Unemployment Insurance and Macro-Financial (In)Stability*

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Abstract

We identify and study two mechanisms that can overturn the stabilizing effects of unemployment insurance (UI) policies. First, households in economies with more generous UI reduce their precautionary savings and borrow more in the mortgage market. Second, the overall share of mortgages as well as the share of mortgages with higher loan-to-income ratios on bank balance sheets increase. As a result, both bank and household balance sheets become more vulnerable to adverse shocks, which deepens recessions. We demonstrate the importance of these channels by employing a quantitative heterogeneous-agent general equilibrium model and by providing county-level empirical evidence from the U.S. housing and mortgage markets.

Keywords: Automatic stabilizers, unemployment insurance, household and bank balance sheets, housing market, mortgage debt, foreclosures.
J.E.L. Classification: E21, E32, E44, E60, G20, G51

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1 Introduction

Automatic stabilizers are government policies that automatically adjust tax rates and transfer payments to stabilize income and consumption without requiring a vote from legislators. Unemployment insurance (UI) is one of the textbook examples of automatic stabilizers. The predominant view is that UI policies stabilize economic downturns by reducing income risk and transferring income to households with a high marginal propensity to consume (MPC).[1]

In this paper, we identify two novel mechanisms strong enough to overturn the stabilizing effects of UI. First, due to the decline in left-tail income risk as UI becomes more generous, households reduce their precautionary savings (liquid assets) and take on more mortgage debt, leading to higher leverage. Second, the decline in households' left-tail income risk also reduces their default risk, inducing banks to offer looser credit terms and increasing the share of mortgages (especially those with higher loan-to-income ratios) on their balance sheets. As a result, both household and bank balance sheets become more vulnerable to adverse shocks. Consequently, an economy with UI-induced vulnerabilities in household and bank balance sheets may experience deeper contractions in response to adverse shocks, despite the cushioning effects of UI benefits. We demonstrate the importance of these channels using a quantitative general equilibrium model and empirical evidence from US household and county level data from housing and mortgage markets.

Our model combines five sectors of the economy: (i) households, with an overlapping-generations structure, who face idiosyncratic income and unemployment risks under incomplete markets and make housing and mortgage decisions, (ii) banks that issue short-term loans to firms and long-term mortgages to households, and are subject to capital constraints; (iii) firms that produce output using capital and labor but need to finance a portion of their working capital through short-term loans from banks, (iv) real estate companies that own a part of the housing stock, which they rent to the households, and (v) the government that manages the UI policy.

Households can default on their mortgages in any period throughout the life of the mortgage. Mortgage contracts internalize the default probability of households, hence each mortgage is individual-specific, and borrowing limits endogenously arise due to limited commitment by households. An implication is that a higher UI reduces households' default risk, ceteris paribus, and allows them to access better credit terms, leading to increased

[1]See, for example, Brown (1955), Blinder (1975), McKay and Reis (2016), and McKay and Reis (2021) for earlier and more recent discussions of these mechanisms.

borrowing in the mortgage market.

Banks provide short-term risk-free loans to firms and long-term defaultable mortgages to households. They fund these loans through bank equity and short-term borrowing at an exogenously given interest rate. As is common in the literature, we assume that bankers can default and keep a fraction of their assets.[2] To prevent such behavior in equilibrium, bank creditors condition their funding to bank equity. Therefore, bank credit supply depends on bank equity. Consequently, any losses in bank balance sheets lead banks to reduce credit supply, causing an increase in the equilibrium bank lending rate. This, in turn, results in higher borrowing costs for households and firms.

We calibrate the steady state of the model to match several US data moments, most importantly those regarding household and bank balance sheets, unemployment risk by earnings, and unemployment duration. We first analyze the steady-state effects of UI. We find that as the UI replacement rate increases from 20 to 60 percent, the mortgage debt-to-GDP ratio increases from 76.4 percent to 82.6 percent, and down payments (on average) decline from 10.4 percent to 8.4 percent, increasing household leverage. Moreover, households reduce their financial assets by 3.3 percent, which increases the fraction of hand-to-mouth households. In parallel, the share of mortgages among bank assets increases from 45.7 percent to 47.7 percent.

Our model confirms that, in the steady state, UI achieves its intended purpose of helping the unemployed despite their higher leverage. Specifically, the unemployed experience higher consumption and lower foreclosures in more generous systems since they receive higher UI payments. However, the opposite is true for the employed since they are more leveraged but do not receive UI benefits. Additionally, the employed pay higher taxes to fund more generous UI. This differential effect of UI on the employed and the unemployed will be crucial in understanding the destabilizing effects of UI in our model in response to aggregate shocks as well.

To analyze how UI affects the economic dynamics during booms and busts, we introduce two unanticipated and permanent shocks to the exogenous bank borrowing rate in the model economy. First, while the economy is in the initial steady state (representing the U.S. economy prior to 1997), a boom starts with the bank funding cost declining from 1997 until 2006 and is expected to stay low thereafter. Second, the bust period starts in 2008, when the bank borrowing rate unexpectedly and permanently reverts to its initial steady-state level.[3]

[2] See Gertler and Kiyotaki (2015).

[3] We have chosen shocks to the bank borrowing rate as the driver of the boom-bust cycle in the benchmark analysis since, in the empirical part of the paper, we show that the effects of changes in interest rates on

Furthermore, to incorporate a stabilizing role for UI, we introduce an additional unemployment shock in 2008 that declines linearly until 2013—mimicking the U.S. experience around 2008. We demonstrate in the paper that the destabilizing effects of UI are larger in the absence of this shock, strengthening the main points of the paper.

These shocks generate a boom-bust cycle in the housing market and the macroeconomy similar to the US experience, although the size of the boom-bust is smaller in the model. During the boom, the equilibrium bank lending rate gradually falls, closely following the decline in the bank funding cost. As borrowing costs for households and firms decline, households increase mortgage borrowing and housing demand, causing house prices to increase; firms hire more labor, leading to increases in labor income and output, which further contributes to the increase in house prices. The combination of the increases in house prices and labor income generates an increase in aggregate consumption.

In the bust period, all aggregate variables of interest fall below their initial steady-state level while the bank capital deteriorates sharply due to increased foreclosures and the decline in mortgage valuations. Since the amount that banks can lend depends on their capital, banks are forced to cut back lending, which in equilibrium causes a large but temporary spike in the bank lending rate. Then, due to high borrowing costs, firms cut back employment, lowering income to households. Households cut back consumption due to the combination of lower income and house prices, and higher borrowing costs.

To understand the (de)stabilizing effects of UI, we compare the boom-bust transitions generated by the shocks above in economies with permanently different levels of UI generosity. The results of this exercise illustrate that, during the bust, economies with more generous UI benefits experience larger increases in foreclosures and bank lending rates, as well as greater declines in bank net worth, house prices, household debt, consumption, and output.

The aggregate destabilizing effects of UI are mainly driven by its influence on the employed. While the balance sheet vulnerabilities affect both the employed and unemployed, the unemployed receive higher benefits in more generous UI economies during the bust but the employed do not. Consequently, the consumption of the unemployed is stabilized in the bust period under more generous systems. However, the foreclosure rate of the unemployed follows a non-monotonic pattern: it increases with UI for low UI levels and then declines. On the other hand, the employed experience larger declines in consumption and a greater increase in foreclosures under more generous UI, driving aggregate trends, as the employed constitute the majority.

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housing and mortgage markets are amplified in more generous systems. However, we demonstrate in the paper that the destabilizing effects of UI are present under productivity and housing demand shocks as well.

The weakening effects of UI on both household and bank balance sheets drive our results. On the household side, first, households' ability to insure against income loss during the bust is lower due to lower precautionary savings in higher UI economies. Second, since households are more leveraged in higher UI economies, a given decline in house prices has a larger wealth effect. On the banking side, the higher share of mortgages in bank balance sheets and higher mortgage debt-to-income ratios in higher UI economies make banks more vulnerable to adverse shocks for two reasons. First, as mortgages are long-term assets, their market value declines as the equilibrium bank lending rate increases. This effect is amplified in more generous UI systems since the fraction of mortgages is higher in bank balance sheets. Second, higher mortgage debt-to-income ratio makes banks more prone to foreclosure losses when an unexpected bust in the economy lowers house prices and income. Consequently, bank net worth declines more during the bust in more generous UI economies, causing a larger decline in credit supply and a larger increase in the equilibrium bank lending rate, which increases borrowing costs more for both households and firms, deepening the recession.

To understand the importance of household and bank balance sheets in our model, we close the bank balance sheet channel and study the economic dynamics during the bust, by closing the general equilibrium feedback from bank balance sheets to the bank lending rate. This essentially eliminates the sharp increase in the bank lending rate during the bust resulting from deteriorating bank balance sheets. We find that, in this case, higher UI no longer destabilizes output and consumption. House prices and household debt still decrease more, and foreclosures still increase more under more generous systems, but the effects are relatively smaller. Overall, these findings highlight the significant roles of both household and bank balance sheets in the destabilizing effects of UI.

The importance of the general equilibrium feedback from bank balance sheets to the bank lending rate in amplifying the destabilizing effects of UI illustrates that increasing UI generosity for the whole economy creates a systemic vulnerability in the national banking system. On the other hand, when one state in the US increases its UI, it does not generate a systemic risk in the national banking system. Consequently, empirical studies relying on cross-state variation in UI might underestimate (overestimate) the destabilizing (stabilizing) effects of UI since they do not capture the systemic risk created by increasing the UI for the whole economy.[4]

The destabilizing effects of UI that we find are not an a-priori unambiguous outcome. In fact, we find that unexpected and temporary increases in UI stabilize downturns. However,

[4]Cross-state variation in UI would capture the effect of higher UI on bank balance sheets only to the extend that banks are local and local households and firms rely on local banks.

permanent differences in UI affect household and bank balance sheets in a manner that makes them vulnerable to downturns, outweighing its stabilizing effects.

In the second part of the paper, we provide empirical evidence from the US housing and mortgage markets, consistent with our model's predictions. We use the UI system in the U.S. as each state sets its UI level, leading to significant heterogeneity in UI generosity across states. First, we explore the relationship between UI generosity and household leverage. We use Home Mortgage Disclosure Act (HMDA) data and show that UI and loan-to-income (LTI) ratio at mortgage origination are highly positively correlated across US counties. Quantitatively, as UI benefits increase from the 10^{th} percentile to the 90^{th} percentile, the LTI ratio increases by 20 percentage points (equivalent to around 10 percent). This economically large effect still holds when we include year, county, and bank-year fixed effects to control for time-invariant county-level characteristics and time-varying bank characteristics.

To support causal interpretation, we also exploit an unexpected cut in UI benefits duration in Missouri in 2011 (from 73 weeks to 57 weeks) (Johnston and Mas (2018)). As Missouri is the only affected unit, we employ a synthetic control approach (Karahan, Mitman and Moore (2019)). We find that the average LTI ratio in Missouri would have been 10 basis points (approximately 5 percent) higher if there were no reductions in the UI duration, indicating a causal positive effect of UI on the LTI ratio.

Next, we analyze the delinquency behavior of the employed households in the data to test the model's prediction that the foreclosure rate among employed is higher in higher UI economies when house prices decline. In doing so, we closely follow Hsu, Matsa and Melzer (2018) and use the Survey of Income and Program Participation (SIPP) data, which includes mortgage delinquency information, a strong predictor of foreclosures. We find that employed individuals in states with higher UI benefits experienced a higher delinquency rate when house prices declined during the 2008 crisis.

Finally, we test the model's prediction that UI policies destabilize the housing market. In particular, we focus on house prices and mortgage credit volume and analyze how UI benefits interact with the changes in long-term interest rates—the shock that we use in the quantitative model. To ensure that our results are not driven by omitted variables, we use border discontinuity design and exploit the heterogeneity in UI levels across state borders by comparing two neighboring counties that are located at state borders, one of them located in one state and the other located in the other state.[5] Our results show that counties with more generous UI benefits experience higher mortgage and house price growth when

[5] Dube, Lester and Reich (2010), Hagedorn et al. (2013), Hagedorn, Manovskii and Mitman (2015), and Arslan, Degerli and Kabas (2024) also use state border discontinuity design.

long-term interest rates decline. In all of our regression models, we include other important macroeconomic variables, their interactions with UI benefits, as well as other state-level social welfare policies and their interactions with long-term rates. Overall, these results provide evidence that UI benefits might fail to act as an automatic stabilizer.

Related Literature

There is ample evidence that supports the balance sheet channels that we highlight in this paper. On the household side, Mian and Sufi (2010) and Mian, Rao and Sufi (2013) show that U.S. counties with higher household leverage as of 2006 experienced a deeper 2007–09 recession. Kaplan and Violante (2014) highlight the importance of "hand-to-mouth" consumers for the response of aggregate consumption to income/wealth shocks. In our model, a more generous UI increases the fraction of hand-to-mouth households, making individual consumption more dependent on individual income, increasing the economy's response to adverse shocks. On the banking side, the role of mortgages in the Great Recession is well documented (Bernanke (2018), Gertler and Gilchrist (2018), and Brunnermeier and Reis (2023)).

Our paper contributes to the literature on the automatic stabilization effects of UI. McKay and Reis (2016, 2021) merge the standard incomplete-markets model of consumption with the New Keynesian model of nominal rigidities and business cycles and find that tax-and-transfer programs reduce aggregate volatility. Di Maggio and Kermani (2016) use cross-sectional variation in benefit replacement rates to show that higher UI attenuates the impact of adverse shocks on employment. Hsu, Matsa and Melzer (2018) find that UI benefits were beneficial in smoothing the housing market by lowering mortgage defaults of the unemployed. We also find similar effects on the unemployed both in our quantitative model and in micro data. We differ from Hsu, Matsa and Melzer (2018) by analyzing the destabilizing effects of UI on the employed, which constitute the majority. Since the employed constitute the majority, the aggregates are dominated by their responses. Overall, we contribute to this literature by identifying new channels that overturn the stabilizing effects of UI, which we demonstrate to be important both quantitatively and empirically.

We also contribute to the literature that investigates the costs and benefits of UI benefits. Most studies have focused on the negative impact of UI on the labor market. While Chodorow-Reich, Coglianese and Karabarbounis (2018) report small effects, Hagedorn et al. (2013) Hagedorn, Manovskii and Mitman (2015), and Nakajima (2012) find significant adverse effects on employment. Recently, Arslan, Degerli and Kabas (2024) studies the negative impact of UI on bank funding. They find that more generous UI lowers bank deposits, banks' safest and most stable funding source, reducing their lending to firms. We do not model job search and/or job creation, and bank funding choice, which have been the main mechanisms considered in these studies, and have already been shown to mute (to different degrees) the stabilizing effects of UI. Instead, we complement these studies by studying the negative effects of UI on household and bank balance sheets.

Our paper shares similarities with Hubbard, Skinner and Zeldes (1995), Athreya and Simpson (2006), and Bornstein and Indarte (2023) that examine the relationship between precautionary savings, credit markets, and public insurance. Consistent with our steady-state findings, Hubbard, Skinner and Zeldes (1995) find that precautionary savings decline significantly with the presence of social insurance. Athreya and Simpson (2006) find that increases in public insurance generosity might lead to more unsecured household debt. Bornstein and Indarte (2023), leveraging zip code heterogeneity in staggered expansions of Medicaid, find that the expansion led to a significant increase in household debt. We complement these studies by studying the effects of UI on mortgage debt. In addition, we analyze the destabilizing effects of UI on mortgage issuance and house prices.

Our findings echo the "volatility paradox" described in Brunnermeier and Sannikov (2014). In their framework, contracts that improve risk-sharing may lead to higher leverage and more frequent crises. Similarly, in our framework, higher UI benefits insure households against risk, and households respond by borrowing more for mortgages, amplifying booms and busts.

Methodologically, our equilibrium framework combines key elements from two literatures. First, one strand of literature has modeled the pricing of household default risk in the mortgage market without considering its consequences on bank balance sheets.[6] Second, another literature has studied the importance of the bank balance sheet channel without taking into account the effect of household foreclosures on bank balance sheets.[7] In addition to studying a different question from those explored in these papers, our theoretical contribution is to combine household, firm, and bank balance sheets into one framework, as done in Arslan, Guler and Kuruscu (2023), who studied the drivers of the US boom-bust cycle around 2008. We introduce unemployment risk and UI benefits to study the (de)stabilizing effects of UI.

[6]Among others, see Jeske, Krueger and Mitman (2013), Corbae and Quintin (2015), Chatterjee and Eyigungor (2015), Arslan, Guler and Taskin (2015), Guler (2015), Hatchondo, Martinez and Sanchez (2015), Boar, Gorea and Midrigan (2021), Kaplan, Mitman and Violante (2020), and Guren, Krishnamurthy and McQuade (2021).

[7]See among others Mendoza and Quadrini (2010), Gertler and Kiyotaki (2010, 2015), Bianchi and Bigio (2022), and Corbae and D'Erasmo (2013, 2021).

2 Quantitative Analysis

2.1 The Model

The model is an extension of Arslan, Guler and Kuruscu (2023) and is composed of five sectors: (i) finitely-lived households, (ii) a continuum of all-identical banks, (iii) real estate companies, (iv) good-producing firms, and (v) the government. There is no aggregate uncertainty. Boom-bust transitions are generated by unexpected shocks, which are perceived as permanent. Other than the shock periods, there is perfect foresight. In this section, we provide a description of each sector. A detailed formulation of all the problems is provided in the Appendix A.

