Fiscal Policy and the Saving Glut of the Rich*

Francesco Bianchi†
JHU & NBER & CEPR

Leonardo Melosi‡
EUI & CEPR

Nicolò Ceneri§
NYU

Alessandro T. Villa¶
FRB Chicago

October 16, 2025

PRELIMINARY. DO NOT CIRCULATE WITHOUT PERMISSION

Abstract

In the post 1980s, the U.S. experienced a significant increase in both public and private debt. This increase was sustained by the *saving glut of the rich*, a large accumulation of assets from the top 1% of earners. We build a NK model with borrowers and savers and redistributive policies that can be funded or unfunded. Unfunded transfers induce fiscal inflation, which erodes the real value of public and private debt, with redistribution occurring through revaluation effects. Funded transfers are instead backed by future taxation on the rich and raise both government and mortgage debt, with redistribution occurring through expected changes in the fiscal burden on high earners. Our structural estimation shows that a shift from unfunded to funded spending in the early 1980s contributed to the *saving glut of the rich*.

JEL Codes: E50, E62, E63, H63, D31.
Keywords: Two-agent New Keynesian model, unfunded fiscal shocks, inflation, saving glut, redistribution.

*We thank Luigi Bocola, Hanno Lustig, our discussant Carlo Galli, and all seminar participants at the SITE session on fiscal sustainability at Stanford University, Sveriges Riksbank, and at the NBER MADEM meeting for useful comments and suggestions. The views in this paper are solely those of the authors and should not be interpreted as reflecting the views of the Federal Reserve Bank of Chicago, or any person associated with the Federal Reserve System.

†Johns Hopkins University. E-mail: francesco.bianchi@jhu.edu.
‡European University Institute. E-mail: leonardo.melosi@eui.eu.
§New York University. E-mail: nicolo.ceneri@nyu.edu.
¶Federal Reserve Bank of Chicago. E-mail: alessandro.villa@chi.frb.org.

I Introduction

Post-1980s U.S. data reveal a pronounced saving glut among high-income households (Mian et al., 2020). The top 10% of the income distribution has increasingly accumulated financial assets by lending to both the federal government and the bottom 90% of households. Over the same period, fiscal transfers have expanded steadily, contributing to a historically high debt-to-GDP ratio. This paper argues that the emergence of the saving glut is partly attributable to a structural shift in the financing of redistribution. Since the 1980s, the composition of fiscal policy has tilted toward funded transfers—those expected to be repaid through future taxation. Importantly, the burden of these anticipated taxes falls disproportionately on high earners. In response, affluent households have increased their savings, channeling funds into public and private debt markets in anticipation of future tax liabilities. We contrast this post 1980s trend with the 1960s-1970s, when the U.S. economy experienced a large increase in unfunded spending (Bianchi et al., 2023; Smets and Wouters, 2024).

Figure I presents a series of motivating stylized facts. The figure reports the dynamics of inflation, real interest rates, tax incidence, household debt, and government borrowing in the United States since 1970. Three patterns emerge from the data.

Starting in the early 1980s, the top 1% and top 10% of income earners have borne an increasingly large share of total income taxes, with a notable structural break occurring in the early 1990s. This shift coincides with the Omnibus Budget Reconciliation Act of 1993, which introduced two new federal income tax brackets and significantly raised marginal tax rates at the top. The average tax share of the top 1% rose from below 20% in the 1980s to above 25% after 1993, while the top 10% consistently contributed more than half of total income tax revenues. These patterns suggest a policy shift toward greater progressivity in the tax code. This trend stands in sharp contrast to the pre-1980s period, which saw a steady decline in the tax share of the top 1% and top 10% of earners. That earlier period also coincided with rampant inflation and extremely low real interest rates. The reversal in the tax share of the top income groups aligns with the Volcker disinflation and the sharp rise in real interest rates in the early 1980s.

Mortgage debt relative to GDP rose steadily from the mid-1980s through the 2000s, with a disproportionately larger increase for households outside the top decile. The Bottom 99% more than doubled their mortgage debt-to-GDP ratio between 1985 and 2007, with a notable surge during the housing boom. This rise in leverage—documented by Mian, Straub, and Sufi (2021)—reflects both expanding access to credit and growing financial strain among lower-income households. The 2008 financial crisis marked a sharp reversal, yet post-crisis deleveraging remained incomplete relative to pre-1990 levels.

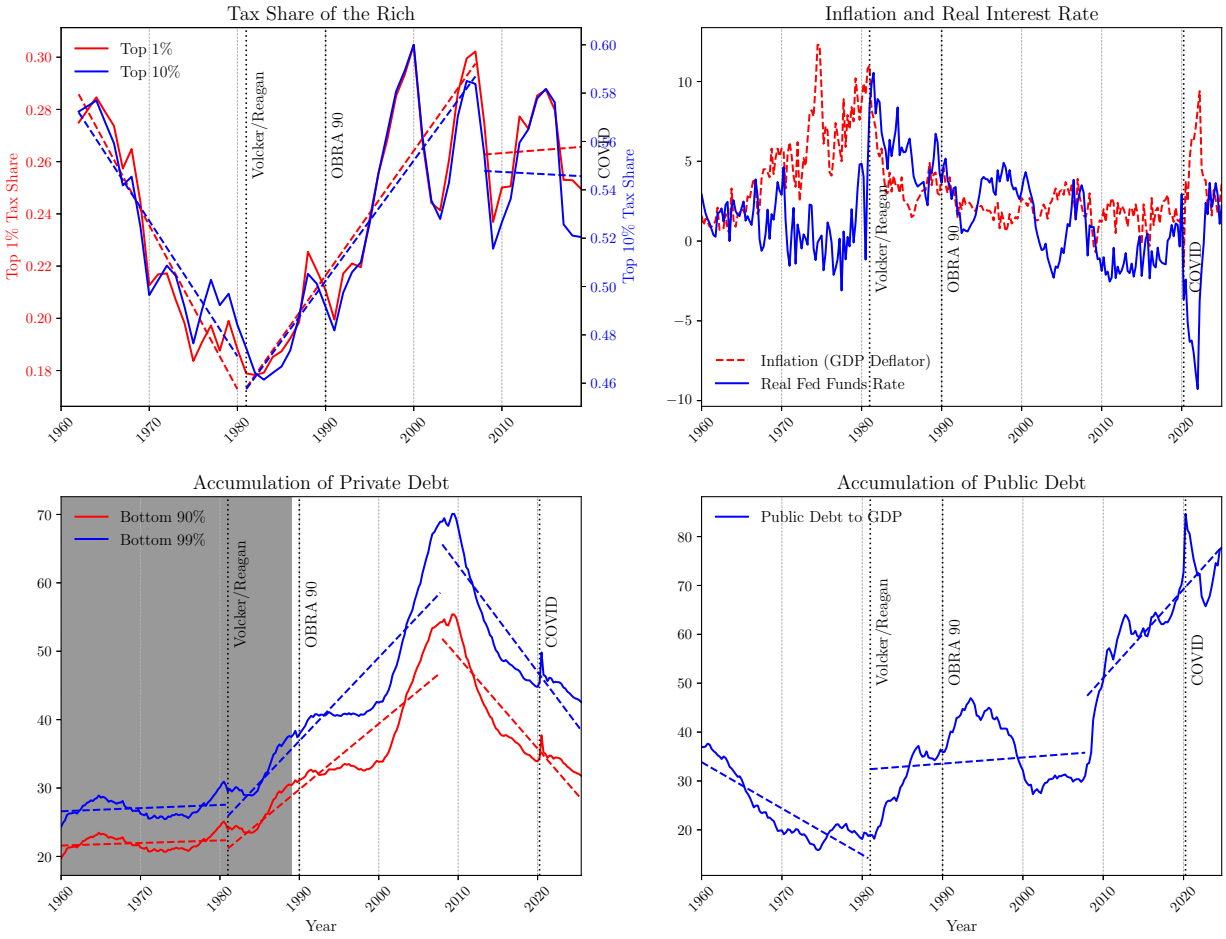
Government debt-to-GDP ratios remained relatively stable prior to the 1980s, a period characterized by persistently high inflation and low real interest rates - suggesting that fiscal transfers were, at least in part, financed through inflationary means. However, beginning in the early 1980s and accelerating after the Global Financial Crisis, fiscal transfers have been increasingly debt-financed. Public debt surged from below 40% of GDP in the 1970s to over 90% by the 2010s, reflecting a persistent shift in the composition of government financing. This pattern coincides with the erosion of inflation as a fiscal tool and the rise of intertemporal fiscal commitments.

We argue that these facts can be explained by a structural transformation in U.S. fiscal policy. In the earlier period (1960–1980), redistribution was more heavily financed through inflation and broad-based taxation. After the early 1980s, redistribution increasingly relied on top-heavy taxation and public borrowing. This shift in fiscal financing coincides with the very well known break in the conduct of U.S. monetary policy that occurred in the early 1980s. These developments likely altered the intertemporal incentives facing savers and the redistributive content of transfers: as the wealthy anticipated higher future tax liabilities, saving rose, while the financing of transfers shifted from inflation to explicit debt. Although wealth inequality increased, the incidence of taxes and transfers—combined with rising borrowing among lower-income households—may have muted contemporaneous changes in consumption inequality.

To uncover these results, we develop and estimate a two-agent New Keynesian model in which funded and unfunded fiscal shocks redistribute resources across the two types of agents. Borrowers ("households") and savers ("investors") differ in their asset and liability positions, so that the composition of fiscal shocks has distributional consequences. In presence of progressive taxation, funded transfers benefiting borrowers are mostly financed by future taxes on savers. Anticipating the future increase in the tax burden, savers optimally choose to increase saving by lending to borrowers and the government, raising both mortgage debt and government debt. Unfunded transfers are not backed by future taxes and generate fiscal inflation—eroding nominal assets, redistributing from wealthy savers to indebted households, and reducing private and public debt.

We estimate the model on U.S. quarterly data from 1960–2022, combining aggregate macroeconomic series with distributional measures of debt, assets, and consumption for the top and bottom of the income distribution. The estimated model uncovers a structural shift in the relative importance of funded and unfunded fiscal shocks. Before the mid-1980s, unfunded shocks dominated, consistent with a fiscal-dominance environment in which inflation acted as a fiscal instrument, eroding public debt and prompting households to reduce mortgage leverage. In later decades, funded shocks became more prominent, with fiscal ex-

Figure I: Dynamics of Debt and Taxes



Notes: The figures depict the time series of Tax Shares of Top Income Groups (blue line top 10% and red line top 1%), annualized quarterly inflation and real interest rate, households mortgage liability to GDP (blue line bottom 99% and red line top 90%), and government debt-to-GDP. The dashed lines represent the simple mean within the length of the line.

pansions financed through higher taxes on top-income households and explicit debt issuance. This shift replaced inflationary finance and broad-based taxation with debt-financed redistribution, producing persistent increases in both public debt and borrowers' mortgage debt, and sustaining a saving glut of the rich.

This paper contributes to the extensive literature on monetary–fiscal policy interactions, including Sargent and Wallace (1981), Leeper (1991), Sims (1994), Woodford (1994, 1995, 2001), Schmitt-Grohe and Uribe (2000), Cochrane (1998, 2001), Bassetto (2002), Reis (2017), Benhabib et al. (2002), and Bassetto and Sargent (2020). Barro (1974) show that non-Ricardian effects can arise if agents perceive government bonds as net wealth. Aiyagari and Gertler (1985) study fiscal backing of government bonds and find that debt irrelevance requires substantial monetary accommodation. Leeper and Zhou (2021) highlight the role of inflation in the optimal marginal financing of fiscal needs. Hall and Sargent (2011) document that historically, most U.S. debt stabilization has been achieved through a combination of growth, revaluation effects, and low real interest rates. Bianchi and Ilut (2017) estimate a model with regime changes in the monetary–fiscal policy mix, linking the high inflation of the 1960s–1970s to a fiscally led regime. Bianchi and Melosi (2022) and Bianchi and Melosi (2017) argue that the possibility of a return to such a regime can explain the absence of deflation after the Great Recession and the surge in post-pandemic inflation. In a related view, Barro and Bianchi (2023) show that the cross-country variation in post-pandemic inflation can be explained by their fiscal interventions. Bianchi et al. (2023) depart from pure regime-switching frameworks, allowing monetary-led and fiscally led rules to coexist and uncovering low-frequency inflation movements tied to unfunded fiscal shocks and persistent inflation.

Relative to these contributions, we introduce heterogeneity across households and allow funded and unfunded fiscal shocks to coexist and differ across agents. This innovation enables us to capture distinct redistribution channels—through future taxation versus fiscal inflation—and to structurally identify their changing roles in shaping both public and private debt dynamics. In particular, the model links the decline of unfunded fiscal shocks to the rise of debt-financed redistribution supported by more progressive taxation, with higher tax burdens on top-income households and concurrent increases in mortgage borrowing among lower-income households.

Our work also connects to a series of recent contribution that study the interaction between monetary and fiscal policies in tractable models with heterogeneous agents and nominal rigidities. A non-exhaustive list includes Angeletos et al. (2024), Rachel and Ravn (2025), Dupraz and Rogantini Picco (2025). An important distinction with respect to existing contributions is that in our model both agents are engaging in consumption smoothing.

The heterogeneity consists in the type of assets that they hold and their income and wealth profile.

II Simple Model

Before turning to the full quantitative model in Section III, we develop a simplified framework to illustrate the core mechanism. This reduced-form environment allows us to abstract from the multitude of channels that may drive inflation and to isolate the conditions under which the fiscal transmission operates most clearly. The deleveraging channel associated with the fiscal theory of the price level emerges from the interaction between fiscal dynamics, the elasticity of intertemporal substitution, and an elastic labor supply—both in the presence and absence of nominal rigidities.

To build intuition, we consider a stylized Two-Agent New Keynesian (TANK) model with borrowers and lenders. Lenders consume and supply labor. They invest in one-period government bonds, own firms, and extend credit to borrowers. Borrowers, in turn, consume, work, and finance consumption by borrowing from lenders.

Production is carried out by monopolistically competitive firms that hire labor in a competitive market and face quadratic adjustment costs when changing prices. The government issues nominal debt and sets lump-sum taxes according to a fiscal rule that differs across household types.

II.A Environment and Equilibrium Conditions

Time is discrete and infinite, indexed by $t = 0, 1, 2, \ldots$. The economy consists of: (i) a continuum of identical households (borrowers) indexed by $i \in [0, \omega]$; (ii) a continuum of identical investors (lenders) indexed by $i \in [\omega, 1]$; (iii) a representative final goods producer; (iv) a continuum of intermediate firms $j \in [\omega, 1]$; (v) a monetary authority; and (vi) a fiscal authority.

Households and investors supply labor to intermediate firms, which produce differentiated goods sold to the final goods producer. Households consume final goods, while investors allocate their wealth between equity claims and government bonds. Intermediate firms operate under monopolistic competition, set prices subject to quadratic adjustment costs à la Rotemberg (1982), and hire labor in a competitive market.

The government finances spending through a combination of labor income taxes, capital income taxes, and lump-sum transfers, and issues non-state-contingent one-period nominal debt held by investors. Fiscal policy satisfies an intertemporal budget constraint, allowing

for deficits when needed. The monetary authority sets the nominal interest rate according to a Taylor rule that responds more than one-for-one to inflation under monetary dominance. Under fiscal dominance, the nominal interest rate is held fixed.

