The Austerity Threshold*

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Abstract

We introduce a new indicator of fiscal capacity, the "austerity threshold": the debt/GDP level above which the government must raise fiscal surpluses to ensure debt safety. In a U.S.-calibrated model with realistic risk premia, nominal rigidities, and an intermediary sector, we estimate this threshold at 234%. We highlight the roles of safety premia, convenience yields, and foreign holdings. Hesitation to implement prescribed austerity sharply lowers fiscal capacity.

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Keywords: fiscal policy, monetary policy, public debt, risk premia, fiscal sustainability

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1 Introduction

The global financial crisis (GFC) and the COVID-19 pandemic triggered large fiscal expansions across advanced economies. Government spending surged, producing high deficits and sharp increases in debt/GDP ratios. In the U.S., government debt rose from 35% of GDP in 2007 to 103% of GDP in 2020. Rather than consolidating, fiscal policy has continued to generate large deficits since then. The Congressional Budget Office (CBO) forecasts a debt/GDP ratio of 175% by 2056 (Congressional Budget Office, 2026). Investors remain largely unfazed: despite higher nominal rates, indicators of default and inflation risk premia have stayed low. Yet, the persistent rise in debt has fueled an active debate over the sustainability of U.S. deficits, with some pointing to real interest rates that were below real rates of growth (Blanchard, 2019), and others questioning how to rationalize the market value of U.S. debt with sustained deficits in modern asset pricing models (Jiang et al., 2024a). The level of U.S. "fiscal capacity" therefore remains highly uncertain.

In this paper we ask: at what debt level, if any, must the government generate surpluses to preserve the safety of debt? We propose a new model-based measure of fiscal capacity and quantify it. In our framework, the government delays any fiscal adjustment until it becomes necessary to keep the debt risk-free. Fiscal capacity is thus defined as the maximum sustainable debt/GDP ratio before surpluses must rise to avert default. In our calibration, this endogenous "austerity threshold" is 234% if stabilization occurs through income tax increases. Delaying adjustment beyond the austerity threshold would make default unavoidable under some future paths of shocks that hit the economy. In an important extension, we show that under weaker political commitment to debt safety, the austerity threshold falls substantially, to 158%.

We obtain these results by building a dynamic stochastic general equilibrium model in the New Keynesian (NK) tradition with several key features. First, it generates non-trivial risk and risk premia. The economy experiences both transitory productivity shocks—standard in macroeconomics—and permanent shocks—standard in finance. Combined with a sufficiently high market price of risk, these shocks deliver a realistic output and equity risk premium. The resulting precautionary savings motive drives demand for safe assets, lowering equilibrium bond yields and government financing costs, thereby raising fiscal capacity. Second, fiscal policy does not adjust continuously to debt. For a broad range of debt ratios, policy focuses

on macroeconomic stabilization and disregards debt sustainability (active fiscal policy). Once debt crosses the austerity threshold, policy shifts to debt management (passive fiscal policy). Consistent with post-war U.S. data, tax increases in response to debt are triggered only at levels never observed. Monetary policy is always active in our setting—the Taylor principle is satisfied. Third, the model allows for purchases of U.S. Treasuries by foreign buyers who are less price-elastic than domestic buyers, an important source of fiscal capacity as long as foreigners absorb a constant share of debt regardless of its level. Fourth, it includes an intermediation sector that uses government debt as an input in producing safe, liquid assets, giving rise to a convenience yield that further reduces government borrowing costs.

A key technical contribution is the algorithm that determines the endogenous austerity threshold. To build intuition, we start with a simple neoclassical model in which the stock of government debt is the only state variable. Fiscal policy is nonlinear: labor income tax rates are increasing in government debt only above a debt threshold. The austerity threshold is the highest value of that threshold for which a debt upper bound exists. At the debt upper bound, the surplus that the economy generates is just enough to pay the debt service under the worst possible productivity and government spending shocks. As tax rates increase beyond the austerity threshold, labor supply and output decline. A Laffer curve effect limits how much surpluses can be raised from higher taxes. Real interest rates on debt also increase in the austerity region, further complicating debt reduction and introducing dynamics into the Laffer curve.

Our main quantitative model adds capital accumulation, a nominal side with standard New Keynesian ingredients and a Taylor rule for monetary policy, permanent productivity shocks, two debt maturities, richer fiscal policy, foreign buyers, a financial sector, and hand-to-mouth (HtM) households. We develop an efficient simulation-based algorithm to determine the austerity threshold, which is insensitive to the details of the shock discretization.

Because the austerity threshold depends on all model parameters, our calibrated framework serves as a laboratory for studying the determinants of fiscal capacity. First, risk and risk aversion are crucial drivers: greater risk curbs fiscal capacity, while higher precautionary motives and safety premia expand capacity by keeping borrowing costs low. Second, we find that a higher elasticity of labor supply reduces fiscal capacity through its effect on the Laffer curve. Third, purchases of U.S. Treasuries by price-inelastic foreign buyers greatly expand fiscal ca-

pacity, but only when foreigners keep absorbing the same share of debt as it grows. Fourth, the maturity structure of debt exerts only a modest effect on the austerity threshold. The observed share of short-term versus long-term debt locally maximizes fiscal capacity: either increasing or decreasing it reduces the austerity threshold. Real rates are lower with more long-term debt, which aids capital formation, but the term spread and risk premia rise. Fifth, we study financial repression modeled as an increase in banks' liquidity coverage requirements. Forcing banks to hold more reserves per dollar of deposits increases the convenience yield in partial equilibrium. However, it makes deposit issuance costlier, so banks create fewer deposits, the leverage constraint binds less, and the convenience yield on government debt falls in general equilibrium. Paradoxically, financial repression hurts fiscal capacity.

We then modify the fiscal rule itself. First, we explore what happens when the government starts raising taxes before the debt reaches the austerity threshold. Doing so lowers average debt and raises long-run welfare for both savers and HtM households because fiscal risk is lower at lower debt levels. Second, one might expect that promising a steeper tax response in austerity would let the government start austerity later. Instead, steeper tax increases are more distortionary and make debt harder to pay down, so the austerity threshold falls. The lower threshold again lowers average debt and raises long-run welfare.

Our economy experiences substantial real effects from increases in transfer spending, despite having a majority of "Ricardian" saver households. As usual, higher transfer spending discourages the labor supply of HtM households who do not pay any taxes. More surprisingly, it also discourages labor supply among the saver households. Transfers increase debt, which partially satisfies the savers' precautionary savings demand, making them richer. That wealth effect is stronger when the economy is farther away from the austerity threshold and the accompanying increases in taxes that reverse the increase in debt. We show that the real effects of government debt supply are inherently linked to the precautionary savings demand that also generates the model's risk premia.

High debt also makes the economy more exposed to negative productivity growth shocks. Such shocks increase debt/GDP by more when debt is already high, and thereby raise the probability of future austerity. The welfare loss is largest just below the austerity threshold. Since government debt is a highly persistent endogenous state variable, a moderately persistent

shock to productivity growth turns into a source of long-run fiscal risk. This mechanism is the main reason why fiscal rules that keep debt lower raise welfare.

In the baseline model, debt can remain default-free and bondholders protected by shifting risk onto taxpayers in the austerity region (Jiang et al., 2026). On average, austerity occurs in high marginal-utility states of the world both because of negative productivity shocks that pushed the economy into the austerity region and because of the tax increases themselves, which engender endogenous output losses and increases in inflation.