2.1.1 Households

Households live until age J, retire at age $J_r < J$, and receive utility from consumption and housing services. There are two types of households: capitalists and depositors, denoted by $i \in \{K, D\}$. There are two fundamental differences between capitalists and depositors. First, capitalists save through shares in good-producing firms and real estate companies, which pay the same rate of return r_k in a perfect foresight equilibrium (more on this later). On the other hand, depositors save through bank deposits, which pay an exogenous interest rate r. Second, we allow them to differ in their discount factors. With these differences the model can match wealth inequality and the share of hand-to-mouth consumers, which allows us to generate reasonable consumption responses (see also Kaplan and Violante (2014)).[8]

Income and Unemployment Risk: Working-age households can be either employed or unemployed exogenously. When they are employed, they supply labor inelastically. The efficiency unit of a household's labor takes the form $\exp(f(j) + z_j^k)$, where $f(j)$ is the life-cycle component of the household's productivity, k is the employment status (e for employed and u for unemployed), and z_j follows an AR(1) process given by $z_j = \rho z_{j-1} + \varepsilon_j$, with ε_j being independently and identically distributed as $N(0, \sigma_\varepsilon^2)$.[9] Here, 'j' represents age, ρ indicates the persistence of the stochastic income shock process, and ε_j represents the innovation.

Along with the income shock, each worker receives an age dependent employment opportunity. The ones who do not get an employment opportunity become unemployed and receive UI benefits. Following McKay and Reis (2016), we assume that UI benefits are given as a fraction of current period potential income (income that would have been earned if the household were employed).

[8] See right plot in Figure 3.

[9] We assume the same process for the stochastic component for both employed and unemployed.

Combining both shocks, a household's income process $y(j, z_j)$ can be summarized by

$$y^k(j, z_j^k) = \begin{cases} (1-\tau_u-\tau_s)\exp(f(j)+z_j^e), & \text{if } j \leqslant J_r, k=e \\ (1-\tau_s)\,\theta\exp(f(j)+z_j^u) & \text{if } j \leqslant J_r, k=u \\ y_R(z_{J_r}), & \text{if } j > J_r \end{cases} \tag{1}$$

where θ is the UI replacement rate, τ_u is the unemployment insurance tax, τ_s is the social security tax, and $y_R(z_{J_r})$ is a function that approximates the US retirement system as in Guvenen and Smith (2014). Following Menzio, Telyukova and Visschers (2016) and Jarosch and Pilossoph (2019), we assume that employed individuals receive age and income dependent unemployment shocks with probability $s_j(z_j)$ and unemployed individuals receive job opportunities at the age-dependent rate λ_j^e, where j is the age of the individual. We also assume that an unemployment shock results in a drop of efficiency level by χ^u. Finally, if an individual is hit with an unemployment shock, the stochastic part of the labor efficiency is adjusted by χ^u, i.e. $z_j^u = z_j^e - \chi^u$.

Household's Decisions: Households can choose between renting and owning a house. There is no unsecured borrowing in the model. If they choose to buy a house, they can finance their housing purchases through long-term defaultable mortgages. Banks offer a menu of mortgage contracts taking into account the default risk, which is a function of household characteristics, house value, and mortgage amount. Then, households choose the loan and the down payment amounts from this menu. As a result, the down payment and mortgage interest rate are endogenously determined. This is one of the mechanisms through which more generous UI benefits affect the economy. More generous UI benefits reduce income risk, hence the default risk, and as a result, banks offer better terms for mortgage credit, resulting in more household borrowing.

Defaulting on a mortgage is costly. After default, households temporarily lose access to the housing market and become *inactive* renters. Inactive renters can return to the housing market with probability π and become *active* renters. Therefore, households have three housing market statuses: homeowner, active renter, or inactive renter. We now describe the decision of each type of household separately.

Active Renters: Households are born as active renters. An active renter has two choices for housing tenure: to continue to rent or to purchase a house. If she continues to rent, she pays the rental price, makes her consumption and saving choices, and remains an active renter in the next period. If she decides to purchase a house, she chooses a mortgage contract among a possible set of contracts offered by the bank. After purchasing a house and making consumption and saving choices, she begins the next period as a homeowner.

Inactive Renters: Inactive renters are households who cannot access the housing market due to their default in previous periods. They become active renters and gain access to the housing market with an exogenous probability π. Since they cannot buy a house, they only make consumption and saving decisions.

Homeowners: Homeowners need to pay δ_h fraction of the house value as the maintenance cost in every period. A homeowner has four options: (i) stay as a homeowner, (ii) refinance, (iii) sell the current house and become a renter or buy a new house, and (iv) default. A homeowner who chooses to stay in her existing house makes the consumption and saving decisions given her income shock, housing, mortgage debt, and assets. The ones who refinance need to pay the whole balance of any existing debt and obtain a new mortgage. The third choice for a homeowner is to sell the current house and either become a renter or buy a new house. Selling a house is subject to a transaction cost, which is a φ_s fraction of the selling price. Moreover, a seller has to pay the outstanding mortgage debt in full to the lender.

The fourth possible choice for a homeowner is to default on the mortgage if she has any. A defaulter has no obligation to the lender. In case of household default, the lender seizes the house, and sells it subject to a foreclosed house transaction cost, which is a φ_e fraction of the house value with $\varphi_e > \varphi_s$, and transfers any positive amount from the sale of the house, net of the outstanding mortgage debt and transaction costs, back to the defaulter. Since defaulting is more costly than selling, a homeowner with positive home equity will choose to sell the house instead of defaulting. Hence, negative equity is a necessary condition for default in the model, and a defaulter receives no funds from the lender. The defaulter starts the next period as an active renter with probability π. With probability $(1-\pi)$, she stays as an inactive renter.

Amortization of mortgages: For tractability, we assume that mortgages are due by the end of life, so that the household's age captures the maturity of the mortgage contract. We also allow for only fixed rate mortgages. Therefore, the mortgage contract can be characterized by its maturity and the periodic mortgage payment m. We assume that the mortgage payments follow the standard amortization formula computed at the bank lending rate r_ℓ.

In reality, the amortization schedule of mortgages are computed at their individual-specific mortgage interest rates. However, to save from an additional state variable, we assume that mortgage amortization is computed at bank lending rate r_ℓ, following the approach of Hatchondo, Martinez and Sanchez (2015) and Kaplan, Mitman and Violante (2020).

Individual default risk will show up in the pricing of the mortgages at the origination rather than in the mortgage interest rate.

Good-Producing Firms: A perfectly competitive firm produces final output by renting from households capital K at rate r_k and labor N at rate w. The firm also chooses the utilization rate (or hours) u per worker. The labor income earned (or aggregate component of labor income) per efficiency units of a worker $w(\overline{w}, u)$ (same as w) is assumed to depend on the hours worked.

Following Christiano and Eichenbaum (1992), Cooley and Quadrini (1999, 2004), Neumeyer and Perri (2005), Mendoza (2010), and Jermann and Quadrini (2012), we assume that the firm finances a fraction μ of the wage payment in advance from banks and pays interest on that portion.

$$\max_{K,N,u} \mathbb{Z}K^{\alpha}(Nu)^{1-\alpha} - (r_k + \delta_k)K - (1 + \mu r_{\ell})\, w(\overline{w}, u)\, N,$$

where $\mathbb{Z}$ is TFP, r_k is the rate of return, and δ_k is the depreciation rate of capital. The working capital requirement makes the firm's labor demand and production decision dependent on the bank lending rate r_{ℓ}. Since a worker's labor income depends on hours worked, labor income and output decline when the firm reduces work hours in response to an increase in bank lending rate.

Real Estate Companies: Real estate companies are owned by households and own a part of the housing stock (subject to depreciation), and rent them to the households at the rental rate p_r. In each period they choose how much new housing units to purchase (or sell). They face quadratic adjustment cost to change their housing stock. Since both capital and real estate company shares are riskless in a deterministic equilibrium, i.e., in the steady-state and along the transition path except for the unanticipated shock periods, both assets have to pay the same rate of return in equilibrium. Given this, the first-order condition of the real estate company gives the rental rate as $p_r = \kappa + p_h(1 + H_r' - H_r) - \frac{p_h'(1-\delta_h + H_r'' - H_r')}{1+r_k}$, where κ is the maintenance cost, p_h and p_h' are house prices in the current and next periods, δ_h is the depreciation rate of housing, and H_r, H_r', H_r'' are the housing stock of the real estate companies in the current and next two periods, respectively.

Banks: We assume a competitive banking industry with a unit of continuum of identical banks that are risk-averse and maximize the discounted lifetime utility $\sum_{t=0}^{\infty} \beta^{t-1} \log\left(c_t^B\right)$ where c_t^B is the bank's dividends. There is no entry to the banking sector. Banks are owned by international investors, and fund their operations from their equity and by borrowing short-term at an exogeneous risk-free interest rate r. They lend to firms at rate r_{ℓ}, and issue mortgages and purchase existing mortgages.

Following Gertler and Kiyotaki (2015), we assume that bankers can walk away at the beginning of a period without paying back their creditors. In that case, they can keep a fraction, ξ, of their assets but are excluded from banking operations in the future and can only invest those assets at rate r. Knowing this, creditors lend to banks to the point where banks do not walk away, which generates a collateral constraint with a haircut.

We focus on a symmetric equilibrium where all banks hold the market mortgage portfolio. This allows simple aggregation despite the fact that banks hold a rich set of heterogenous mortgages (see Arslan, Guler and Kuruscu (2023) for more details).

Government: The government runs two balanced-budget social programs: (i) pay-as-you-go social security program which transfers income to retired individuals (ii) UI program which transfers income to unemployed individuals. Social security program is funded through taxes on working-age individuals, while UI program is funded through taxes on the employed.

2.2 Calibration

The model period is assumed to be one year. Households enter into the economy at the age of 21, work until the age of 65, and live until age 85. We calibrate the steady state of the benchmark model economy to match relevant moments of the US data in 1995 assuming the replacement rate for UI is 40 percent. Given that the model period is one year and unemployment benefit duration is typically 26 weeks, we set the UI replacement rate $\theta = 0.4 * 0.5 = 0.2$ in our benchmark calibration.

Preferences: We assume that households receive utility from consumption and housing services captured by the following CES utility specification: $u(c, s) = \left((1-\gamma)c^{1-\epsilon}+\gamma s^{1-\epsilon}\right)^{\frac{1-\sigma}{1-\epsilon}}/(1-\sigma)$. We choose $\epsilon = 1.25$, consistent with the estimates in Piazzesi, Schneider and Tuzel (2007). Following Conesa, Kitao and Krueger (2009) and Kaplan and Violante (2014), we set $\sigma = 4$, which implies an elasticity of intertemporal substitution of 0.25. We calibrate γ internally and target to match the share of housing services in aggregate income as 15 percent. We set the share of the capitalists to 20 percent. We calibrate the discount factor for the capitalists, to match capital-output ratio of 2. Lastly, we calibrate the discount factor for the depositors, so that the share of aggregate wealth that belongs to top 20 percent is 80 percent, which corresponds to the wealth share of the wealthiest 20 percent. The differences in returns, as well as discount factors, enable the model to match wealth concentration and generate a reasonable MPC.[10]

[10]In Aguiar, Bils and Boar (Forthcoming) and Carroll et al. (2017) discount factor heterogeneity generates large MPC's.

Table 1 – Externally Set Parameters

Parameter	Explanation	Value
σ	Risk aversion	4
ϵ	EIS	1.25
α	Capital share	0.3
θ	Unemployment benefit	0.2
χ^u	Job scarring effect	0.15
ψ	Curvature on hours	0.5
ρ	Persistence of income	0.955
σ_ε	Standard of innovation to AR(1)	0.198
φ_s	Selling cost of a house for a household	7%
φ_e	Selling cost for foreclosures	25%
φ_f	Fixed cost of mortgage origination	2%
φ_v	Variable cost of mortgage origination	0.75%
δ_h	Housing depreciation rate	2.5%
π	Probability of being an active renter	0.14
Parameters that govern the Unemployment-Employment and Employment-Unemployment transitions		
δ_0	Degree of income dependence in job separation rate	0.0015
δ_1	Age dependence curvature in job separation rate	3.08
α_0	Weight parameter in job finding rate	0.49
α_1	Speed of change in job finding rate with unemployment duration	0.36
f_0	Job finding probability in the first month of unemployment	0.292

Income and unemployment risk: We postulate that the risk of unemployment is contingent on both age and present income, characterized by the ensuing functional form: $s_j\left(z_j^k\right) = \bar{s}_j + \delta_0 z_j^k$, where the job separation rate s_j consists of an age component $\bar{s}_j$ and a stochastic component that depends on labor efficiency. We estimate δ_0 from Survey of Income and Program Participation (SIPP) data as 0.0015, implying that a 100 percent increase in income reduces the job separation probability by 0.15 percentage points.[11]

Following Menzio, Telyukova and Visschers (2016), we assign values of 0.03 to $\bar{s}_{21}$, baseline monthly job separation rate at age 21, and 0.001 to $\bar{s}_{65}$, baseline monthly job separation rate at age 65. We then posit that the age component of the job separation rate evolves over the course of the life-cycle in accordance with the following functional form:

$$\bar{s}_j = \bar{s}_{65} + \left(\bar{s}_{21} - \bar{s}_{65}\right)\left(\frac{65 - j}{44}\right)^{\delta_1},$$

where δ_1 governs the curvature of the change in the job separation rate throughout the life-cycle.

In accordance with Jarosch and Pilossoph (2019), we incorporate duration dependency by

[11] We use the 1996 wave of SIPP. We limit the sample to white males between the ages 25 and 55. The income refers to the households earned income (labeled as THEARN) in the survey.

adopting the following functional form for the monthly job finding probability:

$$f_t = \left(\alpha_0 + (1-\alpha_0)e^{-\alpha_1 t}\right) f_0,$$

where t is the month in a year and f_0 is the job finding probability in the first month. Consistent with Jarosch and Pilossoph (2019), we assign values of 0.48 to α_0 and 0.36 to α_1.

We adopt the methodology of Krueger, Mitman and Perri (2016) to transform monthly transition probabilities into annual transition probabilities.[12] Specifically, we calculate the annual unemployment-to-unemployment transition probability as the likelihood of an individual who is unemployed at the beginning of the year being unemployed at the end of the year. Note that individuals may experience multiple transitions within a single year, including periods of employment, during this aggregation process. We compute the annual employment-to-employment probability using the same methodology.[13]

We calibrate δ_1 and f_0 to match an unemployment rate of 5.5 percent and an average probability of not finding a job within a year (as a measure of long-term unemployment) of 10 percent over the life-cycle. This calibration also implies the average job finding probability of 25 percent in a month, which is consistent with the estimates provided in Menzio, Telyukova and Visschers (2016).

After calibrating the unemployment process and unemployment income, we proceed to calibrate the parameters governing the stochastic labor efficiency process in order to ensure that the implied income process within the model aligns with the estimates presented by Storesletten, Telmer and Yaron (2004). Specifically, we postulate that the implied income in the model comprises both a transitory component and a persistent component, as in Storesletten, Telmer and Yaron (2004). We calibrate the autocorrelation coefficient of the persistent component and its standard deviation to match the estimates presented in row C of Table 2 in Storesletten, Telmer and Yaron (2004). The resulting persistence of the income process, ρ is 0.955 and its standard deviation, σ_ε is 0.198. Following Shiro and Butcher (2022), we assume that upon unemployment shock, the stochastic component of the labor efficiency, z_j, drops by 15% to mimic the job scarring effect of the unemployment, i.e. $\chi^u = 0.15$.

To approximate the retirement income within the context of the United States, we adopt

[12] Different from Krueger, Mitman and Perri (2016), we incorporate age and income dependencies in job separation rates.

[13] The resulting annual employment-to-unemployment transition probabilities are 0.15, 0.04, and 0.02 for individuals aged 21, 41, and 61 years, respectively. Correspondingly, the annual unemployment-to-employment transition probabilities for these age groups are 0.80, 0.88, and 0.90.

the methodology outlined by Guvenen and Smith (2014). Furthermore, we adjust the mean of the retirement income to ensure that households of working age are subject to a 12 percent tax rate.

Housing and mortgage markets: Consistent with the estimates in Gruber and Martin (2003), we set the house selling cost, φ_s to 7 percent. Foreclosed properties can be sold by banks at a $\varphi_e = 25$ percent discount, aligning with the estimates provided by Campbell, Giglio and Pathak (2011). We set the fixed mortgage origination cost to $\varphi_f = 2$ percent of the aggregate output, and variable cost of mortgage origination to $\varphi_v = 0.75$ percent of the mortgage loan (Federal Reserve Board (2008)).

The default flag tends to persist for an average of 7 years on a defaulted household. To achieve this, we calibrate the per-period probability of transitioning from default to being an active renter to 0.14. We calibrate rental maintenance cost, κ, to match the house price-to-rent ratio to 11 (Sommer, Sullivan and Verbrugge (2013)). Housing units depreciate at rate $\delta_h = 2.5$ percent (Harding, Rosenthal and C.F. (2007)). The aggregate house supply is fixed and normalized to 1. Finally, we calibrate the minimum house size for owner-occupied units to match a homeownership rate of 64 percent.

Production sector: We target capital-output ratio of 2. We normalize total labor N and steady-state labor utilization to 1. We set the share of capital in production as $\alpha = 0.3$. We calibrate the depreciation rate of capital to match the share of non-residential investment to output ratio as 20 percent.Following Arslan, Guler and Kuruscu (2023) we target the share of housing services in aggregate income as 0.15 and investment to output ratio of 20 percent to calibrate the depreciation rate of capital and assume the wage function takes the following form:

$$w\left(\overline{w}_t, u_t\right) = \bar{w}_t + \vartheta \frac{u_t^{1+\psi}}{1+\psi}.$$

where $\bar{w}$ is the equilibrium base wage rate. We set the curvature ψ to 0.5 as in Arslan, Guler and Kuruscu (2023) and calibrate ϑ to match the utilization rate, $u_t = 1$ in the steady-state.