Borrowers. Households derive utility from consumption and incur disutility from supplying labor, which is continuously divisible and normalized on the unit interval. Each period, a household chooses consumption, labor supply, and the quantity of loans held. For notational simplicity, we suppress the individual household index i. The household's consumption-saving decision is characterized by the solution to the following dynamic program:

$$V^H(B_{H,t-1}, \zeta^H_{s,t}, \zeta^I_{s,t}) = \max_{N_t, C_{H,t}, B_{H,t}} \log C_{H,t} - \frac{N_{H,t}^{1+\eta}}{1+\eta} + \beta \mathbb{E}_t[V^H(B_{H,t}, \zeta^H_{s,t+1}, \zeta^I_{s,t+1})]$$

subject to the (real) budget constraint:

$$C_{H,t} + B^{(H)}_{H,t} = W_t N_{H,t} + R^{(H)}_{t-1} \frac{B^{(H)}_{H,t-1}}{\Pi_t} - T_{H,t},$$

where C_H denotes consumption, N_H is labor supply, W is the real wage, and T_H represents lump-sum taxes. The terms (ζ^H, ζ^I) denote shocks to the fiscal rules, and Π is the gross inflation rate.

The intratemporal optimality condition for labor supply yields $W_t = C_{H,t} N^{\eta}_{H,t}$. The Euler equation for optimal bond holdings is given by $Q^{(H)}_t = \mathbb{E}_t \left[M^H_{t,t+1} \Pi^{-1}_{t+1} \right]$, where the household's stochastic discount factor is $M^H_{t,t+1} = \beta \left(\frac{C_{H,t+1}}{C_{H,t}} \right)^{-1}$, and the price of debt is defined as $Q^{(H)}_t \equiv 1/R^{(H)}_t$.

Investors. Investors choose private loans, short-term government bond holdings $B^{(G)}_{I,t}$, equity positions in firms, consumption, and labor supply. The set of investor choices is denoted by $\mathcal{C}_{I,t} \equiv \{B^{(H)}_{I,t}, B^{(G)}_{I,t}, S_t, C_{I,t}, N_{I,t}\}$, and solves the following program:

$$\begin{aligned} V^I(B^{(H)}_{I,t-1}, B^{(G)}_{I,t-1}, S_{t-1}, \zeta^H_{s,t}, \zeta^I_{s,t}) = \max_{\mathcal{C}_{I,t}} & \log C_{I,t} - \frac{N_{I,t}^{1+\eta}}{1+\eta} + U(B^{(H)}_{I,t}) \\ & + \beta \mathbb{E}_t[V^I(B^{(H)}_{I,t}, B^{(G)}_{I,t}, S_t, \zeta^H_{s,t+1}, \zeta^I_{s,t+1})] \end{aligned}$$

subject to the real budget constraint:

$$\begin{aligned} C_{I,t} + B^{(H)}_{I,t} + B^{(G)}_{I,t} + \int_{\mathtt{w}}^1 P^S_{j,t} S_{j,t} \, \mathrm{d}j = \\ W_t N_{I,t} + R^{(H)}_{t-1} \frac{B^{(H)}_{I,t-1}}{\Pi_t} + R^{(G)}_{t-1} \frac{B^{(G)}_{I,t-1}}{\Pi_t} + \int_{\mathtt{w}}^1 (P^S_{j,t} + D_{j,t}) S_{j,t-1} \, \mathrm{d}j - T_{I,t}, \end{aligned}$$

where C_I, N_I, $B^{(H)}_I$, and $T_{I,t}$ denote investor consumption, labor supply, holdings of loans to households, and transfers, respectively. The term P^S_j is the price of firm j's equity, and S_j is the quantity of shares held.

First, as in Fisher (2015), investors care about the real value of loans $B_{I,t}^{(H)}$. Second, they face lending frictions that impose increasing marginal costs when lending exceeds a threshold $\bar{B}_I^{(H)}$. To capture these two features, we specify:

$$U(B_{I,t}^{(H)}) \equiv -\frac{\omega}{2}\left(B_{I,t}^{(H)} - \bar{B}_I^{(H)}\right)^2. \tag{1}$$

This functional form ensures a unique steady-state level of $B_{I,t}^{(H)}$. Intuitively, $U(\cdot)$ is increasing in $B_{I,t}^{(H)}$ when $B_{I,t}^{(H)} < \bar{B}_I^{(H)}$, reflecting the investor's preference for lending up to the threshold. When $B_{I,t}^{(H)} > \bar{B}_I^{(H)}$, the utility becomes decreasing, capturing the costs of excess lending. This can be interpreted as capturing a soft lending constraint or increasing costs of managing a large portfolio of private assets that require monitoring.

The first-order conditions with respect to bonds, loans, and equity holdings are:

$$\begin{aligned} Q_t^{(H)}(1 - C_{I,t} \cdot U'(B_{I,t}^{(H)})) =& \mathbb{E}_t\left[M_{t,t+1}^I \Pi_{t+1}^{-1}\right], \\ Q_t^{(G)} =& \mathbb{E}_t\left[M_{t,t+1}^I \cdot \Pi_{t+1}^{-1}\right], \\ 1 =& \mathbb{E}_t\left[M_{t,t+1}^I \cdot \frac{P_{t+1}^S + D_{t+1}}{P_t^S}\right], \end{aligned}$$

where $M_{t,t+1}^I = \beta\left(\frac{C_{I,t+1}}{C_{I,t}}\right)^{-1}$, and $Q_t^{(G)} \equiv 1/R_t^{(G)}$. The intratemporal labor-consumption trade-off pins down labor supply via $W_t = C_{I,t} N_{I,t}^{\eta}$.

Production. A representative final goods producer aggregates a continuum of intermediate inputs $Y_{j,t}$, $j \in [\mathtt{w}, 1]$, into final output using a CES production function:

$$Y_t = \left(\int_{\mathtt{w}}^1 Y_{j,t}^{\frac{\theta-1}{\theta}} \, \mathrm{d}j\right)^{\frac{\theta}{\theta-1}},$$

where $\theta > 1$ denotes the elasticity of substitution across varieties. Profit maximization implies the standard demand function:

$$Y_{j,t} = \left(\frac{P_{j,t}}{P_t}\right)^{-\theta} Y_t, \quad \text{with} \quad P_t = \left(\int_{\mathtt{w}}^1 P_{j,t}^{1-\theta} \, \mathrm{d}j\right)^{\frac{1}{1-\theta}}.$$

Intermediate firms are monopolistic competitors that hire labor $N_{j,t}$ to produce output via a linear technology, $Y_{j,t} = N_{j,t}$, and face quadratic price adjustment costs à la Rotemberg (1982)

$$\mathcal{R}_{j,t}\left(\frac{P_{j,t}}{P_{j,t-1}}\right) = \frac{\varphi}{2}\left(\frac{P_{j,t}}{P_{j,t-1}} - \bar{\Pi}\right)^2 Y_t.$$

Each firm chooses $(P_{j,t}, N_{j,t})$ to solve:

$$V^F(N_{j,t-1}, P_{j,t-1}, \zeta_{s,t}^H, \zeta_{s,t}^I) = \max_{P_{j,t}, N_{j,t}} \frac{D_{j,t}^{\$}}{P_t} + \mathbb{E}_t\left[M_{t,t+1}^I V^F(N_{j,t}, P_{j,t}, \zeta_{s,t+1}^H, \zeta_{s,t+1}^I)\right],$$

subject to demand $Y_{j,t} = \left(\frac{P_{j,t}}{P_t}\right)^{-\theta} Y_t$ and where firm profits are:

$$D^{\$}_{j,t} = P_{j,t}Y_{j,t} - W_t N_{j,t} P_t - \mathcal{R}_{j,t}.$$

In symmetric equilibrium $P_{j,t} = P_t$, and marginal cost Γ_t satisfies $W_t = \Gamma_t$. The first-order condition with respect to prices yields the New Keynesian Phillips Curve:

$$(1 - \theta + \theta W_t)\, Y_t - \mathcal{R}'_t \Pi_t + \mathbb{E}_t \left[M^I_{t,t+1} \mathcal{R}'_{t+1} \Pi_{t+1} \right] = 0,$$

where $\Pi_t \equiv \frac{P_t}{P_{t-1}}$ denotes gross inflation. Since each firm j has measure zero and is identical to all other firms, then $N = N_j$. Hence, aggregate production is $Y_t = N_t = (1 - \mathtt{w}) N_{j,t} = (1 - \mathtt{w}) Y_{j,t}$.

Monetary Policy. Under monetary dominance, the central bank targets inflation at $\bar{\Pi}$ and sets the nominal interest rate according to a standard Taylor rule:

$$\frac{R^{(G)}_t}{\bar{R}^{(G)}} = \left(\frac{\Pi_t}{\bar{\Pi}}\right)^{\phi_\pi} \left(\frac{Y_t}{\bar{Y}}\right)^{\phi_Y} e^{\zeta_{M,t}},$$

where $\bar{R}^{(G)} \equiv \frac{\bar{\Pi}}{\beta}$ coincides with the steady-state nominal interest rate.

Fiscal Policy. The government's budget constraint is:

$$B_{G,t} + \mathtt{w} T_{H,t} + (1 - \mathtt{w}) T_{I,t} = R^{(G)}_{t-1} \frac{B_{G,t-1}}{\Pi_t}. \tag{2}$$

Taxes on households and investors evolve according to simple feedback rules:

$$\frac{T_{H,t}}{Y_t} - \frac{\bar{T}}{\bar{Y}} = \left(\frac{T_{H,t}}{Y_t} - \frac{\bar{T}}{\bar{Y}}\right)^{\rho^H} \left(\frac{B_{G,t-1}}{Y_{t-1}} - \frac{\bar{B}_G}{\bar{Y}}\right)^{\delta^H_b (1-\rho^H)} e^{\zeta^H_{s,t}},$$

$$\frac{T_{I,t}}{Y_t} - \frac{\bar{T}}{\bar{Y}} = \left(\frac{T_{I,t}}{Y_t} - \frac{\bar{T}}{\bar{Y}}\right)^{\rho^I} \left(\frac{B_{G,t-1}}{Y_{t-1}} - \frac{\bar{B}_G}{\bar{Y}}\right)^{\delta^I_b (1-\rho^I)} e^{\zeta^I_{s,t}}.$$

where $\zeta^H_{s,t}$ and $\zeta^I_{s,t}$, the persistent component of transfers, follow AR(1) processes specified below.

$$\log \zeta^\chi_{s,t} = \rho^\chi_\zeta \log \zeta^\chi_{s,t-1} + (1 - \rho^\chi_\zeta) \sigma^\chi_s \epsilon^\chi_t, \quad \text{for } \chi \in \{H, I\},$$

The specification captures the fact that welfare programs are announced well in advance, hence reflecting both current and announced transfers.

Market Clearing. The labor market clears when aggregate labor supply equals total labor demand:

$$\mathtt{w} N_{H,t} + (1 - \mathtt{w}) N_{I,t} = N_t.$$

The loan market clears when:

$$\mathtt{w} B^{(H)}_{H,t} + (1 - \mathtt{w}) B^{(H)}_{I,t} = 0,$$

and the government bond market clears when:

$$(1-\mathtt{w})B_{I,t}^{(G)} = B_{G,t}.$$

In the equity market, each firm is owned in full:

$$S_{j,t} = 1 \quad \forall j \in [\mathtt{w}, 1].$$

Finally, the resource constraint of the economy is:

$$\mathtt{w}C_{H,t} + (1-\mathtt{w})C_{I,t} + \mathcal{R}_t = Y_t.$$

II.B Funded and Unfunded Fiscal Shocks

We emphasize that the model presented in this section is for illustrative purposes only. In Section III, we develop and estimate a state-of-the-art Two-Agent New Keynesian (TANK) model with a rich fiscal block and partially unfunded debt dynamics, using both aggregate and cross-sectional U.S. data. The quantitative model incorporates features that have proven successful in replicating U.S. business cycle dynamics, including multiple aggregate shocks, distortionary taxation, habit formation, capital adjustment costs and utilization, staggered price setting, nominal wage rigidities, and realistic maturity structures for both loans and government bonds.

Here, we consider a simplified calibration to build intuition. The model is calibrated at a quarterly frequency. The depreciation rate is set to 0.025, a standard value in the literature. Households supply labor with a Frisch elasticity of 1, implying a labor disutility parameter of $\eta = 1$, whereas investors supply labor perfectly elastically.

We set the intra-sector elasticity of substitution across intermediate goods to $\theta = 7$, a conventional value. For tractability, we assume equal population weights, setting $\mathtt{w} = 0.8$. The degree of nominal rigidity is governed by $\varphi = 20$.

The equality of the two Euler equations for private loans pins down the steady-state level of investor lending $\bar{B}_I^{(H)}$, which, through market clearing, implies $\bar{B}_H^{(H)} = -\bar{B}_I^{(H)}$. We calibrate the steady-state market value of private loans to $\bar{B}_I^{(H)} = 0.5$, and the value of government debt held by investors to $\bar{B}_I^{(G)} = 1$, broadly consistent with empirical evidence.

To isolate the risk-sharing channel emphasized in the impulse response functions (IRFs) below, we set $\omega = 0.1$, a small value that minimizes the impact of lending frictions in the illustrative exercise. In the full quantitative model, all parameters, including ω, are jointly estimated. The complete set of linearized equilibrium conditions is provided in Appendix A.

In the fiscal block, we set the persistence parameters of the tax rules to $\rho^I = 0.1$ and $\rho^H = 0.9$. Fiscal shocks follow AR(1) processes of the form:

$$\log \zeta_{s,t}^{\chi} = \rho_{\zeta}^{\chi} \log \zeta_{s,t-1}^{\chi} + (1-\rho_{\zeta}^{\chi})\sigma_s^{\chi}\epsilon_t^{\chi}, \quad \text{for } \chi \in \{H, I\},$$

with $\rho_\zeta^H = 0.99$, $\rho_\zeta^I = 0.99$, $\sigma_s^H = 10^{-2}$, and $\sigma_s^I = 10^{-4}$.

Unfunded Transfer Shock. Following an unfunded transfer shock, policymakers follow a fiscally-led policy mix. The response of the fiscal authority to the increase in public debt resulting from the transfer shock is not sufficient to keep debt on a stable path. Specifically, we assume that the parameters controlling the responses of taxation on households and investors are ($\delta_B^H = 0$) and ($\delta_B^I = 0$). The central bank accommodates the resulting increasing in inflation holding the nominal interest rate constant, setting $\phi_\pi = \phi_Y = 0$.