A key assumption is that the fiscal authority has the political will to carry out the prescribed austerity in bad times. In a final exercise, we relax this assumption. We introduce a second "hesitation regime" in which fiscal policymakers postpone the called-for tax increases until the debt/GDP ratio is 15 percentage points (pp) higher than the austerity threshold. We calibrate the persistence of this regime to the U.S. presidential political cycle. Risk of hesitation lowers the austerity threshold. Increasing the probability from 0% (the baseline perfect commitment model) to 30% lowers the austerity threshold from 234% to 158% of GDP. Intuitively, tax increases must start sooner on average when there is a chance that they will be delayed. The additional volatility in bond prices caused by the switches between commitment regimes further lowers the austerity threshold. In sum, imperfect commitment to austerity has a large quantitative effect. Since political stamina for sustained austerity is often wanting, this lower estimate of fiscal capacity may well be the more relevant one.

Together, these findings show that understanding fiscal capacity requires a modeling approach capable of capturing a wide range of equilibrium debt/GDP ratios. Our global solution method reveals the full ergodic distribution of government debt, spanning from 20% to 400% of GDP. By contrast, the model's deterministic steady state lies around 80%—a point that is not even modal in the distribution. Approaches that approximate the economy around this steady state cannot quantify fiscal capacity in the sense we define it. Moreover, the U.S. has a relatively short fiscal history with limited variation in debt and surpluses. Our model provides a coherent framework that matches observed macroeconomic and financial moments while quantifying borrowing limits, even if such limits are far away from the current fiscal situation.

Related Literature. We contribute to the literature in macroeconomics that studies fiscal policy. The vast majority of this literature assumes that tax rates respond continuously to changes in the debt/GDP ratio to keep debt bounded, as reviewed comprehensively by Leeper and Leith (2016). Bohn (1998) and Cochrane (2020) provide early empirical evidence for the U.S. of this responsiveness of surpluses to the debt/GDP ratio in the data. However, once the near-unit root behavior of the debt/GDP ratio is considered, Jiang et al. (2024b) conclude that there is little evidence that a higher debt/GDP ratio predicts higher future surpluses in the U.S. post-war period. We build a theory that is consistent with the modern empirical evidence: fiscal policy is unresponsive to debt over a wide range of debt/GDP ratios, and tax increases in response to debt are triggered only at levels never observed in the post-war period.

Our main contribution is the concept and the quantification of the austerity threshold: the endogenous debt/GDP ratio at which the economy switches from active fiscal policy, which stabilizes cyclical fluctuations, to passive fiscal policy, which stabilizes the debt. Related work computes fiscal limits from dynamic Laffer curves (Davig et al., 2011; Bi, 2012), fiscal space from nonlinear fiscal reaction functions (Ghosh et al., 2013), maximum sustainable debt (Collard et al., 2015; D'Erasmo et al., 2016), and debt crises that build up slowly as debt accumulates (Lorenzoni and Werning, 2019). These papers characterize maximum debt levels or the buildup to a crisis. The austerity threshold is instead the latest point at which a given fiscal rule can begin adjusting while keeping debt safe, and we compute it in a globally solved NK model with risk premia, convenience yields, and no default. Bianchi and Melosi (2019) introduce state-dependent policy targets for fiscal and monetary authorities. Our fiscal rule is also state-dependent but the switches are determined endogenously as a function of the debt level and not event-driven.

Our measure of fiscal capacity is inherently forward-looking: the market value of debt reflects the expected present discounted value of future primary surpluses and other debt revenue, and applies to environments with aggregate risk. In contrast, much of the literature takes a backward-looking accounting approach or considers a deterministic model (Buiter, 1985). Fiscal capacity and debt sustainability then depend on $r - g$. Bohn (1995) shows that empirical tests of debt sustainability that rely on $r - g$ are not appropriate in stochastic economies. Although our model features an average risk-free rate below the rate of growth ($r < g$), fiscal capacity

is finite. Safety premia and convenience yields erode as the debt supply rises, increasing the equilibrium r, and limiting the amount of safe debt the government can issue.

We contribute to a recent literature that studies fiscal capacity in a world where the government enjoys low borrowing costs due to safety premia, convenience yields, or financial repression.[1] Our approach quantifies limits to precautionary safety premia and intermediation-driven convenience yields in a model with realistic fiscal policy.

Our nonlinear fiscal rule, the presence of non-trivial risk, and bank leverage constraints make the model nonlinear and require a global solution method. The NK model becomes more difficult to solve and calibrate since the stochastic steady state is far away from the deterministic steady state. We employ state-of-the-art global projection methods to overcome this challenge. This includes the design of a computationally efficient method to pin down the austerity threshold, which allows us to study how different structural parameters such as the labor supply elasticity or risk aversion as well as policy variables such as the maturity structure of government debt or the liquidity coverage ratio for banks affect fiscal capacity. Alternative models with lower risk aversion and a linear fiscal rule result in dramatically different debt dynamics, illustrating the importance of our new model features and solution method.[2]

We study the interaction of a rich set of fiscal policy tools with conventional monetary policy.[3]

[1] On safety premia, see Aiyagari and McGrattan (1998), Woodford (1990), Barro (2020), Brunnermeier, Merkel and Sannikov (2024), Mian, Straub and Sufi (2025), Schmid, Valaitis and Villa (2021), among others. On convenience yields and liquidity benefits, see Krishnamurthy and Vissing-Jorgensen (2012), Angeletos et al. (2023), Krishnamurthy and Li (2023), Du et al. (2018), Jiang et al. (2021), Reis (2021), Mankiw and Ball (2021), Chen, Jiang, Lustig, Van Nieuwerburgh and Xiaolan (2025). On financial repression, see, e.g., Payne, Szőke, Hall and Sargent (2024), Payne and Szőke (2025), Gómez-Cram et al. (2026).

[2] Standard NK models typically omit permanent shocks and calibrate low shock volatilities. Standard monetary and fiscal policies remove what little remaining consumption risk households might otherwise face. As a result, the standard NK model generates trivial risk premia. Furthermore, the NK model is typically solved using log-linearization or low-order perturbation methods which mostly ignore aggregate risk premia and their time-variation. De Paoli, Scott and Weeken (2010) document that nominal rigidities combined with monetary policy following a Taylor rule greatly reduce consumption risk in a standard business cycle model. Gourio and Ngo (2020) generate meaningful risk premia in a globally solved NK model with rare disasters and a ZLB on interest rates. Isoré and Szczerbowicz (2017) adapt Gourio (2012)'s approach to perturbation methods, yet require large disaster probabilities to create non-negligible risk premia. Campbell, Pflueger and Viceira (2020) and Pflueger and Rinaldi (2022) introduce habit preferences in an NK model to produce realistically time-varying risk premia.

[3] An extensive literature studies the effects of government spending on output. See, for example, Nakamura and Steinsson (2014) and the references therein. Billi and Walsh (2021) and Mian, Straub and Sufi (2025) find that higher discretionary spending in an economic crisis can decrease the debt/GDP ratio due to a large fiscal multiplier. Another large literature studies the interaction of fiscal and monetary policy. See Sargent and Wallace (1981); Leeper (1991); Sims (1991); Woodford (1994, 2001); Cochrane (1998); Cochrane (2001); Schmitt-Grohé and Uribe (2000); Bassetto (2002); Reis (2016); Sims (2016), among many others.

Labor income and corporate profit taxation, transfer spending, and discretionary spending all depend on the state of the economy, producing the countercyclicality of spending and procyclicality of tax revenues quantitatively consistent with the data.

Finally, a literature at the intersection of macroeconomics and finance studies how fiscal risk manifests itself in asset prices.[4] Our model focuses on the effect of fiscal policy at different levels of debt/GDP and its asset pricing implications. We emphasize uncertainty associated with the political will to implement austerity as a key driver of fiscal capacity.