Financial Sector: We assume that bankers have log utility. We view banks in our model as broader than a typical deposit taking institution. We follow Arslan, Guler and Kuruscu (2023) and the ratio of mortgages to total bank's financial assets as 45 percent. We calibrate bank funding rate, r, to match debt-output ratio of 80 percent , and we target $r_\ell - r = 1.5$ percent representing average annual gap between 30-year mortgage interest rate and treasury rate in the data. We also target steady-state bank leverage as 10. With these targets we calibrate bank's discount factor and the hair cut on bank borrowing from the international markets.

Table 2 – Internally Calibrated Parameters

Parameter		Value
β_K	Discount factor–capitalist	1.06
β_D	Discount factor–depositor	0.76
$\underline{h}$	Minimum house size	0.53
r	Deposit rate	0.03
γ	Weight of housing services in utility	0.23
δ_k	Capital depreciation rate	0.1
κ	Rental maintenance cost	0.05
μ	Share of wage bill financed from banks	1.42
β_L	Bank discount factor	0.83
ξ	Bank seizure rate	0.23

Table 3 – Moments

Statistic	Data	Model
Capital-output ratio	2	2
Homeownership rate–aggregate	64 percent	64 percent
Share of wealth that belongs to capitalists	80 percent	80 percent
Debt-GDP ratio	80 percent	80 percent
Share of housing services in GDP	15 percent	15 percent
Share of non-residential investment in GDP	20 percent	20 percent
House price-rental price ratio	11	11
Ratio of mortgage loans to total loans in bank assets	0.45	0.45
Mortgage premium	0.015	0.015
Bank leverage ratio	10	10

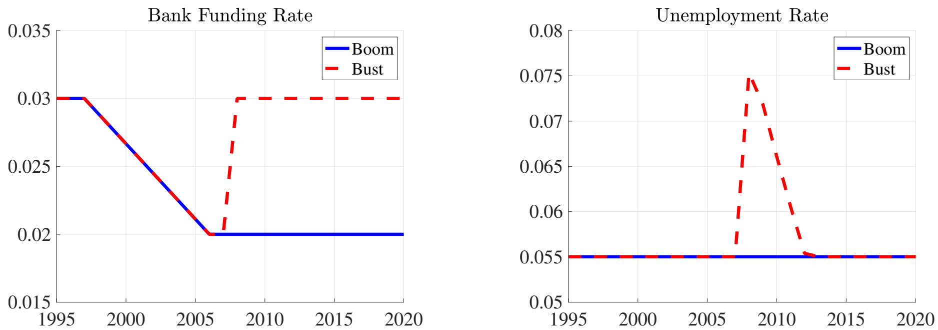
Note: Flow variables (output and rental price) are measured annually.

After externally calibrating most of the parameters, we internally calibrate the remaining 10 parameters shown in Table 2 to jointly match the following 10 data moments reported in Table 3: 64 percent average home-ownership rate, capital-output ratio of 2, share of wealth that belongs to top 20 percent of individuals as 80 percent, debt-to-GDP ratio as 80 percent, share of housing services in GDP as 15 percent, share of non-residential investment in GDP as 20 percent, house price to rental price ratio of 11, leverage ratio of 10 for banks, 1.5 percent premium for mortgages, and the share of mortgages in bank balance sheet as 45 percent.

Shocks: We study how the model economy reacts to changes in interest rates, corresponding to the bank-funding rate in our framework.[14] For our analysis, we assume that the economy is in a steady state before 1998. In 1998, the bank funding rate starts to decline linearly

[14] In Appendix C, we demonstrate the destabilizing effects of UI carries when the economy is hit with aggregate productivity and house price expectation shocks.

Figure 1 – Boom-bust shocks



Notes: The graph plots the shocks that generate the boom-bust episode. The shock during the boom is a gradual decline in interest rates from 3 to 2 percent. During the bust, interest rates reverse to the initial steady-state and unemployment rate increases to 7.5 percent and declines back to 5.5 percent linearly in 6 years. Both the boom and bust shocks are unexpected. But, once realized there is perfect foresight.

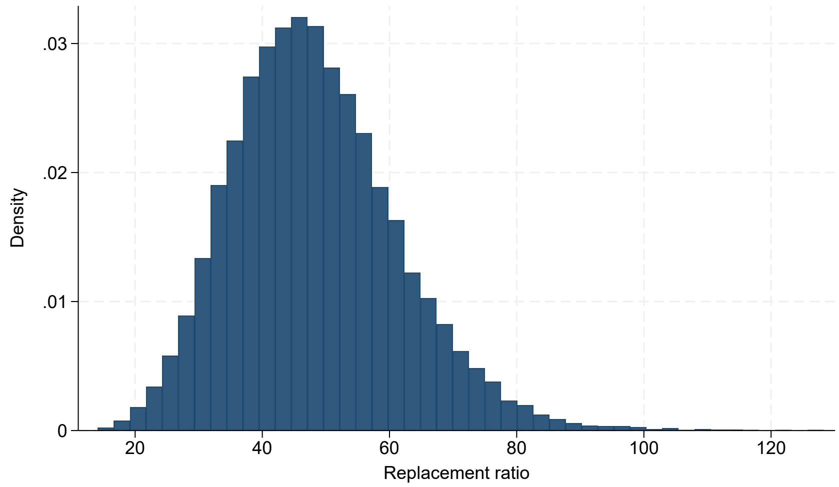
until 2008 and is expected to remain at the 2008 level thereafter. We assume that shocks are expected to be permanent. However, in 2008, the bank funding rate unexpectedly reverts to its initial steady state (Figure 1, left panel). We choose the size of the interest rate shock as one percentage point, consistent with the decline in mortgage rates during this period (Justiniano, Primiceri and Tambalotti (2019)). These two unexpected shocks to the bank funding rate generate a sizable boom-bust cycle in the housing, banking, and real sectors.

In addition, to incorporate a stabilizing role for UI as well as the bust dynamics in the economy, we assume that the unemployment rate rises unexpectedly in 2008 and then declines linearly until 2013 (Figure 1, right panel).[15] We demonstrate in Appendix C that the destabilizing effects of UI are larger in the absence of this shock, strengthening the main points of the paper.

We choose the increase in the unemployment rate to be half of the decline in output following Okun's law. Overall, the unemployment rate increases from 5.5 to 7.5 percent during the bust period. We implement this increase by adjusting the employment-unemployment and unemployment-employment transition probabilities proportionally across the entire population. The government finances the increase in unemployment benefits through taxes on the employed. The UI systems runs a balanced budget in every period.

[15]Our framework does not include endogenous labor supply decisions. While modeling job search, job creation, and destruction, and accepting/rejecting job offers would certainly enrich the model, it would also introduce a large computational burden. Consequently, we exogenously generate an increase in the unemployment rate.

Figure 2 – Variation in UI replacement rates ($\frac{\text{maximum UI benefit}}{\text{county median income}}$) in US Counties



3 Quantitative Results

There is a large variation in UI replacement rates across US counties, measured by the ratio of the maximum UI benefit to 6-month median county income (Figure 2). A significant part of this variation is attributable to the numerator (maximum benefit level), which increases by around two and a half fold from the lowest to highest maximum replacement rate. The remaining variation is accounted for by differences in county median income levels. Motivated by these observations, in the simulations that follow, we will compare economies with permanent different UI levels, focusing on UI replacement rates of 20, 30, 40, 50, and 60 percent.[16]

3.1 Steady-State Analyses

To quantify the effects of UI benefits on balance sheets in the steady-state, we solve the model with different UI benefit levels and report corresponding steady-state values of several balance sheet strength measures. Then we compare the effects of UI generosity on unemployed and employed. Finally, we compare life-cycle dynamics.

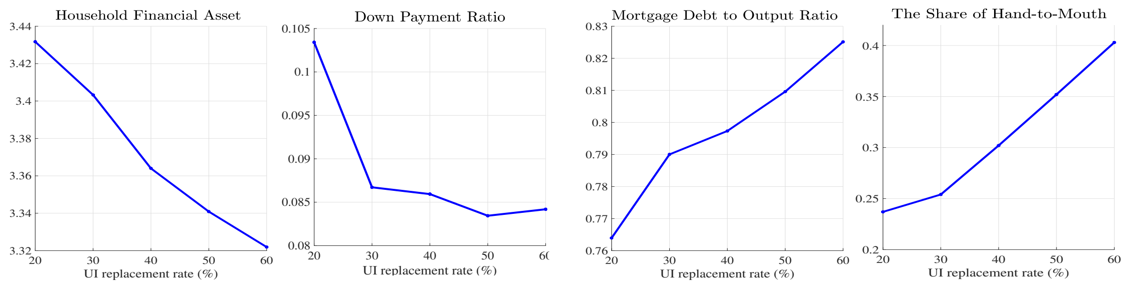
3.1.1 The Effects of UI on Household and Bank Balance Sheets

UI generosity weakens the balance sheets of households and banks in the steady state (Figure 3). As UI becomes more generous, households' income risk declines. Consequently, they reduce their precautionary savings (top left panel). Moving from an economy with a

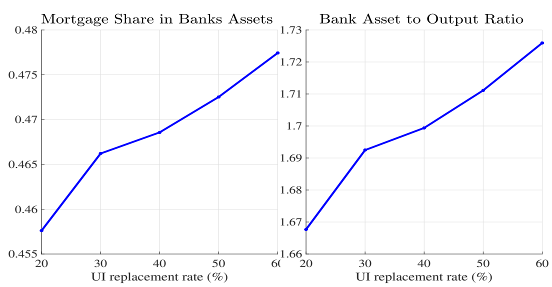
[16]It is important to note that these replacement rates are multiplied by 0.5 in the model, given that the model period is one year and the benefit duration is 6 months.

Figure 3 – Steady State Effect of UI on Balance Sheets

Panel A: Household Balance Sheets



Panel B: Bank Balance Sheets



Notes: Panel A plots the steady-state values of several household balance sheet items for a range of UI generosity levels. "Hand-to-mouth" households are the ones with financial assets less than half of their annual labor income. Panel B plots the steady-state values of several bank balance sheet items for a range of UI generosity levels.

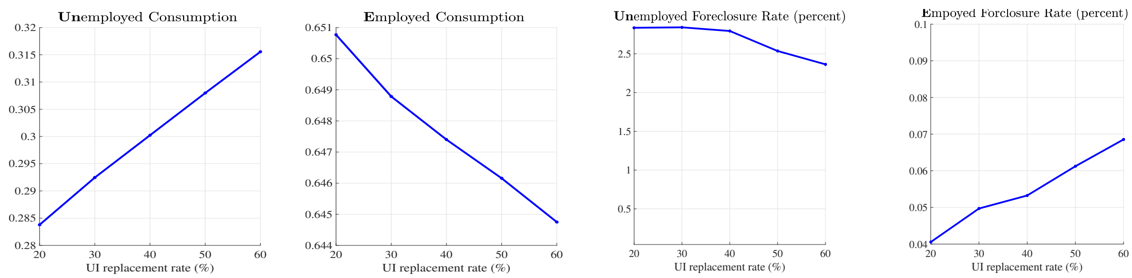
20 percent replacement rate to one with a 60 percent replacement rate, reduces household financial assets by 3.3 percent. Second, households' default risk, ceteris paribus, also decreases, resulting in better credit terms from banks. The combination of lower income risk and improved credit terms allows households to borrow more in the mortgage market, increasing their leverage.[17] As a result, the average mortgage debt-to-output ratio increases from 76.4 percent to 82.6 percent, and the average down payment ratio decreases from 10.4 percent to 8.4 percent when the UI replacement rate increases (top middle, and right panels).

Since mortgage liabilities of households are assets on bank balance sheets, we can decompose the variation in the mortgage debt-to-output ratio as variations in the mortgage share in bank assets and the bank asset-to-output ratio, noting that the product of the last two variables gives the mortgage debt-to-output ratio. As seen in the bottom two panels, the share of mortgages in banks' assets, as well as the size of the banking sector measured by the bank asset-to-output ratio, increases as we move from a less generous UI system to a more

[17]Consistent with the implications of our model, Hsu, Matsa and Melzer (2018) find that both unemployed and employed households are offered lower mortgage and credit card interest rates and higher credit card limits in US states with higher maximum UI benefits.

Figure 4 – Steady State Effects of UI on Unemployed and Employed

Consumption | Foreclosure Rate



Notes: The graph plots the steady-state averages of consumption and foreclosure rates of unemployed and employed for a range of UI generosity levels.

generous one.

A bigger share of mortgages in bank balance sheets make them more vulnerable to adverse shocks. This is because the market value of mortgages, which are long-term assets, declines when credit markets tighten, and bank lending rates increase during the bust. Therefore, even holding the effect of UI on foreclosures constant during recessions, the banks with more mortgages will reduce credit more. In addition, mortgages become more fragile in the face of adverse shocks due to higher loan-to-income ratios. Consequently, the vulnerability of bank balance sheets to adverse shocks increases even further.

3.1.2 Unemployed versus Employed

UI affects unemployed and employed individuals differently. A more generous UI system weakens the balance sheets of both employed and unemployed. However, while unemployed enjoys more generous benefit payments during unemployment, employed will not get this benefit and they will pay higher taxes. Therefore, we expect to have relatively more favorable effects of more generous UI on the unemployed, compared to the employed.

The left panel in Figure 4 illustrates that the unemployed indeed enjoy higher average consumption in more generous UI economies: going from a 20 percent replacement rate to a 60 percent replacement rate increases the average consumption of the unemployed by 11 percent. On the other hand, the employed experience slightly lower consumption in more generous economies because of higher taxes (the second panel).

For foreclosure rates, two patterns emerge. First, while the foreclosure rate for the unemployed is around 2.5 percent, it is only around 0.04 percent for the employed. Thus, foreclosures in the steady state are primarily due to the unemployed.[18] Second, the foreclosure

[18]This is consistent with the findings of Rendon and Bazer (2021).

rate among the unemployed declines with higher UI, while the foreclosure rate among the employed slightly increases with it. Overall, these patterns suggest that higher UI insures the unemployed in the steady state against consumption losses and foreclosures, while it has a slightly opposite effect on the employed. However, as we demonstrate in Section 3.2.2, these differences become more apparent in the bust.

3.1.3 Life-Cycle Dynamics in the Steady State

Consumption, homeownership rate, and mortgage debt increase concavely over the life cycle in our benchmark economy, which is broadly consistent with the data (see Figure 14 in Appendix B for details). Moreover, consumption and homeownership rates start at lower levels and increase more steeply under less generous UI systems. The reason is that as UI generosity declines, the precautionary saving motive becomes more powerful, which keeps consumption and the homeownership rate low at young ages. Since unemployment risk declines with age, consumers start to consume their savings. Additionally, the higher risk of default under less generous systems lowers the demand for mortgages over the life cycle.

The model generates a significant decline in consumption upon unemployment, which is consistent with the data. Additionally, the effect of UI on the reduction in consumption aligns with estimates reported in the literature.[19] Finally, a substantial refinancing activity is observed among the unemployed, which is more prevalent in economies with lower UI benefits, indicating a substitution effect between UI and refinancing.[20]

3.2 The Boom-Bust Analysis

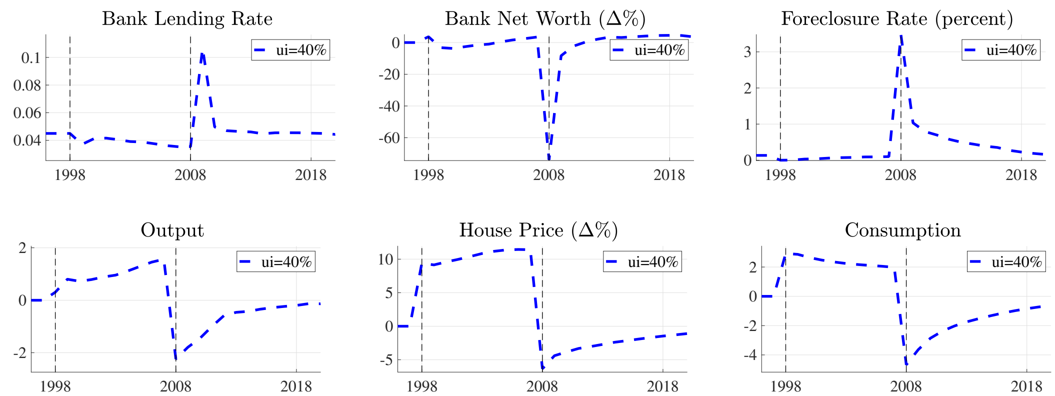
Before we delve into comparing how aggregate fluctuations in economies with different UI levels differ, it is instructive to illustrate how the shock to the bank borrowing rate, $\mathtt{r}$, transmits to the economy. For this purpose, we present the boom-bust dynamics of some key aggregate variables from our benchmark economy with the 40 percent replacement rate in Figure 5.

Transmission of the Shock: The driver of the boom-bust is the changes in the bank lending rate, $\mathtt{r}_\ell$. During the boom period, bank lending rate mostly follows the change in the exogenous bank funding cost; whereas, during the bust period, the deterioration of

[19]For example, Ganong and Noel (2019) document that household consumption declines by about 10 percent upon unemployment. Regarding the effects of UI generosity, Gruber (1997) (and more recently Kroft and Notowidigdo (2016)) find that a 10 percentage point increase in UI generosity leads to about a 2.8 percent reduction in the fall in consumption upon job loss. The model implies similar size effects (Figure 14 in Appendix, lower left panel).