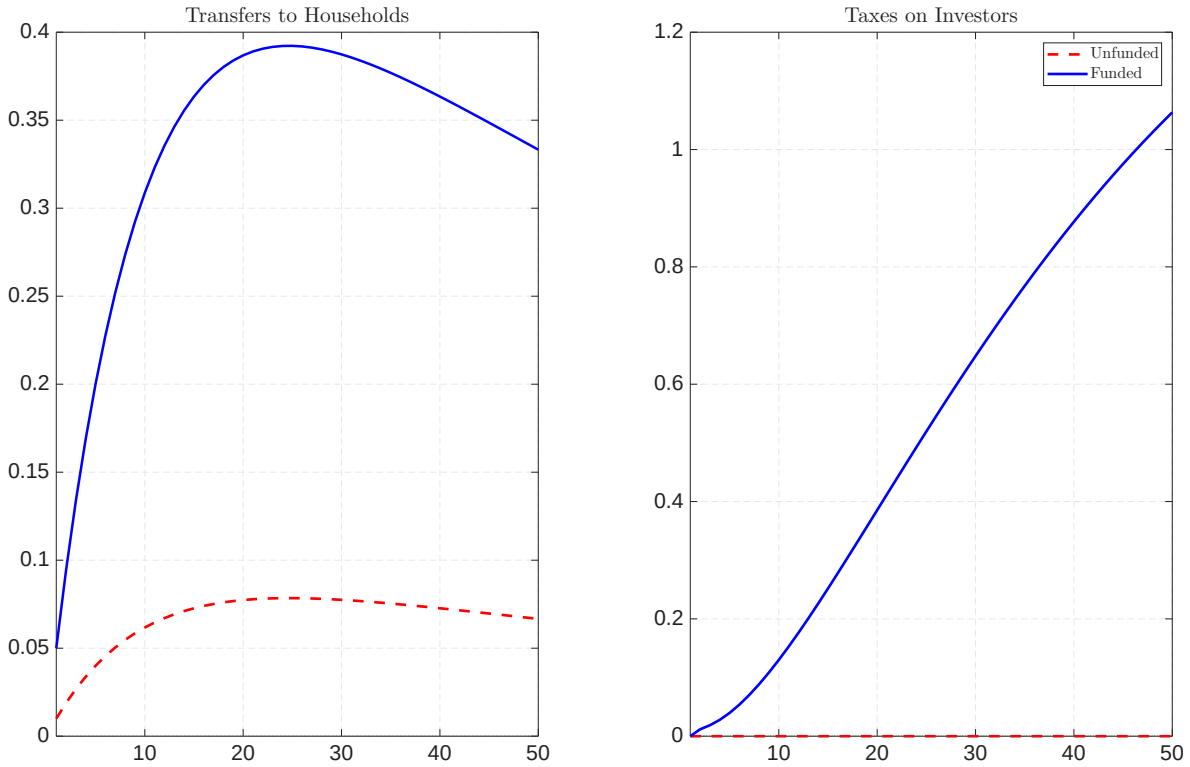
Funded Transfer Shock. In response to a funded transfer shock, policymakers coordinate on a Monetary-led policy mix. The central bank responds more than one-to-one to inflation and aims to stabilize output $\phi_\pi = 1.2$ and $\phi_Y = 0.3$. The fiscal authority implements the necessary fiscal adjustments increasing taxation on the savers in response to the resulting increase in debt ($\delta_B^I = 0.1$), while it leaves the level of taxation on households unchanged ($\delta_B^H = 0$).

II.C Responses to Funded and Unfunded Fiscal Shocks

We now consider impulse responses to funded and unfunded transfer shocks to households. The model features net taxes. For convenience, Figure II plots the dynamics of household *transfers* and investor *taxes* following a positive fiscal transfer shock to households. The solid blue line corresponds to a funded shock, while the dashed red line depicts the response to an unfunded shock. The standard deviations of the two types of shocks are chosen to be approximately consistent with the estimated quantitative model. Thus, funded fiscal shocks are assumed to be five times larger than unfunded fiscal shocks. Following an unfunded fiscal shock, the increase in transfers does not result in a sufficiently large increase in taxes on investors (right panel). By contrast, following a funded fiscal shock, the investor tax increases significantly, but with a delay due to smoothing in taxation.

Figure III reports the impulse responses for inflation, the real interest rate, the government debt-to-GDP ratio, and the mortgage-to-GDP ratio. The responses differ markedly between the two shocks. Following a funded fiscal shock, inflation declines on impact and gradually returns to its steady state due to nominal rigidities. Importantly, the persistence of the shock generates redistribution: investors anticipate future taxation and respond by increasing labor supply and savings, while households seek to borrow against the expected increase in transfers. The increase in investors' labor supply is key to generating deflation alongside positive output in the long run.

Figure II: Response of Subsidies to Household Shock



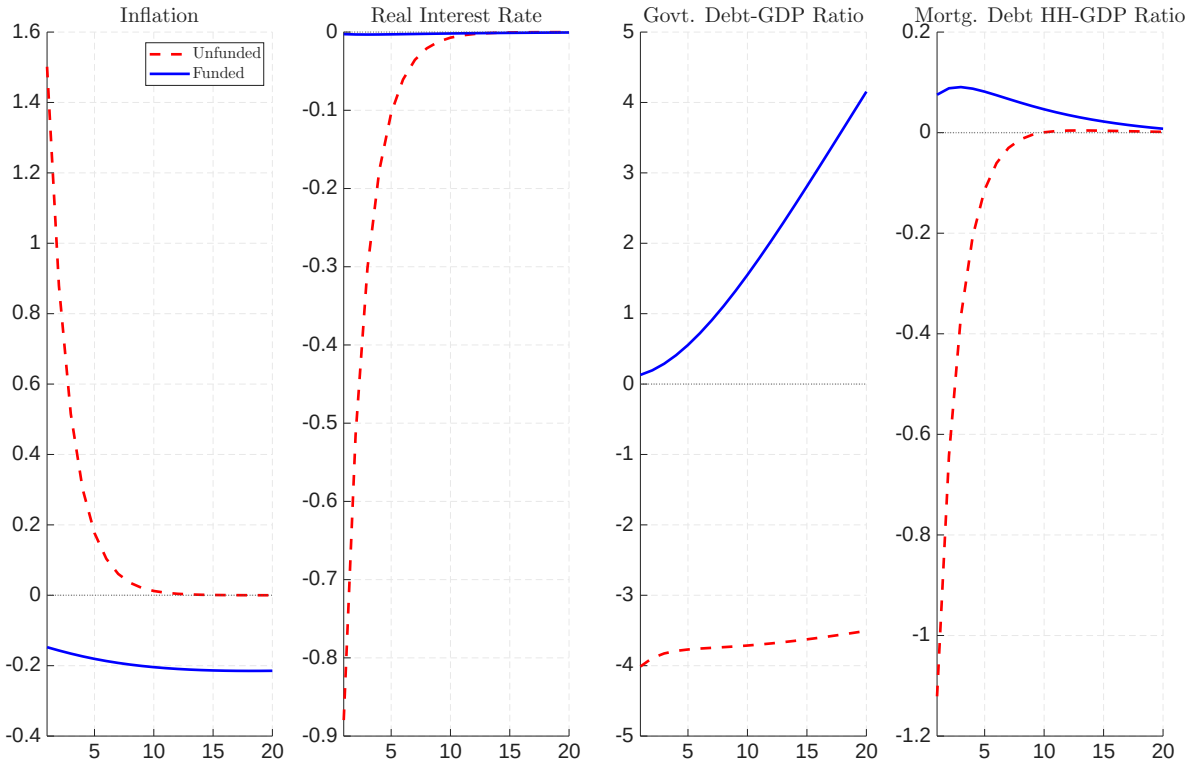
Notes: The figure plots the Impulse Responses of subsidies to a standard deviation fiscal shock to households $\zeta_{s,t}^{H}$. The solid blue line corresponds to a funded shock, while the dashed red line depicts the response to an unfunded shock. The x-axis are quarters and the y-axis are percentage points deviations from the steady state.

Households and investors both want to respond immediately to the announced increase in spending favoring households. However, the supply of government debt is initially limited, as the spending is back-loaded. As a result, investors and households initially achieve their desired levels of saving and borrowing through the private market. Once the spending begins to materialize, households can deleverage, and investors rebalance their portfolios from private loans to public lending. Consequently, we observe a gradual reduction in mortgages and an increase in public debt.

In contrast, following an unfunded fiscal shock both realized and expected inflation rise on impact. Because the central bank keeps interest rates unchanged, the resulting inflationary pressure lowers the real interest rate, reducing the incentives to save. Investors, anticipating continued fiscal expansion and high inflation, reduce their holdings of both private loans and government bonds. Meanwhile, households use the subsidy to deleverage, repaying their debt.

The sharp contrast between the two types of shocks illustrates how a persistent increase

Figure III: Fiscal Shock to Households



Notes: The figure plots the Impulse Response Functions to a standard deviation fiscal shock to households $\zeta^H_{s,t}$. The solid blue line corresponds to a funded shock, while the dashed red line depicts the response to an unfunded shock. The x-axis are quarters and the y-axis are percentage points deviations from the steady state.

in funded spending – or a shift from unfunded to funded spending – can generate significant accumulation of assets by high earners who anticipate a future increase in taxes. Households, on the other hand, are willing to borrow from investors in anticipation of a persistent stream of payments in their favor. In the next subsection, we inspect the mechanism behind this saving glut of the rich in detail.

II.D The Fiscal Financing Mechanism and the Saving Glut

Government spending is financed through either explicit or implicit taxation via inflation. Funded transfers are funded by higher future taxes; unfunded transfers are financed by the inflation tax. The mechanism operates through the differential asset positions of households and investors, captured by their intertemporal Euler equations:

$$Q_t^{(H)} = \mathbb{E}_t \left[M^H_{t,t+1} \Pi^{-1}_{t+1} \right], \quad Q_t^{(H)} \left(1 - C_{I,t} U'(B^{(H)}_{I,t})\right) = \mathbb{E}_t \left[M^I_{t,t+1} \Pi^{-1}_{t+1} \right] = Q_t^{(G)}.$$

Under funded shocks, higher expected taxes increase investors' incentives to save, thereby

raising their demand for government bonds, $B_{I,t}^{(G)}$, and private loans, $B_{I,t}^{(H)}$. Lower expected inflation further increases the real return on nominal assets, reinforcing the incentive to save. In equilibrium, the expansion in investor saving must be matched by an equivalent increase in borrowing by other sectors. The government accommodates part of this demand to finance transfers, while households absorb the remainder. For households, the transfer raises current and future disposable income and reduces their propensity to save through a positive wealth effect.

Initially, the government issues only a limited amount of debt, as the increase in spending unfolds gradually. Investors, anticipating future taxes, seek to accumulate safe assets and thus complement their lending to the government by also extending credit to households. Households, by contrast, wish to borrow in anticipation of rising transfers. As government spending expands, bond issuance rises, and investors rebalance their portfolios toward government securities. Meanwhile, households begin to deleverage once transfers materialize. The share of total taxes paid by the top decile evolves as:

$$\text{Top Tax Share}_t = \frac{(1-\mathtt{w})T_{I,t}}{\mathtt{w}T_{H,t} + (1-\mathtt{w})T_{I,t}}. \tag{3}$$

Under unfunded shocks, investors anticipate that their tax burden will not increase. The fact that spending is not backed by future surpluses generates inflationary pressure, thereby reducing the real return on nominal assets. On impact, the inflation surprise determines a decline in the real value of debt. Subsequently, the higher persistent inflation reduces the market value of debt and the lower return on nominal assets reduce the incentives to save. This mechanism lower investors' government bond holding $B_{I,t}^{(G)}$ and private loan holdings $B_{I,t}^{(H)}$. Households use transfers to deleverage and decrease their debt as inflation erodes their debt burden. As a result, in response to the unfunded shock, inflation acts as an implicit tax on holders of nominal assets, with the tax revenue given by:

$$\text{Inflation Tax}_t = \left(1 - \frac{1}{\Pi_t}\right) B_{G,t-1}. \tag{4}$$

Structural Shift. The differential response to funded and unfunded transfer shocks suggests how a structural shift from unfunded to funded fiscal financing can generate the joint dynamics of public debt, private leverage, and tax progressivity observed in the data. To this end, consider an initial increase in spending that is partially unfunded. This would generate inflationary pressure and lower real interest rates and low debt-to-GDP ratio with no accumulation of savings from the rich. Once the share of unfunded spending drops in favor of funded spending, we would observe a jump in real interest rates, a drop in inflation, and a progressive accumulation of assets by investors, a saving glut of the rich.

In light of the observation above, we would expect the pre-1980s period to be char-

acterized by the following ingredients: (i) government debt remains low because inflation systematically erodes the real debt stock via equation (4); (ii) household leverage stays low as households optimally use the inflation subsidy to deleverage; (iii) tax incidence is broad-based: since the inflation tax in equation (4) falls on all nominal asset holders, explicit taxes can be spread more evenly across the population. All in all, this would translate into an economy in which there is not a saving glut of the rich.

Conversely, we would expect the post-1980s period to be characterized by: (i) government debt persistently rising because fiscal transfers are no longer financed through inflation but through explicit borrowing; (ii) household leverage increases as households anticipate transfers and optimally smooth consumption by borrowing against future income; (iii) tax progressivity rises: since investors must finance higher government debt through future taxation, and investors correspond to higher-income households, the tax burden shifts toward the top of the income distribution. All in all, this would translate into a saving glut of the rich initially sustained through direct lending to households and, subsequently, through a large accumulation of government debt.

This mechanism provides a unified explanation for the three stylized facts documented in the introduction: the rise in government debt-to-GDP after the 1980s, the initial rapid increase in household mortgage leverage and its subsequent retreat, and the growing concentration of tax payments among high-income earners. In what follows we develop and estimate a quantitative model to confront this hypothesis with the data.

III A Quantitative Model

In this section, we extend the simplified framework of Section II to a fully specified quantitative model. The model incorporates a series of key features that have proven successful in replicating U.S. business cycle dynamics: a comprehensive set of structural shocks, a rich fiscal block, and partially unfunded government debt. Importantly, instead of modeling funded and unfunded shocks separately, we allow them to coexist at the same time. In other words, the central bank stabilizes inflation around a moving target that depends on the amount of unfunded spending, similarly to Bianchi et al. (2023). Differently from Bianchi et al. (2023), we allow borrowers and investors to trade with each other. Furthermore, we allow for redistribution policies implemented via agent-specific funded and unfunded transfers.

III.A The Economy

The economy consists of a measure $\mathtt{w}$ of borrowers (hereafter, households), a measure $1-\mathtt{w}$ of savers (hereafter, investors), a continuum of monopolistically competitive intermediate goods producers, a continuum of perfectly competitive final goods producers, a fiscal authority, and a monetary authority. Financial markets feature the following assets: (i) a long-term loan between households and investors in zero net supply; (ii) a long-term government bond held in positive net supply by investors; and (iii) a short-term government bond.

Households. A household (borrower) indexed by j consumes $C_t^{*H}(j)$, a composite good consisting of private consumption $C_t^H(j)$ and government consumption G_t such that

$$C_t^{*H}(j) = C_t^H(j) + \alpha_G G_t.$$

The parameter α_G governs the substitutability between private and government consumption: a negative value implies complementarity, while a positive value implies substitutability.

External habits in consumption imply that utility depends on current consumption relative to the previous period's aggregate consumption of the composite good, $\theta C_{t-1}^{*H}(j)$, where $\theta \in [0,1]$ is the habit parameter. Households also incur disutility from supplying differentiated labor services across their members, indexed by l,

$$L_t^H(j) = \int_0^1 N_t^H(j,l)\, dl.$$

The period utility function is given by

$$U_t^H(j) = u_t^b(j) \left[\ln\left(C_t^{*H}(j) - \theta C_{t-1}^{*H}(j)\right) - \frac{N_t^H(j)^{1+\xi}}{1+\xi} \right],$$

where u_t^b is a discount factor shock and ξ denotes the inverse of the Frisch elasticity of labor supply.

Households can borrow using a long-term debt instrument with payment structure $\rho_H^{T-(t+1)}$ for $T > t$ and $0 < \rho_H < 1$. The value of such an instrument issued in period t in any future period $t+j$ is

$$Q_{t+j}^{(n-j)} = \rho_H^j Q_{t+j}^{(n)}.$$

This asset can be interpreted as a portfolio of infinitely many bonds, with maturity weights given by $\rho_H^{T-(t+1)}$. Varying ρ_H changes the average maturity of debt.

