where house prices responds to demand changes. Our welfare measure is the consumption equivalent required to compensate a newborn as we vary steady state trend inflation.

When house prices are fixed, we find that a 1 percentage point increase in inflation (i.e, from 2 % to 3 %) lowers welfare (in consumption equivalents) by roughly 0.08%. When we endogenize the relative price of housing, we find that inflation reduces aggregate housing demand and thus (real) house prices. This partially mitigates the tighter borrowing constraints of younger homebuyers resulting from inflation, which reduces the welfare cost of inflation.

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 are owners than for low income households 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, when we compare households based on their initial persistent income draw, the welfare costs of inflation are much higher for the upper income than lower income earners. Moreover, inflation has little impact on households born into the lowest income percentiles who are very likely to

rent over their lifetimes. In contrast, top income earners face a welfare cost roughly twice as large as the economy-average. The larger welfare losses of upper-middle than lower-income households are driven by the fact that lower inflation lowers the initial payment to income ratio of (younger) homeowners. Since most upper income households become homeowners, this relaxes borrowing constraints on the low wealth but high income young.

When we endogenize housing supply, we find that higher inflation lowers the real price of houses which leads to smaller welfare costs of inflation. By front loading mortgage payments, higher inflation reduces housing demand and puts downward pressure on real house prices. With a price elasticity of 0.4 (roughly the estimate of Baum-Snow and Han (2024), real house prices decrease by roughly 0.2 percentage points per percentage point increase in inflation. A fall in the real price of houses relaxes the PTI of homeowners, and as a result, the welfare cost of inflation is roughly half that of the partial equilibrium estimate with fixed prices. Perhaps more interestingly, this also provides a channel via which the welfare cost of inflation varies systematically across cities with the elasticity of housing supply.

We use the calibrated model to quantify the steady state impacts of the Volcker disinflation. For an housing supply elasticity of 1.7, a fall in inflation from 10 to 2 percent increases steady state welfare by nearly 0.05 %.[5] These gains were mainly captured by the college educated and higher income households. Using the city level estimates of housing supply elasticities from Saiz (2010), we find a large variation in the welfare gains from the Volcker disinflation across cites. Cities with the lowest housing supply elasticity experience roughly half the welfare gains of cities with highly elastic housing supply.[6]

The large literature on the welfare cost of anticipated inflation has largely focused on costs arising from inflation acting as a tax on money balances or price stickiness (e.g., Driffill, Mizon, and Ulph (1990), Schmitt-Grohe and Uribe (2011)). Lucas (2000) uses U.S. data from 1900-94 to estimate a money demand equation, and finds that reducing inflation from 10 to 0 percent would see a gain in income of roughly 1 percent. This motivated a number

[5]We use the housing supply elasticity estimates from Saiz (2010), which are closer to the 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.

[6]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.

of other studies including Ireland (2009) whose estimates are roughly a fourth as large. Our estimates are roughly 80% as large those of Lucas, and since our mechanism is independent from money demand they provide another channel that adds to the welfare cost of inflation.[7]

A related literature on the implications of nominal rigidities for the welfare cost of inflation finds a range of welfare costs. Ascari, Phaneuf, and Sims (2018) examine a New Keynesian model with multiple 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. Nakamura et al. (2018) however argue that relative price dispersion during the U.S. great inflation was modest. The discussion of the welfare costs of trend inflation is related to a debate over whether money is neutral or superneutral. Hahn (2022) and Afrouzi et al. (2024) note that in the standard New Keynesian model money (trend inflation) is not superneutral as changes in steady state inflation affects real variables. The mechanism in our paper points to another mechanism via which money is not supernetutral, as inflation changes the mix of housing and non-housing consumption over the life-cycle.

Despite the long debate over the consequences of high inflation for mortgage borrowing (e.g., see Lessard and Modigliani (1975) and Garriga, Kydland, and Šustek (2017)), there is no quantitative evaluation of the welfare cost of inflation arising from housing finance. This is surprising as the qualitative implications of inflation for mortgages and housing were illustrated by Kearl (1979) and Schwab (1982).[8] We show analytically that when consumers are borrowing constrained and borrow using fixed-amortization nominal mortgages that the level of anticipated inflation has real effects on lifecycle homeownership and consumption decisions. Our quantitative analysis shows that this leads to meaningful welfare costs for even moderate inflation rates.[9] Moreover, by allowing for responsive house prices and endogenous housing tenure choice, our framework highlights the heterogeneous effects of inflation across both income groups and housing markets.

Our calibration implies that a number of households are borrowing constrained during the initial years of homeownership. This is consistent with empirical studies of the impact of changes in mortgage finance regulations. For example, Backman, Moran, and van santen

[7]We share with Cao et al. (2021) the view that life-cycle motives are important for assessing the welfare costs of inflation.

[8]Schwab (1982) conducted a small numerical simulation of the welfare effects with the assumption of interest-only mortgages with fixed house prices.

[9]In related work, MacGee and Yao (2026b) examine the implications of changes in inflation over time for the ratio of mortgage debt to income.

(2024) find that a Swedish regulatory reform that eliminated interest only mortgages for mortgages with LTVs above 50% resulted in bunching at the LTV threshold and lower mortgage borrowing. mainly due to higher nominal payments for newly originated mortgages above the LTV threshold. Similarly, policy reforms in the 1990s in the Netherlands and the early 2000s in Denmark that facilitated borrowing via interest only mortgages (which offered lower payments during the initial years of a mortgage) were followed by substantial take-up of these products (Bäckman and Khorunzhina (2024), Rouwendal (2007)).

This paper is also related to the growing literature that uses quantitative models to study the housing market. Boar, Gorea, and Midrigan (2022) argues that the liquidity constraints are severe in the housing market. Their analysis are conducted in the low inflation environment and our paper complements their discussion by showing that high inflation may further tighten the constrains and results in a significant welfare loss. Our modeling approach shares a number of features with other recent papers that study the housing market including: Yang (2009), Ma and Zubairy (2021) Chambers, Garriga, and Schlagenhauf (2009), Sommer, Sullivan, and Verbrugge (2013). In contrast to these papers, which typically assume constant low inflation or no inflation, we discuss the implication of constant high inflation on the housing market and estimate the welfare cost.

The rest of this paper is organized as follows. Section 2 presents the empirical evidence that supports the relationship between inflation and household mortgage debt. Section 3 presents the two-period model which illustrate the key mechanism. Section 4 outlines the quantitative model. Section 5 discusses the calibration strategy and presents the calibration results. Section 6 discusses the welfare implications of inflation. Section 7 concludes.

2 The Mechanism: Inflation Tilts Mortgage Payments

Although the implications of trend inflation for mortgage PTI were documented in the 1970s (e.g., Kearl (1979), Schwab (1982), Lessard and Modigliani (1975)), the implications for the real effects of anticipated inflation have been largely ignored until recently. Given that the tilt effect of inflation on the profile of real payments is not widely discussed, we use an example to illustrate how significant the effect can be. We then develop a stylized two period model to analytically show how anticipated inflation can give rise to real effects in the presence of borrowing constrained consumers.

The two 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 easiest to see for a Hand-to-mouth borrower as non-housing consumption is simply $1 - PTI$. However, for any borrowing constrained household, holding housing consumption fixed, higher inflation tilts their non-housing consumption profile. This implies that changes in trend inflation may lead some borrowing constrained households to vary either the timing or the size of the house they purchase and their mortgage borrowing. We formalize the implications of this intuition for welfare in the stylized two-period household choice problem in Section 3, and use our quantitative model to estimate the quantitative implications of these forces for the welfare cost of inflation.