[20]The widespread use of refinancing among the unemployed is consistent with recent findings in Braxton, Herkenhoff and Phillips (2020), which suggest that unemployed individuals have significant access to credit.

FIGURE 5 – Benchmark (UI=40 percent) Boom-bust



Notes: The graph plots the model's boom-bust dynamics for the 40 percent UI economy. The shock during the boom is a gradual decline in interest rates from 3 to 2 percent. During the bust, interest rates reverse to the initial steady state, and the unemployment rate increases to 7.5 percent and declines back to 5.5 percent linearly in 6 years. Both the boom and bust shocks are unexpected. But, once realized there is perfect foresight.

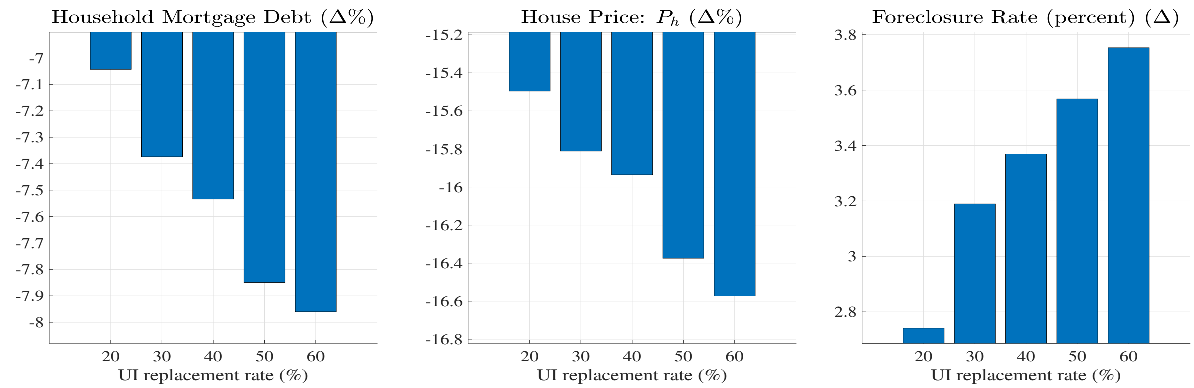
bank balance sheets causes a spike in bank lending rate. During the boom, the equilibrium bank lending rate gradually falls and is expected to stay low permanently. Due to the lower borrowing costs, households increase their housing demand, causing house prices to increase. In parallel, firms hire more labor, increasing labor income and output, which further contributes to the increase in house prices. The combination of the increases in house prices and labor income generates an increase in consumption.

The bank funding cost, r, unexpectedly and permanently reverts to its initial steady-state level during the bust, leading to a permanent increase in r_ℓ. However, the deterioration of bank balance sheets amplifies this increase at the time of the bust. An iterative approach demonstrates how this mechanism works: the increase in bank funding cost causes an increase in the equilibrium bank lending rate $r_{\ell,t+1}$, which reduces mortgage prices. Since mortgages are long-term assets and all assets have to pay the same rate of return in a perfect foresight equilibrium, mortgage prices drop to reflect the higher $r_{\ell,t+1}$. As mortgages are banks' collateral, this results in a decline in loan supply L_{t+1} and further increases in $r_{\ell,t+1}$. With higher $r_{\ell,t+1}$, mortgage prices and bank net worth decline further, generating further increases in $r_{\ell,t+1}$. Foreclosures also contribute to the declines in bank net worth and credit supply.

3.2.1 (De)stabilizing Effects of Unemployment Insurance on Aggregates:

Next, we study the effects of UI on the boom-bust cycle, which is our main question. Our results indicate that the busts in the financial, housing, and goods markets (real sector) are more severe under more generous UI systems.

FIGURE 6 – Bust in the Housing Market



Notes: The graph plots the dynamics of key housing market variables during the bust episode. Each bar measures the change of a variable during the time of the bust compared to the its value at the peak of the boom. The shock during the boom is a gradual decline in interest rates from 3 to 2 percent. During the bust, interest rates reverse to the initial steady state, and the unemployment rate increases to 7.5 percent and declines back to 5.5 percent linearly in 6 years. Both the boom and bust shocks are unexpected. But, once realized there is perfect foresight.

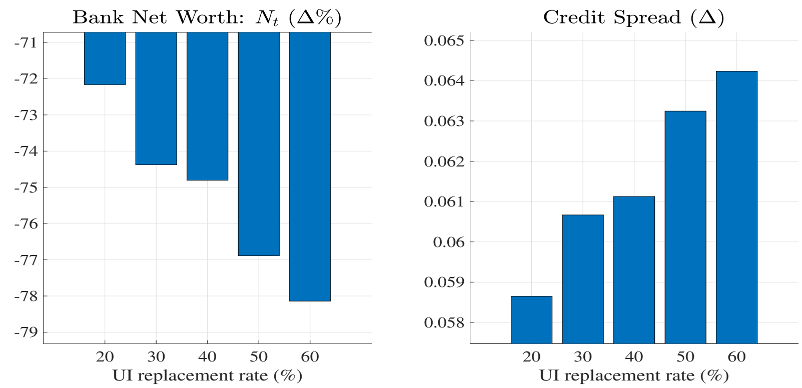
Housing Market Dynamics: In the model, a more generous UI amplifies the boom-bust cycle in the housing market (Figure 6). For example, during the bust, household mortgage debt declines by 7 percent when the replacement ratio is 20 percent and declines by approximately 8 percent when the benefits are 60 percent. The decline in house prices is also bigger in the more generous UI economy: 15.4 percent for the 20-percent economy and 16.6 percent for the 60-percent one.

Foreclosure rates increase more for the 60-percent UI economy and exceed 3.7 percent, while they stay below 3 percent for the 20-percent UI economy. The larger decline in house prices, higher household debt, lower liquid asset holdings, and lower down payment rates cause larger increases in foreclosure rates for more generous UI economies.[21]

Banking Sector Dynamics: Banking sector as well performs worse in economies with more generous UI (Figure 7). The bank net worth declines more in more generous UI economies because mortgages, whose prices decline with a higher bank lending rate, constitute a larger fraction of banks' assets, and each mortgage is riskier due to lower down payment. Additionally, the bigger increase in foreclosure rates contributes to the larger decline in the bank net worth. The larger decline in bank net worth generates a bigger spike in the bank lending rate $r_{\ell,t}$ (a 0.6 percentage points greater increase in the bank lending rate in the 60-percent UI economy than the 20-percent one), which lowers the bank net worth even more. The larger decline in credit supply and the larger increase in the bank lending rate in

[21] Negative equity is a necessary condition for default in our framework. Otherwise, it would be optimal to sell the house. However, negative equity is not sufficient because of the cost of default. Additional triggers, such as low liquidity and lower income (both of which worsen as UI becomes more generous), are also important for the foreclosure dynamics.

Figure 7 – Bust in the Banking Sector



Notes: The graph plots the dynamics of key banking market variables during the bust episode. Each bar measures the change during the time of the bust compared to the peak of the boom. The shock during the boom is a gradual decline in interest rates from 3 to 2 percent. During the bust, interest rates reverse to the initial steady state, and the unemployment rate increases to 7.5 percent and declines back to 5.5 percent linearly in 6 years. Both the boom and bust shocks are unexpected. But, once realized there is perfect foresight.

more generous UI makes borrowing more costly for both households and firms, deepening the recession.

Real Sector Dynamics: The bust in the real sector (household labor income, output, and consumption) is also stronger under more generous UI systems (Figure 8). One of the main factors behind the more severe bust in higher UI economies is the larger increase in the bank lending rate, raising borrowing costs for households and firms. This, in turn, causes firms to cut back on labor demand more, resulting in larger declines in labor income and output. The larger drop in income, coupled with the higher borrowing costs, leads households to reduce consumption more.

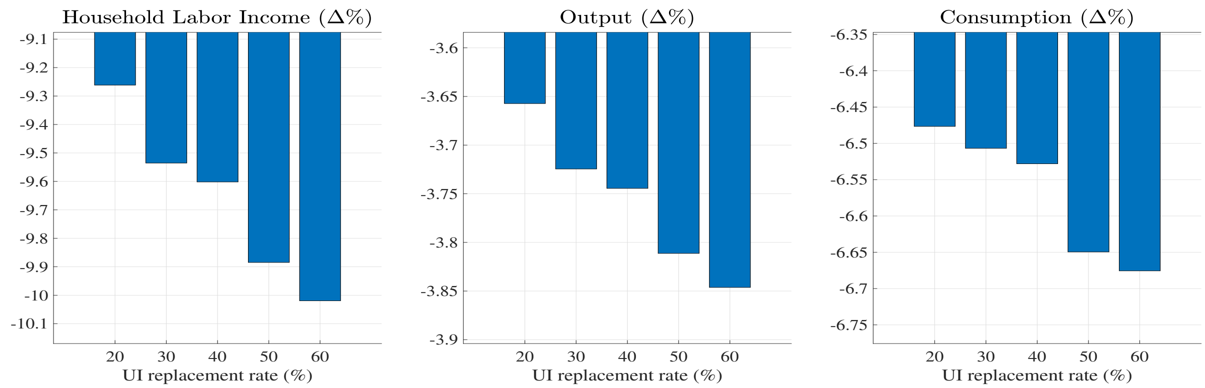
The other main factor that causes a deeper bust is the weaker household balance sheets in more generous UI economies. The declines in house prices and labor income (assuming the declines are the same across different UI economies) generate bigger declines in household consumption and housing demand in higher UI economies because of higher household leverage, and lower savings. As a result of weaker demand, house prices and consumption decline more, and foreclosures increase more in higher UI economies.

3.2.2 Unemployed versus Employed

Generous UI increases balance sheet vulnerabilities for both unemployed and employed individuals, affecting them negatively during adverse shocks. However, it also provides insurance for the unemployed, thus affecting the two groups differently.

The left panel in Figure 9 shows that the insurance channel clearly dominates the balance sheet channel for the consumption of the unemployed: their consumption declines by 7.8

Figure 8 – Bust in the Real Sector



Notes: The graph plots the dynamics of key goods market variables during the boom-bust episode. Each bar measures the percent change during the time of the bust compared to the peak of the boom. The shock during the boom is a gradual decline in interest rates from 3 to 2 percent. During the bust, interest rates reverse to the initial steady state, and the unemployment rate increases to 7.5 percent and declines back to 5.5 percent linearly in 6 years. Both the boom and bust shocks are unexpected. But, once realized there is perfect foresight.

percent in the economy with 20 percent replacement rate, while the corresponding number is 6.8 percent when the replacement rate is 60 percent. Thus, UI does its intended job of helping the unemployed not only in the steady state, as we demonstrated in Section 3.1.2, but also in the bust.

The opposite is true for the employed. Since they enter the recession with a higher leverage under a higher UI economy and do not receive the benefit of UI, they experience larger declines in consumption and larger increases in foreclosures during the bust.[22] Since the majority of the population is employed, aggregates are mainly driven by their behavior.

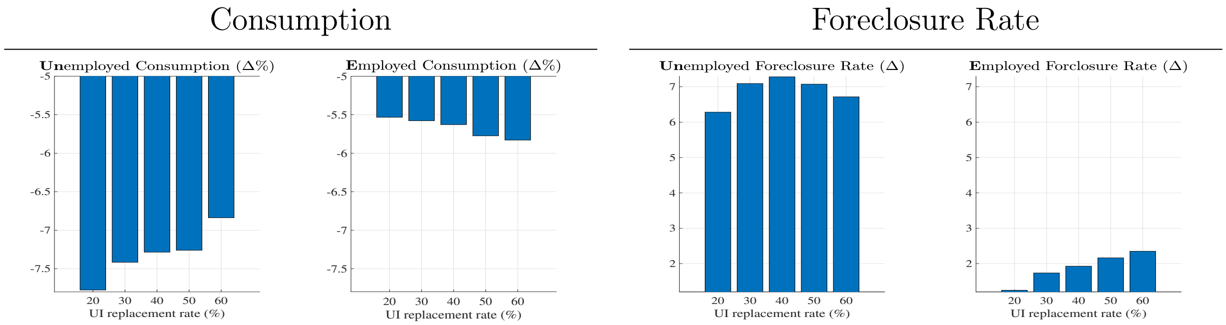
The foreclosure rate of the unemployed on the other hand follows a non-monotonic pattern because initially, for low UI, the destabilizing effects dominate. However, as UI generosity increases further, the insurance effect starts to dominate. For the employed, foreclosures during the bust is higher for the higher UI economies.

3.2.3 The Role of Bank Balance Sheet

In the previous experiments, we compared economies with permanently differing UI levels. These economies vary in the vulnerabilities of their banking systems, resulting in larger declines in bank net worth and larger increases in the equilibrium bank lending rate during the bust in more generous systems. Increasing UI for the entire economy generates a systemic vulnerability in the banking system, a factor not captured by studies relying on cross-sectional variation across regions within a country. On the other hand, when one state

[22]Their foreclosure rates vary from 1.2 percent with 20 percent replacement rate to 2.4 percent with 60 percent replacement rate.

Figure 9 – (De)stabilizing Effects: Unemployed versus Employed



Notes: The graph plots the dynamics of foreclosures and consumption for the employed and unemployed during the bust. Foreclosure rates are normalized by each group's homeownership rate. Consumption for employed and unemployed are normalized by the employment and unemployment rates for the respective groups. The shock during the boom is a gradual decline in interest rates from 3 to 2 percent. During the bust, interest rates reverse to the initial steady state, and the unemployment rate increases to 7.5 percent and declines back to 5.5 percent linearly in 6 years. Both the boom and bust shocks are unexpected. But, once realized there is perfect foresight.

in the US increases its UI, it does not generate a systemic risk in the national banking system. Consequently, empirical studies relying on cross-state variation in UI might underestimate (overestimate) the destabilizing (stabilizing) effects of UI since they do not capture the systemic risk created by increasing the UI for the whole economy.[23]

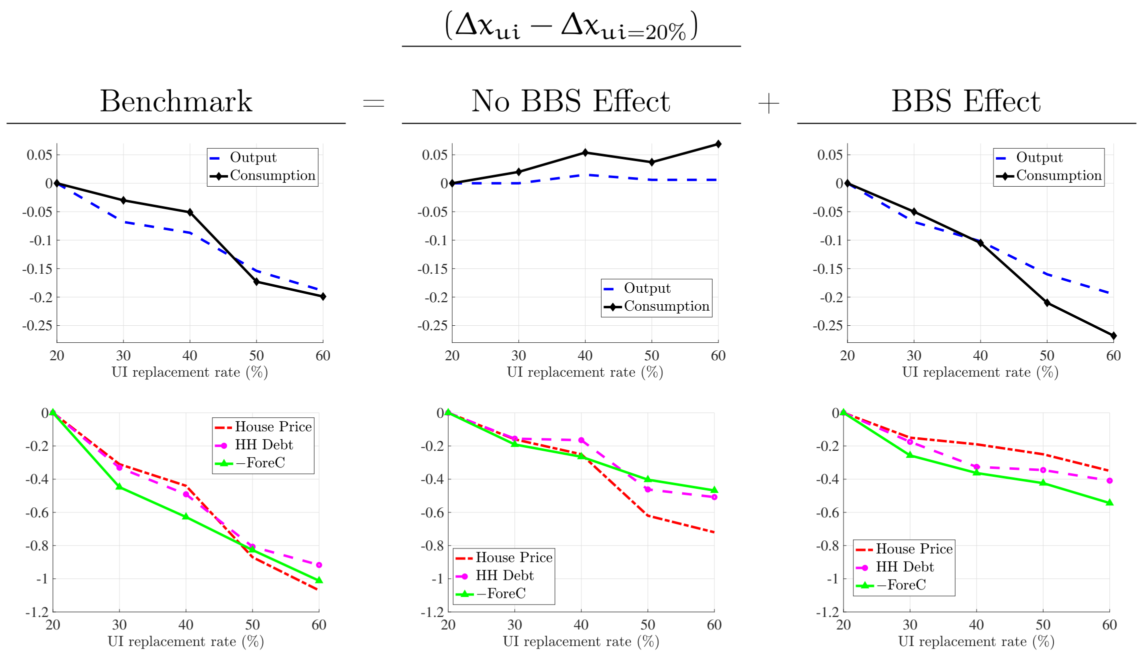
In this section, we shut down the bank balance sheet channel and isolate its role in the destabilizing effects of UI. To achieve this, we fix the credit spread $(r_\ell - r)$ to its steady state level, ensuring that r_ℓ moves one-for-one with the change in r. This essentially eliminates the spike in r_ℓ at the time of the bust. As a result, all bank balance sheet weaknesses that would arise due to more generous UI benefits do not affect the model dynamics, and the differences across different economies are driven solely by the household balance sheet channel.

Figure 10 presents the results of this exercise. In the left column, we present our benchmark results as the decline in a variable in an economy relative to the economy with a 20 percent replacement rate. The left column shows that the decline in output, consumption, house prices, and household mortgage debt is higher in economies with higher UI. The figure reports the negative of the foreclosure rate, so the increase in the foreclosure rate is larger in more generous systems.

We divide variables of interest into two groups. On the top row, we report consumption and output. The middle panel of that row presents the results when the bank balance sheet channel is shut down, showing that the destabilizing role of UI on output disappears. In fact, without the bank balance sheet channel, consumption declines less at the time of the bust in

[23]Cross-state variation in UI would capture the bank balance sheets effects in our model only to the extend that banks are local and local households and firms rely on local banks.