The rest of the paper is organized as follows. Section 2 presents a simple model to establish the definition of debt safety and the austerity threshold. Section 3 sets up the quantitative model. Section 4 describes the calibration and solution method for pinning down the austerity threshold. Section 5 contains our main results on the drivers of fiscal capacity and the effects of high debt. Section 6 modifies the fiscal rule: it starts tax increases earlier, varies the slope of tax increases in austerity, and relaxes the assumption of full commitment to austerity. Section 7 concludes. The appendix provides details on model derivations of the simple (A) and quantitative (B) models, calibration (C), additional results (D), and computation (E).

2 Simple Model

This section studies an economy with the minimal ingredients to define our key object of interest, the austerity threshold, and how it relates to safety of debt.

Model Setup. Time is discrete and infinite. The only factor of production is labor N_t, supplied by a representative household in a competitive market with wage w_t. The production function of the representative firm is $Y_t = Z_t N_t^{\alpha}$, where Y_t is output of the sole consumption good, N_t is labor demand, and Z_t is stochastic productivity that follows a Markov chain with realizations $\mathcal{Z} = \{Z_j\}_{j=1}^{N_Z}$ and transition matrix Π_Z. Firms choose labor to maximize profits, and households choose consumption and labor supply to maximize utility. The government rebates a

[4] See Croce, Nguyen and Schmid (2012b); Croce, Kung, Nguyen and Schmid (2012a); Pastor and Veronesi (2012); Kelly, Pastor and Veronesi (2015); Croce, Nguyen, Raymond and Schmid (2019); Liu, Schmid and Yaron (2020); Corhay, Kind, Kung and Morales (2021). In several of these papers, uncertainty about future taxes affects firms' incentives to invest in R&D, leading to lower long-run productivity growth through an endogenous growth mechanism. A separate literature studies how fiscal risk is priced in claims on the government itself: Chernov et al. (2020) explain elevated U.S. CDS premiums with default that occurs once taxes and inflation are exhausted.

fraction θ_t of output each period to households in the form of transfers, where $\theta_t \in \mathcal{T} = \{\theta_\ell, \theta_h\}$ follows a two-state Markov chain with transition matrix Π_θ. It also maintains a stock of one-period risk-free bonds B_t that trade at price q_t. To finance its expenditures, the government levies a tax on labor income at rate $\tau_t = f(B_t)$, where $f(\cdot)$ is a deterministic function of the outstanding level of debt – a tax rule. Thus, the government budget constraint is:

$$q_t B_{t+1} = B_t + \theta_t Y_t - \tau_t w_t N_t. \tag{1}$$

The household maximization problem is:[5]

$$\max_{\{C_t, N_t^H, B_{t+1}^H\}} \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t \left(\log(C_t) - \omega_0 (N_t^H)^{1+\omega_1}\right) \tag{2}$$

subject to

$$(1-\tau_t) w_t N_t^H + \theta_t Y_t + B_t^H + \text{Profits}_t = q_t B_{t+1}^H + C_t.$$

Market clearing conditions are $N_t = N_t^H$, $B_{t+1} = B_{t+1}^H$, and $Y_t = C_t$, for labor, bond, and goods markets, respectively.

Equilibrium Conditions. In addition to these market clearing conditions, equilibrium is characterized by the first-order conditions for firms and households. Firm optimization implies $w_t = \alpha Z_t N_t^{\alpha-1} = \alpha \frac{Y_t}{N_t}$, while household utility maximization yields $(1-\tau_t) w_t C_t^{-1} = \omega_0 (1+\omega_1)(N_t^H)^{\omega_1}$ for labor supply and the usual Euler equation $q_t = \mathrm{E}_t\left[M_{t,t+1}\right]$, where we define the stochastic discount factor $M_{t,t+1} = \beta \left(\frac{C_{t+1}}{C_t}\right)^{-1}$. Given the model's simplicity, we can directly solve for equilibrium labor by combining firm and household optimality conditions

$$N_t = \left(\frac{\alpha(1-\tau_t)}{\omega_0(1+\omega_1)}\right)^{\frac{1}{1+\omega_1}}. \tag{3}$$

Output and consumption are then $Y_t = C_t = Z_t \left(\frac{\alpha(1-\tau_t)}{\omega_0(1+\omega_1)}\right)^{\alpha/(1+\omega_1)}$. Since debt B_t is the model's only endogenous state variable, equilibrium dynamics are characterized by the solution to the transition law for debt, obtained by inserting (3) into the government budget constraint (1)

[5] In Appendix A, we include full derivations for the simple model with constant-Frisch-elasticity (CFE) preferences of Trabandt and Uhlig (2011). The preference specification in (2) is the limit of CFE preferences in the limit when the preference parameter $\varphi \to 1$. We use CFE preferences in the quantification.

and using the fact that $\tau_t = f(B_t)$ follows the tax rule:

$$B_{t+1} = \frac{1}{q_t}\left(B_t - \underbrace{Z_t\left(\frac{\alpha(1-f(B_t))}{\omega_0(1+\omega_1)}\right)^{\alpha/(1+\omega_1)}(\alpha f(B_t) - \theta_t)}_{\text{primary surplus}}\right). \tag{4}$$

This equation must be solved jointly with the bond pricing condition:

$$q_t = \beta \mathrm{E}_t\left[\left(\frac{Z_{t+1}}{Z_t}\left(\frac{1-f(B_{t+1})}{1-f(B_t)}\right)^{\frac{\alpha}{1+\omega_1}}\right)^{-1}\right]. \tag{5}$$

The tax rule $f(B_t)$ enters the RHS of (4) twice with opposite signs. On the one hand, a higher tax rate increases the primary surplus for given output, as captured by the $(\alpha f(B_t) - \theta_t)$ term. On the other hand, higher taxes further distort labor supply, lowering output. The net effect is that the surplus is maximized at an interior tax rate, the well-known Laffer curve. Moreover, the tax rule affects expected consumption growth and hence bond prices and interest rates following (5), changing the cost of rolling over existing debt and thereby making the Laffer curve effects dynamic.

Debt Stationarity. Equations (4) and (5) will only yield stationary dynamics for government debt B_t if the tax rule $f(B_t)$ has the right properties, given all other parameters of the model. Generally, a stationary equilibrium exists if government debt stays bounded, $B_t \in [\underline{B}, \overline{B}]$, $\forall t$. Our focus is on the existence of an upper bound:

Definition 1. *The upper bound $\overline{B}$ is implicitly defined by:*

$$(1-\overline{q})\bar{B} = Z_{\min}\left(\frac{\alpha(1-f(\overline{B}))}{\omega_0(1+\omega_1)}\right)^{\alpha/(1+\omega_1)}(\alpha f(\overline{B}) - \theta_h), \tag{6}$$

where the bond price $\overline{q}$ is:

$$\overline{q} = \beta E\left[\left(\frac{Z'}{Z_{\min}}\right)^{-1} \mid Z_{\min}, \theta_h\right]. \tag{7}$$

The upper bound in (6) is defined as the largest value of debt at which the economy remains as long as the exogenous shock realizations are such that debt increases by the maximum

amount. These are the lowest possible realization of the productivity shock $Z_{\min}$ and the high transfer spending state θ_h. Put differently, once the economy is at the upper bound, it will stay at this bound as long as the "worst possible" shocks realize; the upper bound is akin to a natural borrowing limit for the government.[6] Any other shock combination will move debt to the interior. The upper bound $\overline{B}$ is a fixed point of the debt transition law and depends on the joint dynamics of debt and bond prices, with the bond price at the upper bound given by (7). The requirement that a stationary equilibrium with a strict upper bound $\overline{B}$ on the model's endogenous state variable B_t exists is a sufficient condition for the absence of bubbles in B_t.