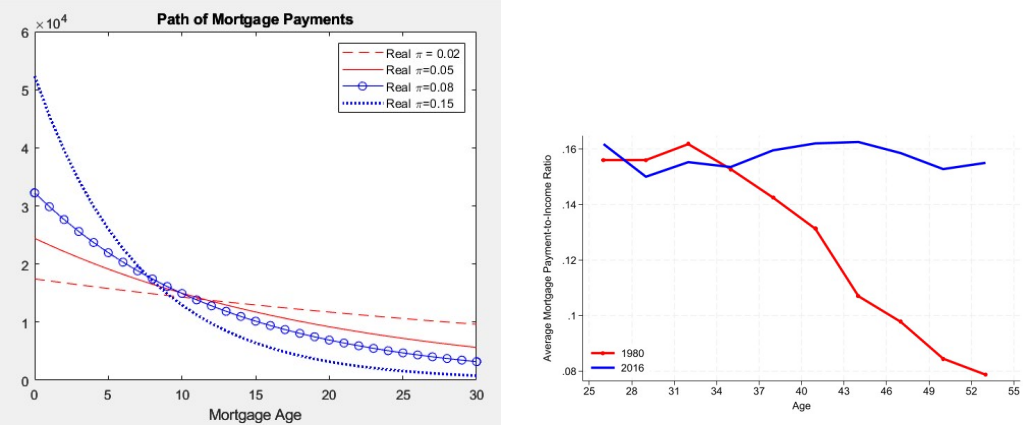
2.1 Inflation and Mortgage Payments

To provide some intuition on how inflation impacts the path of mortgage payments, we use a simple numerical example to illustrate how inflation twists the path of mortgage payments (MacGee and Yao (2026a)). We compare the path of real mortgage payments on a $ 300,000 30-year amortization mortgage for anticipated annual inflation rates of two, four, eight and fifteen percent (see Figure 1). Real mortgage payments are the nominal mortgage payment adjusted by inflation since the origination of the mortgage. Since the Fisher equation links nominal interest rates and inflation, the nominal mortgage payment rises with inflation. For a $ 300,000 mortgage, the nominal annual payment mortgage nearly doubles from $ 17,433 when inflation is 2% to $ 32,249 when inflation is 8%. Higher inflation tilts the profile of real payments (adjusted for cumulative inflation since origination), which are higher initially but lower in later years of the mortgage term at higher inflation rates. Indeed, in this example, real payments with 8% inflation fall below those of 2% inflation by the twe;th year of the amortization.

An natural way to assess the implications for a borrowing constrained consumer of the tilt in the profile of mortgage payments is the path of the mortgage payment to income (PTI) ratio. Consistent with the empirical evidence discussed in MacGee and Yao (2026a), we assume that inflation does not affect real income growth but proportionately shifts nominal income growth. For the same nominal income at origination, the PTI ratio for 8% inflation is almost twice that of 2% inflation. However, after 12 years, the PTI ratio with 8% inflation rate is lower than with 2% inflation. For a borrowing constrained consumer, this pushes non-housing consumption from the early to the later years of the amortization.

To assess these implications of inflation on life-cycle PTI, we compare the age profile of PTI in 1980 and 2016 among US homeowners. We construct PTI using data on mortgage payments and household income from the Census (1980 and 2000) and the American Community Survey (2016) (see Figure 1). PTI declines faster with age in 1980 when inflation rate was high compared to 2000 and 2016 when inflation was stable at a lower level.[10]

Figure 1: Inflation, Payment to Income and Nonhousing Consumption



(a) Inflation & Real Mortgage Payments

(b) Payment to Income

Panels a presents the mortgage payment to income ratios under different trend inflation. Panel b presents the mortgage payment to income ratios among owners: computed using data from Census (wave 1980) and American Community Survey (2016).

3 Welfare costs when consumers are borrowing constrained: Two Period Model

The welfare costs of trend inflation that we examine arise from how the path of nominal payments of fixed amortization mortgages impact the consumption and housing decisions of borrowing constrained consumers. Since this mechanism is relatively novel, in this section we develop a simplified 2-period version of our quantitative model to illustrate the intuition.[11] We show analytically that the front loading of real mortgage payments that result from higher anticipated inflation distorts the intra-temporal and intertemporal consumption decisions of a

[10] See **?** for more details on the empirical implications.

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

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

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 housing stock. The only borrowing instrument is a standard fixed amortization mortgage. The real interest rate is fixed exogenously, and inflation (which we vary exogenously) moves nominal wages, prices and interest rates by factor $1 + \pi$.

To show the essential role of borrowing constrained consumers, we compare two household borrowing constraints in the presence of fixed amortization mortgages. In the first, the household can borrow up to their intertemporal budget constraint. In the second, we impose that households can only borrow using debt collateralized by the value of their house. In both cases, we assume that the path of mortgage payments are the same. We show that inflation has no impact on household's decisions (or welfare) when households can borrow at the risk-free nominal rate against their entire future income. However, in the presence of borrowing constraints, inflation can distort household's consumption decisions, with higher rates of inflation having a larger negative impact on welfare.

3.1 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 and housing services. The price P denotes the price of a unit of housing in units of the non-durable good which young households are endowed with. The nominal price of housing and wage income between periods moves proportionately with inflation π.

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 $D = \frac{Ph}{1+\pi}$ which amortizes over two periods with **fixed-nominal** payments. At the end of the first period, households receive income 1, make a mortgage payment of interest and the first of two principal payments. We use the end of the first period (the beginning of the second period) as the base period for all real values.

Households enter the second period with housing h and their remaining debt. At the end of the second period, households make mortgage interest and principal payments. Finally,

they sell the house (after consuming the flow of services from owning the house during the period) and consume their wealth.

The timing of transactions and of the evolution of real and nominal debt across periods are summarized in Figure 2.

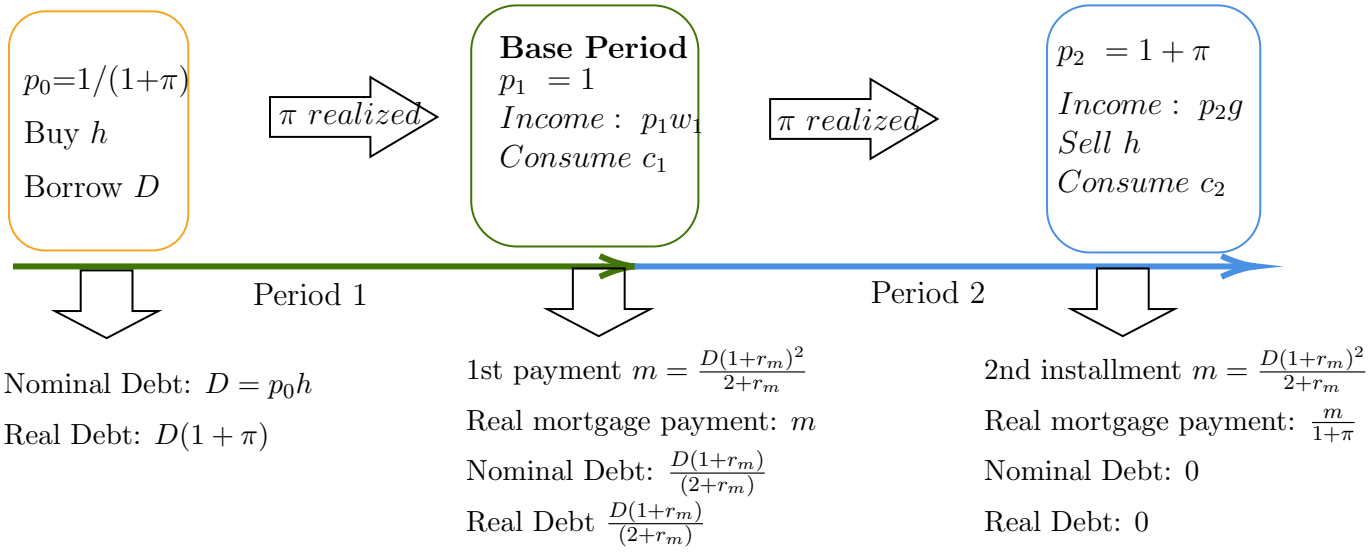
3.2 Financial Markets

We examine a small open economy with exogenous incomplete markets. Mortgages are secured against the housing good, and are fixed amortization. The nominal interest rate r_m on a mortgage is: $(1 + r_m) = \underbrace{(1 + \bar{r})}_{\text{real rate}} \underbrace{(1 + \pi)}_{\text{inflation}}$

To make it easier to see how the nominal interest rate (which varies with inflation) impacts mortgage payments we incorporate some simplifying algebra in the household budget constraint. Specifically, for a loan amount of D, the nominal mortgage payment per period paid in two future periods is $\frac{D(1+r_m)^2}{2+r_m}$.