Figure 10 – The Role of Bank Balance Sheets (BBS)



Notes: The graph plots the dynamics of some of the key variables during the boom-bust episode where we decompose the bank and household balance sheet mechanisms. We compare the declines in variables to the decline in the 20-percent UI economy. The negative of the foreclosure rate is shown, so a more negative value for foreclosure indicates a larger decrease.

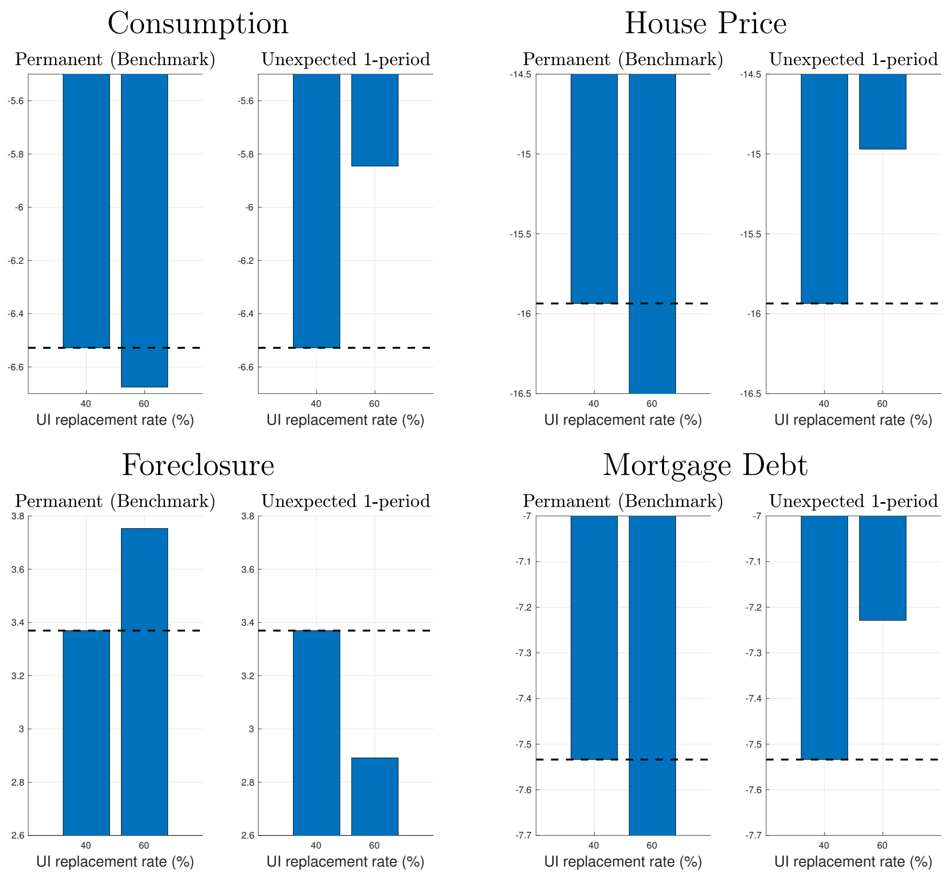
more generous UI systems. Thus, if we were not to take into account the bank balance sheet channel, we would have concluded that higher UI stabilizes consumption in the bust.

The second row reports the dynamics of house prices, household mortgage debt, and foreclosures, revealing that higher UI destabilizes these variables even in the absence of the bank balance sheet channel. Overall, the household balance sheet channel is a significant driver of the destabilizing effects of UI, and the bank balance sheet channel amplifies these effects on these variables. Moreover, this exercise shows that the destabilizing effects of UI on housing market variables should be visible even in a cross-sectional study that does not take into account the systemic risk. We pursue such an analysis in Section 4.

3.2.4 Unexpected Changes versus Permanent Differences in UI

The destabilizing effects of UI that we find is not an a-priori unambiguous outcome. In fact, the mechanisms that UI can stabilize the economy exist in our model. However, the balance sheet effects dominate its stabilizing effects. To illustrate this point, instead of comparing economies that are permanently different in UI generosity, we conduct an experiment in which, in the benchmark economy with a 40 percent replacement rate, the replacement rate is unexpectedly and temporarily increased to 60 percent during the bust period.

Figure 11 – Unexpected and Temporary Increase in UI



Notes: The graph plots the dynamics of some of the key variables during the bust episode where we compare the benchmark results with the case where UI benefits unexpectedly and temporarily increased to 60 percent (for one period) during the bust period.

We report the results of these experiments in Figure 11. Under each variable name, the left panel replicates our benchmark results. For example, the decline in consumption in the bust in the economy with a 60 percent replacement rate is larger than the one with a 40 percent replacement rate. The right panel shows that the decline in consumption in the economy in which the replacement rate is unexpectedly increased to 60 percent in the bust period is smaller than the one in our benchmark (5.84 percent versus 6.52 percent). Thus, an unexpected increase in UI actually stabilizes the economy in the downturn. The same conclusion applies to house prices, foreclosures, and mortgage debt.

Overall, temporary and unexpected increases in UI generosity stabilize downturns. But once the generosity becomes permanent, the economy enters the next recession with weaker balance sheets, which destabilizes the economy.

Our findings corroborate recent studies by Coglianese (2015), Kekre (2023), and Mitman and Rabinovich (2021). Coglianese (2015) examines the impact of UI extensions during the Great Recession and finds evidence of UI benefits boosting aggregate demand. Kekre (2023) argues that even a marginal increase in UI generosity can enhance aggregate demand, as the unemployed have a higher marginal propensity to consume. Mitman and Rabinovich (2021) study the optimal (Ramsey) UI policy in response to a shock that imitates the COVID-19 recession and conclude that a substantial and transitory increase in UI is optimal. Like these studies, we demonstrate that unexpected and temporary extensions of UI benefits can stabilize downturns. However, permanent differences in UI weaken household and bank balance sheets, outweighing its stabilizing effects. A related literature suggests that implementing counter-cyclical UI benefits, which are more generous during recessions, may be beneficial (Kroft and Notowidigdo (2016), Landais, Michaillat and Saez (2018*a*,*b*), and Gorn and Trigari (2024)).

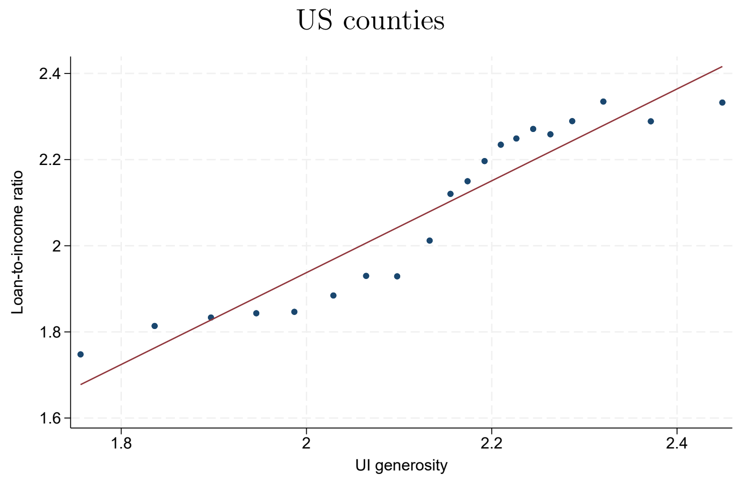
However, we refrain from drawing a policy conclusion that discretionary increases in UI during a bust or counter-cyclical UI stabilize the economy. Our results highlight the importance of ex-ante risk-taking effects of UI benefits. Absent those, unemployment benefits smooth downturns. However, policymakers cannot consistently surprise households and banks with temporary increases in benefits during recessions. If households and banks expect governments to expand the generosity of UI benefits in every deep recession, they will adjust their balance sheets accordingly. Thus, quantifying whether counter-cyclical UI policies stabilize or destabilize the economy requires proper modeling of aggregate risk.

4 Evidence from Micro Data

Our quantitative model provides three key empirically testable implications about the destabilizing nature of UI policies. First, the amount of mortgage debt is higher in regions with more generous UI. Second, as UI benefits become more generous, employed people are more likely to experience mortgage delinquency during an economic bust. Third, regions with more generous UI experience larger fluctuations in aggregates. In this section, we use individual, county and state level data from the U.S. to test these three implications.

In the U.S., the states have discretionary power over determining the dollar cap and the benefit duration for the UI benefit payments. The dollar cap is the weekly maximum dollar amount a person can receive, and the benefit duration is the maximum number of weeks he/she can receive this payment. To test the first and third implications, we follow the literature and use the product of the dollar cap and benefit duration as the measure of UI generosity of a state, which represents the maximum UI amount an unemployed individual can receive during his/her unemployment spell. To test the second implication about delinquency behavior of the employed, we follow Hsu, Matsa and Melzer (2018) and exploit the individual-level

Figure 12 – Loan-to-Income Ratio Increases with UI Generosity



Note: This graph plots a bin-scatter plot with a linear fit of LTI ratios on the vertical axis and the UI generosity on the horizontal axis. LTI ratio is the ratio of the mortgage amount to the income. UI generosity is the log of the maximum amount of money a person can get from UI.

information in the SIPP data, and use individual-level UI payment amount if that individual were unemployed. We discuss the data sources and summary statistics in Section D in the Appendix.

4.1 UI and Mortgage Borrowing

Our model illustrates a clear picture about the relationship between UI benefits and mortgage borrowing: more generous UI benefits increase mortgage borrowing. We conduct two exercises to see whether the data supports this implication.

4.1.1 Evidence from the US Counties

In the first exercise, we look at the association between loan-to-income (LTI) ratios at loan origination for residential mortgages and UI benefits. We start by plotting LTI ratios against UI benefits in Figure 12. This plot documents a positive and significant relationship between these two variables, providing evidence in favor of our model. Yet, this positive association could be driven by confounding factors, thereby we estimate the following regression model:

$$\mathsf{LTI}_{bcy} = \beta * \mathsf{UI\,benefits} + \gamma * \mathsf{Controls} + \mathsf{Year\,FE} + \mathsf{County\,FE} + \mathsf{Bank\,FE} + \varepsilon_{bcy}$$

where LTI_{bcy} is LTI ratio at county-bank-year level and $\mathsf{UI\,benefits}$ is at the state-year level. County-level controls include the log of average income, the share of subprime borrowers, the log of the size of labor force, HHI of industry composition and deposit markets; state-level controls include policies such as the log of minimum wage, health insurance payments, non-UI

Table 4 – Loan-to-Income Ratio and UI

	(1)	(2)	(3)	(4)	(5)	(6)
UI Benefits	0.330***	0.263***	0.149***	0.214***	0.220***	0.213***
	(0.042)	(0.041)	(0.040)	(0.077)	(0.076)	(0.074)
Controls	N	Y	Y	Y	Y	Y
Year FE	N	N	Y	Y	Y	Y
County FE	N	N	N	Y	Y	Y
Bank FE	N	N	N	N	Y	N
Bank*Time FE	N	N	N	N	N	Y
Obs.	2,008,819	2,008,819	2,008,819	2,008,819	2,008,819	2,008,819
R^2	0.065	0.082	0.100	0.183	0.305	0.370

Notes: This table documents the positive association between the LTI ratios and UI generosity. The dependent variable is LTI ratio at loan origination, which is the ratio of the mortgage amount to the income at the county-bank-year level. The main independent variable is UI generosity, which is the log of the maximum amount of UI benefit payment a person can receive during his unemployment spell. Control variables and fixed effects are indicated at the bottom of each column. Control variables are the log of county-level average income, the share of subprime borrowers, the log of the size of labor force, county-level HHI of industry composition and deposit markets, state-level log of minimum wage, health insurance payments, non-UI transfer payments, and union coverage. Standard errors are clustered at the state-year level.* $p<0.10$, ** $p<0.05$, *** $p<0.01$

transfer payments, and union coverage. We cluster the standard errors at the state-year level as this is the treatment level.

Table 4 shows the results. In column (1), we estimate the model without any control variables, except county-level income, and find a positive and significant coefficient for the UI benefits. In column (2), we include county- and state-level control variables. In the next four columns, we saturate the model with fixed effects. Column (3) includes year fixed effects to control for macro effects. Column (4) includes county fixed effects to control for time-invariant county characteristics.

One concern could be that observed or unobserved bank characteristics might drive the positive relationship between LTI ratios and UI benefits. We use the granularity of our data and include bank and bank$*$year fixed effects to control for time-invariant and time-varying bank characteristics in columns (5) and (6), respectively. The size of the estimate in column (6) suggests that as UI benefits increase from the 10^{th} percentile to the 90^{th} percentile, the LTI ratio increases by more than 20 percentage points (or 10 percent). Being economically large, this magnitude is also in line with the estimates we obtain from our model.

Table 5 – Construction of the Synthetic Missouri

	Weights
Connecticut	0.021
Illinois	0.113
Indiana	0.294
Minnesota	0.041
Nebraska	0.024
Ohio	0.004
Tennessee	0.402
West Virginia	0.101

	Missouri	Synthetic Missouri
LTI	2.08	2.08
Average Wages	39570.50	39571.20
Δlog(Wages)	2.70	2.70
House Prices	253.74	255.39
Unemployment Rate	6.72	6.73
Population	5900265.67	6370584.61
Δlog(GDP per-capita)	0.53	0.53
log(GDP per-capita)	10.66	10.66

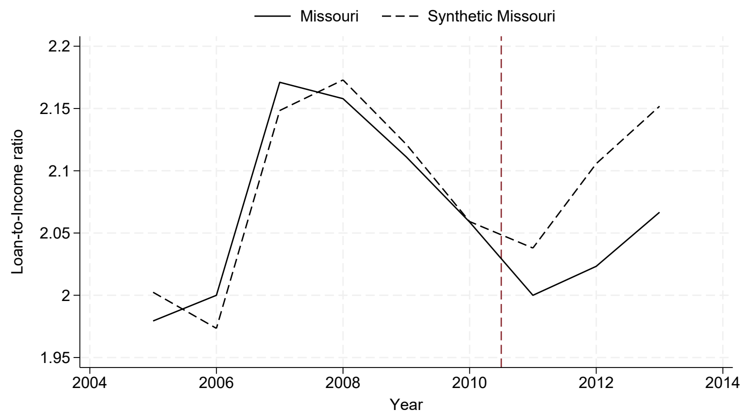
4.1.2 Evidence From Missouri: An Unexpected Cut in UI Duration

Although the positive relationship between LTI ratios and UI benefits documented in Table 4 is robust to various specifications, it is still subject to endogeneity given that UI generosity in a state is not random. We exploit an unexpected cut in UI benefits duration in Missouri in 2011 to investigate whether UI benefits have a causal effect on households' borrowing (Johnston and Mas (2018)).

The unexpected cut in UI benefits in Missouri is a result of the policies that become active after the Global Financial Crisis: Extended Benefits (EB) and Emergency Unemployment Compensation (EUC). EB is a permanent program that is enacted in states with high unemployment. Before the crisis, the federal government shared the costs of this program with the state governments. Yet, the federal government started to cover all of the program costs once the Recovery Act was passed in 2009. As a reaction, Missouri implemented a legislation that increased EB duration to 20 weeks from 13 weeks. Similar to EB, EUC provided additional duration, while it is a temporary program implemented after the crisis and lasted until December 2013. EUC was federally funded from the beginning and can provide potentially 53 weeks of additional benefits, depending on the amount of the existing UI benefits.

The unexpected reduction in UI benefit duration in Missouri was a consequence of a filibuster. Four Missouri State Senate members objected to accepting federal money to increase UI duration under the EB program. To end the filibuster, the lawmakers agreed to cut the regular UI duration to 20 weeks from 26 weeks, while accepting the funding via EB program. Since the duration provided by the EUC program depends on the duration of the regular UI duration, the 6-week cut triggered an additional 10-week cut in the EUC program, decreasing the total duration to 57 weeks from 73 weeks. As documented in detail by Johnston and Mas (2018), this reduction is completely unexpected and unrelated to the

Figure 13 – Loan-to-Income Ratio and UI Generosity: Evidence from Missouri



Note: The graph plots the dynamics of LTI ratio for Missouri and the "synthetic Missouri".

economic conditions in Missouri. Moreover, the whole filibuster and negotiation process lasted slightly more than a month, making this policy change an ideal setting for our research question.

We exploit this policy change by applying a synthetic control approach as Missouri is the only affected unit (Karahan, Mitman and Moore (2019)). Intuitively, this approach creates a synthetic Missouri by assigning weights to other states. The weights are assigned to each state to minimize the mean squared prediction error between Missouri and control states prior to the benefit cut.[24] Our baseline synthetic counterfactual is constructed from state-specific weights selected to match the pre-treatment values of certain moments. Table 5 displays the basket of states with their assigned weights as well as the moments that we used to generate the synthetic Missouri. The similarity between Missouri and the synthetic Missouri indicates that this approach can replicate the treatment unit successfully. The reduction in duration is implemented in April 2011. Since we have LTI data at the annual level, we classify 2011 and the years after as post-treatment period.

Figure 13 shows our results: the average LTI ratio in Missouri would have been 10 basis points (approximately 5 percent) higher if the unexpected cut did not happen.[25] In line with the similarity documented in Table 5, Missouri and synthetic Missouri have parallel trends before the policy change, indicating a causal relationship between UI benefits and LTI ratios.

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[24]We exclude states that cut UI duration around the time of Missouri's policy change from the donor pool, as the synthetic control must be a weighted average of untreated units.

[25]The results are very similar in magnitude when we use the state-level aggregate LTI ratio or median LTI ratio.