Omitting the index j, the representative household's state and decision variables are defined as

$$\mathcal{S}_t^H \equiv \{C_{t-1}^{*H}, B_{H,t-1}^{(\rho_H)}, Z_t\}, \quad \mathcal{D}_t^H \equiv \{C_t^H, C_t^{*H}, B_{H,t}^{(\rho_H)}\}.$$

The household's problem is:

$$V^H(\mathcal{S}_t^H) = \max_{\mathcal{D}_t^H} \quad U_t(C_t^{*H}, C_{t-1}^{*H}, N_t^H) + \beta \mathbb{E}_t \left[V^H(C_{H,t}, B_{H,t}^{(\rho_H)}, Z_{t+1}) \right]$$

subject to (in real terms)

$$(1+\tau_{C,t})C_t^H + B_{H,t}^{(\rho_H)} = (1-\tau_{N,t}) \int W_t(l) N_t^H \, dl + \frac{\left(1+\rho_H Q_t^{(\rho_H)}\right)}{Q_t^{(\rho_H)}} \frac{B_{H,t-1}^{(\rho_H)}(j)}{\Pi_t} - T_{H,t},$$

$$C_t^{*H} = C_t^H + \alpha_G G_t,$$

where Z_t is a vector of aggregate shocks (to be defined), $T_{H,t}$ is a lump-sum tax, and $\Pi_t = P_t/P_{t-1}$ denotes gross inflation.

Investor. Unlike households, investors can accumulate wealth in the form of physical capital $\bar{K}_t^I$. The stock of capital depreciates at rate δ and increases with investment I_t^I, net of adjustment costs. The law of motion for physical capital is

$$\bar{K}_t^I(j) = (1-\delta)\bar{K}_{t-1}^I(j) + u_t^i \left[1 - s\left(\frac{I_t^I(j)}{I_{t-1}^I(j)} \right) \right] I_t^I(j),$$

where u_t^i is a shock to the marginal efficiency of investment, and $s(\cdot)$ is an investment adjustment cost function satisfying $s(e^{\varkappa}) = s'(e^{\varkappa}) = 0$ and $s''(e^{\varkappa}) \equiv s > 0$. The parameter $\varkappa$ captures the logarithm of the gross steady-state technology growth rate.

Investors rent effective capital $K_t^I(j)$ to intermediate firms, where effective capital is linked to physical capital through

$$K_t^I(j) = \nu_t(j)\bar{K}_{t-1}^I(j),$$

and $\nu_t(j)$ denotes the capital utilization rate. The cost of utilizing one unit of physical capital is given by $\Psi(\nu_t(j))$. In steady state, $\nu(j) = 1$, $\Psi(1) = 0$, and the elasticity condition

$$\frac{\Psi''(1)}{\Psi'(1)} = \frac{\psi}{1-\psi}$$

holds for $\psi \in [0, 1)$. The gross rental rate of capital is denoted $R_{K,t}$, and $\tau_{K,t}$ is the tax rate on capital rental income.

In addition to accumulating capital, investors can save by purchasing one-period government bonds in zero net supply and a portfolio of long-term government bonds in positive net supply. As with private loans, the long-term government bond has a payment structure $\rho_G^{T-(t+1)}$ for $T > t$ and $0 < \rho_G < 1$. The value of such an instrument issued in period t in any future period $t+j$ is

$$Q_{t+j}^{(n-j)} = \rho_G^j Q_{t+j}^{(n)}.$$

This bond can be interpreted as a portfolio of infinitely many bonds, with weights along the maturity structure given by $\rho_G^{T-(t+1)}$.

Each period, the investor receives after-tax nominal labor income, after-tax rental income from capital, lump-sum transfers from the government Z_t^S, and dividends from firms D_t. These resources are allocated to consumption, investment in physical capital, and asset accumulation. The period utility function is

$$U_t^I(j) = u_t^b(j)\left[\ln\left(C_t^{*I}(j) - \theta C_{t-1}^{*I}(j)\right) - \frac{N_t^I(j)^{1+\xi}}{1+\xi} - u_t^l W\left(B_{I,t}^{(\rho_H)}\right)\right],$$

where $W(\cdot)$ is the utility of loans and u_t^l is a loan premium shock which follows an AR(1) process. The former has an equivalent interpretation and functional form as specified in equation (1). Omitting the index j for brevity, the state and decision variables are

$$\mathcal{S}_t^I \equiv \{C_{t-1}^{*I}, B_{I,t-1}, B_{I,t-1}^{(\rho_H)}, B_{I,t-1}^{(\rho_G)}, \bar{K}_{t-1}, S_{t-1}, Z_t\},$$
$$\mathcal{D}_t^I \equiv \{I_t, \bar{K}_t, B_{I,t}^{(\rho_G)}, B_{I,t}^{(\rho_H)}, S_t, C_{I,t}, \nu_t\}.$$

The investor's problem is

$$V^I(\mathcal{S}_t^I) = \max_{\mathcal{D}_t^I} U_t(C_t^{*I}, C_{t-1}^{*I}, N_t^I, B_{I,t}^{(\rho_H)}) + \beta \mathbb{E}_t\left[V^I(\mathcal{S}_{t+1}^I)\right]$$

subject to (in real terms)

$$\begin{aligned}
&(1+\tau_{C,t})C_{I,t} + X_t + B_{I,t} + B_{I,t}^{(\rho_G)} + B_I^{(\rho_H)} + \int_0^1 P_{j,t}^S S_{j,t}\,\mathrm{d}j \\
&= (1-\tau_{N,t})\int W_t(l)L_t^I\,dl + \frac{B_{I,t-1}}{Q_t\Pi_t} + (1-\tau_{K,t})r_{K,t}\nu_t\bar{K}_{I,t-1} \\
&\quad + \frac{(1+\rho_G Q_t^{(\rho_G)})}{Q_t^{(\rho_G)}}\frac{B_{I,t-1}^{(\rho_G)}}{\Pi_t} + \frac{(1+\rho_H Q_t^{(\rho_H)})}{Q_t^{(\rho_H)}}\frac{B_{I,t-1}^{(\rho_H)}}{\Pi_t} \\
&\quad + \int_0^1 \left[P_{j,t}^S + (1-\tau_{D,t})D_{j,t}\right] S_{j,t-1}\,\mathrm{d}j - T_{I,t} - \Phi(\nu_t)\bar{K}_{I,t-1},
\end{aligned}$$

and the capital accumulation equation

$$\bar{K}_{I,t} = \bar{K}_t^I(j) = (1-\delta)\bar{K}_{t-1}^I(j) + u_t^i\left[1 - s\left(\frac{I_t^I(j)}{I_{t-1}^I(j)}\right)\right] I_t^I(j).$$

Production. The final goods producer is identical to that in the simple model of Section II. A continuum of intermediate goods firms operate under monopolistic competition. Each firm j rents capital $K_{j,t}$ from investors and hires labor $L_{j,t}$ in perfectly competitive factor markets to produce output according to

$$Y_{j,t} = K_{j,t}^{\alpha}(A_t L_{j,t})^{1-\alpha} - A_t\Omega,$$

where Ω is a fixed cost of production that grows at the labor-augmenting rate of technological progress. Productivity A_t evolves according to a stationary growth-rate process,

$$u_t^a = (1-\rho_a)\varkappa + \rho_a u_{t-1}^a + \varepsilon_t^a, \quad \text{where } u_t^a = \log\left(\frac{A_t}{A_{t-1}}\right).$$

Labor L_t is a composite of differentiated labor services l, aggregated by a competitive labor agency (described below). The firm's problem is

$$V^F(L_{j,t-1}, K_{j,t-1}, P_{j,t-1}, Z_t) = \max_{K_{j,t}, P_{j,t}, N_{j,t}} \frac{D^{\$}_{j,t}}{P_t} + \mathbb{E}_t \left[M^I_{t,t+1} V^F(L_{j,t}, K_{j,t}, P_{j,t}, Z_{t+1}) \right],$$

subject to the intermediate goods demand condition

$$K^{\alpha}_{j,t}(A_t N_{j,t})^{1-\alpha} - A_t \Omega - \left(\frac{P_{j,t}}{P_t} \right)^{-\theta} Y_t = 0, \tag{5}$$

and where nominal dividends are given by[1]

$$D^{\$}_{j,t} = P_{j,t} Y_{j,t} - r^K_t K_{j,t-1} P_t - W_t N_t P_t,$$

and $M^I_{t,t+1}$ is the investors' stochastic discount factor.

Cost minimization yields

$$MC_t = (1-\alpha)^{\alpha-1} \alpha^{-\alpha} (R_{K,t})^{\alpha} W_t^{1-\alpha} A_t^{-1+\alpha}.$$

Price-setting is subject to Calvo frictions: in each period, a firm can reoptimize its price with probability $1-\omega_p$. If it cannot, it follows a partial indexation rule to lagged inflation,

$$P_{j,t} = \Pi^{\chi_p}_{t-1} \bar{\Pi}^{\,1-\chi_p} P_{j,t-1},$$

where $\bar{\Pi}$ is the steady-state inflation target and $\chi_p \in [0,1]$ measures the degree of indexation. If the firm can reoptimize, it chooses $P_{j,t}$ to maximize expected discounted nominal profits:

$$\mathbb{E}_t \sum_{\tau=0}^{\infty} (\beta \omega_p)^{\tau} \frac{\Lambda_{I,t+\tau}}{\Lambda_{I,t}} \left(\left[\prod_{s=1}^{\tau} \Pi^{\chi_p}_{t+s-1} \bar{\Pi}^{\,1-\chi_p} \right] P_{j,t} Y_{j,t+\tau} - MC_{j,t+\tau} Y_{j,t+\tau} \right),$$

which, under symmetry, yields the New Keynesian Phillips Curve.

Labor Agency. Wage-setting frictions follow Erceg et al. (2000). Households and investors supply differentiated labor services l to a competitive labor agency, which hires each type at wage $W_{l,t}$ and aggregates them into a homogeneous input:

$$N_t = \left(\int_0^1 N_{l,t}^{\frac{1}{\eta^w_t + 1}} \, dl \right)^{\eta^w_t + 1},$$

where η^w_t is an i.i.d. wage markup shock. The demand for each labor service is

$$N_{l,t} = \left(\frac{W_{l,t}}{W_t} \right)^{\frac{-1+\eta^w_t}{\eta^w_t}} N_t.$$

Wages are set à la Calvo: in each period, with probability $1-\omega_w$, a wage can be reoptimized; otherwise, it is partially indexed to past inflation:

$$W_{l,t} = W_{l,t-1} (\Pi_{t-1})^{\chi_w} (\bar{\Pi})^{1-\chi_w},$$

[1] In equilibrium, real aggregate dividends satisfy $D_t/P_t = Y_t - r^K_t K_{t-1} - W_t N_t - \Phi_t$.

where $\chi_w \in [0,1]$ measures the degree of indexation. When reoptimizing, the wage $W^*_{l,t}$ solves

$$\max_{W^*_{l,t}} \mathbb{E}_t \sum_{k=0}^{\infty} (\beta\omega_w)^k \left[\prod_{s=1}^{k} \Pi_{t+s-1}^{\chi_w} \bar{\Pi}^{1-\chi_w}\right] \sum_{i\in\{H,I\}} U_t(C_t^{*i}, C_{t-1}^{*i}, N_t^i),$$

subject to

$$L_{l,t} = \left(\frac{W^*_{l,t}\left[\prod_{s=1}^{k} \Pi_{t+s-1}^{\chi_w} \bar{\Pi}^{1-\chi_w}\right]}{W_{t+k}}\right)^{\frac{-1+\eta_t^w}{\eta_t^w}} L_{t+k}.$$

Fiscal Policy. Assuming that one-period government bonds are in zero net supply and that households and investors receive the same transfers, the government's nominal budget constraint can be written, in real terms, as

$$\tau_{C,t}C_t + \tau_{K,t}R_{K,t}K_t + \tau_{N,t}W_tN_t + B_{G,t} + Q_t^{(\rho_G)}B_{G,t}^{(\rho_G)} + T_t = \frac{B_{G,t-1}}{\Pi_t Q_t} + \frac{1+\rho_G Q_t^{(\rho_G)}}{Q_t^{(\rho_G)}}\frac{B_{G,t-1}^{(\rho_G)}}{\Pi_t},$$

where $C_t = \mathtt{w}C_t^N + (1-\mathtt{w})C_t^I$ and $T_t = \mathtt{w}T_t^H + (1-\mathtt{w})T_t^I$ denote aggregate consumption and total transfers, respectively.

We define $g_t = G_t/A_t$ and $z_t^\chi = T_t^\chi/A_t$ for $\chi \in \{H, I\}$, and let $s_{b,t}$ denote the debt-to-GDP ratio. The superscripts on transfer shocks are used only to distinguish the two types of transfer shocks; all other shocks affect only the funded portion of debt.

The fiscal authority adjusts government spending $\tilde{g}_t$, transfers $\tilde{z}_t$, and tax rates on capital, labor, and consumption $\tilde{\tau}_{J,t}$, $J \in \{K, N, C\}$, according to:

$$\tilde{g}_t = \rho_G\tilde{g}_{t-1} - (1-\rho_G)\gamma_G(\tilde{s}_{b,t-1} - \tilde{s}^F_{b,t-1}) + \zeta_{g,t}, \tag{6}$$

$$\tilde{z}_t^b = \rho_Z\tilde{z}_{t-1}^b - (1-\rho_Z)\left[\gamma_Z(\tilde{s}_{b,t-1} - \tilde{s}^F_{b,t-1}) + \phi_{zy}\tilde{y}_t\right] + \zeta_{z,t}, \tag{7}$$

$$\tilde{\tau}_{J,t} = \rho_J\tilde{\tau}_{J,t-1} + (1-\rho_J)\gamma_J(\tilde{s}_{b,t-1} - \tilde{s}^F_{b,t-1}), \tag{8}$$

where $\tilde{s}_{b,t-1} - \tilde{s}^F_{b,t-1}$ is the portion of debt the fiscal authority is committed to stabilize with fiscal adjustments. This commitment is captured by γ_G, γ_Z, and $\gamma_J > 0$, chosen large enough to ensure stability of the funded debt component. The remaining portion $\tilde{s}^F_{b,t-1}$ is unfunded.

Total transfers are given by:

$$\tilde{z}_t \equiv \mathtt{w}\tilde{z}_t^H + (1-\mathtt{w})\tilde{z}_t^I,$$

with

$$\tilde{z}_t^H = \tilde{z}_t^b + \bar{\zeta}_t^{M,H} + \bar{\zeta}_t^{F,H}, \quad \tilde{z}_t^I = \tilde{z}_t^b + \bar{\zeta}_t^{M,I} + \bar{\zeta}_t^{F,I}.$$

In particular, $\bar{\zeta}_t^{M,H}$, $\bar{\zeta}_t^{M,I}$, $\bar{\zeta}_t^{F,H}$, and $\bar{\zeta}_t^{F,I}$ represent the trend component of funded and unfunded shares of transfers and follow persistent AR(1) processes. Instead, the term $\tilde{z}_t^b$ captures transitory movements in funded transfers and their adjustment to debt and the business cycle. The fiscal shocks $\zeta_{g,t}$ and $\zeta_{z,t}$ also follow AR(1) processes.

To reflect the fact that large welfare programs are typically announced well before they start having an impact on spending, the persistent (trend) components of spending are modeled as:

$$\bar{\zeta}_t^{M,\chi} = \rho_{\bar{\zeta}^{M,\chi}} \bar{\zeta}_{t-1}^{M,\chi} + (1 - \rho_{\bar{\zeta}^{M,\chi}}) \zeta_t^{M,\chi}, \tag{9}$$

$$\bar{\zeta}_t^{F,\chi} = \rho_{\bar{\zeta}^{F,\chi}} \bar{\zeta}_{t-1}^{F,\chi} + (1 - \rho_{\bar{\zeta}^{F,\chi}}) \zeta_t^{F,\chi}. \tag{10}$$

where $\zeta_t^{F,\chi}$ and $\zeta_t^{M,\chi}$ are fiscal shocks announcements, with $\chi \in \{H, I\}$.