Corollary 3.0.1 *The first period real mortgage payment is decreasing in inflation and the second period real mortgage payment is increasing in inflation.*

Figure 2: Time Line and Debt Evolution



3.3 Households' problem

The household's problem is characterized by:

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

subject to the budget constraints when young and old:

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

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

where c_t is non-durable consumption, δph is maintenance, $\frac{(1+r_m)^2}{2+r_m} D$ is the scheduled nominal mortgage payments, S is saving. We assume that inflation scales up the nominal house price and income by $(1+\pi)$, and that the nominal return on saving S is $(1+r)(1+\pi)$.

3.4 Anticipated Inflation has Real Effects with Fixed Amortization and Borrowing Constraints

The nominal interest rate and the relative prices of goods are fully indexed to inflation. Thus, any real effects of inflation households' optimal choices arise via how inflation impacts the household's budget constraints. We show that higher rates of inflation can tighten the borrowing constraint on young households with fixed nominal payment mortgages. We show that borrowing constraints — which we formalize by assuming all borrowing is collateralized by a mortgage with a maximum LTV constraint — inflation can impact the timing and mix of household consumption.

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.

3.4.1 Unconstrained Lifetime Borrowing Constraint

To illustrate how inflation interacts with borrowing constraints, we first show that when households can borrow up to their intertemporal budget constraint that anticipated inflation does not impact consumer consumption or housing choices.

Lemma 3.1 *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:

$$c_1 + \frac{c_2}{1+r} + \delta ph + \frac{\delta ph}{1+r} + \frac{(r+2r)ph}{1+r} = 1 + \frac{g}{1+r} \tag{4}$$

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:

$$\begin{aligned} c_1^* &= \frac{1+\frac{g}{1+r}}{1+\beta+\theta} \\ c_2^* &= \frac{\beta(1+r)(1+\frac{g}{1+r})}{1+\beta+\theta} \\ h^* &= \frac{\theta(1+\frac{g}{1+r})}{p(1+\beta+\theta)(\delta+\frac{\delta}{1+r}+\frac{(r+2r)}{1+r})} \end{aligned} \tag{5}$$

■

Although the consumption allocation is independent of inflation, nominal savings, S, does vary with inflation. As the mortgage payment, $\frac{(1+r_m)^2}{2+r_m}\frac{p}{1+\pi}$ increases with inflation, savings S declines.

3.4.2 Borrowing Constrained Allocation

A household is credit-constrained when $c_1^* + \delta ph^* + \frac{(1+r_m)^2}{2+r_m}\frac{Ph^*}{1+\pi} > 1$

$$(\frac{1+\frac{g}{1+r}}{1+\beta+\theta})[1 + (\delta + \frac{(1+r_m)(1+r)}{2+r_m})\frac{\theta}{\delta+\frac{\delta}{1+r}+\frac{r^2+2r}{1+r}}] > 1 \tag{6}$$

Equation 6 implies that for a given 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 households' housing and non-housing consumption through credit constrained households, 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 with price stability (setting π to 0 in Equation 6).

Theorem 3.2 *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.

3.4.3 General Equilibrium: Fixed Housing Supply

The previous analysis showed that when households are credit-constrained, higher inflation reduces housing demand. This shift in housing demand could impact equilibrium house prices, which may ameliorate the welfare loss due to higher inflation in the partial equilibrium setting. For analytical tractability, we consider the inelastic housing supply case where total housing is fixed at $\bar{H}$.

Theorem 3.3 *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 abstentee landlord in economy.

4 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. 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.[12]

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 than non-college households. In our numerical experiments, these differences in income dynamics lead to differential effects of inflation on college and non-college and thus the welfare cost of higher inflation. College households, who experience faster real income growth, are more likely to be borrowing constrained if they purchase a house and impacted by higher trend inflation front-loads real mortgage payments.

Homeowners borrow via 30-year fixed-amortization mortgages. The 30-year fixed amortization (and fixed rate) is the most common mortgage contract in the US. Buyers and sellers of houses incur transaction costs which makes adjusting housing costly for owners. When a new 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 how it affects 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 nominal mortgage payments do not change over time.[13]

[12]The ownership premium captures features such as owners being able to customize their homes according to their own taste as well as additional space. According to Yao (2019), 93% of owners live in detached home while 63% of renters live in apartments.

[13]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, during a transition between between steady states following a change in trend inflation the mortgage term (i.e.,

4.1 Households

The economy is populated by J period lived households who work from period 1 to Jr and then enter retirement. 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:

$$V_j^e(\cdot) = \frac{((1-\eta)C^{1-\xi} + \eta d^{1-\xi})^{\frac{1-\sigma}{1-\xi}}}{1-\sigma} + \beta_j s_j V_{j+1}^e(\cdot) + \beta_j(1-s_j)B(W_{j+1}). \tag{7}$$

where β_j is the discount factor combined with the consumption expenditure equivalence scale which captures the change in household size over the life cycle (Muellbauer, 1979), s_j is the probability a household survives from age j to age $j+1$, c_j is age j consumption, and h_j is age j housing services. The ownership premium, θ, captures the value to a household between a standard owner-occupied house and a standard 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 the literature (e.g. Guren et al. (2021)), the bequest functional form is $B(W) = \frac{B_0(B_1+W)^{1-\sigma}}{1-\sigma}$.

4.1.1 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 of which the distribution depends on the type ϵ_{ij}:

$$w_{ij}(\epsilon)^e = \bar{w_j^e}\epsilon_{ij} \text{ if } j \leq Jr \tag{8}$$

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

$$ln(\epsilon_{ij}) = \rho^e ln(\epsilon_{ij-1}) + \xi_i, \xi_i \sim N(0, \sigma_\epsilon^e) \tag{9}$$

fixed versus variable rate) also matters (see MacGee and Yao (2026a)).

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

$$w_{ij}(\epsilon)^e = \bar{w_j^e}\epsilon_{iJr} \text{ if } j > Jr \tag{10}$$

Households are subject to a progressive income tax schedule $\tau(\bar{w}_j\epsilon_i)$. Following Kaplan, Mitman, and Violante (2020), we assume

$$\tau(\bar{w}_j\epsilon_i) = \tau_0(\bar{w}_j\epsilon_i)^{1-\tau_1} \tag{11}$$

where τ_0 captures the average tax rate and τ_1 represents how taxes increase with income.

4.2 Assets

Households can accumulate wealth in housing equity or risk-free bonds. Households can only borrow via collateralized mortgages. Households can save through the risk-free bond 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 a house 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_bPh and a seller a cost of k_sPh. There is a minimum size for an owner occupied house $\underline{h}$.