4.2 UI and Delinquency Behavior of the Employed

Our model suggests a crucial role for the employed to understand the (de)stabilizing effects of the UI. Namely, while a higher UI increases leverage ratios of both employed and unemployed, only the unemployed enjoy the UI payments, leaving the employed more vulnerable to negative economic shocks. We assess the empirical relevance of this mechanism by using the SIPP data, in which we observe the mortgage delinquency and employment status of individuals. First, we document that while the delinquency rate is higher for the unemployed, the employed also experience delinquency. Panel A of Table 6 shows that the delinquency rate is around 4 percent for the employed and around 12 percent for the unemployed. These magnitudes indicate that, in an economy with an unemployment rate of 5 percent, the majority of the delinquencies are experienced by the employed.

Motivated by this fact, we use the 2010 cycle of the SIPP data to explore whether employed individuals who would receive higher UI benefits experienced a higher delinquency during the 2008 crisis. To test this hypothesis, following Hsu, Matsa and Melzer (2018), we first calculate an individual-level UI generosity by using the wage and employment status in the SIPP data, which captures the amount of UI payments an employed person would get if he/she was unemployed. Then, we regress the delinquency dummy on the individual UI generosity in Panel B of Table 6. In line with our model's prediction, the delinquency probability of the employed increases as their UI generosity increases. Specifically, the delinquency probability increases by 73 basis points, or 12 percent, when UI generosity increases by one standard deviation. Controlling for state-level or individual-level characteristics in the next two columns of Panel B does not change this result.[26]

4.3 Destabilizing Effects of UI

In this section, we test whether UI benefits act as an automatic stabilizer. Our quantitative model suggests that UI can work as a destabilizer in the housing market even after controlling for the general equilibrium effects if its effect through borrowing is stronger than its effect through UI payments. We test whether UI works as a stabilizer or destabilizer by investigating how county-level home prices and mortgage originations respond to the changes in long-term interest rates conditional on the level of UI generosity in the county.[27] We use long-term interest rates since we study the implications of such rates in the quantitative model.

[26] We also report a positive association between UI benefits and LTV ratios in Table 9.

[27] We obtain mortgage information from Neil Bhutta's webpage (Bhutta (2024)) and explain the details in the Online Appendix.

Table 6 – UI and Delinquency Behavior of the Employed

Panel A

	All	Unemployed	Employed
Delinquency Rate	5.37	12.10	4.23

Panel B

	Delinquency of Employed		
	(1)	(2)	(3)
UI Benefits	0.155*	0.149*	0.127*
	(0.083)	(0.082)	(0.069)
Controls:			
State Controls		✓	✓
Individual Controls			✓
Obs.	9,901	9,901	9,901
R^2	0.013	0.014	0.021

Notes: This table documents that the employed also experience delinquency (Panel A), and they are more likely to experience delinquency in an economic bust period when UI benefits are higher (Panel B). Panel A reports the mean values of mortgage delinquency rate of the employed, unemployed, and the whole population. Panel B reports a regression analysis, in which the dependent variable is delinquency status and the main independent variable is UI generosity at the individual-level. All regression models include earnings as control. State control variables include unemployment rate, real GDP per capita, and wages. Individual controls include education status, and household earnings in the quarter prior to the one-year mortgage delinquency window. Standard errors are clustered at the state level. * p<0.10, ** p<0.05, *** p<0.01

Specifically, we estimate the following model

$$\begin{aligned}\Delta y_c^m &= \beta_1 \Delta \mathit{Int.\ Rate}_{10y}^{q-1} + \beta_2 \Delta \mathit{Int.\ Rate}_{10y}^{q-1} \cdot \mathit{UIBen.}_c^y + \mathit{UIBen.}_c^y \\ &\quad + \mathit{Macro\ Controls}^{q-1} + \mathit{State\ Controls}_c^y + \mathit{County\ Controls}_c^y + \theta_c + \mu_m + \epsilon_{c,t} \end{aligned} \tag{2}$$

where Δy_c^m is the quarterly outcome variable (house prices and new mortgage loans), $\Delta \mathit{Int.\ Rate}_{10y}^{q-1}$ is quarterly change in 10-year U.S. Treasury interest rate, $\mathit{UIBen.}_c^y$ is a dummy variable, which takes value 1 if UI generosity is above the median.[28] We expect to find a negative effect of long-term rates (i.e., negative β_1) since an increase in long term rates should decrease mortgage originations and house prices. Our coefficient of interest is the interaction of UI benefits and long-term rates, captured by β_2. If the interaction term is positive, it would indicate UI dampens the impact of long-term rates. On the other

[28]We scaled the variables so that the coefficient of $\Delta \mathit{Int.\ Rate}_{10y}^{q-1}$ shows the magnitudes in standard deviation.

hand, if the interaction term is negative, it would indicate that UI fails to be an automatic stabilizer, instead, amplifies the impact of the long-term rates on house prices and mortgage originations.

There are a few challenges that we need to address to interpret the coefficient of the interaction term correctly. The first challenge is related to the macroeconomic variables that are correlated with UI benefits, house prices, and mortgages. To control for such factors, we include log changes in GDP, changes in the unemployment rate, and changes in the CPI, and interact these variables with UI benefits. Therefore, our coefficient of interest is not affected by the major macroeconomic variables and their interaction with UI benefits.

The second challenge is that UI is not the only welfare policy determined at the state level since U.S. States can choose their minimum wage, public health insurance coverage, and the amount of total monetary transfers. If the other state-level welfare policies also interact with $\Delta \mathsf{Int.\ Rate}^{q-1}_{10y}$, then β_2 would be biased. To address this challenge, we add the interactions of $\Delta \mathsf{Int.\ Rate}^{q-1}_{10y}$ with other state-level welfare policies into the model. Moreover, we include month fixed effects, μ_m, to control for seasonality in outcome variables, county fixed effects, θ_c, to control for time-invariant county characteristics, and a battery of county control variables in the model.[29]

We report the results of our estimations in Table 7. We find that, for both house prices and mortgages, $\Delta \mathsf{Int.\ Rate}^{q-1}_{10y}$ has the expected negative sign. The magnitude of the coefficient suggests that as $\Delta \mathsf{Int.\ Rate}^{q-1}_{10y}$ increases by one standard deviation, mortgage growth rates decrease by 1.13 standard deviation and house price growth rates decrease by 0.84 standard deviation. More importantly, the interaction term of $\mathsf{UIBen.}^{y}_{c}$ and $\Delta \mathsf{Int.\ Rate}^{q-1}_{10y}$ has a negative sign, indicating that UI amplifies the effect of the interest rate shock and works as a destabilizer. In particular, one standard deviation higher UI benefits increases the effect of $\Delta \mathsf{Int.\ Rate}^{q-1}_{10y}$ by approximately 10 percent for both mortgages and house prices. Next, we control for observed and unobserved time factors by including year fixed effects in columns (2) and (6). Year fixed effects absorb the direct effect of the long-term rates. Yet, the size of the interaction term stays stable with high statistical significance.

Even though we control for major macroeconomic variables, state-level welfare policies, and a battery of county-level variables, there could still be factors that could induce a bias. We tackle this concern with two strategies. First, we use a propensity score matching to create county pairs that are as similar as possible, except for the UI benefits. By doing so, we

[29] County controls are log of total wage, log change of labor force, log of population, log change of establishments, log change of nominal personal income, change in sectoral employment HHI, change in deposit market HHI.

can compare how two matched counties differ in their reaction to long-term rates due to their different UI benefits. Second, we utilize the heterogeneity in UI benefit generosity across the states. We exploit this heterogeneity by employing a border discontinuity design at the county level (Dube, Lester and Reich (2010); Hagedorn et al. (2013); Hagedorn, Manovskii and Mitman (2015); Arslan, Degerli and Kabas (2024)). Being located next to each other, these counties arguably experience similar economic shocks. Yet, being located in different states, these counties have different levels of UI benefits. Thus, comparing these neighboring counties to each other controls for the economic shocks that could introduce a bias into our estimations. To make this comparison, we form county pairs that consist of two neighboring counties located in different states and include pair$*$year fixed effects. We report the results in columns (3)-(4) and (7)-(8). Consistent with the previous columns, the interaction term is negative with a similar magnitude. Overall, these results provide robust evidence that UI benefits might fail to act as an automatic stabilizer.

Table 7 – Interest Rate Shock and UI Benefits: Mortgages and House Prices

	$\Delta\log(\text{Mortgages})$				$\Delta\log(\text{House Prices})$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All	All	Pair(matching)	Pair(border)	All	All	Pair(matching)	Pair(border)
$\Delta\text{Int.Rate}^{10y}_{q-1}$ X UI Ben.	-0.128***	-0.121***	-0.056*	-0.059*	-0.077***	-0.068***	-0.084***	-0.059*
	(0.031)	(0.037)	(0.031)	(0.030)	(0.014)	(0.018)	(0.024)	(0.033)
$\Delta\text{Int.Rate}^{10y}_{q-1}$	-1.128***				-0.840***			
	(0.383)				(0.258)			
County Controls	✓	✓	✓	✓	✓	✓	✓	✓
State Controls					✓	✓	✓	✓
Macro Controls	✓	✓	✓		✓	✓		
County FE	✓	✓	✓	✓	✓	✓	✓	✓
Seasonality FE	✓				✓			
Time FE		✓				✓		
Pair(matching)*Time FE			✓				✓	
Pair(border)*Time FE				✓				✓
Obs.	93,873	93,873	29,214	34,932	280,903	280,903	175,826	124,384
R^2	0.491	0.774	0.892	0.933	0.193	0.298	0.705	0.722

Notes: This table estimates the effect of long term interest rates changes on house prices and mortgages and how generous UI benefits affect this relationship. The dependent variable is quarterly log change of house prices, $\Delta\log(\text{House Prices})$ in columns (1)-(4) and quarterly log change of mortgage originations, $\Delta\log(\text{Mortgages})_c$ in columns (5)-(8). The main independent variable is the change in 10-year interest rate, $\Delta\text{Int. Rate}^{10y}_{q-1}$ and its interaction with UI benefits, UIBen.^{y}_{c}. UIBen.^{y}_{c}. is a dummy variable which is 1 if the value is above median of the sample of each year. Control variables and fixed effects are indicated at the bottom of each column. County controls are log of total wage, log change of labor force, log of population, log change of establishments, log change of nominal personal income, change in sectoral employment HHI, change in deposit market HHI. County controls are yearly. Macro controls are log change in GDP, change in unemployment rate, change in VIX, change in CPI, and interaction of these variables with UIBen.^{y}_{c}. All macro controls are quarterly and enter the model with 1 quarter lag. State controls include minimum wage, aggregate non-UI transfers, aggregate state health insurance payments and their interactions with $\Delta\text{Int. Rate}^{10y}_{t-1}$. These variables are dummy variables which is 1 if the value is above median of the sample of each year. Columns (1)-(2) and (5)-(6) use the entire sample. Columns (3) and (7) use matched sample. Columns (4) and (8) use contiguous counties across state borders. In columns (4) and (8), crucial fixed effects are $\text{Pair} * \text{Time}$ fixed effects. Standard errors are clustered at state and time level in columns (1)-(3) and (5)-(7), at border segment and state level in column (4). * p<0.10, ** p<0.05, *** p<0.01

5 Conclusion

In this paper, we examine whether UI policies stabilize economic cycles. Contrary to the common view, we present both empirical and theoretical evidence that UI can, in fact, destabilize economic fluctuations. We abstain from making any normative arguments. Instead, we provide a new perspective on a particular question that has been of interest to both researchers and policymakers.

Two interconnected mechanisms drive our results. First, with higher UI, individual income risk is lower, prompting households to reduce precautionary savings and increase mortgage borrowing. Since default risk for households is also lower, banks offer better credit terms, further increasing household borrowing. As a result, household balance sheets become more vulnerable to adverse aggregate shocks. Second, since mortgages are assets on bank balance sheets, these balance sheets also become more susceptible to adverse aggregate shocks. Our quantitative model demonstrates that these balance sheet channels dominate the stabilizing effects of UI, leading to more significant economic downturns in more generous economies in response to negative aggregate shocks. We also confirm the predictions of the quantitative model for house prices and mortgage debt by providing evidence from the U.S. micro data. We have particularly focused on UI in this paper. However, any government policies that provide insurance, such as welfare programs or progressive taxation, may reduce precautionary saving and increase household leverage. This can add to the destabilizing effects of UI. Extending the analysis to include such policies is an interesting area for future research.

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APPENDIX

A Model Details

A.1 Household Decision Problems

The rate of return on household liquid wealth a is denoted by r_i, where $r_i = r_k$ for the capitalists and $r_i = r_d$ for depositors. The timing of events is as follows:

1. Labor efficiency shock is realized
2. Household makes housing tenure decisions (i.e., being a homeowner versus a renter) depending on the current housing tenure
3. Household makes consumption, saving, mortgage debt, housing services choices and moves to the next period.

Household can be in one of three housing tenure status in the beginning of a period: (i) active renter, (ii) inactive renter, (iii) homeowner. Below we define the value functions and choices for each case.

A.1.1 Active Renters

An active renter has two choices: to continue to rent or purchase a house, i.e. $V^r = \max\left\{V^{rr}, V^{rh}\right\}$ where V^{rr} is the value function if she decides to continue renting and V^{rh} is the value function if she decides to purchase a house. An active renter who chooses to rent only makes housing services (s), consumption (c), and saving decisions and continues to the next period as an active renter.

$$V^{rr}_{ij}(a, z, k) = \max_{c,s,a' \geqslant 0} \left\{u(c, s) + \beta_i E V^r_{j+1}(a', z', k')\right\} \tag{3}$$

subject to

$$c + a' + p_r s \quad = \quad wy(j, z) + a\,(1 + r_i)$$

If an active renter chooses to purchase a house, she can access the mortgage market to finance her purchase. She chooses a mortgage debt level d that determines $q^m(d; a, h, z, j, k)$, the price of the mortgage at the origination, which will be a function of the current state of the household (current wealth a, income realization z, employment status k, and age j), house size h, and the amount of debt d. The housing services of the homeowner is assumed to be equal to the housing size: $s = h$. The value function of an active renter who buys a house is given by

$$V_{ij}^{rh}(a, z, k) = \max_{c,d,h,a' \geqslant 0} \left\{ u(c, h) + \beta_i E V_{ij+1}^{h}(a', h, d, z', k') \right\} \tag{4}$$

subject to

$$\begin{aligned} c + (1+\delta_h)\, p_h h + \varphi_f + a' &= wy(j, z) + a\,(1 + r_i) + d\,(q^m(d; a, h, z, k, j) - \varphi_\nu) \\ d &\leqslant p_h h\,(1 - \phi)\,, \end{aligned}$$

x': the next period value of any variable x,

z: income shock,

k: employment status

a: the beginning-of-period financial wealth,

p_r: the rental rate,

r_i: is the return to savings. Capitalists have rate of return $r_k = \tilde{r}$ and depositors have rate of return $r_d = r$.

w: wage rate per efficiency unit of labor.

E: expectation operator is over the income shock z'.

p_h: housing price,

δ_h: depreciation rate for housing,

υ: the maintenance cost proportional to the housing size,

ν: the variable cost of mortgage origination,

φ_f: the fixed cost of paid at the origination,

ϕ: is the minimum down payment ratio.

A.1.2 Inactive Renters

Inactive renters are not allowed to purchase a house because of their default in previous periods. However, they can become active renters with probability π. Since they cannot buy a house, they only make housing services, consumption, and saving decisions. The value function of an inactive renter is given by

$$V_{ij}^{d}(a,z,k)=\max_{c,s,a'\geqslant 0}\left\{u(c,s)+\beta_i\left[\pi EV_{j+1}^{r}(a',z',k')+(1-\pi)EV_{ij+1}^{d}(a',z',k')\right]\right\} \quad (5)$$

subject to her budget constraint

$$c+a'+p_r s \;=\; wy(j,z)+a\left(1+r_i\right)$$

A.1.3 Homeowners

A homeowner has four options: i.e., $V^h=\max\left\{V^{hh},V^{hf},V^{hr},V^{hd}\right\}$, where $V^{hh}$is the value of staying as homeowner, V^{hf} is the value of refinancing,V^{hr} is the value of selling, and V^{hd} is the value of defaulting.

Stayer: A stayer makes consumption and saving decisions given his income shock, housing, mortgage debt, and assets.

$$V_{ij}^{hh}\left(a,h,d,z,k\right)=\max_{c,a'\geqslant 0}\left\{u\left(c,h\right)+\beta_i EV_{ij+1}^{h}\left(a',h,d',z',k'\right)\right\} \quad (6)$$

subject to

$$c+\delta_h p_h h+a'+m \;=\; wy\left(j,z\right)+a\left(1+r_i\right)$$

where m is the periodic mortgage payment. Given the assumptions on the mortgage structure, the relation between mortgage debt d and mortgage payment m in a period is given by

$$d=m\left(1+\frac{1}{1+r_\ell}+\frac{1}{\left(1+r_\ell\right)^2}+...+\frac{1}{\left(1+r_\ell\right)^{J-j}}\right) \;\Leftrightarrow\; m\left(d\right)=d\frac{r_\ell\left(1+r_\ell\right)^{J-j}}{\left(1+r_\ell\right)^{J-j+1}-1} \quad (7)$$

Then, the remaining mortgage debt in the following period will be $d'=\left(d-m\right)\left(1+r_\ell\right)$. Notice that the homeowner needs to pay δ_h fraction of the house value as the maintenance cost to cover the depreciation of the house.