Tax Rule and Austerity Threshold. The system of equations (6)–(7) may not have a real solution; in that case, no stationary equilibrium exists. In particular, existence of the upper bound depends on the tax rule $f(B)$. We consider tax rules of the form:

$$\tau_t = f(B_t) = \begin{cases} \bar{\tau}\left(\frac{B_t}{B^P}\right)^{\tau_P} & \text{if } B_t < B^P \\ \bar{\tau} & \text{if } B^P \leq B_t \leq B^A \\ \bar{\tau}\left(\frac{B_t}{B^A}\right)^{\tau_A} & \text{if } B_t > B^A. \end{cases} \tag{8}$$

This tax rule has an inaction region between the thresholds B^P and B^A, in which the government sets a constant tax rate $\bar{\tau}$.[7] If debt drops below B^P, the tax rate declines with elasticity τ_P, while debt levels above B^A cause a rise in the tax rate governed by τ_A. At the upper bound, the primary surplus (the RHS of (6)) is exactly sufficient to pay the interest on the outstanding debt (the LHS). By definition, it is impossible for the economy to reach higher levels of debt.

We are now ready to define the austerity threshold. Collect all other model parameters into the vector $\Omega = (\mathcal{Z}, \mathcal{T}, \Pi_Z, \Pi_\theta, \alpha, \beta, \omega_0, \omega_1, B^P, \bar{\tau}, \tau_P, \tau_A)$.

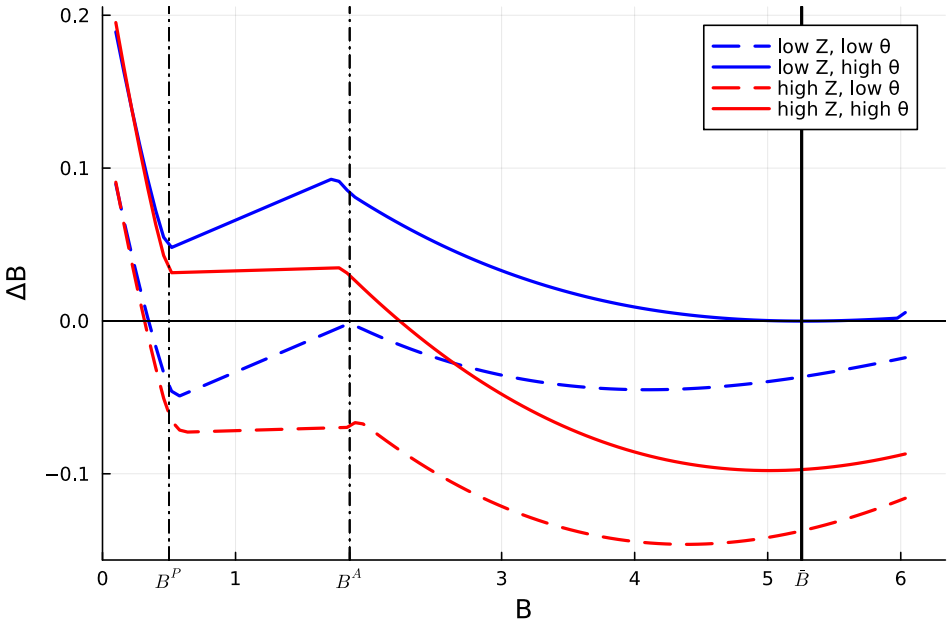
Definition 2. *Given other parameters Ω, the austerity threshold $B^*(\Omega)$ is the highest value of B^A in the tax rule $f(B)$ defined in (8), for which an upper bound $\overline{B}$ exists.*

[6] Our upper bound is the counterpart, for a given tax rule, of the natural debt limit of Aiyagari, Marcet, Sargent and Seppälä (2002): the maximum debt a government issuing only risk-free debt can repay under the worst sequence of shocks, with tax revenue at the peak of the Laffer curve. Unlike their limit, ours applies under a fixed tax rule rather than optimal taxes, so it exists only if the rule raises taxes early enough, and it is computed with an endogenous bond price rather than a constant interest rate.

[7] This rule specification nests a rule with smooth adjustments around a steady-state level of debt B^A, $f(B_t) = \bar{\tau}\left(\frac{B_t}{B^A}\right)^{\tau_A}$, for $B^P = B^A$ and $\tau_P = \tau_A$.

If parameters are such that an equilibrium with austerity threshold $B^*(\Omega)$ exists, then it also exists for tax rules with threshold B^A that satisfies $B^P \leq B^A \leq B^*(\Omega)$, but it does not for higher levels of B^A. Intuitively, if the upward adjustment of tax rates starts "too late," then the transition law (4) always yields an increase in debt when the worst shocks $(Z_{\min}, \theta_h)$ realize, implying that government debt would diverge to infinity.

Figure 1: Government Debt Transition Functions



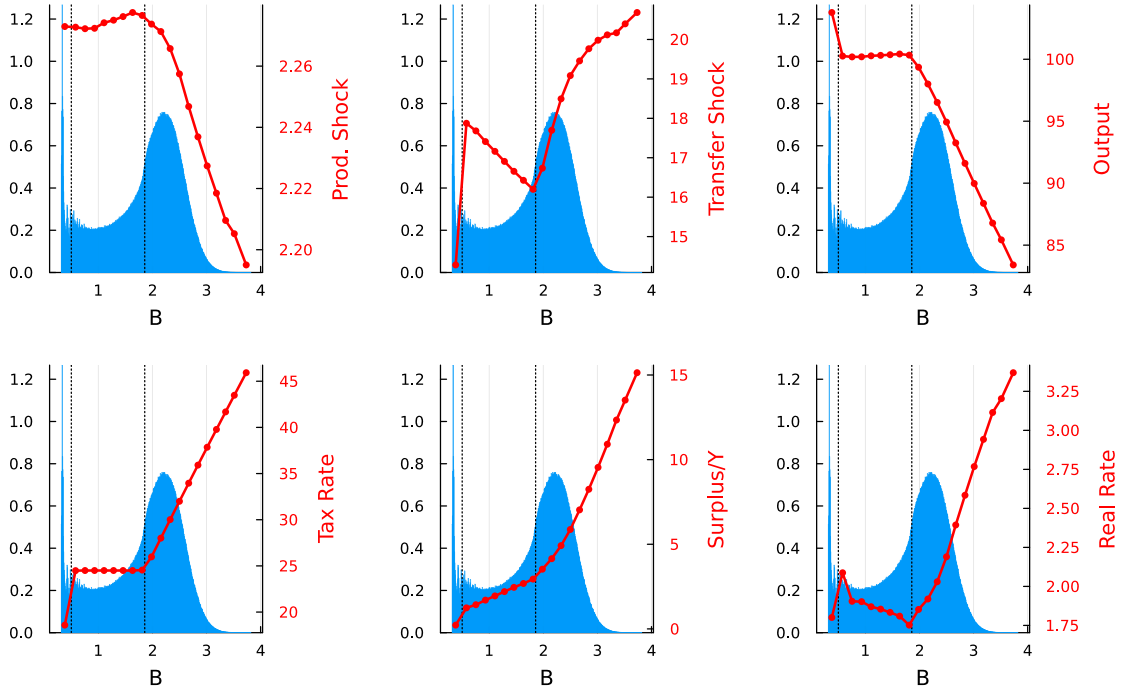
Note: This figure shows the equilibrium transition functions for government debt from equation (4). It plots the change in debt $B_{t+1} - B_t$ against the current level B_t. The dashed vertical lines are thresholds $B^P = 0.5$ and $B^A = B^*(\Omega) = 1.86$. The upper bound is at $\bar{B} = 5.25$.