Monetary Policy. The central bank adjusts the short-term nominal interest rate $\tilde{R}_{n,t}$ in response to inflation fluctuations arising from typical business cycle shocks and from funded fiscal shocks, while fully accommodating the inflationary movements required to stabilize the unfunded portion of public debt. This behavior can be represented by embedding shock-specific policy responses into a conventional Taylor rule in which the central bank reacts to deviations of inflation from the level necessary to stabilize the unfunded share of debt. We denote this debt-stabilizing level of inflation as *fiscal inflation*, $\tilde{\pi}_t^F$. Bianchi et al. (2023) show that fiscal inflation can be derived by modeling a shadow economy in which policymakers follow a fiscally-led policy mix and the economy is only hit by unfunded fiscal shocks. The Appendix provides additional details, as in this paper we allow for unfunded shocks to both households and investors.

The linearized monetary policy rule, incorporating an effective lower bound (ELB) constraint, is given by:

$$\tilde{r}_{n,t} = \max \left[-\ln \underline{R}_n, \rho_r \tilde{r}_{n,t-1} + (1 - \rho_r) \left[\phi_\pi \left(\tilde{\pi}_t - \tilde{\pi}_t^F \right) + \phi_y \tilde{y}_t \right] + u_t^m \right], \tag{11}$$

where u_t^m is a monetary policy shock.

A value $\phi_\pi > 1$ satisfies the Taylor principle, implying that monetary policy is active in stabilizing deviations of inflation $\tilde{\pi}_t$ from fiscal inflation $\tilde{\pi}_t^F$. The latter measures the increase in inflation—relative to the central bank's long-run target and steady-state rate—that the central bank tolerates in order to stabilize the unfunded portion of debt $\tilde{s}_{b,t-1}^F$.

The policy mix defined by equations (6)–(11) therefore implies that: (i) monetary policy is *active* with respect to deviations of inflation from fiscal inflation, but *passive* toward movements in fiscal inflation itself; and (ii) fiscal policy is *Ricardian* with respect to stabilizing the funded share of debt $\tilde{s}_{b,t-1} - \tilde{s}_{b,t-1}^F$, but *non-Ricardian* with respect to the unfunded share.

In this configuration, the central bank's willingness to accommodate persistent increases in inflation—combined with the fiscal authority's decision not to stabilize a fraction of the outstanding debt—generates fiscal inflation. Thus, a monetary-led policy stance toward business cycle shocks coexists with a fiscally-led stance toward unfunded fiscal shocks.

Conceptually, the inclusion of fiscal inflation $\tilde{\pi}_t^F$ in the Taylor rule resembles the treat-

ment of time-varying inflation targets or inflation drifts in estimated medium-scale DSGE models (Smets and Wouters, 2007), which are often introduced to capture persistent inflation dynamics in the data. In contrast to those settings, fiscal inflation here is not an exogenous drift but an endogenous policy variable, determined by the coordination between monetary and fiscal authorities to stabilize the unfunded portion of public debt.

III.B Solving the Model

We proceed as in the simple model of Section II. First, we detrend all non-stationary variables, an essential step in the quantitative model given the unit root in labor-augmenting technology A_t. We then log-linearize the model equations around the deterministic steady state. Appendix B.A provides further details and lists all log-linearized equations. The model is solved using standard techniques for linear rational expectations systems.

IV Inference

We estimate the model using Bayesian methods, combining prior distributions for the parameters with the model's likelihood function, which is evaluated via the Kalman filter.

IV.A Data

The estimation uses a dataset of twelve quarterly U.S. macroeconomic and distributional series spanning 1960:Q1–2022:Q3: real per-capita GDP growth; real per-capita consumption growth; real per-capita investment growth; an hours gap measure; the effective federal funds rate; growth of average weekly earnings; GDP-deflator inflation; growth of real government transfers; growth of government consumption and investment; the government debt-to-GDP ratio; the 30-year mortgage rate; the ratio of mortgage liabilities to GDP for the bottom 90th percentile of the income distribution.

To account for the effective lower bound (ELB) on the federal funds rate during most of 2008:Q1–2022:Q3, we estimate the model over two subsamples: 1960:Q1–2007:Q4 and 2008:Q1–2022:Q3. For the latter subsample, we augment the dataset with market expectations of the federal funds rate one to ten quarters ahead, based on overnight index swaps.[2] Formally modeling the ELB would substantially increase computational complexity by introducing a non-linearity that requires non-linear Monte Carlo filters to evaluate the likelihood (Fernandez-Villaverde and Rubio-Ramirez, 2007). Instead, following Campbell et al. (2012),

[2]We construct expected federal funds rate series following Campbell et al. (2017). See Supplementary Data Section E for details.

we use market-based expectations to discipline the model after 2008:Q4, effectively incorporating the ELB constraint into agents' expectations. The construction of the distributional variables relies on aggregate cross-sectional microdata. Household balance sheet information is sourced from the Distributional Financial Accounts (DFA) of the Federal Reserve Board (Batty et al., 2019), which integrate the Financial Accounts (Table B.101.h) with the Survey of Consumer Finances (SCF). To account for the upper tail of the wealth distribution, SCF sample weights are re-scaled using a weighted version of the Forbes 400. For the bottom 90 percent of the distribution, we measure mortgage liabilities relative to GDP by employing the "Home Mortgages" liability category. Since the Financial Accounts are available only from 1989:Q3 onward, we impose the assumption that the mortgage share of the bottom 90 percent remains constant over the period 1960:Q1–2022:Q2. Under this assumption, the aggregate household mortgage debt-to-GDP ratio is used to recover the corresponding series for the bottom 90 percent.

A few remarks on the aggregation thresholds are in order. To map the model to the data, we require representative counterparts for "households" (borrowers) and "investors" (lenders). We identify the top 10th percentile as representative of investors, and the bottom 90th percentile as representative of households. This choice is guided by both data availability—percentile thresholds are reported at the 50th, 90th, 99th, and 99.9th percentiles—and by observed net worth positions with respect to mortgages and treasuries, for which the 90th percentile provides a reasonable partition.

IV.B Posterior Distributions

Table I presents the prior and posterior distributions for the estimated model parameters. We choose diffuse priors for the parameters of the model, except for the parameters controlling the persistence of the trend components of funded and unfunded transfers. This choice is akin to an identifying assumption as we are interested in isolating secular shifts in spending and their impact on the dynamics of public and private debt. For a similar reason, we choose a tight prior on the persistence of the long-term NKPC shifter. As explained above, this shock captures secular changes in the macroeconomic environment that affect low-frequency movements in inflation, such as globalization.

The parameters controlling the response of the central bank to deviations of inflation from fiscal inflation are well-identified and imply a more than one-to-one response to inflation, $\phi_\pi = 1.46$. In line with the literature, we find a fair amount of nominal rigidities, especially in wage setting. The parameter controlling substitution between private and government consumption is instead estimated to be close to zero.

Funded fiscal shocks are found to be substantially more volatile than unfunded fiscal shocks. This finding reflects the fact that changes in the share of unfunded spending have large effects on the economy, as described below. Furthermore, it is consistent with the fact that most of the changes in spending are expected to be eventually covered by future fiscal adjustments.

Table I: Prior and Posterior Distributions

Parameters	Dist	Prior Mean	Prior Std	Posterior Mode	Posterior Std	Description
s_b	N	2.40	0.050	2.62	0.007	Government debt/GDP
$\varkappa_{100}$	N	0.500	0.050	0.557	0.066	Steady state growth rate
$\pi^{\star}_{100}$	N	0.500	0.050	0.297	0.107	Steady state inflation
ξ_I	G	2	0.100	1.97	0.046	Inverse Frisch Elasticity
ξ_H	G	2	0.100	1.63	0.051	Inverse Frisch Elasticity
μ_H	B	0.900	0.010	0.887	0.028	Share of Households
ω_w	B	0.800	0.010	0.837	0.026	Wage Calvo param.
ω_p	B	0.800	0.010	0.900	0.020	Price Calvo param.
ψ	B	0.800	0.100	0.574	0.022	Capital utilization cost
s	N	6	0.500	11.4	0.032	Investment Adjustment Cost
χ_w	B	0.050	0.010	0.038	0.144	Wage inflation indexation
χ_p	B	0.250	0.010	0.240	0.025	Price inflation indexation
θ_I	B	0.500	0.100	0.773	0.190	Habit formation Investor
θ_H	B	0.500	0.100	0.065	0.049	Habit formation Household
ζ_I	G	1.00	0.100	1.08	0.057	Inverse EIS
ζ_H	G	1.00	0.100	0.0066	0.082	Inverse EIS
α_g	N	0	0.100	0.020	0.068	Subst. gov/private cons.
ϕ_y	C	0.010	0	0.010	-	Int. resp. to GDP
ϕ_{π_c}	N	2.00	0.500	1.20	0.208	Int. resp. to non fiscal infl.
ϕ_{yc}	N	0.500	0.100	0.0497	0.181	Int. resp. to non fiscal output
ϕ_{zy}	G	0.100	0.050	0.0127	0.292	Tr. resp. to GDP Counterfactual
γ_{Gc}	N	0.250	0.100	0.0024	0.298	Gov cons resp. to debt counter.
γ_{Kc}	N	0.250	0.100	1.09	0.043	Capital tax resp. to debt counter.
γ_{Lc}	N	0.250	0.100	0.458	0.110	Labor tax resp. to debt counter.
γ_{Zc}	N	0.250	0.100	0.0015	0.332	Transfer resp. to debt counter.
ρ_r	B	0.500	0.100	0.010	0.101	AR coeff. mon. rule
ρ_{gc}	B	0.500	0.100	0.879	0.162	AR coeff. govt cons. rule
ρ_z	B	0.500	0.100	0.987	0.094	AR coeff. short-term trans.
ρ_{eg}	B	0.500	0.100	0.883	0.159	AR coeff. gov. cons.
$\rho_{e\tilde{z}}^{MI}$	B	0.500	0.100	0.252	0.069	AR coeff. Fun. transfer Inv.
$\rho_{e\tilde{z}}^{MH}$	B	0.500	0.100	0.700	0.066	AR coeff. Fun. transfer HH.
$\rho_{e\tilde{z}}^{FI}$	B	0.500	0.100	0.982	0.091	AR coeff. Unf. transfer Inv.
ρ_{ez}^{FH}	B	0.500	0.100	0.499	0.149	AR coeff. Unf. transfer HH.
ρ_a	B	0.500	0.100	0.066	0.058	AR coeff. technology
ρ_b	B	0.500	0.100	0.860	0.031	AR coeff. preference
ρ_{em}	B	0.500	0.100	0.028	0.161	AR coeff. mon. policy
ρ_i	B	0.500	0.100	0.690	0.044	AR coeff. investment
ρ_{rp}	B	0.500	0.100	0.413	0.018	AR coeff. risk premium
ρ_{zt}	B	0.500	0.100	0.658	0.076	AR coeff. transitory transfer
ρ_{bH}	B	0.500	0.100	0.994	0.208	AR coeff. mortgage premium
b_H	C	0.316	0	0.316	-	Household debt / GDP
pen_I	B	0.050	0.005	0.139	0.034	Penalty Loan
σ_{gc}	I	0.500	0.100	2.82	0.052	AR coeff. govt consumption
$\sigma_{\tilde{z}}^{MI}$	U	25.00	-	49.9	0.166	Std.dev. Fun. transfer Inv.
$\sigma_{\tilde{z}}^{MH}$	U	25.00	-	9.82	0.074	Std.dev. Fun. transfer HH.
$\sigma_{\tilde{z}}^{FI}$	U	25.00	-	0.733	0.186	Std.dev. Unf. transfer Inv.
σ_z^{FH}	U	25.00	-	49.9	0.147	Std.dev. Unf. transfer HH.
σ_a	I	0.500	0.100	1.93	0.051	Std.dev. technology
σ_b	I	0.500	0.100	2.39	0.059	Std.dev. coefficient preference
σ_m	I	0.500	0.100	2.97	0.102	Std.dev. mon. policy
σ_i	I	0.500	0.100	3.00	0.074	Std.dev. investment
σ_w	I	0.500	0.100	0.590	0.097	Std.dev. wage markup
σ_p	I	0.500	0.100	0.312	0.113	Std.dev. trans. cost push shock
σ_{rp}	I	0.500	0.100	0.277	0.147	Std.dev. risk premium
σ_{zt}	I	0.500	0.100	0.495	0.154	Std.dev. transitory transfer
σ_{bH}	I	0.500	0.100	0.342	0.115	Std.dev. mortgage premium
σ_{GDP}^{ME}	I	0.500	0.200	0.942	0.075	Meas. error GDP
σ_{BY}^{ME}	I	0.500	0.200	1.78	0.087	Meas. error Debt/GDP

V Results

In this section, we describe the main results of the model. We first explore the behavior of funded and unfunded fiscal shocks using impulse responses. We then use the model to understand how these two shocks contributed to the saving glut of the rich.

V.A Impulse Responses

Figure IV presents the impulse responses at the posterior mode to a funded and unfunded fiscal transfers to households in the quantitative model. The solid blue line corresponds to a funded fiscal shock, while the dashed red line corresponds to an unfunded fiscal shock. These two cases parallel the cases analyzed for the simple model in Figure III of Section II.

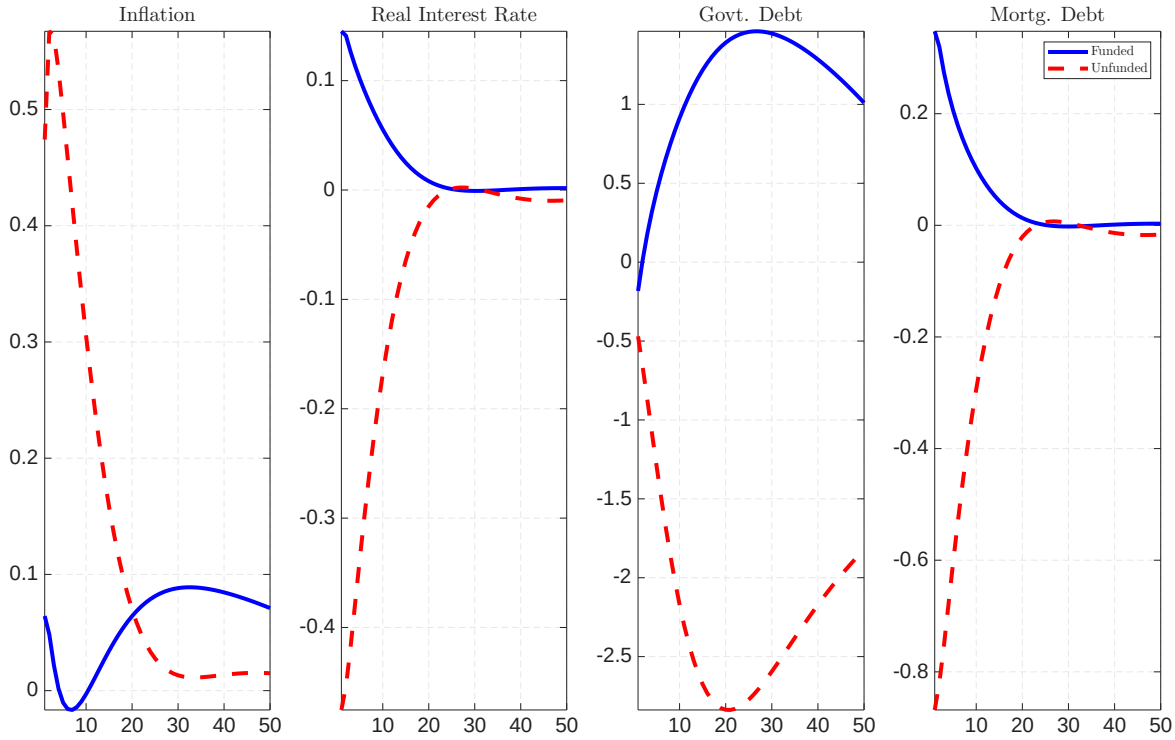
Following a funded shock, inflation has a modest increase on impact, triggering an increase in the real interest rate. Household mortgage debt rises temporarily as borrowers smooth consumption despite higher real rates and investors save in anticipation of future taxation. As the amount of spending starts to materialize, government debt increases, reflecting the decision to finance the transfer through borrowing today with the expectation of future fiscal adjustments. This dynamic echoes the funded fiscal shock analyzed in the simple model: the central bank responds more than one-for-one to inflation, stabilizing prices through tighter policy and inducing intertemporal reallocation. Importantly, the saving glut of the rich materializes first via private, then public lending. However, in both cases the accumulation of savings by investors is in anticipation of future taxation. In this sense, agents are behaving in a Ricardian way in the sense of Barro (1974).