Refinancer: Refinancing requires paying the full balance of any existing debt and getting a new mortgage. We assume that refinancing is subject to the same transaction costs as new mortgage originations.

$$V_{ij}^{hf}(a,h,d,z,k)=\max_{c,d',a'\geqslant 0}\left\{u(c,h)+\beta_i E V_{ij+1}^{h}(a',h,d',z',k')\right\} \tag{8}$$

subject to

$$c+d+\delta_h p_h h+\varphi_f+a'=wy(j,z)+a\,(1+r_i)+d'\left(q^m(d';a,h,z,k,j)-\varphi_v\right)$$

$$d'\leqslant p_h h\,(1-\phi)\,.$$

Seller: Selling a house is subject to a transaction cost that equals fraction φ_s of the selling price. Moreover, a seller has to pay the outstanding mortgage debt, d, in full to the lender. A seller, upon selling the house, can either rent a house or a buy a new one. Her problem is identical to a renter's problem.

$$V_{ij}^{hr}\,(a,h,d,z,k)=V_{ij}^{r}\,(a+p_h h(1-\varphi_s)-d,z,k)$$

Defaulter: A defaulter has no obligation to the bank. The bank seizes the house, sells it on the market, and returns any positive amount from the sale of the house, net of the outstanding mortgage debt and transaction costs, back to the defaulter. For the lender, the sale price of the house is assumed to be $(1-\varphi_e)\,p_h h$. Therefore, the defaulter receives $\max\{(1-\varphi_e)\,p_h h-d,0\}$ from the lender. The defaulter starts the next period as an active renter with probability π. With probability $1-\pi$, she stays as an inactive renter.

$$V_{ij}^{hd}\,(a,d,z,k)=\max_{c,s,a'\geqslant 0}\left\{u\,(c,s)+\beta_i E\left[\pi V_{ij+1}^{r}\,(a',z',k')+(1-\pi)\,V_{ij+1}^{d}\,(a',z',k')\right]\right\} \tag{9}$$

subject to

$$c+a'+p_r s \;=\; a\,(1+r_i)+wy\,(j,z)+\max\{(1-\varphi_e)\,p_h h-d,0\}$$

A.2 Banks

As shown in Arslan, Guler and Kuruscu (2023), the problem of bankers can be written as:

$$V^{B}(\omega)=\max_{c_B,B',L'}\left\{\log(c_B)+\beta_L V^{B}(\omega')\right\}$$

subject to

$$\begin{aligned} c_B+L' &= \omega+B' \\ (1-\eta)(1+r'_\ell)L' &\geqslant (1+r')B' \end{aligned} \tag{10}$$

where

$$\eta=\xi^{1-\beta_L}\left((1+r')/(1+r'_\ell)-(1-\eta')\right)^{\beta_L}$$

is the endogenous leverage constant which arises due to the possibility of bank default. It limits the amount of borrowing the bank can make. The evolution of bank net worth, ω, is given by: :

$$\omega = L(1+r_\ell)-B(1+r),$$

where the amount of loans, L, is given by the sum of total loans made to firms, L^k, and households:

$$L = L^k+\int_\theta p_\ell(\theta)\,\ell(\theta)$$

where $\ell(\theta)$denotes the amount of mortgage loans given to households with characteristics summarized by $\theta\equiv(a,d,h,j,z)$ and $p_\ell(\theta)$ is the market value of one unit of loan made to a household with characteristics θ. $p_\ell(\theta)$ is given by the present discounted value of mortgage payments:

$$p_\ell(\theta)=m_\ell(\theta)+\frac{1}{1+r'_\ell}\int_{\theta'}p_\ell(\theta')\,\Pi(\theta'|\theta) \tag{11}$$

where Π denotes the transition matrix of the household state including the endogenous states such as asset, debt and housing together with the exogenous ones such as age and income shocks, m_ℓ denotes the current period payments of the loan, which includes either the periodic mortgage payment, $m(d)$, if the mortgage holder keeps the current mortgage, or the mortgage principle, d, if the mortgage holder prepays either by selling the house or refinancing the mortgage, or the value of the foreclosed property, $\min\{p_h h(1-\varphi_e),d\}$, if the mortgage holder defaults on the mortgage:

$$m_\ell(\theta) = \begin{cases} m(d) & \text{if stays} \\ d & \text{if refinance or sell} \\ \min\{p_h h(1-\varphi_e), d\} & \text{if defaults} \end{cases}$$

The price of a mortgage at origination is determined through zero-profit condition for banks:

$$d = q^m(d;\theta) = \bar{m}_\ell(\theta) + \frac{1}{1+r'_\ell}\int_{\theta'} p_\ell(\theta')\Pi(\theta'|\theta) \tag{12}$$

where $\bar{m}_\ell$ is the first-period payment of the mortgage which also includes the upfront fees to reduce the mortgage interest rate to the risk-free mortgage rate, r_ℓ. The default risk will show up in $\bar{m}_\ell$, which will pin down q^m. In the absence of any default risk $\bar{m}_\ell(\theta) = m(\theta)$, which is given in equation 7.

c_B: the banker's consumption,

B: bank's borrowing amount,

r: bank's borrowing rate,

L^k: bank lending to the firm,

$\theta = (d; a, h, z, j)$: define type of a mortgage (defined above by the household's problem),

$p_\ell(\theta)$: the market value of a mortgage type $\theta = (d; a, h, z, j)$,

ω: the bank's net worth,

$\ell(\theta)$: the amount of bank's holding of mortgage type θ.

A.3 Good-producing Firms

A perfectly competitive firm maximizes

$$\max_{K,N,u} \mathbb{Z}K^\alpha (Nu)^{1-\alpha} - (r_k+\delta)K - (1+\mu r_\ell)\,w(\bar{w}, u)\,N. \tag{13}$$

$\mathbb{Z}$: productivity,

N: number of workers,

u: labor utilization rate,

K:capital,

w: wage rate, $w(\bar{w}, u) = \bar{w} + \varphi \frac{u^{1+\psi}}{1+\psi}$,

$\bar{w}$: base wage rate

A.4 Real Estate Companies

The objective of the company is to maximize its total market value $V^{rc}(H_r)$:

$$\begin{aligned} V^{rc}(H_r) &= \max_{H'_r} \frac{1}{1+r_k}\left(d_r + V(H'_r)\right) \\ &\text{s.t.} \\ d_r &= (p_r - \kappa) H'_r + p_h (1-\delta_h) H_r - p_h H'_r - \frac{p_h (H_r - H'_r)^2}{2}. \end{aligned} \tag{14}$$

$(1-\delta_h) H_r$: units of housing stock that rental company owns,

δ_h: depreciation rate of housing,

$p_h (H_r - H'_r)^2$: quadratic adjustment cost,

$(p_r - \kappa) H_r$: net rent,

κ : per-period maintenance cost,

d_r: dividend to shareholders.

From the no-arbitrage condition:

$$1 + r_k = \frac{d_r + V^{rc}(H'_r)}{V^{rc}(H_r)},$$

where $V^{rc}(H'_r)$ is the post-dividend market value of the company at the end of period. The solution to this problem gives us the equation for the rental prices:

$$p_r = \kappa + p_h (1 + H'_r - H_r) - \frac{p'_h (1 - \delta_h + H''_r - H'_r)}{1 + r_k} \tag{15}$$

A.5 Government

Government runs the social security and the UI programs. Both programs are balanced-budget programs, i.e. the costs of the programs are solely financed through taxes. Social security program taxes are collected from working age population including the unemployed.

UI taxes are collected from employed individuals. Thus, these taxes need to satisfy the government's budget constraints:

$$\sum_{j=1}^{J_R} \sum_{k \in \{e,u\}} \sum_{z^k} \tau_s \exp(f(j) + z_j^k) \Gamma_{j,k}\left(z^k\right) = \sum_{j=J_R+1}^{J} \sum_{z} y_R\,(j,z)\,\Gamma_j\,(z) \tag{16}$$

$$\sum_{j=1}^{J_R} \sum_{z^e} \tau_u \exp(f(j) + z_j^e) \Gamma_{j,e}\,(z^e) = \theta \sum_{j=1}^{J_R} \sum_{z^u} \exp(f(j) + z_j^u) \Gamma_{j,u}\,(z^u) \tag{17}$$

where $\Gamma_{j,k}$ represents the marginal distribution of individuals over labor efficiency shocks conditional on age j and employment status k.

A.6 Definition of Equilibrium

We provide a definition of equilibrium for the stationary equilibrium. The equilibrium definition for the transition is similar.

Definition 1. A Stationary Competitive Equilibrium is a collection of value functions for households, V^o $(o \in \{h, r, d\})$, for banks V^B, for real estate companies, V^{rc}, policy functions for households' consumption (g_c), saving (g_a), housing services (g_s), housing stock (g_h), mortgage debt (g_d), tenure decisions (g_o), firms' labor (N), capital (K), utilization (u), real estate companies' housing stock (H_r), banks' consumption (c_B), loans $\left(\ell, L^k, L\right)$, borrowing (B), prices for labor (w), capital (r_k), houses (p_h), rental properties (p_r), loans (r_ℓ, q^m), taxes (τ_s, τ_u), and a stationary distribution (Γ) such that

1. Given prices $(p_h, p_r, w, r_k, r_\ell, q^m, r)$ and taxes (τ_s, τ_u), policy functions for households $(g_c, g_a, g_s, g_h, g_d, g_o)$ solve the households' problems in 3-9, and V^o is the associated value function for households.

2. Given prices (r_ℓ, w, r_k), firms' policy functions (K, N, u) solve firms' problem in 13

3. Given prices (p_h, p_r, r_k), real estate companies' policy function (H_r) solves the problem in 14

4. Given prices (r_ℓ, r), banks' policy function (c_B, L, B) solves 10

5. q^m solves 12

6. p_r solves 15

7. Given stationary distribution Γ, markets clear:

$$\text{asset market:} \int a d\Gamma(\theta) = A = K + V^{rc}(H_r)$$

$$\text{labor market: } N = 0.945$$

$$\text{housing market:} \int h d\Gamma(\theta) + H_r = H = \bar{H}$$

$$\text{credit market:} L^k + \int_\theta p_\ell(\theta)\,\ell(\theta) = L$$

where $L^k = \mu w(\bar{w}, u) N$ is the firm's borrowing, $\ell(\theta) = \Gamma(\theta)$, i.e. banks' mortgage holding is equal to the demand for mortgages by households, and p_ℓ is given by 11.

8. Given stationary distribution Γ, the government runs balanced-budget, i.e. $\{\tau_s, \tau_u\}$ solve equations 16 and 17.

9. The distribution Γ is stationary and consistent with the policy functions of households:

$$\Gamma = G(\Gamma)$$

where the mapping G is obtained through the policy functions of households and evolution of exogenous states.

B Auxiliary Quantitative Results

B.1 Life-Cycle Dynamics in the Steady-state

Consistent with the earlier literature, consumption is hump-shaped and more than doubles from age 21 to 55 in all economies. But the rise of consumption is higher in lower UI economies (Figure 14, top-left panel). homeownership rate and mortgage debt start lower in the 20-percent UI economy (Figure 14, top-middle and -right panels).

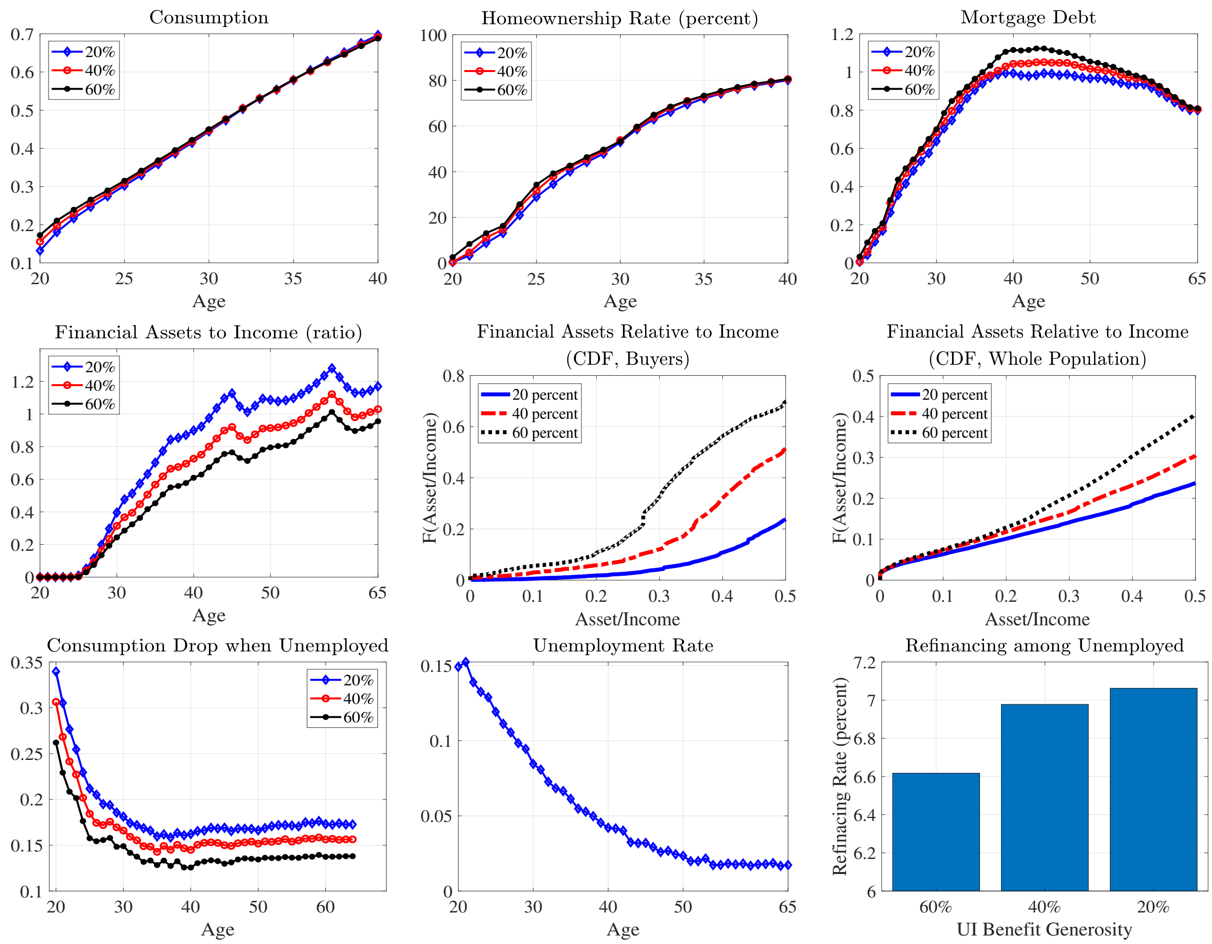
Liquid asset holdings of households decline as UI gets more generous (Figure 14, middle panels). Over the life-cycle, households in the 20-percent UI economy accumulates financial assets faster. And at the age of 50, they hold about 25 percent more financial assets compared to the household in 60-percent UI economy. A similar picture arises when we compare financial assets to debt (for both owners and new buyers).

For all these results, the dynamics of income risk plays a crucial role. When UI generosity declines, the precautionary saving motive becomes more powerful, which keeps consumption and housing low at young ages. As unemployment risk declines with age, consumers start to consume their savings. On top of that, default cost lowers the mortgage demand over the life cycle.

Both the decline in consumption when unemployed and the effect of benefits on the consumption drop are in line with the estimates found in the literature (Figure 14, lower-left panel). For example, Ganong and Noel (2019) document that household consumption declines by about 10 percent upon unemployment. Regarding the effects of UI generosity, Gruber (1997) and more recently Kroft and Notowidigdo (2016) find that a 10 percentage point increase in UI generosity leads to about a 2.8 percent reduction in the fall in consumption upon job loss.

UI also affects the refinancing activity (Figure 14, lower-right panel). Once unemployed, households tap into their home equity and refinance. However, refinancing is larger for lower UI economies as the UI benefits are not enough to smooth the decline in consumption. This suggests that UI and refinancing act like substitutes. The wide-spread use of refinancing among unemployed is consistent with the recent findings in Braxton, Herkenhoff and Phillips (2020) that suggest unemployed individuals maintain significant access to credit.

FIGURE 14 – UI and Life-Cycle Dynamics



Notes: The graph plots life-cycle dynamics of key variables in the steady-state for different UI benefit levels. "Consumption drop" is the average of consumption drops of recently unemployed relative to their consumption when employed during the previous period. "Refinancing" is the percent of individuals who refinances. Consumption and homeownership rate graphs are plotted for ages between 20 and 40 to make the differences visible.