Numerical Example. To shed light on debt dynamics under a tax rule like (8), we solve the system (4)–(5) numerically using global methods and search for $B^*(\Omega)$ and the associated upper bound. We set parameters to reasonable values foreshadowing the calibration of the quantitative model in Section 4.1.[8] Given these parameters, we find an austerity threshold of $B^*(\Omega) = 1.86$, i.e., 186% of steady-state GDP, and the upper bound of debt is $\bar{B} = 5.25$.

[8]We set the two transfer spending states to $\theta_\ell = 0.12$ and $\theta_h = 0.22$, with transition matrix Π_θ that has a staying probability of 0.87 for low and 0.9 for high spending. The productivity process $(\mathcal{Z}, \Pi_Z)$ is a 3-node Markov chain that approximates an AR(1) process for $\log Z_t$ with persistence 0.8 and unconditional standard deviation 0.03 (Rouwenhorst, 1995). Average productivity is normalized such that average GDP is 1. We set standard preference and technology parameters with discount factor $\beta = 0.98$, CRRA coefficient $\varphi = 2$ and inverse Frisch elasticity $\omega_1 = 1$ in the preferences, and returns to scale $\alpha = 0.78$. We set disutility from labor ω_0 such that average equilibrium hours are $N = 0.35$. The average labor tax rate is $\bar{\tau} = 0.245$, the profligacy threshold is fixed at $B^P = 0.5$, and the elasticities in the tax rule are $\tau_P = 1.0$ and $\tau_A = 0.9$.

Because Definition 1 is based on the worst productivity state $Z_{\min}$, both $B^*(\Omega)$ and $\bar{B}$ depend on the support of the productivity chain.[9] This dependence motivates the simulation-based criterion we use for the quantitative model in Section 4.2.

Figure 2: Simple Model Simulation



Note: This figure shows the histogram of debt B_t from the simulated model overlaid with conditional means of productivity Z_t (top left), transfer shock θ_t (top middle), output Y_t (top right), the tax rate τ_t (bottom left), the surplus/GDP ratio $\alpha\tau_t - \theta_t$ (bottom middle), and the real interest rate $1/q_t - 1$ (bottom right). Productivity is in levels. All other variables are in percent. Vertical dashed lines indicate the profligacy and austerity thresholds, respectively.

Figure 1 shows the equilibrium law of motion of government debt conditional on realizations of the exogenous shocks. At the upper bound $\bar{B}$ (solid vertical line), the change in debt for the low productivity, high spending state (low Z, high θ) is exactly zero, meaning debt stays at the upper bound. The austerity threshold is determined to ensure this condition. For all other shock realizations, the transitions at the upper bound are strictly below zero, mapping debt back to the interior of the state space. Hence, the economy can never reach debt levels beyond the upper bound. Figure 1 shows the hypothetical transitions in this region of the state space nonetheless. The upper bound is the tangency point of the worst-case transition function (low

[9] With a 5-node chain that approximates the same AR(1) process and an otherwise unchanged calibration, $B^*(\Omega) = 1.54$ and $\bar{B} = 4.35$. The finer chain adds worse productivity states, which lowers both.

Z, high θ) with the zero line. What if the candidate austerity threshold B^A were set to a lower value of $1.7 < B^*(\Omega) = 1.86$? Figure A.1 in Appendix A.6 plots the transition functions for such an economy. The worst-case transition in that economy crosses zero, taking negative values for $B_t > \bar{B} = 3.72$. This means that one can increase B^A and still obtain existence of $\bar{B}$, and hence 1.7 is not yet the austerity threshold. As our algorithm increases B^A toward $B^*(\Omega) = 1.86$, the worst-state transitions shift upward until $\bar{B}$ reaches tangency at $B^A = B^*(\Omega)$.

Figure 2 shows key model variables from a simulation of 400 paths, each 10,000 periods in length. The histogram of the ergodic debt/GDP distribution in each panel is overlaid with the conditional mean of a model variable.[10] The largest value of debt B_t in the 4 million simulated periods is 3.81, well below the upper bound of 5.25, highlighting that reaching the upper bound is essentially a probability-zero event in finite time in this parameterization. The equilibrium tax rule is depicted in the bottom left panel. The tax rate is flat between thresholds at $\bar{\tau} = 24.5\%$, then rises steadily once debt crosses the austerity threshold. The average tax rate in austerity is 29.8%, a 22% increase over tax rates in the inaction region. While the government must commit to more than double tax rates if necessary, these states of the world are almost never reached. As tax rates increase, labor supply and thus output decline (top right). The left and middle panels in the top row show that the economy enters the high debt region through a combination of low productivity and high transfer spending. The middle and right panels in the bottom row display surplus and interest rate dynamics. High tax rates lead to high surpluses, but interest rates also increase substantially with higher debt, reflecting positive expected consumption growth as agents anticipate a return to lower tax rates.

Profligacy and Lower Bound. While the low-debt region below B^P is not the focus of our analysis, we can use Figures 1 and 2 to understand the economics in this area of the state space. In particular, the economy has a lower bound on debt $\underline{B}$, which is the level of B_t at which the government budget is balanced, inclusive of debt service, in the (high Z, low θ) state – the intersection of the red dashed line in Figure 1 with zero. Debt can never move below this level, and it is easy to find empirically plausible values of B^P that guarantee existence of $\underline{B}$.

[10] Debt in the deterministic steady state of the model is around 0.75, inside the inaction region. The full nonlinear dynamics reveal a bimodal ergodic distribution with more than 50% of the mass in the profligacy and austerity regions.

Both figures show clear asymmetries between profligacy and austerity. Below B^P, all stabilizing forces work in the same direction: tax cuts open a deficit while stimulating the economy and the tax base, and the interest burden on the small debt stock is negligible. The transition functions are correspondingly steep, reflecting debt back into the inaction region quickly regardless of the shock state. Above B^A, the same forces work against each other: tax increases erode the tax base as output contracts, and a growing interest burden absorbs part of the additional revenue. Even large tax increases induce only a weak downward drift in debt. Worse, in high-transfer states, debt continues to rise well beyond B^A–debt reduction must wait for transfers to revert–so the economy takes long, shock-dependent paths through the austerity region. The ergodic distribution reflects this asymmetry in the effectiveness of debt stabilization.

3 Quantitative Model

The simple model is useful for establishing the notion of debt safety and defining the austerity threshold. However, the model lacks many key economic forces that shape fiscal capacity. Relative to the simple model, the quantitative model introduces (1) capital accumulation, (2) nominal rigidities leading to endogenous inflation and a role for monetary policy, (3) permanent shocks to productivity inducing realistic asset prices, (4) short- and long-term government debt, (5) more realistic fiscal policy that aims to stabilize the macroeconomy and distinguishes between purchases and transfers, (6) a financial sector whose leverage and liquidity regulation link capital formation to convenience yields in government debt, (7) basic household heterogeneity in marginal propensities to consume for realistic fiscal multipliers, and (8) foreign holdings of government debt.

The economy is populated by two types of households: savers and HtM consumers. The representative saver supplies labor, operates the investment technology, and owns the non-financial firms and financial intermediaries (banks for short). The saver derives utility from holding deposits issued by banks. Savers also hold long-term government debt. HtM consumers supply labor and consume their wage income and transfers each period. The government issues short-term and long-term nominal debt securities to fund its deficits. Short-term debt includes both T-bills and reserves, high-powered money issued by the central bank. Banks

hold short-term government debt and firm capital as assets and issue deposits and equity to saver households. We assume that only banks hold short-term debt and only savers hold long-term debt, broadly in line with the U.S. data (as discussed in the calibration section). Foreign investors have price-inelastic demand for both types of government debt.