In contrast, an unfunded shock generates a large and immediate increase in inflation, a sharp fall in the real interest rate, and a pronounced decline in government debt as higher inflation erodes its real value. Mortgage debt drops on impact, consistent with households using the transfer to deleverage, while investors reduce their holdings of nominal claims in anticipation of persistent fiscal expansion and high inflation. These patterns closely match the qualitative predictions of the unfunded fiscal shock in the simple model, though here the magnitudes are shaped by the richer propagation channels in the estimated framework.

While the quantitative model incorporates a richer set of frictions, a broader range of shocks, and estimated structural parameters that alter magnitudes and persistence, the underlying mechanisms remain consistent: active monetary stabilization in the funded case and inflationary debt erosion in the unfunded case. In response to funded spending, investors accumulate significant savings, while in response to an unfunded shock, we observe a significant deleveraging.

To qualitatively illustrate these mechanisms, Figure V presents a simulation in which unfunded shocks—affecting households—hit the economy during the first 20 quarters (indicated by the dashed vertical line). Over the following 80 quarters, the economy experiences a sequence of funded shocks that progressively increase the share of funded spending. The figure depicts investor behavior consistent with our thesis. Initially, the rise in spending leads to deleveraging and an absence of saving among the rich. However, in response to the fiscal policy shift from unfunded to funded spending, investors begin to increase their savings, resulting in what can be described as a saving glut of the rich.

Figure IV: Impulse responses to funded and unfunded fiscal shocks



Notes: The figure plots the Impulse Response Functions to a standard deviation fiscal shock to households. The solid blue line is the response to a funded fiscal shock and the dashed red line is the response to an unfunded fiscal shock. The x-axis are quarters and the y-axis are percentage points deviations from the steady state.

V.B Fiscal Policy and the Saving Glut of the Rich

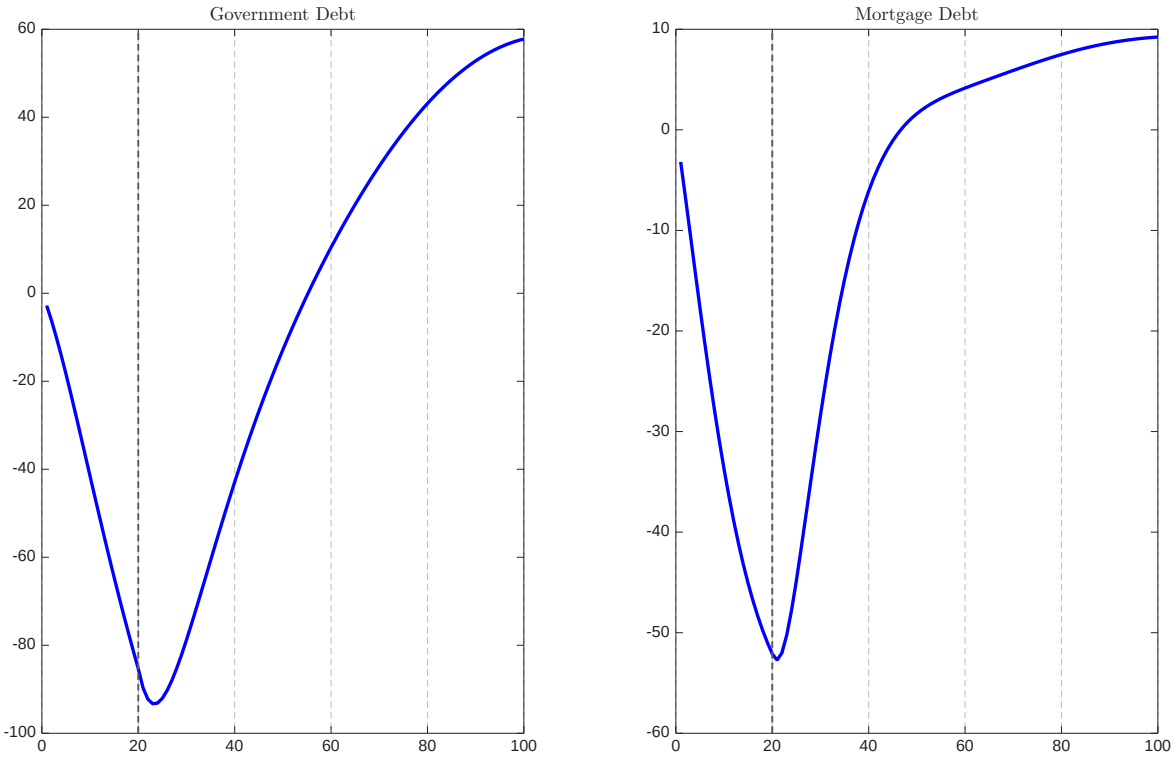
Building on the intuition from the impulse responses in Figure IV, we now use the estimated model to decompose the historical evolution of private and public debt into the contributions of funded and unfunded fiscal shocks. The goal is to understand what role the amount of transfer policies from the government and their financing have played in explaining the rise of public and private lending.

Figure VI presents model-based counterfactual simulations for government and household mortgage debt. We consider two counterfactual simulations. In the first one, solid blue line, we report what the evolution of debt would have been if only unfunded fiscal shocks had occurred. In this simulation, all the other fiscal and macro shocks are set to zero. In the second counterfactual simulation, red dashed line, we repeat the exercise considering both funded and unfunded fiscal shocks. In both cases, we add the steady state and initial conditions as implied by the posterior mode. This implies that the starting point of the simulations is always the actual data at the beginning of the sample, 1960:Q1.

In interpreting the results, it is important to consider that we are allowing for only two of the several shocks that occurred in reality. Thus, we would not expect these counterfactual simulations to replicate the actual series closely. We use the simulations to understand the contribution of these two particular shocks to the saving glut of the rich.

The results provide a structural validation of the patterns suggested by the descriptive evidence in Figure

Figure V: Announced shift in fiscal policy

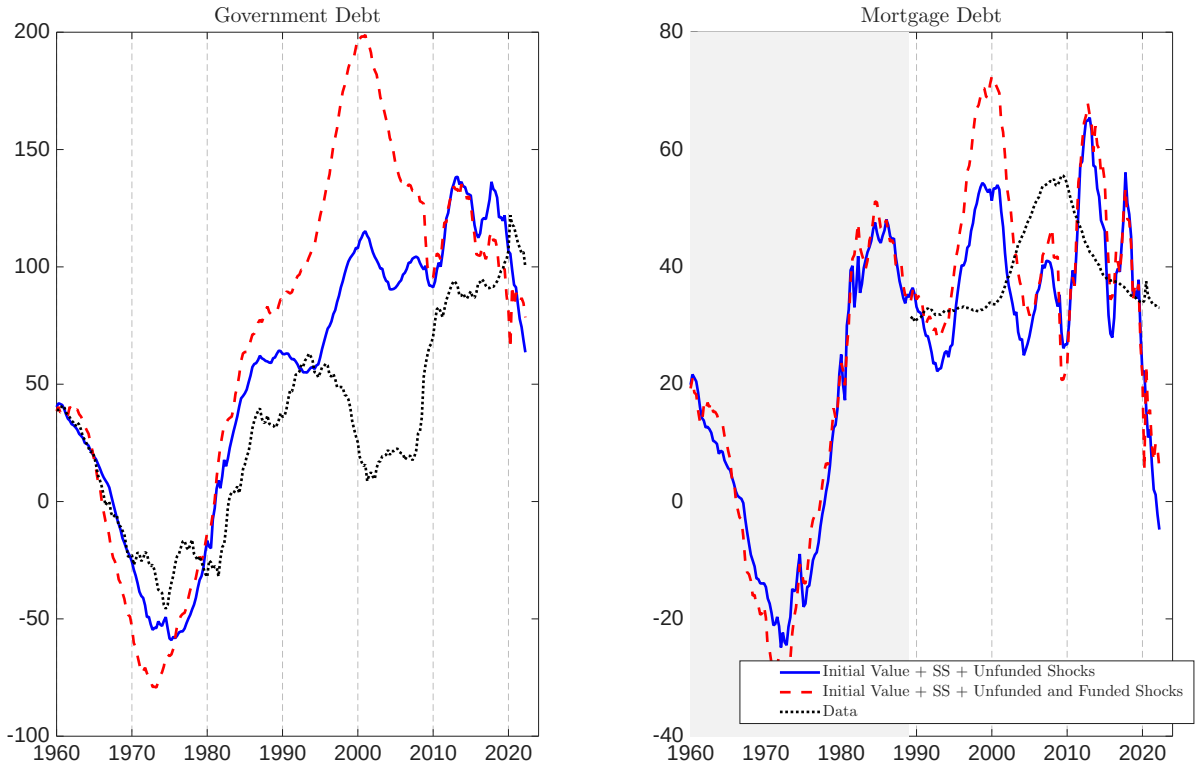


Notes: The left and right panels report respectively government and mortgage debt, in ratio to GDP, in response to an announced shift in fiscal policy from unfunded to funded spending. The response is obtained by simulating the estimated model. The dashed vertical line marks the switch from unfunded to funded shocks, which happens at quarter 20. The x-axis are quarters and the y-axis are percentage point deviations from the steady state.

I. In the 1960s and 1970s, unfunded fiscal shocks would have implied a substantial drop in both private and public lending from investors to the rest of the economy. Adding funded fiscal shocks to the previous series would not significantly change this pattern, as implied by the small difference between the red and blue lines during this period. In the late 1970s, these patterns start to revert and the change accelerates in the 1980s and 1990s. Note that the contribution of unfunded transfer shocks is a large increase in debt. As we explain in more detail below, this can be interpreted as a *decline* in unfunded spending. Over this period of time, the difference between the two counterfactual simulations opens up, implying larger fluctuations in the amount of funded spending. While the two counterfactual simulations are more volatile than the actual data, it is clear that they can account for a large share of the rise in public and private lending by investors to the rest of the economy.

To better understand what drives these results, we can inspect in more detail the fluctuations in the different components of transfers. Figure VII reports a decomposition of the *innovations* to total transfers in deviations from the balanced growth path controlling for initial conditions. In other words, the figure reports the surprises with respect to what agents were already expecting at the beginning of the sample. In the 1960s and 1970s, we observe a large acceleration of transfers with respect to the balanced growth path. This means that this type of spending is increasing significantly with respect to the size of the economy. This pattern reverts in the late 1970s and especially in the early 1980s. Thus, the growth in the total amount of

Figure VI: Counterfactual Debt Series



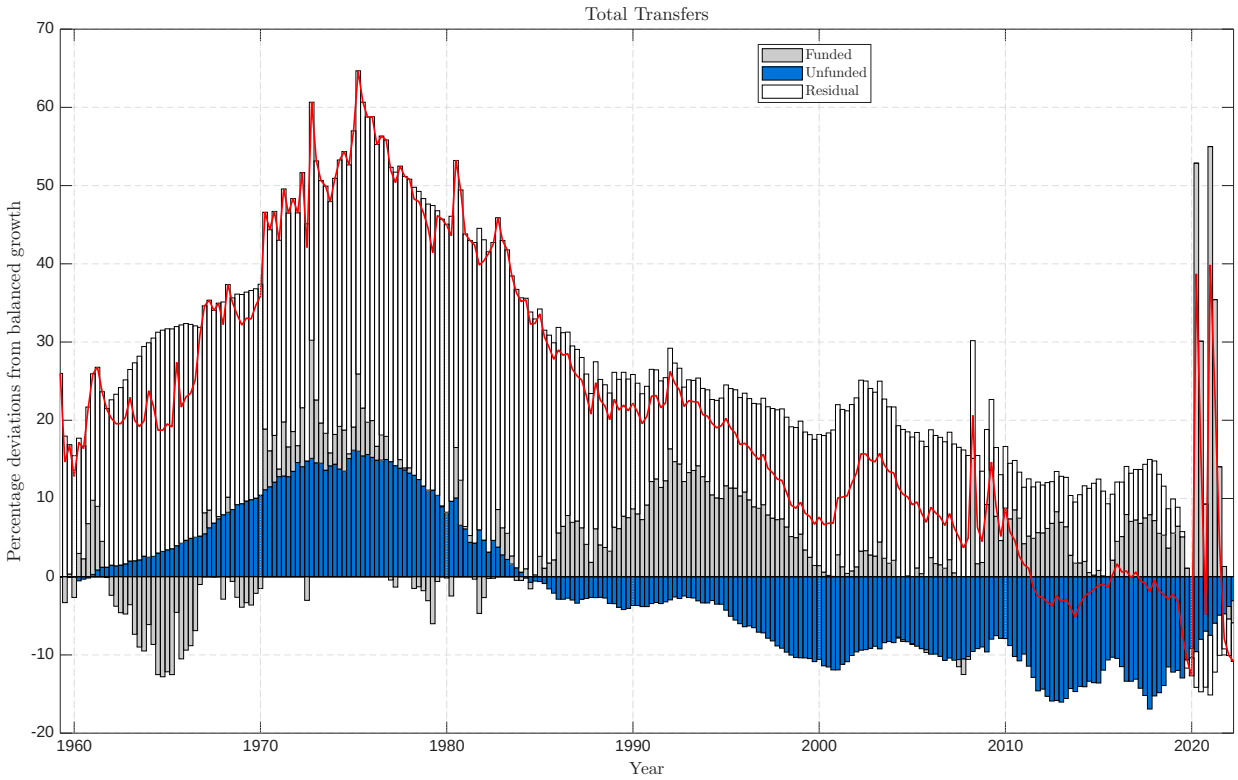
Notes: Counterfactual public and private debt. The left panel shows the counterfactual path of government debt-to-GDP absent the smoothed innovations of unfunded fiscal shocks $\ln\left(\frac{GOVT.\ DEBT}{GDP}\right)\cdot 100$. The right panel reports the corresponding exercise for households' mortgage debt-to-GDP $\left(\frac{MORTG.\ DEBT}{GDP}\right)\cdot 100$. GDP is annualized. Dashed red lines denote the counterfactual series, while solid blue lines depict the realized series.

transfer spending decelerates during these years.