Households can (only) borrow via mortgages collateralized by housing.[14] 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.

$$r_m = (1+r)(1+\zeta_m)(1+\pi). \tag{12}$$

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

$$m = \frac{r_m L}{1-(1+r_m)^{-30}}. \tag{13}$$

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:

$$\begin{aligned} D(m,0) &= \frac{m(1-(1+r_m)^{-30})}{r_m} \\ D(m,n) &= (1+r_m)D(m,n-1) - m, \quad n \in \{1,2,...,30\} \end{aligned} \tag{14}$$

[14] This is a common assumption in the housing literature, see e.g., Yang (2009) and Sommer, Sullivan, and Verbrugge (2013).

A closing cost k_m, proportional to the face value of the mortgage L, is incurred every time a (new) mortgage contract is signed. 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. Consistent with senior households having a difficulty to get mortgages, we assume that retired household cannot obtain new mortgages.[15]

4.3 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 household who was a renter in the previous period can costlessly adjust their rental if they continue as a renter. If the household owned a house in the previous period, choosing to rent requires selling the house. In this case, he/she chooses the rental unit size d, consumption c, and saving a' to maximize:

$$
\begin{aligned}
&V^{e,1}(a, h, m, n, \epsilon, j) = \max_{c,d,a'} \frac{((1-\eta)C^{1-\xi} + \eta d^{1-\xi})^{\frac{1-\sigma}{1-\xi}}}{1-\sigma} + \beta e_j s_j E_{\epsilon'|\epsilon}(V^e(a', 0, 0, 0, \epsilon', j+1)) \\
&+ \beta e_j (1-s_j) B(a') \\
&s.t.\ \ c + a' + Rd = (1 - \tau(w_j(\epsilon)^e) w_j^e(\epsilon) \\
&+ (1+r)a - (\delta + \tau_h)Ph - \frac{m}{(1+\pi)^n} + (1-k_s)Ph - \frac{D(m,n)}{(1+\pi)^n}
\end{aligned}
\tag{15}
$$

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 h, $\frac{m}{(1+\pi)^n}$ 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 outstanding debt $\frac{D(m,n)}{(1+\pi)^n}$.[16] $\beta e_j(1-s_j)B(a')$ captures the value of leaving a bequest of value a' as savings are the only asset available to renters.

[15] See e.g. Bernstein, "A Great Credit Score, but She Can't Get a Mortgage", The New York Times, April 8, 2024.

[16] 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 the real interest rate r.

2. Owner who continues with mortgage: An owner with mortgage payment m of age n who keeps their house $h > 0$ and mortgage chooses consumption c and saving a' to maximize:

$$V^{e,2}(a,h,m,n,\epsilon,j) = \max_{c,a'} \frac{((1-\eta)C^{1-\xi} + \eta d^{1-\xi})^{\frac{1-\sigma}{1-\xi}}}{1-\sigma} + \beta e_j s_j E_{\epsilon'|\epsilon}(V^e(a',h,m,n+1,\epsilon',j+1)\mathbb{1}_{n<30}$$
$$+ V^e(a',h,0,0,\epsilon',j+1)\mathbb{1}_{n=30}) + \beta e_j(1-s_j)B(W_T)$$
$$s.t.\ \ c + a' = (1-\tau(w_j(\epsilon)^e))w_j(\epsilon)^e + (1+r)a - (\delta+\tau_h)Ph - \frac{m}{(1+\pi)^n}. \tag{16}$$

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.

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 choose housing asset h', new mortgage contract m', saving a', and consumption c to maximize the current utility and expected future values.

$$V^{e,3}(a,h,m,n,\epsilon,j) = \max_{c,h',m',a'} \frac{((1-\eta)C^{1-\xi} + \eta(\theta h')^{1-\xi})^{\frac{1-\sigma}{1-\xi}}}{1-\sigma} + \beta e_j s_j E_{\epsilon'|\epsilon}(V^e(a',h',m',1,\epsilon,j+1))$$
$$+ \beta e_j(1-s_j)B(W_T)$$
$$s.t.\ \ c + a' + Ph' = (1-\tau(w_j(\epsilon)^e))w_j(\epsilon)^e + (1+r)a - (\delta+\tau_h)Ph - \frac{m}{(1+\pi)^n} - (k_s Ph + k_b Ph')\mathbb{1}_{h\neq h'}$$
$$+ Ph - \frac{D(m,n)}{(1+\pi)^n} + (1-\tau_m)\frac{m(1-(1+r_m)^{-30})}{r_m} \tag{17}$$

$$\frac{m'(1-(1+r_m)^{-30})}{r_m} \leq (1-\chi)Ph' \tag{18}$$
$$\frac{m'}{w_j(\epsilon)^e} \leq \varphi.$$

Equation 17 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 a mortgage debt with a schedule mortgage payment m after n periods.

In Equation 14, $\frac{m'(1-(1+r_m)^{-30})}{r_m}$ is the real balance of a 30-year fixed-rate mortgage with annual payment m' and τ_m is the refinancing or closing cost. Similar to Greenwald (2018),

we allow for two constraints at origination: a Loan-to-Value ratio (LTV) and a Payment-to-Income ratios (PTI). The first line in Equation 18 is the LTV constraint of a minimum downpayment of χ percent. The second line in Equation 18 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

$$V^e(a, h, m, n, \epsilon, j) = max\{V^{e,1}(a, h, m, n, \epsilon, j), V^{e,2}(a, h, m, n, \epsilon, j), V^{e,3}(a, h, m, n, \epsilon, j)\} \tag{19}$$

4.4 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

$$H = K^{\alpha} L^{1-\alpha} \tag{20}$$

The developers solve the following problem.

$$\max_{K,L} PK^{\alpha} L^{1-\alpha} - K - qL \tag{21}$$

where q is the equilibrium price of land. The developers' problem and market clearing condition for land yield the housing supply function:

$$H = (\alpha P)^{\frac{\alpha}{1-\alpha}} \bar{L} \tag{22}$$

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

5 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 ratios, debt-to-income ratios and

payment-to-income ratios.A subset of the parameters are directly estimated from the data or taken from the literature (see Table 1). The remaining parameters are estimated using the generalized method of moments.

5.1 Parameters Determined Outside of the Model

Each period in our model corresponds to two years.

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 remained 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.[17]

Asset: The annual risk-free interest r is set to 2%. Annual inflation is set to 2%, similar to its average between the late 1990s and 2019. This implies an annual nominal return on the risk free asset of roughly 4.04%. The nominal mortgage rate is the risk free rate plus the mortgage spread $\zeta_m = 1\%$, which is 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 annual property tax and maintenance cost are set to 1% and 2.5%, respectively based on the average property taxes and owner costs, maintenance and insurance included, reported in the American Community Survey (2016). Transaction costs for buyers and sellers are set to $k_b = 6\%$ and $k_s = 2\%$ (see e.g. Sommer, Sullivan, and Verbrugge (2013)). The mortgage financing cost is set to $\tau_m = 2.5\%$, 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 20%, 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 Survey (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.

[17]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 income process 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 match the average household labor income by age in the Survey of Consumer Finances (2019).

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

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	2%	Standard in the literature
Annual inflation rate π	2%	Inflation target and realized inflation rates (2010-
Mortgage spread ζ_m	1%	Federal Housing Finance Agency & Federal Reser
Annual property tax	1%	American Community Survey
Annual maintenance cost	2.5%	American Community Survey
Transaction cost for buyers	6%	Sommer, Sullivan, and Verbrugge (2013)
Mortgage closing cost	2.5%	Federal Housing Fiance 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	20%	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

5.2 Calibration Strategy

We calibrate the ownership premium θ, discount factor β, minimum house size $\underline{h}$, housing share η, and the two parameters that shape the bequest motive, B_0 and B_1, to the age profile

(for 59 age groups) of the homeownership rate, the LTV ratios, DTI ratios and PTI ratios of owners. Thus, we have 472 moments in total. We estimate these parameters using the Simulated Method of Moments.