3.1 Production Technology

Productivity. Productivity Z_t has a permanent and a transitory component, $Z_t = (Z_t^p)^{\alpha+\alpha_H} Z_t^r$, where

$$\log(Z_t^r) = z_t^r = (1-\rho^z)\log(\bar{Z}) + \rho^z z_{t-1}^r + \varepsilon_t^z, \tag{9}$$

$$\log(Z_t^p) = z_t^p = z_{t-1}^p + g_t, \tag{10}$$

$$g_t = (1-\rho^g)\bar{g} + \rho^g g_{t-1} + \varepsilon_t^g. \tag{11}$$

The innovations to transitory and permanent productivity are jointly normally distributed:

$$(\varepsilon_t^z, \varepsilon_t^g) \sim \text{Normal}(\mu, \Sigma).$$

Means μ are chosen such that $\mathrm{E}[Z_t^r] = \bar{Z}$ and $\mathrm{E}[g_t] = \bar{g}$. The exponent $\alpha + \alpha_H$, the labor share in the production function below, makes permanent productivity labor-augmenting, so that g_t is the trend growth rate of output. Productivity level and growth shocks are the first source of aggregate risk in the model. For the numerical implementation, we transform both components into a discrete Markov chain. Transfer spending shocks, introduced below in equation (22), are the second source of aggregate risk.

Goods Production. Production follows the standard New Keynesian framework (Galí, 2015) with price rigidities. The final output good Y_t is a composite of intermediate good varieties $Y_t(i)$, $i \in [0,1]$ that are combined by a final-goods producer with elasticity of substitution parameter ϵ. Intermediate goods producers are monopolists for their varieties. They choose price $P_t(i)$ and inputs capital $k_t(i)$, labor from savers $n_t(i)$, and labor from HtM consumers

$n_t^H(i)$ to maximize real profit:

$$Div_t^P(i) = \frac{P_t(i)}{P_t} Y_t(i) - \left(w_t n_t(i) + w_t^H n_t^H(i) + r_t^K k_t(i)\right) - Z_t^p \Xi^P(P_t(i)/P_{t-1}(i)), \tag{12}$$

where w_t and w_t^H are the real wages for savers and HtM consumers, respectively, and $\Xi^P(P_t(i)/P_{t-1}(i))$ is a convex menu cost for adjusting prices. The general price level P_t is a CES aggregate of intermediate goods prices $P_t(i)$. Profits are paid out in the form of dividends to savers. Intermediate output is produced using a standard Cobb-Douglas technology with aggregate productivity Z_t: $Y_t(i) = Z_t k_t(i)^{1-\alpha-\alpha_H} n_t(i)^{\alpha} n_t^H(i)^{\alpha_H}$. The details are in Appendix B.

3.2 Banks

Banks maximize the present value of dividends paid to their shareholders, the savers. On the asset side, banks invest in K_t^I units of capital at real price Q_t and buy $B_t^{I,S}$ short-term government bonds at nominal price p_t^S. On the liability side, they issue deposits D_t^I, modeled as one-period discount bonds, at nominal price p_t^D, and equity to the saver households.

Banks are subject to two regulatory restrictions. First, equity capital regulation requires the following constraint on deposits D_t^I (bank debt):

$$D_t^I \leq \nu \left(B_t^{I,S} + \nu_K P_t Q_t K_t^I \right), \tag{13}$$

where ν restricts the total leverage of the intermediary, and ν_K reflects the higher risk weight on capital relative to short-term government bonds. The overall maximum leverage ratio ν reflects the Supplementary Leverage Ratio (SLR) constraint in real-world bank capital regulation.[11]

The second regulatory restriction banks face captures the Liquidity Coverage Ratio (LCR) in U.S. bank regulation. Banks incur a liquidity cost per unit of deposits issued:

$$\varrho_t = \varrho_0 \zeta_\varrho \left(\frac{B_t^{I,S}}{\zeta_\varrho D_t^I} \right)^{1-\varrho_1}, \tag{14}$$

where ζ_ϱ is the fraction of deposits a particular bank's depositors can be expected to withdraw

[11] The price level P_t appears in the expression because D_t^I and B_t^I are nominal quantities, while $Q_t K_t^I$ is the real value of capital.

per period, and ϱ_0 scales the liquidity cost. We assume that the exponent $\varrho_1 > 1$, such that the cost is decreasing in the amount of short-term bonds (reserves) relative to deposits.

The real dividend paid out to bank shareholders each period is:

$$Div_t^I = \left(r_t^K + (1-\delta)Q_t\right) K_{t-1}^I - Q_t K_t^I + \frac{B_{t-1}^{I,S} - D_{t-1}^I + (p_t^D - \varrho_t) D_t^I - p_t^S B_t^{I,S}}{P_t} + \text{Rebates}_t^I, \tag{15}$$

with r_t^K the marginal product of capital and δ the capital depreciation rate. The dividend consists of the proceeds from last period's portfolio and the cost of purchasing new assets for $t+1$. Liquidity costs are rebated lump-sum, $\text{Rebates}_t^I = \varrho_t D_t^I / P_t$, which the bank takes as given. In summary, banks solve:

$$\max_{K_t^I, B_t^{I,S}, D_t^I} \sum_{k=0}^{\infty} \mathcal{M}_{t,t+k} Div_{t+k}^I$$

subject to no-shorting constraints $K_t^I \geq 0$, $B_t^{I,S} \geq 0$, and the regulatory constraint (13). Banks discount dividend payouts with the saver households' stochastic discount factor $\mathcal{M}_{t,t+k}$.

3.3 Household Sector

We discuss the problem of the two types of households in turn.

Savers. Savers consume C_t of the final output good and supply labor N_t to intermediate goods producers. They invest D_t^S in intermediary deposits, which they value for their liquidity services in addition to their pecuniary payoff. The period utility function is:

$$u(C_t, D_t^S/P_t, N_t) = \frac{\left(C_t^{1-\psi}(D_t^S/P_t)^{\psi}\right)^{1-\varphi} (1 - (1-\varphi)\omega_0 N_t^{1+\omega_1})^{\varphi}}{1-\varphi}. \tag{16}$$

These are Constant Frisch Elasticity (CFE) preferences introduced by Trabandt and Uhlig (2011), adapted to our setting. The parameter ψ determines liquidity demand for deposits. Labor supply is endogenous and $1/\omega_1$ is the Frisch elasticity. Savers have recursive preferences with subjective time discount factor β, intertemporal elasticity of substitution $1/\varphi$, and risk

aversion parameter γ. Their value function is:

$$V_t^S = \left\{(1-\beta)u(C_t, D_t^S/P_t, N_t) + \beta \mathrm{E}_t\left[(V_{t+1}^S)^{1-\gamma}\right]^{\frac{1-\varphi}{1-\gamma}}\right\}^{\frac{1}{1-\varphi}}. \tag{17}$$

In addition to deposits, savers purchase $B_t^{S,L}$ long-term government bonds at nominal price p_t^L. Savers do not hold capital directly: when the bank leverage constraint (13) binds, capital held by banks relaxes it, so banks value capital above its value under the saver SDF and direct holdings would be strictly suboptimal for savers. Savers operate the economy's investment technology, which creates I_t units of capital from $I_t + \Phi(I_t, K_{t-1})$ units of the consumption good. In summary, each period savers choose consumption, investment, deposits, and long-term bond holdings to maximize (17) subject to the budget constraint:

$$\begin{aligned} &P_t C_t + P_t(I_t + \Phi(I_t, K_{t-1})) + p_t^D D_t^S + p_t^L B_t^{S,L} \\ &\quad \leq W_t^S + P_t(1-\tau_t^w) w_t N_t + P_t Q_t I_t + P_t Div_t^I + P_t(1-\tau_t^{div}) Div_t^P + P_t \Theta_t + Z_t^p P_t \Xi^P(P_t(i)/P_{t-1}(i)), \end{aligned} \tag{18}$$

where W_t^S is saver financial wealth at the beginning of t. Additional resources for savers are labor income, which gets taxed at rate τ_t^w (see (23) below), profits of intermediate producers, which get taxed at rate τ_t^{div}, bank dividends, value of investment goods $P_t Q_t I_t$, transfer payments from the government $P_t \Theta_t$ (see (22) below), and lump-sum rebates of menu costs from producers.[12] The transition law for saver wealth is:

$$W_t^S = D_{t-1}^S + (c + 1 - \delta^B + \delta^B p_t^L) B_{t-1}^{S,L}. \tag{19}$$

The payoff to each long-term bond in (19) consists of the coupon c, amortization of old debt $1-\delta^B$, and the market value of remaining debt $\delta^B p_t^L$.