Figure VIII illustrates that while the growth in transfer spending decelerated in the early 1980s, its composition also changed significantly. The left panel of the figure shows the contribution of unfunded spending to total transfers, while the right panel displays the share of unfunded spending relative to the long-term component of transfer spending. In both cases, a noticeable shift occurs in the late 1970s and early 1980s: the share of unfunded spending dropped significantly and has remained low ever since. Although overall transfer spending did not halt—only slowed compared to the 1960s and 1970s—this figure suggests that large government transfer programs have continued to grow in size, but with the expectation that a greater share will be financed by future taxes. Given the progressivity of the tax system, this structural shift results in a substantial accumulation of savings by top earners—the *saving glut of the rich*.

Consistent with the impulse responses and stylized facts presented in the Introduction, the saving glut of the rich initially manifests through private lending in anticipation of future benefits. Once spending materializes, private leverage falls while public debt increases, as taxes adjust only gradually. This transition from unfunded to funded spending also aligns with the changes in the tax code discussed earlier in the Introduction.

Figure VII: Decomposition of Transfers



Notes: The figure reports the decomposition of total transfers as percentage deviation from the balanced growth. The residual represents the portion of transitory (endogenous) transfers. The red line in the panel corresponds to total transfers to the sum of all components.

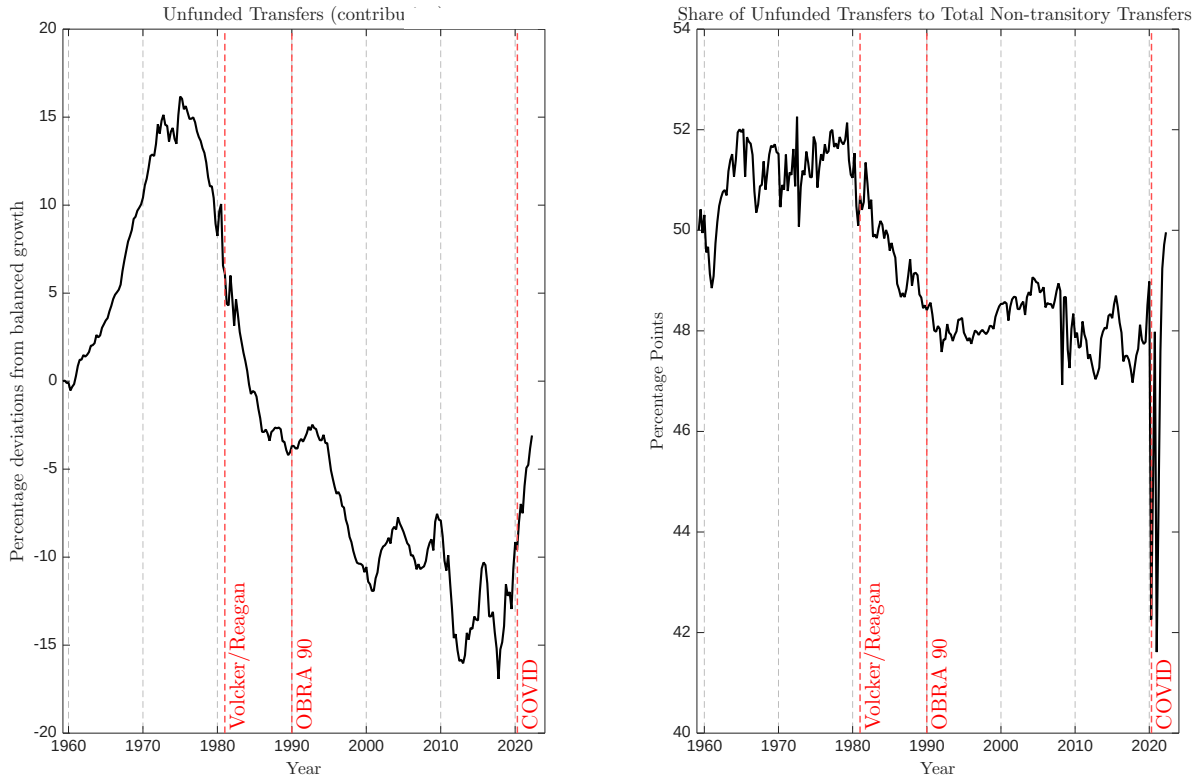
VI Conclusions

This paper develops and estimates a two-agent New Keynesian model in which funded and unfunded fiscal shocks coexist and serve to transfer resources from high-income investors to low-income households. When redistribution is unfunded, the economy experiences inflation and household deleveraging. When redistribution is funded, investors accumulate significant savings—initially through private lending, and subsequently through public lending.

Estimated on U.S. quarterly data from 1960–2022, combining aggregate macroeconomic series with distributional measures of debt, assets, and consumption, the model uncovers a fundamental transformation in fiscal financing. Before the mid-1980s, unfunded shocks were the primary driver of transfer dynamics, consistent with an environment in which inflation served as a fiscal instrument. In this regime, public debt ratios remained contained and private leverage among borrowers was persistently lower. After the mid-1980s, funded shocks became dominant, replacing inflationary finance and broad-based taxation with debt-financed redistribution supported by top-heavy taxation. This shift sustained historically high levels of public debt, coincided with a pronounced leveraging of borrowers through mortgage debt, and contributed to a persistent saving glut among the rich. This narrative is consistent with the increase in progressivity of the U.S. tax system that occurred in the 1990s and the timing of the increase in private and public lending.

By structurally decomposing the historical contribution of funded and unfunded shocks, the analysis

Figure VIII: Share of Unfunded Transfers



Notes: The left subplot represents the share of unfunded transfers as a percentage of total non-transitory transfers. The right subplot is the historical evolution of unfunded transfers as a percentage deviation from the balanced growth path.

validates hypotheses suggested by descriptive evidence: the mechanisms through which fiscal policy redistributes—via future taxation versus fiscal inflation—have changed markedly over time, with important implications for the joint dynamics of public and private debt. The framework highlights that the distributional composition of fiscal shocks is central to understanding the macroeconomic transmission of fiscal policy, the interaction between fiscal and monetary authorities, and the long-run evolution of leverage in the household sector.

References

Aiyagari, S. R. and M. Gertler (1985). The Backing of Government Bonds and Monetarism. *Journal of Monetary Economics 16*(1), 19–44.

Angeletos, G.-M., C. Lian, and C. K. Wolf (2024). Can deficits finance themselves? *Econometrica 92*(5), 1351–1390.

Barro, R. J. (1974, Nov.-Dec.). Are Government Bonds Net Wealth? *Journal of Political Economy 82*(6), 1095–1117.

Barro, R. J. and F. Bianchi (2023). Fiscal influences on inflation in oecd countries, 2020-2022. Technical report, National Bureau of Economic Research.

Bassetto, M. (2002). A Game-Theoretic View of the Fiscal Theory of the Price Level. *Econometrica 70*(6), 2167–2195.

Bassetto, M. and T. J. Sargent (2020). Shotgun Wedding: Fiscal and Monetary Policy. *Annual Review of Economics 12*(1), 659–690.

Batty, M. M., J. Bricker, J. S. Briggs, A. H. Volz, E. B. Holmquist, S. H. McIntosh, K. B. Moore, E. R. Nielsen, S. Reber, M. Shatto, and K. Som (2019, March). Introducing the Distributional Financial Accounts of the United States. Finance and Economics Discussion Series 2019-017, Board of Governors of the Federal Reserve System (U.S.).

Benhabib, J., S. Schmitt-Grohe, and M. Uribe (2002). Avoiding Liquidity Traps. *Journal of Political Economy 110*(3), 535–563.

Bianchi, F., R. Faccini, and L. Melosi (2023, 05). A fiscal theory of persistent inflation. *The Quarterly Journal of Economics 138*(4), 2127–2179.

Bianchi, F. and C. Ilut (2017). Monetary/Fiscal Policy Mix and Agents' Beliefs. *Review of Economic Dynamics 26*, 113–139.

Bianchi, F. and L. Melosi (2017). Escaping the Great Recession. *American Economic Review 107*(4), 1030 – 58.

Bianchi, F. and L. Melosi (2022). Inflation as a Fiscal Limit. 2022 Jackson Hole Economic Symposium, Federal Reserve Bank of Kansas City.

Campbell, J. R., C. L. Evans, J. D. Fisher, and A. Justiniano (2012). Macroeconomic Effects of Federal Reserve Forward Guidance. *Brookings Papers on Economic Activity 43*(1 (Spring), 1–80.

Campbell, J. R., J. D. M. Fisher, A. Justiniano, and L. Melosi (2017). Forward Guidance and Macroeconomic Outcomes Since the Financial Crisis. *NBER Macroeconomics Annual 31*(1), 283–357.

Cochrane, J. H. (1998). A Frictionless Model of U.S. Inflation. In B. S. Bernanke and J. J. Rotemberg (Eds.), *NBER Macroeconomics Annual 1998*, pp. 323–384. Cambridge, MA: MIT Press.

Cochrane, J. H. (2001). Long Term Debt and Optimal Policy in the Fiscal Theory of the Price Level. *Econometrica 69*, 69–116.

Dupraz, S. and A. Rogantini Picco (2025). Fiscal requirements for price stability when households are not ricardian.

Erceg, C. J., D. W. Henderson, and A. T. Levin (2000). Optimal monetary policy with staggered wage and price contracts. *Journal of Monetary Economics 46*(2), 281–313.

Fernandez-Villaverde, J. and J. F. Rubio-Ramirez (2007). Estimating Macroeconomic Models: A Likelihood Approach. *Review of Economic Studies 74*(4), 1059–1087.

Fisher, J. D. (2015). On the structural interpretation of the smets–wouters "risk premium" shock. *Journal of Money, Credit and Banking 47*(2-3), 511–516.

Hall, G. J. and T. J. Sargent (2011). Interest Rate Risk and Other Determinants of Post-WWII U.S. Government Debt/GDP Dynamics. *American Economic Journal: Macroeconomics 3*(3), 192–214.

Leeper, E. M. (1991). Equilibria Under Active and Passive Monetary and Fiscal Policies. *Journal of Monetary Economics 27*, 129–147.

Leeper, E. M. and X. Zhou (2021). Inflation's role in optimal monetary-fiscal policy. *Journal of Monetary Economics 124*, 1–18.

Mian, A. R., L. Straub, and A. Sufi (2020, April). The saving glut of the rich. (26941).

Rachel, L. and M. O. Ravn (2025). Brothers in arms: Monetary-fiscal interactions without ricardian equivalence.

Reis, R. (2017, April). QE in the Future: The Central Bank's Balance Sheet in a Fiscal Crisis. *IMF Economic Review 65*(1), 71–112.

Rotemberg, J. (1982). Sticky prices in the united states. *Journal of Political Economy*.

Sargent, T. and N. Wallace (1981). Some Unpleasant Monetarist Arithmetic. *Federal Reserve Bank of Minneapolis Quarterly Review Fall*, 1–17.

Schmitt-Grohe, S. and M. Uribe (2000). Price Level Determinacy and Monetary Policy Under a Balanced-Budget Requirement. *Journal of Monetary Economics 45*(1), 211–246.

Sims, C. A. (1994). A Simple Model for Study of the Determination of the Price Level and the Interaction of Monetary and Fiscal Policy. *Economic Theory 4*, 381–399.

Smets, F. and R. Wouters (2007). Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach. *The American Economic Review 97*(3), 586–606.

Smets, F. and R. Wouters (2024). Fiscal backing, inflation and US business cycles. Technical report, mimeo.

Woodford, M. (1994). Monetary Policy and Price Level Determinacy in a Cash-in-Advance Economy. *Economic Theory 4*, 345–389.

Woodford, M. (1995). Price Level Determinacy without Control of a Monetary Aggregate. *Carnegie-Rochester Series of Public Policy 43*, 1–46.

Woodford, M. (2001). Fiscal Requirements of Price Stability. *Journal of Money, Credit, and Banking 33*, 669–728.

A Simple Model: Additional Material

A.A Linearized System of Equations

In this appendix we report the list of linearized equations of the simple model. Hence, we report the results under the linear model.

First, we define $b_{H,t} \equiv B_{H,t}/Y_t$, $b_{G,t} \equiv B_{G,t}/Y_t$ and adjust the equations accordingly after having used the market clearing to substitute out $B_{I,t}^{(G)}$ and $B_{I,t}^{(H)}$. Second, we also define the primary surplus-to-GDP ratio of the government (in absence of government expenditure) as $s_{I,t} \equiv T_{I,t}/Y_t$ and $s_{H,t} \equiv T_{H,t}/Y_t$. Then we transform the equations accordingly.

Hence, define $X_t \equiv \bar{X}e^{\tilde{x_t}}$, where $\tilde{x}_t$ represents log-deviations from the steady state. Note that we linearize (and not log-linearize) with respect to s_t and b_t and we log-linearize all other variables. Also, we set $u(C) = C^{1-\mu}/(1-\mu)$ and $v(N) = \chi_H N^{1+\eta_H}/(1+\eta_H)$ and define $R_t^{(H)} \equiv 1/Q_t^{(H)}$ and $R_t^{(G)} \equiv 1/Q_t^{(G)}$, which implies $\tilde{r}_t^{(H)} = -\tilde{q}_t^{(H)}$ and $\tilde{r}_t^{(G)} = -\tilde{q}_t^{(G)}$. Hence, the list of linearized equations reads:

1. Household Budget: $\frac{\bar{C}_H}{\bar{N}}(\tilde{c}_{H,t} - \tilde{n}_t) + \tilde{b}_{H,t} = \frac{\bar{W}\bar{N}_H}{\bar{N}}\left(\tilde{w}_t + \frac{-\tilde{c}_{H,t} + \tilde{w}_t}{\eta} - \tilde{n}_t\right) + \beta^{-1}\tilde{b}_{H,t-1}$
$+ \beta^{-1}\bar{b}_H(\tilde{r}_{t-1}^{(H)} - \tilde{\pi}_t - \Delta\tilde{n}_t) - \tilde{s}_{H,t}$
2. Household Euler: $\tilde{r}_t^{(H)} + \tilde{c}_{H,t} = \mathbb{E}_t[\tilde{c}_{H,t+1} + \tilde{\pi}_{t+1}]$
3. Resource Constraint: $\mathtt{w}\bar{C}_H\tilde{c}_{H,t} + (1-\mathtt{w})\bar{C}_I\tilde{c}_{I,t} = \bar{N}\tilde{n}_t$
4. Investor Euler: $\tilde{r}_t^{(G)} + \tilde{c}_{I,t} = \mathbb{E}_t[\tilde{c}_{I,t+1} + \tilde{\pi}_{t+1}]$
5. NKPC: $\theta\bar{W}\tilde{w}_t - \varphi\bar{\Pi}^2\tilde{\pi}_t + \beta\varphi\bar{\Pi}^2\mathbb{E}_t\tilde{\pi}_{t+1} = 0$
6. Government Budget: $\tilde{b}_{G,t} = \beta^{-1}\tilde{b}_{G,t-1} + \beta^{-1}\bar{b}_G(\tilde{r}_{t-1}^{(G)} - \tilde{\pi}_t - \Delta\tilde{n}_t) - (\mathtt{w}\tilde{s}_{H,t} + (1-\mathtt{w})\tilde{s}_{I,t})$
7. Labor Market Clearing: $\mathtt{w}\bar{N}_H\frac{-\tilde{c}_{H,t} + \tilde{w}_t}{\eta} + (1-\mathtt{w})\bar{N}_I\frac{-\tilde{c}_{I,t} + \tilde{w}_t}{\eta} = \bar{N}\tilde{n}_t$
8. Investor Loan Euler: $\tilde{r}_t^{(H)} + \tilde{c}_{I,t} + \omega\bar{R}^{(G)}\bar{C}_I\tilde{b}_{H,t} = \mathbb{E}_t[\tilde{c}_{I,t+1} + \tilde{\pi}_{t+1}]$

After substituting using:

1. Household Labor: $\frac{-\tilde{c}_{H,t} + \tilde{w}_t}{\eta} = \tilde{n}_{H,t}$
2. Investor Labor: $\frac{-\tilde{c}_{I,t} + \tilde{w}_t}{\eta} = \tilde{n}_{I,t}$
3. Fiscal Rule Investors: $\tilde{s}_{I,t} = \rho^I\tilde{s}_{I,t-1} + (1-\rho^I)\delta_b^I\tilde{b}_{G,t-1} + \zeta_{s,t}^I$
4. Fiscal Rule Households: $\tilde{s}_{H,t} = \rho^H\tilde{s}_{H,t-1} + (1-\rho^H)\delta_b^H\tilde{b}_{G,t-1} + \zeta_{s,t}^H$
5. Taylor Rule: $\tilde{r}_t^{(G)} = \phi_\pi\tilde{\pi}_t + \phi_Y\tilde{y}_t + \zeta_{M,t}$
6. Dividend: $\bar{D}\tilde{d}_t = \bar{Y}\tilde{y}_t - \bar{W}\bar{N}(\tilde{w}_t + \tilde{n}_t)$
7. Production Function: $\tilde{n}_t = \tilde{y}_t$

B Quantitative Model: Additional Material

B.A System of Log-linearized Equations

This model features a trend in the state of labor-augmenting technological progress. In order to make the model stationary, we define the following variables: $y_t = \frac{\gamma_t}{A_t}, c_t^{*I} = \frac{C_t^{*I}}{A_t}, c_t^I = \frac{C_t^I}{A_t}, c_t^H = \frac{C_c^H}{A_t}, k_t = \frac{K_t}{A_t}, g_t = \frac{G_t}{A_t}, z_t = \frac{Z_t}{A_t}, b_t = \frac{P_t^m B_t^m}{P_t A_t}, s_{b,t} = \frac{P_t^m B_t^m}{P_t Y_t}, w_t = \frac{W_t}{P_t A_t}$, and $\lambda_t^I = \Lambda_t^I A_t$.