Although we jointly calibrate six 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 functionη, 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 mortgage refinancing to extract equity.

5.3 Calibration Results

The calibrated parameters are reported in Table 2. Consistent with the 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.[18] As the price and rent we observe in the data reflect the difference in owned and rented units, the estimated ownership premium, 1.8, captures the difference in the utility generated by owner-occupied and rental units.

The calibrated annual discount factor is 0.9. The housing share in utility is 0.27, similar to other estimates in the literature (see e.g. Davis and Ortalo-Magné (2011)). The calibrated 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).

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

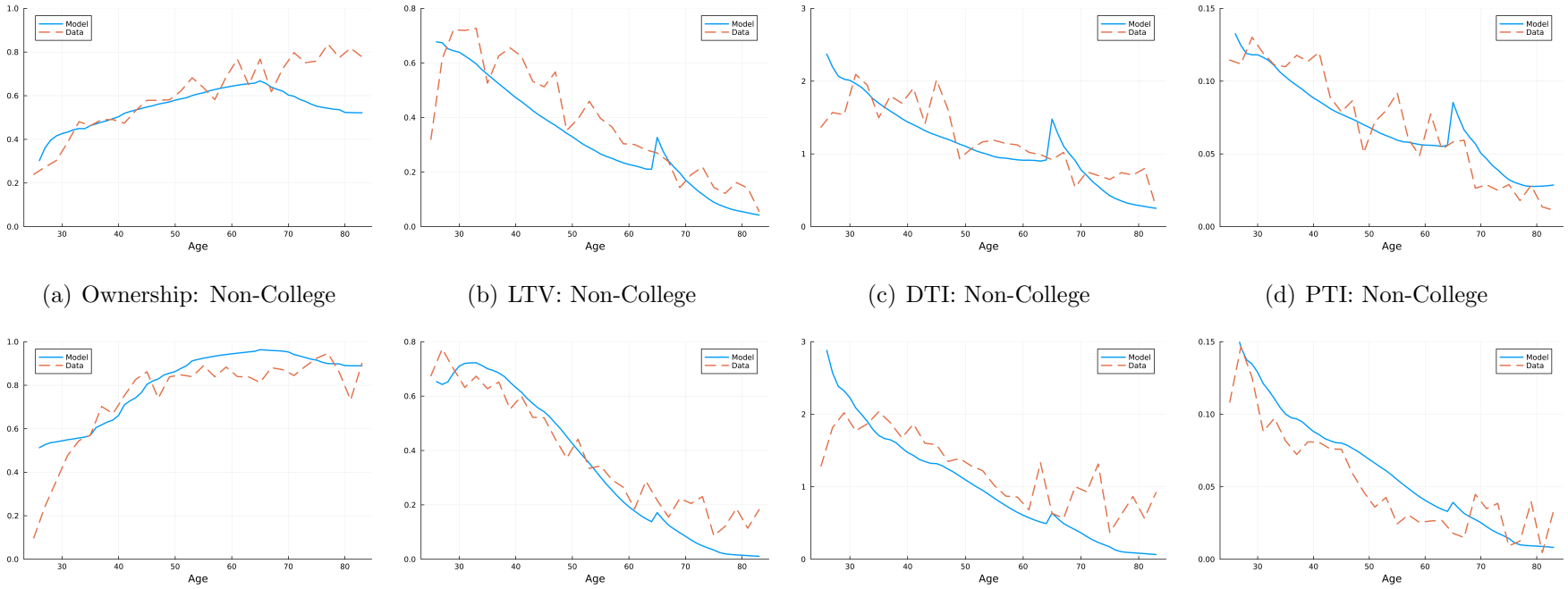
[18] According to the American Housing Survey (2007), the average unit size for owner-occupied units is around 2262 square feet while the average unit size for rental units is 1209 square feet.

Table 2: Calibration Results

Parameter		Value	Target
η	Housing Share	0.27	DTI
θ	Ownership Premium	1.8	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	1	of Senior Households

analysis as we focus on how inflation distorts life-cycle housing and non-housing consumption through the front-loading of real mortgage payments.

Figure 3: Benchmark Calibration



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

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

Note: 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).

6 Welfare Cost of Inflation

We use the calibrated model to quantify the steady-state welfare cost of anticipated and stable inflation (i.e., *"trend inflation"*). In our counterfactuals, we compare the expected utility of a newborn in an economy with different levels of inflation. We compare the partial equilibrium welfare costs when real house prices and rents are held fixed across inflation steady states with the general equilibrium costs when real house prices and rents (relative to non-housing consumption) adjust in response to changes in housing demand.[19] In both the partial and general equilibrium analysis, by increasing nominal interest rates, higher steady state inflation tightens the credit constraint of homebuyers which reduces their welfare. The general equilibrium analysis introduces an offsetting effect of inflation on borrowing constrained consumers. By tightening credit constraints higher inflation weakens aggregate housing demand, which leads to a fall in house prices which relaxes credit constraints. As we show, the house price channel leads to differences in the welfare cost inflation across cities due to differences in the elasticity of housing supply.

We find that anticipated and stable inflation entails meaningful welfare costs. In partial equilibrium (i.e., when real house prices are held fixed), a one percentage point increase in inflation lowers welfare (lifetime consumption) by 0.08% for a newborn household. There is substantial heterogeneity across household types: a one percentage point increase in inflation lowers welfare by 0.14% of lifetime consumption for college households and by 0.06% for non-college households. We find that welfare losses and gains differ systematically across income groups. These gains and losses are driven by differences across income groups in how tighter borrowing constraints impact homeownership and consumption decisions. Higher trend inflation reduces the welfare of high income household more than low income households as high income households are more likely to become owners and therefore expose themselves tightened borrowing constraints where as lower income households generally are renters, and thus are less impacted by higher inflation tilting the PTI ratio of mortgages.

In the general equilibrium analysis, the welfare cost of inflation depends on the elasticity of housing supply, as house price responses partially mitigate the tightening of borrowing constraints induced by higher trend inflation. In economies with low housing supply elasticity, where house prices decline more in response to lower housing demand, higher inflation

[19] Following Guren et al. (2021) and Coven et al. (2024), we fix price/rent ratios in the general equilibrium analysis.

reduces welfare by less. This implies that the welfare cost of inflation can vary substantially across cities.

6.1 Welfare Cost of Inflation with Fixed House Prices

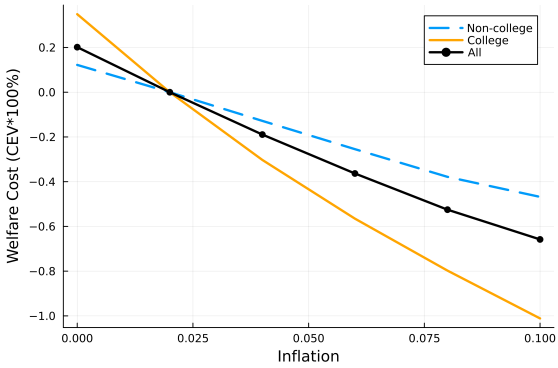
We begin by examining the welfare cost of inflation when we hold fixed the relative price of housing and non-housing goods. This isolates the direct effect of inflation via fixed amortization mortgages on borrowing constrained consumers. Our counterfactuals compare annual steady state inflation between 0 and 10 percent. In each experiment we compute the expected lifetime utility of a new born (based on their type and initial income shocks). We compare this to our benchmark economy with annual inflation of 2%. We report the consumption equivalent variation, which is the fraction of consumption and housing consumption required to leave the new born indifferent between the benchmark and the counterfactual economy.