Hand-to-Mouth Households. HtM households (Campbell and Mankiw, 1989; Bilbiie, 2008) do not hold savings. Each period, they consume their full income which consists of labor earnings and transfers. They maximize the same period utility function as the savers (absent

[12] As is standard, investment adjustment costs $\Phi(I_t, K_{t-1})$ are not rebated and thus represent resource losses. Profit taxes reduce after-tax dividends but do not distort firms' choices.

deposits since they do not save):

$$u(C_t^H, N_t^H) = \frac{(C_t^H)^{1-\varphi}(1-(1-\varphi)\omega_0(N_t^H)^{1+\omega_1})^{\varphi}}{1-\varphi},$$

subject to the budget constraint:

$$C_t^H = (1-\tau_t^{w,H})w_t^H N_t^H + \Theta_t^H.$$

3.4 Government

3.4.1 Fiscal Policy

The fiscal authority raises revenue by taxing producer payouts (T_t^{div}) and labor earnings of both types of households ($T_t^w + T_t^{w,H}$). Its uses of funds are transfers ($\Theta_t + \Theta_t^H$) and discretionary spending (G_t). The primary surplus is:

$$S_t = T_t^w + T_t^{w,H} + T_t^{div} - G_t - \Theta_t - \Theta_t^H. \tag{20}$$

The government follows fiscal rules to determine taxation and spending. The cyclical components of all fiscal rules depend on output growth, $\Delta \log Y_t = \log Y_t - \log Y_{t-1}$. Further, fiscal rules may depend on the level of government debt relative to GDP,

$$\mathcal{B}_t = W_t^G/(P_t Y_t),$$

with W_t^G denoting the market value of government bonds at the beginning of t.

Spending. Discretionary government spending is a fraction γ_t of GDP, $G_t = \gamma_t Y_t$, where:

$$\gamma_t = \gamma_0 \hat{\gamma}(\Delta \log Y_t). \tag{21}$$

The first component is the steady-state spending share γ_0. The second component $\hat{\gamma}(\Delta \log Y_t)$ is concerned with macroeconomic stabilization, $\hat{\gamma}'(\cdot) < 0$, meaning the government raises spending relative to GDP during an economic downturn and vice versa.

Transfer spending to both types of households is also a fraction of GDP:

$$\Theta_t = \vartheta_t \theta_t Y_t, \quad \Theta_t^H = \vartheta_t \theta_t^H Y_t. \tag{22}$$

The transfer spending function for savers $\theta_t = \theta_0 \hat{\theta}(\Delta \log Y_t)$ is defined analogously to the discretionary spending function in (21), with steady-state transfer share θ_0 and cyclical component $\hat{\theta}(\Delta \log Y_t)$ that satisfies $\hat{\theta}'(\cdot) < 0$. The transfer spending rule for HtM consumers is identical to the rule for savers, but with a different steady-state level of transfers θ_0^H. Transfer spending depends on an exogenous low-frequency shock, ϑ_t, which follows a Markov chain with transition matrix Π_ϑ. It captures demographic and political trends outside the model. Together with productivity shocks, innovations to ϑ_t generate aggregate risk.

Taxation. Labor earnings tax rates are defined as:

$$\tau_t^w = \tau^w(\Delta \log Y_t, \mathcal{B}_t) = \begin{cases} \tau_0^w \hat{\tau}(\Delta \log Y_t) f_\tau^P(\mathcal{B}_t) & \text{if } \mathcal{B}_t < \mathcal{B}^P \\ \tau_0^w \hat{\tau}(\Delta \log Y_t) & \text{if } \mathcal{B}^P \leq \mathcal{B}_t < \mathcal{B}^A \\ \tau_0^w \hat{\tau}(\Delta \log Y_t) f_\tau^A(\mathcal{B}_t) & \text{if } \mathcal{B}_t \geq \mathcal{B}^A, \end{cases} \tag{23}$$

where τ_0^w specifies the steady-state tax rate and $\hat{\tau}(\Delta \log Y_t)$ governs the procyclicality of tax revenues out of labor income with $\hat{\tau}'(\cdot) > 0$. The third component, consisting of functions $f_\tau^P(\mathcal{B}_t)$ and $f_\tau^A(\mathcal{B}_t)$, is concerned with debt stabilization. When the debt/GDP ratio $\mathcal{B}_t$ falls below the threshold $\mathcal{B}^P$, the fiscal authority enters "profligacy" and cuts the tax rate according to the function $f_\tau^P(\mathcal{B}_t) \leq 1$. Similarly, when $\mathcal{B}_t$ rises above $\mathcal{B}^A$, the fiscal authority enters "austerity" and raises the tax rate according to $f_\tau^A(\mathcal{B}_t) \geq 1$. The tax function for HtM consumers $\tau_t^{w,H}$ is identical except for a different steady-state tax rate $\tau_0^{w,H}$. Labor income tax revenue collected from savers and HtM consumers is $T_t^w = \tau_t^w w_t N_t$ and $T_t^{w,H} = \tau_t^{w,H} w_t^H N_t^H$.

The tax rule for corporate payouts τ_t^{div} likewise incorporates macro and debt stabilization. It is identical to (23) except for a different steady-state tax rate τ_0^{div}, so it shares the cyclical component $\hat{\tau}(\Delta \log Y_t)$ and the adjustment factors $f_\tau^P(\mathcal{B}_t)$ and $f_\tau^A(\mathcal{B}_t)$. The tax base is producer profits, so corporate tax revenue collections are $T_t^{div} = \tau_t^{div} Div_t^P$.

Profligacy and Austerity. Debt stabilization relies on the tax rule (23), which responds to debt/GDP $\mathcal{B}_t$. Fiscal adjustments that prevent $\mathcal{B}_t$ from becoming very low occur through lower tax rates, using the functional form:

$$f_\tau^P(\mathcal{B}_t) = \left(\frac{\mathcal{B}_t}{\mathcal{B}^P}\right)^{\tau_P}. \tag{24}$$

In the profligacy region, tax rates decline with an elasticity parameter τ_P. Symmetrically, the government raises taxes in the austerity region according to:

$$f_\tau^A(\mathcal{B}_t) = \left(\frac{\mathcal{B}_t}{\mathcal{B}^A}\right)^{\tau_A}, \tag{25}$$

with elasticity parameter τ_A. These tax adjustment functions mirror the specification in the simple model in equation (8), with the important difference that tax policy contains a component that stabilizes the macroeconomy through the term $\hat{\tau}(\Delta \log Y_t)$.[13]

Debt Issuance. Given the surplus in (20) and beginning-of-period debt W_t^G, the government budget constraint dictates how much new debt must be issued:

$$W_t^G = P_t S_t + p_t^S B_t^{G,S} + p_t^L B_t^{G,L}, \tag{26}$$

where $B_t^{G,m}$ is the quantity of nominal bonds issued at market price p_t^m of maturity $m \in \{S, L\}$.