We list below the equations of the log-linear model, starting with those that characterize the actual-economy block.

Production function:

$$\tilde{y}_t = \frac{y+\Omega}{y}\left[\alpha\tilde{k}_t + (1-\alpha)\tilde{N}_t\right] \tag{12}$$

Capital-labor ratio:

$$\tilde{r}_{K,t} - \tilde{w}_t = \tilde{N}_t - \tilde{k}_t \tag{13}$$

Marginal cost:

$$\widetilde{mc}_t = \alpha\tilde{r}_{K,t} + (1-\alpha)\tilde{w}_t \tag{14}$$

Phillips curve:

$$\tilde{\pi}_t = \frac{\beta}{1+\chi_p\beta}\mathbb{E}_t\tilde{\pi}_{t+1} + \frac{\chi_p}{1+\chi_p\beta}\tilde{\pi}_{t-1} + \kappa_p\widetilde{mc}_t + \kappa_p\tilde{\eta}_t^p + \kappa_p\tilde{u}_t^{NKPC} \tag{15}$$

where $\kappa_p = \left[\left(1-\beta\omega_p\right)\left(1-\omega_p\right)\right] / \left[\omega_p\left(1+\beta\chi_p\right)\right]$. Investor's FOC for consumption:

$$\tilde{\lambda}_t^I = \tilde{u}_t^b - \frac{\theta}{e^{\varkappa}-\theta}\tilde{u}_t^a - \frac{e^x}{e^x-\theta}c_t^{*I} + \frac{\theta}{e^x-\theta}c_{t-1}^{*I} - \frac{\tau^C}{1+\tau^C}\tilde{\tau}_{C,t}, \tag{16}$$

where $\tilde{u}_t^a = u_t^a - \varkappa$. Public/private consumption in utility:

$$\tilde{c}_t^* = \frac{c^I}{c^I+\alpha_G g}\tilde{c}_t^I + \frac{\alpha_G g}{c^I+\alpha_G g}\tilde{g}_t \tag{17}$$

Investor's Euler equation bond:

$$\tilde{\lambda}_t^I = \tilde{r}_{n,t} + \mathbb{E}_t\tilde{\lambda}_{t+1}^I - \mathbb{E}_t\tilde{\pi}_{t+1} - \mathbb{E}_t\tilde{u}_{t+1}^a + \tilde{u}_t^{rp} \tag{18}$$

Investor's Euler equation loan:

$$\tilde{\lambda}_t^I + \mathcal{C}\tilde{b}_{I,t}^H = \tilde{r}_{n,t}^{(H)} + \mathbb{E}_t\tilde{\lambda}_{t+1}^I - \mathbb{E}_t\tilde{\pi}_{t+1} - \mathbb{E}_t\tilde{u}_{t+1}^a + \tilde{u}_t^{rp} \tag{19}$$

where $\mathcal{C}$ is the investor's utility from holding a loan. Household's Euler equation loan:

$$\tilde{\lambda}_t^H = \tilde{r}_{n,t}^{(H)} + \mathbb{E}_t\tilde{\lambda}_{t+1}^H - \mathbb{E}_t\tilde{\pi}_{t+1} - \mathbb{E}_t\tilde{u}_{t+1}^a + \tilde{u}_t^{rp} \tag{20}$$

Maturity structure of bond:

$$\tilde{r}_{n,t} + \tilde{P}_t^{rn} = \frac{\rho}{R}\mathbb{E}_t \tilde{P}_{t+1}^{m} - \tilde{u}_t^{rp} \tag{21}$$

Maturity structure of loan:

$$\tilde{r}_{n,t}^{(H)} + \tilde{P}_t^{(H)rn} = \frac{\rho_H}{R}\mathbb{E}_t \tilde{P}_{t+1}^{(H)m} - \tilde{u}_t^{rp} \tag{22}$$

Investor's household's FOC for capacity utilization:

$$\tilde{r}_{K,t} - \frac{\tau_K}{1-\tau_K}\tilde{\tau}_{K,t} = \frac{\psi}{1-\psi}\tilde{\nu}_t \tag{23}$$

Investor's FOC for capital:

$$\tilde{q}_t = \mathbb{E}_t\tilde{\pi}_{t+1} - \tilde{r}_{n,t} + \beta e^{-\varkappa}(1-\tau_K)\, r_K \mathbb{E}_t\tilde{r}_{K,t+1} - \beta e^{-x}\tau_K r_K \mathbb{E}_t\tilde{\tau}_{K,t+1} + \beta e^{-x}(1-\delta)\mathbb{E}_t\tilde{q}_{t+1} - \tilde{u}_t^{rp} \tag{24}$$

Investor's FOC for investment:

$$\tilde{\imath}_t + \frac{1}{1+\beta}\tilde{u}_t^a - \frac{1}{(1+\beta)se^{2x}}\tilde{q}_t - \tilde{u}_t^i - \frac{\beta}{1+\beta}\mathbb{E}_t\tilde{\imath}_{t+1} - \frac{\beta}{1+\beta}\mathbb{E}_t\tilde{u}_{t+1}^a = \frac{1}{1+\beta}\tilde{\imath}_{t-1} \tag{25}$$

Effective capital:

$$\tilde{k}_t = \tilde{\nu}_t + \widetilde{k}_{t-1} - \tilde{u}_t^a \tag{26}$$

Law of motion for capital:

$$\widetilde{k}_t = (1-\delta)e^{-x}\left(\tilde{\bar{k}}_{t-1} - \tilde{u}_t^a\right) + \left[1-(1-\delta)e^{-x}\right]\left[(1+\beta)se^{2x} + \tilde{k}_t\right] \tag{27}$$

Household's budget constraint:

$$\begin{aligned} &\tau_C c^H \tilde{\tau}_{C,t} + (1+\tau_C)\, c^H \tilde{c}_t^H - \bar{b}^{(H)}\rho_H e^{-\varkappa}\tilde{P}_t^{(H)} + \bar{b}^{(H)}\tilde{b}_{H,t}^{(H)} \\ &= \frac{\bar{b}^{(H)}}{\beta}\tilde{b}_{H,t-1}^{(H)} - \frac{\bar{b}^{(H)}}{\beta}\tilde{P}_{H,t-1}^{(H)} - \frac{\bar{b}^{(H)}}{\beta}\pi_t\,(1-\tau_L)\, w_H L_H\left(\tilde{w}_t + \tilde{N}_{H,t}\right) - \tau_L w_H L_H \tilde{\tau}_{N,t} + z\tilde{z}_t \end{aligned} \tag{28}$$

where $\kappa_w^I \equiv \left[(1-\beta\omega_w)(1-\omega_w)\right] / \left[\omega_w(1+\beta)\left(1+\frac{(1+\eta^w)\xi^I}{\eta^{(w)}}\right)\right]$. Investor's wage equation:

$$\begin{aligned} \tilde{w}_t^I =& \frac{1}{1+\beta}\tilde{w}_{t-1}^I + \frac{\beta}{1+\beta}\mathbb{E}_t\tilde{w}_{t+1}^I - \kappa_w\left[\tilde{w}_t^I - \xi_I\tilde{N}_{I,t} + \tilde{\lambda}_t^I - \frac{\tau_L}{1-\tau_L}\tilde{\tau}_{N,t}\right] + \frac{\chi_w}{1+\beta}\tilde{\pi}_{t-1} \\ &- \frac{1+\beta\chi_w}{1+\beta}\tilde{\pi}_t + \frac{\beta}{1+\beta}\mathbb{E}_t\tilde{\pi}_{t+1} + \frac{\chi}{1+\beta}\tilde{u}_{t-1}^a - \frac{1+\beta\chi_w-\rho_a\beta}{1+\beta}\tilde{u}_t^a + \kappa_w\tilde{\eta}_t^w \end{aligned} \tag{29}$$

Household's wage equation:

$$\begin{aligned} \tilde{w}_t^H =& \frac{1}{1+\beta}\tilde{w}_{t-1}^H + \frac{\beta}{1+\beta}\mathbb{E}_t\tilde{w}_{t+1}^H - \kappa_w\left[\tilde{w}_t - \xi_H\tilde{N}_{H,t} + \tilde{\lambda}_t^H - \frac{\tau_L}{1-\tau_L}\tilde{\tau}_{N,t}\right] + \frac{\chi_w}{1+\beta}\tilde{\pi}_{t-1} \\ &- \frac{1+\beta\chi_w}{1+\beta}\tilde{\pi}_t + \frac{\beta}{1+\beta}\mathbb{E}_t\tilde{\pi}_{t+1} + \frac{\chi}{1+\beta}\tilde{u}_{t-1}^a - \frac{1+\beta\chi_w-\rho_a\beta}{1+\beta}\tilde{u}_t^a + \kappa_w\tilde{\eta}_t^w \end{aligned} \tag{30}$$

where $\kappa_w^H \equiv \left[(1-\beta\omega_w)(1-\omega_w)\right] / \left[\omega_w(1+\beta)\left(1+\frac{(1+\eta^w)\xi^H}{\eta^{(w)}}\right)\right]$.
Aggregate households' consumption

$$c\tilde{c}_t = c^I(1-\mathtt{w})\tilde{c}_t^I + c^H\mathtt{w}\tilde{c}_t^H \tag{31}$$

Aggregate resource constraint:

$$y\tilde{y}_t = c\tilde{c}_t + i\tilde{i}_t + g\tilde{g}_t + \psi'(1)k\tilde{\nu}_t \tag{32}$$

Government budget constraint:

$$\begin{aligned} &\frac{b}{y}\tilde{b}_t + \tau_K r_K \frac{k}{y}\left[\tilde{\tau}_{K,t} + \tilde{r}_{K,t} + \tilde{k}_t\right] + \tau_L w\frac{N}{y}\left[\tilde{\tau}_{N,t} + \tilde{w}_t + \tilde{N}_t\right] + \tau_C\frac{c}{y}\left(\tilde{\tau}_{C,t} + \tilde{c}_t\right) \\ =&\frac{1}{\beta}\frac{b}{y}\left[\tilde{b}_{t-1} - \tilde{\pi}_t - \tilde{P}_{t-1}^m - \tilde{u}_t^a\right] + \frac{b}{y}\frac{\rho}{e^*}\tilde{P}_t^m + \frac{g}{y}\tilde{g}_t + \frac{z}{y}\tilde{z}_t \end{aligned} \tag{33}$$

Fiscal Rules:

$$\begin{aligned} \tilde{g}_t &= \rho_G\tilde{g}_{t-1} - (1-\rho_G)\gamma_G\left(\tilde{s}_{b,t-1} - \tilde{s}_{b,t-1}^F\right) + \zeta_{g,t} \\ \tilde{z}_t^b &= \rho_Z\tilde{z}_{t-1}^b - (1-\rho_Z)\left[\gamma_Z\left(\tilde{s}_{b,t-1} - \tilde{s}_{b,t-1}^F\right) + \phi_{zy}\tilde{y}_t\right] + \zeta_{z,t} \\ \tilde{z}_t &= \tilde{z}_t^b + \zeta_{M,t} + \zeta_t^F \\ \tilde{\tau}_{N,t} &= \rho_L\tilde{\tau}_{N,t-1} + (1-\rho_L)\gamma_L\left(\tilde{s}_{b,t-1} - \tilde{s}_{b,t-1}^F\right) \\ \tilde{\tau}_{K,t} &= \rho_K\tilde{\tau}_{K,t-1} + (1-\rho_K)\gamma_K\left(\tilde{s}_{b,t-1} - \tilde{s}_{b,t-1}^F\right) \end{aligned} \tag{34}$$

Monetary Rule:

$$\tilde{r}_{n,t} = \max\left(-\ln\underline{R}, \rho_r\tilde{r}_{n,t-1} + (1-\rho_r)\left[\phi_\pi\left(\tilde{\pi}_t - \tilde{\pi}_t^F\right) + \phi_y\tilde{y}_t\right] + u_t^m\right) \tag{35}$$

The block of equations that characterize the shadow economy consists in an additional set of equations (66) to (83), where any variable that refers to the actual economy x_t is replaced by the same variable in the shadow economy x_t^F, plus the rule for the monetary authority

$$\tilde{r}_{n,t}^F = \max\left(-\ln R, \rho_r\tilde{r}_{n,t-1}^F + (1-\rho_r)\left[\phi_\pi\tilde{\pi}_t^F + \phi_y\tilde{y}_t^F\right] + u_t^m\right) \tag{36}$$

and the rules for the fiscal authority,

$$\begin{aligned} \tilde{g}_t^F &= \rho_G\tilde{g}_{t-1}^F - (1-\rho_G)\gamma_G\tilde{s}_{b,t-1}^F + \zeta_{g,t} \\ \tilde{z}_t^{b,F} &= \phi_{zy}\tilde{y}_t^F + \rho_Z\tilde{z}_{t-1}^{b,F} - (1-\rho_Z)\gamma_Z\tilde{s}_{b,t-1}^F + \zeta_{z,t} \\ \tilde{z}_t &= \tilde{z}_t^{b,F} + \zeta_t^F \\ \tilde{\tau}_{N,t}^F &= \rho_L\tilde{\tau}_{N,t-1}^F + (1-\rho_L)\gamma_L\tilde{s}_{b,t-1}^F \\ \tilde{\tau}_{K,t}^F &= \rho_K\tilde{\tau}_{K,t-1}^F + (1-\rho_K)\gamma_K\tilde{s}_{b,t-1}^F \end{aligned} \tag{37}$$