The results are plotted in the left panel of Figure 4. On average, a 1 percentage point increase in inflation leads to welfare cost comparable to 0.08% drop in life-time consumption. This is about 80% of the estimated welfare cost based on money demand models reported by Lucas (2000), who finds that a 1 percentage point increase in inflation leads to a welfare loss slightly smaller than 0.1% consumption loss.

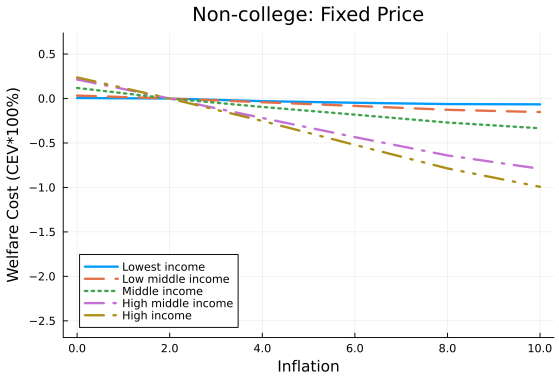
Our analysis highlights substantial heterogeneity in the welfare costs of inflation across education and income groups. The welfare cost per percentage point increase in inflation is 50% higher for college-educated households than for non-college households. This difference is driven by both the steeper life-cycle income growth and the higher average income of college-educated households. Higher trend inflation frontloads real mortgage payments and tightens borrowing constraints for homeowners with mortgage debt. As a result, the welfare implications of inflation depend on (i) the likelihood that a household purchases a home financed through mortgage debt at early ages when borrowing constraints are most binding, and (ii) the expected growth of real income over the life cycle, which determines the extent to which these borrowing constraints bind.

Homeownership rates among the college educated are 20 to 30 percentage points higher than those of the non-college educated over the life cycle. As a result, a larger fraction of college-educated households are affected by higher inflation front-loading the real profile of mortgage payments, since they are more likely to become homeowners. This effect is further amplified by the steeper life-cycle earnings profile of college-educated households. Faster

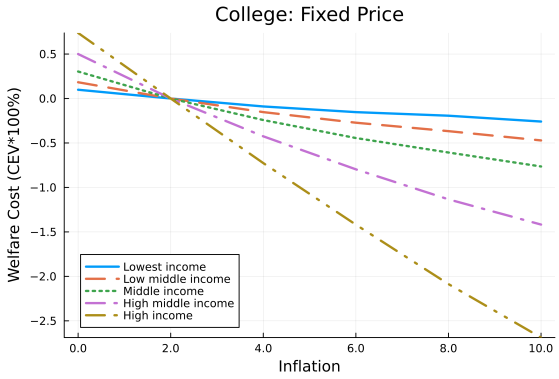
Figure 4: Welfare Cost of Inflation: Fixed Real House Prices



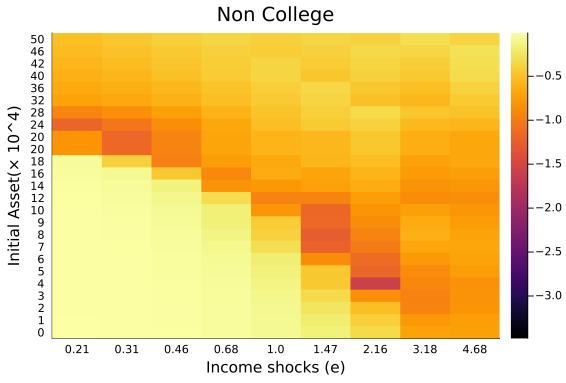
(a) Welfare Cost of Inflation by Education



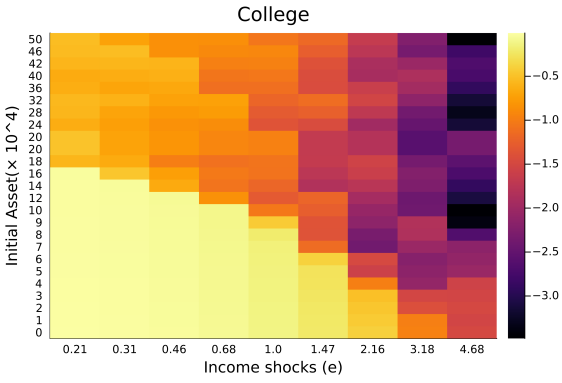
(b) Welfare Cost of Inflation by Income: Non-college



(c) Welfare Cost of Inflation by Income: College



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



(e) Welfare Cost of Inflation by Income and Initial Wealth: College

income growth tightens borrowing constraints at early ages because mortgage payments are fixed in nominal terms and therefore represent a larger share of income when households are young. Higher inflation exacerbates this effect by further front-loading real mortgage payments.

A similar pattern of larger welfare costs for higher-income households also holds conditional on education. To examine this, we conduct the welfare analysis across different income groups. In the quantitative model, the persistent income process is discretized using a nine-state Markov process.[20] For reporting purposes, we group these states into five income groups so that the lines in the figure remain visually distinct. We then calculate the value of a newborn household for each income realizations by type (see Panels b and c of Figure 4). The within-education type differences are substantial. Newborn households in the highest income groups (the two highest income bins) experience welfare losses that are nearly ten times larger than those of households in the lowest income groups (income groups 1 and 2). Since these households share the same expected real income growth over the life cycle, the welfare differences arise mainly from the fact that higher-income households tend to purchase homes earlier and are therefore more exposed to the effects of inflation on the profile of real mortgage payments.

Inflation affects the path of real mortgage payments and therefore household welfare through three channels: (i) the extensive margin, i.e. the timing of homeownership; (ii) the intensive margin, i.e. housing consumption among homeowners; and (iii) life-cycle non-housing consumption, holding life-cycle housing consumption fixed. To examine these channels, we compare the lifetime value of a newborn household with different initial income shocks and initial wealth endowments in an economy with 8% trend inflation to one with 2% trend inflation for each household type. The rationale is that initial assets affect the timing of home purchases because of down payment requirements. The results are presented in Panels (d) and (e) of Figure 4.

For both college and non-college households, the welfare cost of inflation generally increases with initial assets up to a point. At intermediate asset levels, 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.

[20] We have nine evenly spaced grids for income shocks: $\{0.22, 0.31, 0.46, 0.68, 1.0, 1.47, 2.16, 3.18, 4.68\}$.

6.2 Welfare Costs of Inflation and Endogenous House Prices

Since the level of inflation influences housing demand, if housing supply is not perfectly elastic, it can shift the (real) price of housing relative to non-housing. Intuitively, since the direct effect of higher inflation is to tighten borrowing constraints and lower 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).[21] We fix the share of college graduates at 35% when aggregating the housing demand.

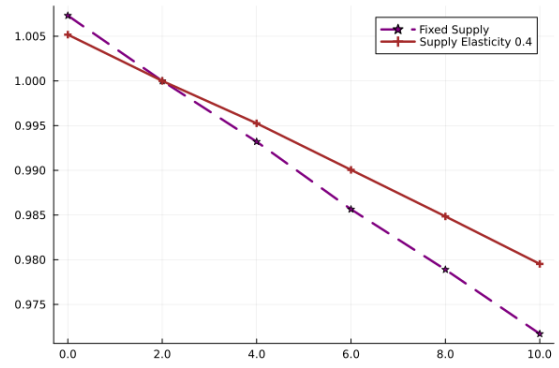
The general equilibrium effects of inflation via house prices are significant. In the baseline with a supply elasticity of 0.4, a one percentage increase in inflation lowers equilibrium house prices (relative to the non-durable good) by roughly 0.25% (see panel a of Figure 5). The effect of inflation on house prices with a fixed supply of housing is roughly 50% higher: a one percentage increase in inflation lowers equilibrium house prices by 0.35%.