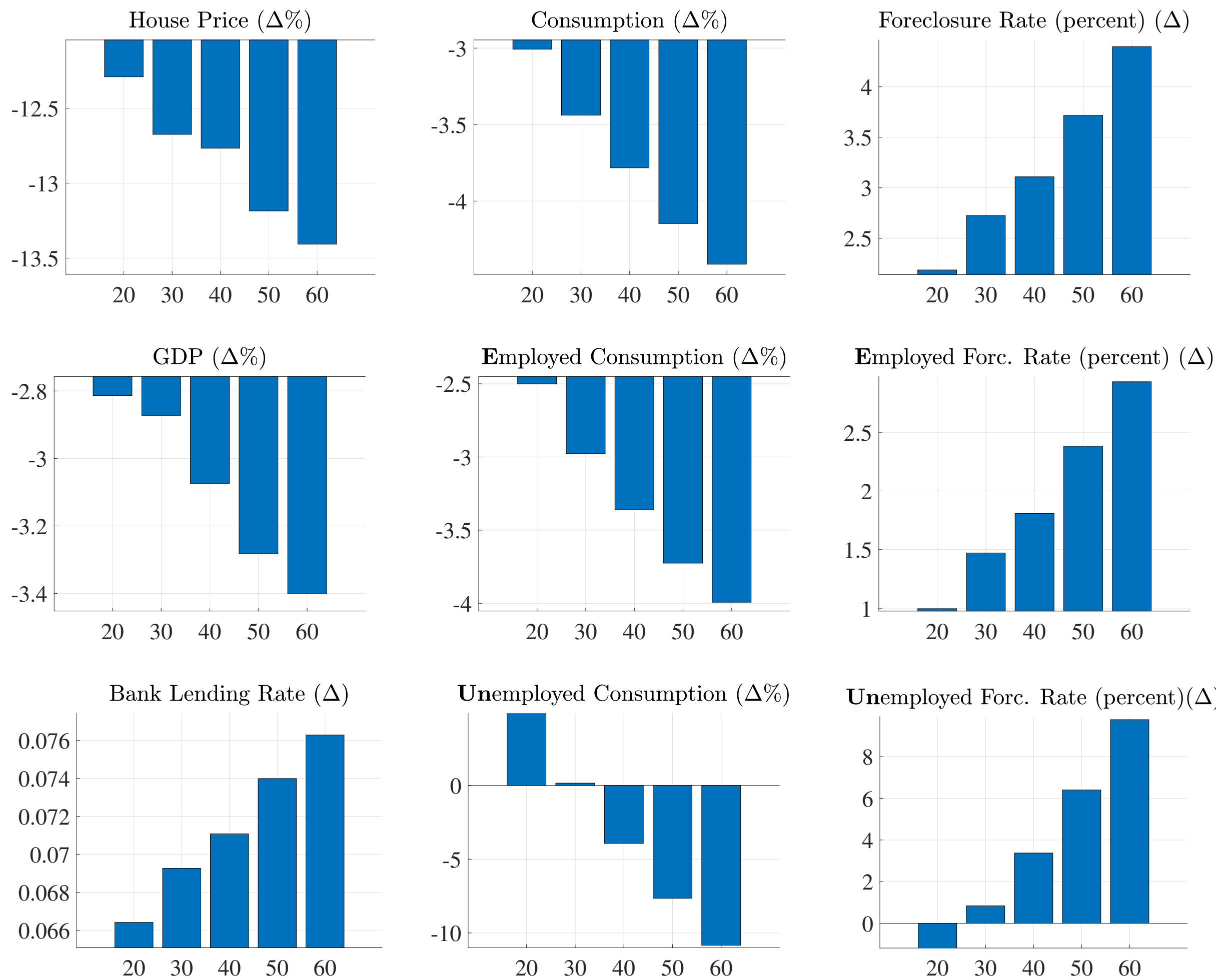
C Boom-bust Dynamics with Alternative Shocks

In this section, first, we solve the boom-bust dynamics without the unemployment shock during the bust. Next, we solve the dynamics of the model with productivity and house price expectation shocks. In both cases we choose the size of the shocks so that we have a similar-sized boom in house prices with the benchmark.

Our results suggest that main conclusions do not change with these alternative shocks. Without the unemployment shock the destabilizing effects of UI becomes even stronger (Figure 15). With the productivity shock, model dynamics are very similar to the dynamics with our benchmark. And more generous UI destabilizes the economies. With the expectation shock, the only difference is that consumption becomes more stable as UI generosity increases. The reason is that during the bust, the decline in house price expectations lower credit demand. As a result, bank lending rate barely increases. Therefore, the bank balance sheet mechanism ceases to exist. As we showed in Section 3.2.3 consumption becomes more stable without the bank balance sheet mechanism.

C.1 No Unemployment Shock During the Bust

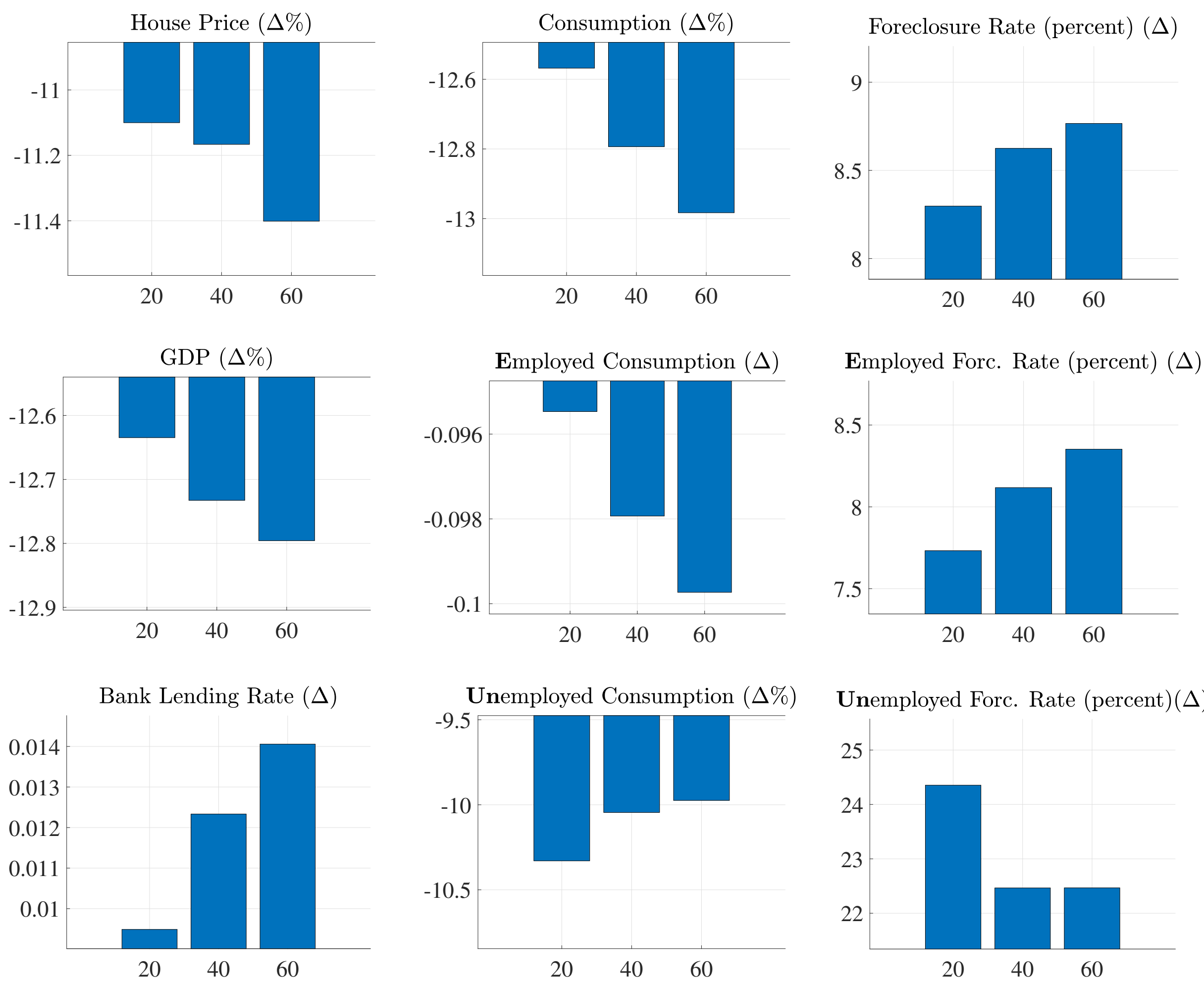
FIGURE 15 – Boom-Bust without the Unemployment Shock during the Bust



Notes: The graph plots the dynamics of key variables during the boom-bust episode. The shock during the boom is a gradual decline in interest rates from 3 to 2 percent. During the bust, interest rates reverse to the initial steady state. The difference from our benchmark is that and in the benchmark the unemployment rate increases to 10 percent and declines back to 5.5 percent linearly in 6 years. Here, we do not give that shock. Both the boom and bust shocks are unexpected. But, once realized there is perfect foresight.

C.2 Productivity Shocks

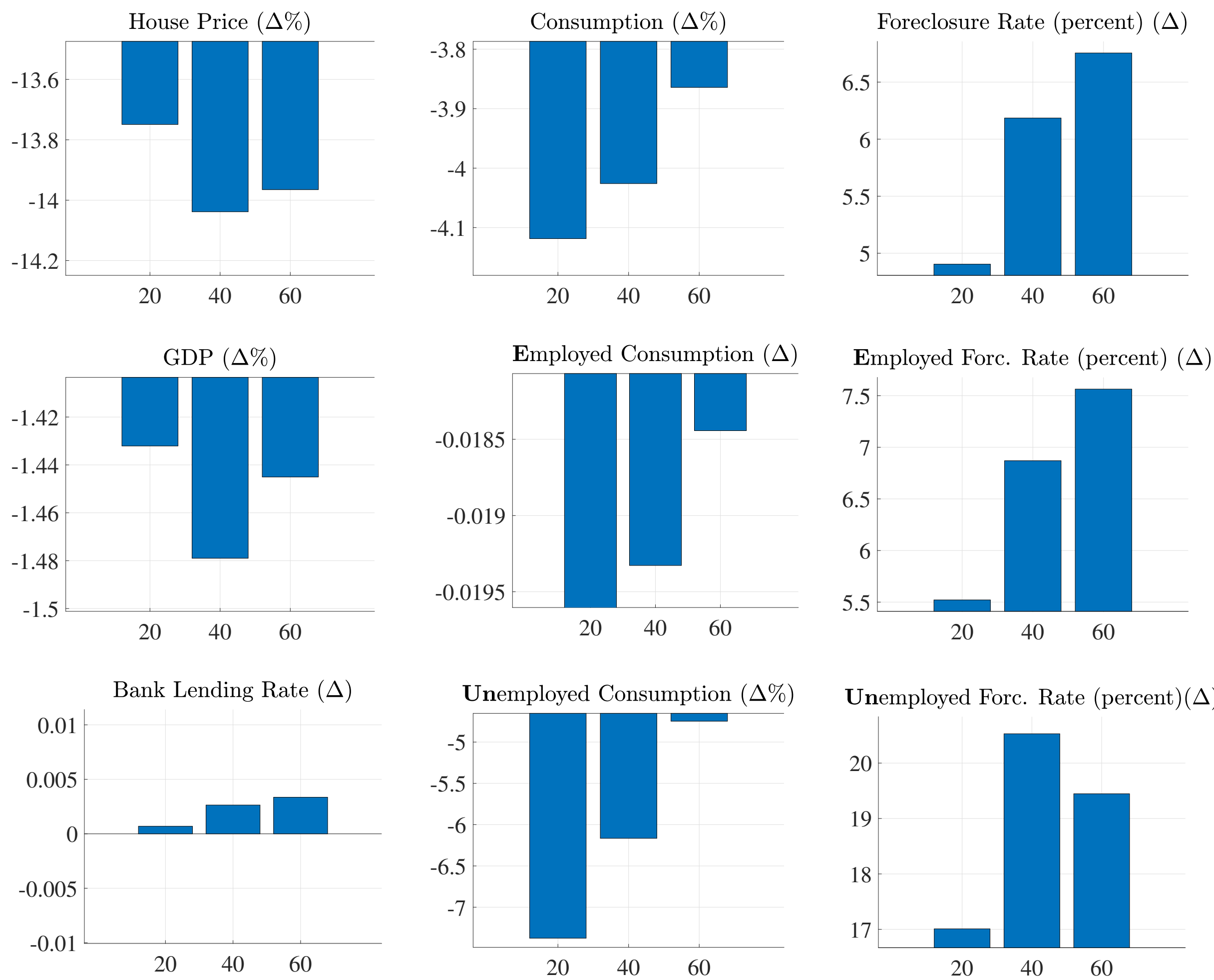
FIGURE 16 – Boom-Bust with Productivity Shocks



Notes: The graph plots the dynamics of key variables during the boom-bust episode. The shock during the boom is a gradual increase in productivity. During the bust, productivity reverses to the initial steady-state and unemployment rate increases to 7.5 percent and declines back to 5.5 percent linearly in 6 years. Both the boom and bust shocks are unexpected. But, once realized there is perfect foresight.

C.3 Expectation Shocks

Figure 17 – Boom-Bust with Expectation Shocks



Notes: The graph plots the dynamics of key variables during the boom-bust episode. The shock during the boom is an expectation shock: everyone in the economy expects that house prices will increase by about 19 percent. During the bust, expectation reverses to the initial steady-state and unemployment rate increases to 7.5 percent and declines back to 5.5 percent linearly in 6 years. Both the boom and bust shocks are unexpected. But, once realized there is perfect foresight.

D Summary Statistics and Additional Empirical Evidence

This section explains the main variables and provides descriptive statistics.

We use the Home Mortgage Disclosure Act (HMDA) as the main source for households' mortgage borrowing. HMDA is the most comprehensive source of information for mortgages in the U.S. and includes information about mortgage applications, mortgage amounts, and borrower income for each loan. We use this information to calculate loan-to-income ratios that we use in Section 4.1. When we investigate how the (de)stabilizing effects of UI benefits interact with long-term interest rates in Section 4.3, we use monthly mortgage data obtained from Neil Bhutta's website since higher frequency enables us to capture such effects more accurately. Since the monthly mortgage data is at the county level, we aggregate LTI up to the county-bank level to have a similar granularity. Using LTI data at the loan level yields virtually the same results.

The main independent variable of our empirical analysis is UI benefits generosity, defined as the maximum amount of UI payment an unemployed person can get during her unemployment spell, which is obtained from the U.S. Department of Labor. In addition, we collect county- and state-level data, such as county-level income, population, labor force, state-level minimum wage, non-UI money transfers, and public health coverage. We also use log change in GDP, changes in the unemployment rate, and CPI as macro-level control variables.

Since we are interested in the automatic stabilizer effects of UI benefits, we exclude the periods when the federal government uses UI benefits as an active tool. Therefore, our sample period is between 1995 and 2010, excluding the post-crisis periods when UI benefits increased substantially. Due to the nature of the shock, we use the period between 2006 and 2014 in the Missouri exercise. Table 8 provides the summary statistics. The average quarterly increase in mortgages at the county level is two basis points (bp), and the average house price growth rate is one bp. Monthly mortgage origination information is available for the largest 500 counties. Thus, the number of observations is different for these credit and house price growth rates. Quarterly changes in 10-year U.S. Treasury rates have a mean of -5 bp in our sample with a large standard deviation of 44 bp. The mean value of UI benefits is 8,800 USD, and its standard deviation is 2,530 USD, indicating a large variation in UI generosity among states.

Table 8 – Summary Statistics

This table provides the summary statistics for main variables. Time period is between 1994 and 2010. Δ denotes quarterly changes for house prices, mortgages origination and macro variables, whereas it denotes yearly changes for county level variables. $\mathsf{non-UI\,Trans.}_s$, Health_s, and $\mathsf{Tot.}\,\mathsf{Wage}_c$ are in million dollars. $\mathsf{Pop.}_c$ is in thousands.

	Mean	SD	25^{th} perc.	Median	75^{th} perc.
LTI_{cb}	2.08	0.89	1.51	2.03	2.56
$\Delta\log(\mathsf{HMDA})_c$	0.02	0.31	-0.18	0.00	0.21
$\Delta\log(\mathsf{HP})_c$	0.01	0.02	-0.00	0.01	0.02
$\Delta Int.\ Rate^{q-1}_{10y}$	-0.05	0.44	-0.39	-0.07	0.27
$UI\ \mathsf{Ben.}_s$	8.82	2.57	7.15	8.42	10.22
$\Delta\log(\mathsf{GDP})$	0.01	0.01	0.00	0.01	0.01
$\Delta\mathsf{CPI}$	-0.02	1.01	-0.40	-0.01	0.37
$\Delta\mathsf{VIX}$	0.19	7.35	-2.90	-0.40	2.60
$\Delta Unemp.$	0.07	0.34	-0.20	0.00	0.20
$non\text{-}UI\ \mathsf{Trans.}_s$	4.48	4.98	1.44	2.73	5.20
Health_s	7.61	8.49	2.58	4.98	8.82
$Min.\ \mathsf{Wage}_s$	5.29	1.29	4.95	5.15	6.15
$Tot.\ \mathsf{Wage}_c$	2032.66	7749.76	121.56	327.05	1075.68
$\Delta\log(\mathsf{Inc.})_c$	4.57	4.52	2.39	4.63	6.84
$\mathsf{Pop.}_c$	140.04	377.12	21.07	42.95	112.95
$\Delta\log(\mathsf{Labor})_c$	0.79	3.68	-0.74	0.79	2.33
$\Delta\mathsf{Unemp.}_c$	0.25	1.29	-0.40	0.00	0.70
$\Delta\log(\mathsf{Estab.})_c$	1.14	3.20	-0.72	0.97	2.88
$\Delta HHI^{\mathsf{Emp}}_c$	13.82	135.48	-10.19	3.40	26.97
$\Delta HHI^{\mathsf{Dep}}_c$	-0.00	0.03	-0.01	-0.00	0.00

Table 9 – UI Benefits and LTV Ratios

	LTV Ratio		
UI Benefits	0.006*	0.006*	0.005^{+}
	(1)	(2)	(3)
	(0.003)	(0.003)	(0.003)
Controls:			
State Controls		✓	✓
Individual Controls			✓
Obs.	68,812	68,812	68,812
R^2	0.007	0.011	0.022

Notes: This table documents that individual LTV ratios increase as UI benefits become more generous. The main independent variable is UI benefits payment at individual-level. All regression models include earnings as control. State control variables include unemployment rate, real GDP per capita, wages. Individual controls include education status and household earnings in quarter prior to one-year mortgage delinquency window. Standard errors are clustered at the statel level. $^{+}$ p<0.13, * p<0.10, ** p<0.05, *** p<0.01