The indirect effect of inflation on house prices ameliorates the welfare costs of inflation. 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. The economy with fixed housing supply features a larger impact of inflation on house prices and this a smaller welfare cost of inflation. A one percentage point increase in inflation reduces households welfare by only 0.015%.

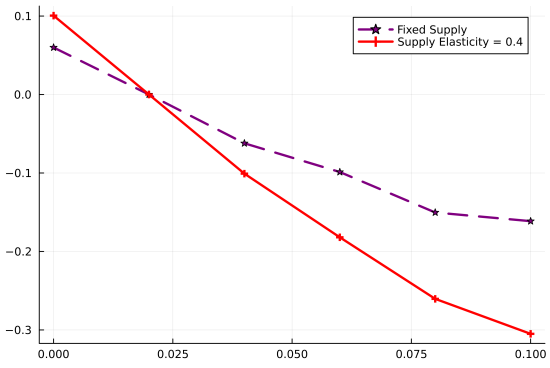
The mitigating effect of house price adjustments is broadly shared across households with different initial income realizations. Two competing forces are at play: households suffer from higher inflation, but they also benefit from the decline in house prices. For college households, the pattern of welfare costs increasing with income generally persists even in general equilibrium. In contrast, for non-college households, this relationship reverses at the higher end of the income distribution. In other words, the highest-income non-

[21] 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.

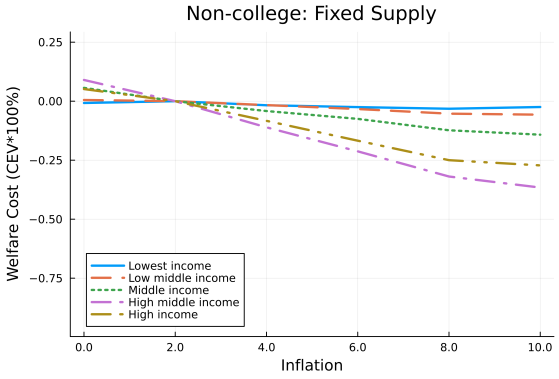
Figure 5: Welfare Cost/Gain of Inflation: Endogenous Real House Prices



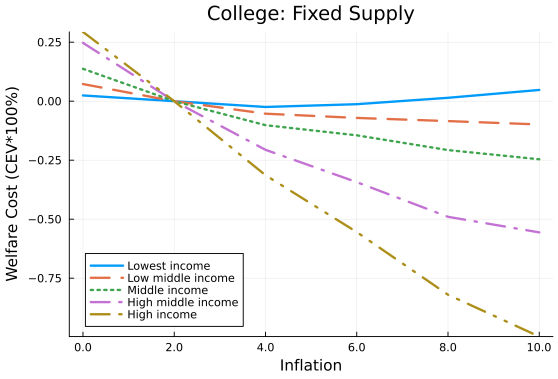
(a) Equilibrium House Prices



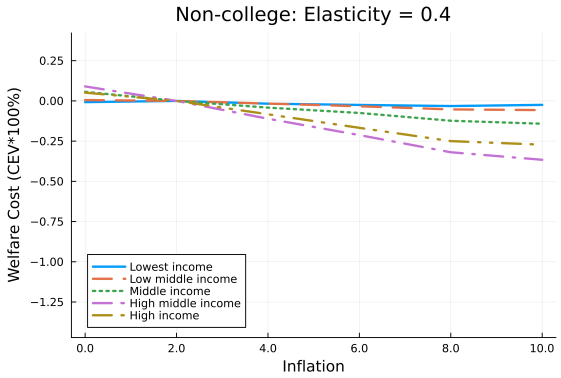
(b) Aggregate Welfare



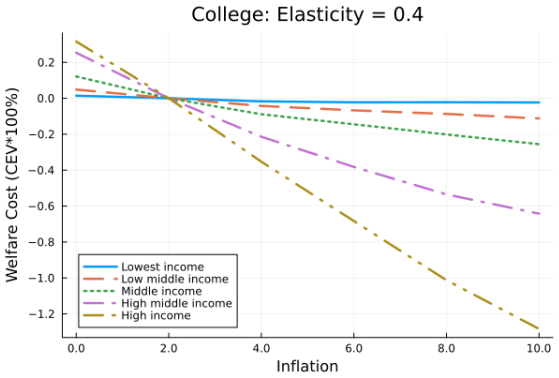
(c) Welfare Cost Non-college: Fixed Supply



(d) Welfare Cost College: Fixed Supply



(e) Welfare Cost Non-college: Supply Elasticity 0.4



(f) Welfare Cost College: Supply Elasticity 0.4

college households experience smaller welfare losses from higher inflation than middle–high income households once house prices adjust. This suggests that higher-income non-college households benefit more from lower house prices than middle-income households.

6.3 Volcker Disinflation: Cross-City Welfare Gains

Our analysis indicates that the welfare effects of changes in trend inflation depend importantly on housing supply conditions. To illustrate how these differences translate into heterogeneous welfare effects across locations, we examine the implications of the early 1980s disinflation (Volcker disinflation). This episode, during which U.S. inflation dropped from roughly double-digit levels to low and stable rates, is termed by Goodfriend and King (2005) "the most widely discussed and visible macroeconomic event" of recent US history across areas.

We use our general equilibrium model to evaluate the welfare gains from a permanent reduction in trend inflation from 10% to 2%. Specifically, we compare the welfare of a newborn household entering an economy with a steady-state inflation rate of 10% to one entering an otherwise identical economy with inflation at 2%. To estimate the average welfare gain for the US, we assume a housing supply of elasticity of 1.7, which is near the average reported by Saiz (2010). To examine the difference in the welfare gains across cities sue to difference in housing supply elasticities, we repeat this exercise using elasticities at metropolitan-level reported by Saiz (2010), which capture the extent to which geographic and regulatory constraints limit housing construction. [22]

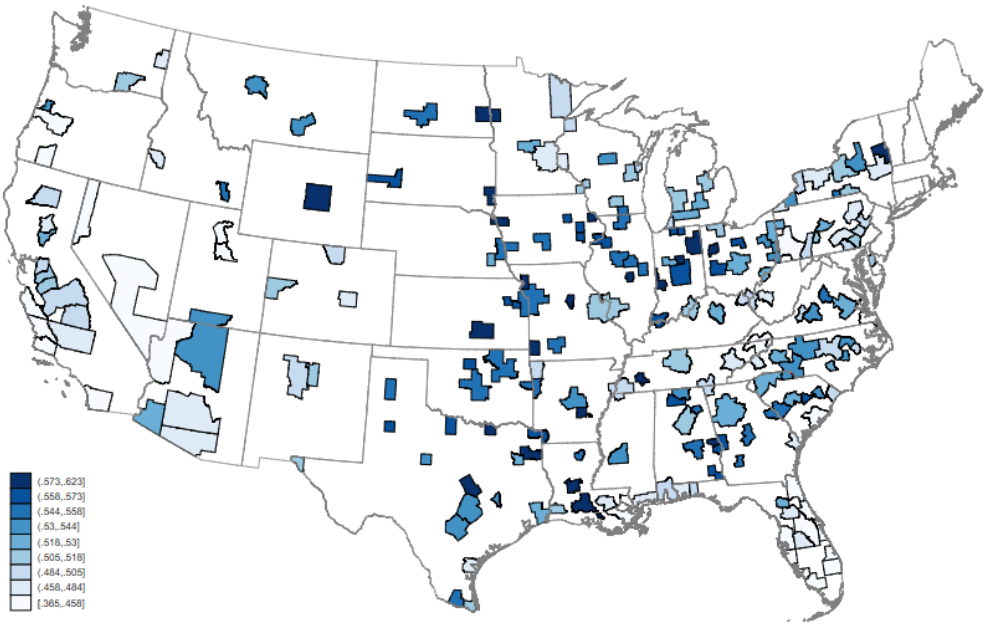
Figure 6 presents the results. We find an 8 percentage point reduction in trend inflation increases welfare equivalent to a lifetime consumption of 0.48%: 0.78% for college households and 0.33% for non-college households. These welfare gains varies substantially across cities. Cities with low supply elasticity, such as San Diego, CA, benefit significantly less, almost half less, compared to cities with high supply elasticity such as Columbia, MO.

These results highlight that the welfare implications of monetary policy can differ substantially across regions due to structural differences in housing markets. In particular, policies that lower long-run inflation generate larger welfare improvements in cities where housing supply can respond more easily to increases in demand. Conversely, in areas where housing

[22]These estimates are particularly relevant for our exercise, as the Volcker disinflation occurred during a period when housing supply was generally more responsive than in later decades. More recent estimates by Baum-Snow and Han (2024) reflects a lower housing supply elasticity.

supply is tightly constrained, price adjustments absorb a larger portion of the benefits from improved borrowing conditions, resulting in smaller welfare gains.

Figure 6: Welfare Gain of Volcker disinflation across cities



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).

7 Conclusion

We examine a novel housing market finance channel via which anticipated inflation can impact households. Our main mechanism takes as given the standard mortgage contract which specifies a constant nominal mortgage payment. This implies that variations in inflation tilt the profile of real mortgage payments over the term of a mortgage. Higher levels of anticipated inflation result in more front-loaded real mortgage payments, which 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 0.08 percent of lifetime consumption for a newborn household. The welfare costs are heterogeneous across households and are substantially 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. Our analysis also suggests that further work on the role of mortgage finance innovations in mitigating the costs of high inflation could be useful.

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Appendix

A Proof of Theorem 3.2: 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

$$\begin{aligned} &\max_{c_1,h,c_2} \ln(c_1) + \theta \ln(h) + \beta \ln(c_2) \\ s.t.\ \ &c_1 + (\delta + \frac{(1+r_m)(1+r)}{2+r_m})ph + S = 1 \\ &c_2 + \delta ph + \frac{(1+r)^2}{2+r_m} ph = g + ph + (1+r)S \\ &S \geq 0 \end{aligned} \tag{23}$$

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

$$\begin{aligned} \frac{\partial x}{\partial \pi} &= \frac{(1+r)^2}{(2+r_m)^2} \\ \frac{\partial y}{\partial \pi} &= \frac{(1+r)^3}{(2+r_m)^2} \end{aligned} \tag{24}$$

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:

$$\begin{aligned} \hat{c}_1 &= 1 - xP\hat{h} \\ \hat{c}_2 &= g + yP\hat{h} \end{aligned} \tag{25}$$

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

$$\frac{\theta}{\hat{h}} + \frac{\beta yp}{g + yp\hat{h}} = \frac{xp}{1 - xp\hat{h}} \tag{26}$$

Rewriting equation 26

$$(1+\beta+\theta)xyp^2\hat{h}^2 + [(1+\theta)xg - (\beta+\theta)y]p\hat{h} - \theta g = 0 \tag{27}$$

Solving Equation 27, we get

$$p\hat{h} = \frac{[(\beta+\theta)y - (1+\theta)xg] + \sqrt{[(1+\theta)xg - (\beta+\theta)y]^2 + 4(1+\beta+\theta)xy\theta g}}{2(1+\beta+\theta)xy} \tag{28}$$

Taking the total differentiation of equation 27 :

$$\frac{\partial p\hat{h}}{\partial \pi} = -\frac{(1+\beta+\theta)(p^2\hat{h}^2)[x\frac{\partial y}{\partial \pi} + y\frac{\partial x}{\partial \pi}] + (1+\theta)gp\hat{h}\frac{\partial x}{\partial \pi} - (\beta+\theta)p\hat{h}\frac{\partial y}{\partial \pi}}{2(1+\beta+\theta)xyp\hat{h} + (1+\theta)xg - (\beta+\theta)y} \tag{29}$$

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 26 $xp\hat{h} = (\theta + \frac{\beta yp\hat{h}}{g+yp\hat{h}})(1-xp\hat{h})$

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

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

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.*

$$\frac{\partial \hat{c}_1}{\partial \pi} = \frac{\partial (1 - xp\hat{h})}{\partial \pi} = -\frac{\partial xp\hat{h}}{\partial \pi} \tag{30}$$

$$\begin{aligned}
\frac{\partial xp\hat{h}}{\partial \pi} &= p\hat{h}\frac{\partial x}{\partial \pi} + x\frac{\partial p\hat{h}}{\partial \pi} \\
&= p\hat{h}\frac{\partial x}{\partial \pi} - \frac{x(1+\beta+\theta)(p^2\hat{h}^2)[x\frac{\partial y}{\partial \pi} + y\frac{\partial x}{\partial \pi}] + (1+\theta)gxp\hat{h}\frac{\partial x}{\partial \pi} - (\beta+\theta)xp\hat{h}\frac{\partial y}{\partial \pi}}{2(1+\beta+\theta)xyp\hat{h} + (1+\theta)xg - (\beta+\theta)y} \\
&= \frac{[x(1+r)-y][(\beta+\theta) - (1+\beta+\theta)xp\hat{h}]}{2(1+\beta+\theta)xyp\hat{h} + (1+\theta)xg - (\beta+\theta)y} p\hat{h}\frac{\partial x}{\partial \pi}
\end{aligned} \tag{31}$$

According to Equation 28

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

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

Therefore $\frac{\partial xp\hat{h}}{\partial \pi} > 0$ and $\frac{\partial \hat{c}_1}{\partial \pi} < 0$

Similarly

$$\begin{aligned}
\frac{\partial \hat{c}_2}{\partial \pi} = \frac{\partial (g + yp\hat{h})}{\partial \pi} &= p\hat{h}\frac{\partial y}{\partial \pi} + y\frac{\partial p\hat{h}}{\partial \pi} \\
&> p\hat{h}\frac{\partial x}{\partial \pi} + x\frac{\partial p\hat{h}}{\partial \pi} > 0
\end{aligned} \tag{32}$$

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

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

$$V = \ln(\hat{c}_1) + \theta \ln(\hat{h}) + \beta \ln(\hat{c}_2) \tag{33}$$

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 (34)

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

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 3.3: 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

$$\begin{aligned}&\max_{c_1,h,c_2} \ln(c_1)+\theta\ln(h)+\beta\ln(c_2)\\ s.t.\ \ &c_1+(\delta+\frac{(1+r_m)(1+r)}{2+r_m})ph+S=1\\ &c_2+\delta ph+\frac{(1+r)^2}{2+r_m}ph=g+ph+(1+r)S\\ &S\geq 0\end{aligned} \tag{35}$$

Housing market clears:

$$h^* = \bar{H} \tag{36}$$

Combining households' constrained optimal housing consumption 29 with the housing market market clearing condition yields

$$\begin{aligned} &\frac{\partial p^* h^*}{\partial \pi} < 0 \\ &p^* \frac{\partial h^*}{\partial \pi} + h^* \frac{\partial p^*}{\partial \pi} < 0 \\ &h^* \frac{\partial p^*}{\partial \pi} < 0 \end{aligned} \tag{37}$$

Following the same logic as in 31 and 32, we still have

$$\frac{\partial c_1^*}{\partial \pi} < 0, \frac{\partial c_2^*}{\partial \pi} > 0 \tag{38}$$

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.*

$$V = ln(c_1^*) + \beta ln(c_2^*) + \theta ln(\bar{H}) \tag{39}$$

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

as $\frac{xp^*h^*}{1 - xp^*h^*} > \theta > \theta(1 - \beta)$according to households' optimal decision described in Equation 27

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