The fiscal authority keeps the maturity composition of newly issued government debt constant in book value terms, with a fraction $\bar{\mu}$ of debt being long-term. Then constant issuance in book values for debt requires:

$$\frac{B_t^{G,S}}{B_t^{G,L}} = \frac{1-\bar{\mu}}{\bar{\mu}}.$$

The total issuance required to satisfy the budget constraint, $W_t^G - P_t S_t$, must be met in market value terms, implying:

$$B_t^{G,S} = \frac{(1-\bar{\mu})(W_t^G - P_t S_t)}{(1-\bar{\mu})p_t^S + \bar{\mu} p_t^L}, \quad B_t^{G,L} = \frac{\bar{\mu}(W_t^G - P_t S_t)}{(1-\bar{\mu})p_t^S + \bar{\mu} p_t^L}. \tag{27}$$

[13] Also, in the simple model, the adjustment functions depend on the book value of debt. The quantitative model has two debt maturities and permanent shocks (stochastic growth), requiring a stabilization target expressed in terms of the market value of debt relative to GDP.

The transition law for the market value of the government debt portfolio is:

$$W_{t+1}^G = B_t^{G,S} + (c + 1 - \delta^B + \delta^B p_{t+1}^L) B_t^{G,L}. \tag{28}$$

3.4.2 Monetary Policy

The central bank chooses the interest rate on short-term government debt $i_t^S = 1/p_t^S - 1$.[14] We consider a standard Taylor rule:

$$\frac{1}{p_t^S} = \frac{1}{\bar{p}^S} \left(\frac{\Pi_t}{\bar{\Pi}} \right)^{\phi^\pi} \left(\frac{\hat{Y}_t}{\bar{Y}} \right)^{\phi^y}, \tag{29}$$

where gross inflation is $\Pi_t = P_t/P_{t-1}$. The central bank's inflation target is $\bar{\Pi}$ and its target level for cyclical output, $\hat{Y}_t = Y_t/Z_t^p$, is $\bar{Y}$. The rule specifies deviations from the average gross interest rate $1/\bar{p}^S$.

3.5 Foreign Demand for U.S. Government Bonds

Foreign investors purchase $B_t^{F,S}$ and $B_t^{F,L}$ short-term and long-term bonds, respectively. Denote the market value of debt issued at the end of period t by $W_t^{G,new} = p_t^S B_t^{G,S} + p_t^L B_t^{G,L}$. Foreigners buy a constant fraction $\bar{\mu}^F$ of this debt, up to a cap on their holdings:

$$W_t^{F,new} = \bar{\mu}^F \min \left\{ W_t^{G,new},\ \bar{W}^F P_t Z_t^p \right\}. \tag{30}$$

As long as debt stays below $\bar{W}^F P_t Z_t^p$, foreigners absorb the share $\bar{\mu}^F$ of all debt. Once debt exceeds this level, foreign holdings remain at $\bar{\mu}^F \bar{W}^F P_t Z_t^p$, and domestic investors must absorb all additional debt.[15] Foreign demand is price-inelastic and spread proportionately across both

[14] This is consistent with the central bank directly setting the interest rate on reserves, as in the current policy regime. It is also compatible with a central bank that has a small balance sheet and uses open-market operations to target the rate in the interbank market. In both cases, absence of arbitrage ensures that the policy rate set by the central bank coincides with the yield on short-term debt and reserves.

[15] The threshold is nominal: $\bar{W}^F$ is scaled by the price level and permanent productivity, $P_t Z_t^p$, so that the threshold grows with nominal output.

maturities, $B_t^{F,S} = \mu_t^F B_t^{G,S}$ and $B_t^{F,L} = \mu_t^F B_t^{G,L}$, where the foreign share of government debt is:

$$\mu_t^F = \frac{W_t^{F,new}}{W_t^{G,new}} = \bar{\mu}^F \min\left\{1,\ \frac{\bar{W}^F P_t Z_t^p}{W_t^{G,new}}\right\}. \tag{31}$$

It equals $\bar{\mu}^F$ below the threshold and declines toward zero as debt grows beyond it.

Changes in foreign holdings of U.S. government debt and interest payments made to foreigners lead to net financial outflows, in units of the consumption good:

$$NF_t = \frac{B_{t-1}^{F,S} - p_t^S B_t^{F,S} + (c + 1 - \delta^B + \delta^B p_t^L) B_{t-1}^{F,L} - p_t^L B_t^{F,L}}{P_t}. \tag{32}$$

By national income accounting, this net financial outflow equals real net exports: $NX_t = NF_t$.

3.6 Equilibrium

Households, firms, and banks optimize. Bond and goods market clearing require:

$$B_t^{G,S} = B_t^{I,S} + B_t^{F,S}, \tag{33}$$

$$B_t^{G,L} = B_t^{S,L} + B_t^{F,L}, \tag{34}$$

$$Y_t = C_t + C_t^H + I_t + G_t + \Phi(I_t, K_{t-1}) + NX_t. \tag{35}$$

Deposit, labor, and firm capital markets must also clear in equilibrium. Appendix B contains the full set of optimality and market clearing conditions.

4 Solution and Calibration

We solve the model using a global nonlinear solution method, and calibrate parameters by matching model moments from a long simulation to corresponding data moments. We first discuss the calibration and then provide an overview of how the model is solved and simulated. We describe the simulation algorithm that determines the austerity threshold as the upper bound of the government's inaction region for debt stabilization.

4.1 Calibration

Appendix C contains a detailed discussion of the extensive model calibration work. In the interest of brevity, the main text summarizes the key points. Our calibration matches data moments from the post-war era. To compute moments from the model, we use a conditional simulation sample with debt/GDP ratios of 103% or smaller, which was the peak of marketable debt/GDP in the data reached in 2020.[16] Thus, debt/GDP ratios in the model span the same range as in the post-war sample.[17]

Productivity parameters directly target real consumption growth and detrended real GDP. To help the model produce an upward-sloping term structure of interest rates, permanent and transitory shocks are perfectly positively correlated. Production and adjustment cost parameters are standard. The elasticity of substitution for the final goods producer matches the average profit share, and the Rotemberg adjustment cost targets the volatility of the labor share through its effect on labor demand.

Bank sector parameters match regulatory features such as the maximum leverage ratio (ν in the SLR constraint) and equity requirement for capital (the risk weight ν_K). The fraction of deposits ζ_ϱ that a particular bank's depositors can be expected to withdraw per period is set to 0.05 following BIS (2013). The LCR parameter ϱ_0 targets the spread between short-term debt and deposits of 0.20% per quarter.

HtM consumers' share of labor, $\alpha_H = 5.35\%$, is set based on the share of labor income received by households with low net worth to income in the Survey of Consumer Finances. This data source also informs the share of transfers received by the HtM households. We assume they pay no taxes: $\tau_0^{w,H} = 0$.

Both types of households, savers and HtM consumers, share the same preferences (16)–(17). The coefficient of risk aversion γ targets the risk premium on a claim to GDP of 1.0% per quarter. We set the elasticity of intertemporal substitution to $1/\varphi = 1/0.7$ to target the volatility of the short-term yield. The subjective discount factor of households β targets the

[16] The one exception is the average real rate, which we compute on the full simulation. The mean risk-free rate strongly affects the distribution of debt/GDP and the time the economy spends in austerity, so conditioning this moment on the 103% sample would destabilize the calibration.

[17] The baseline calibration assumes perfect commitment to tax increases in the austerity region. Since the austerity threshold is far above 103% of GDP, even in the case of imperfect commitment, this assumption exerts little influence on the calibration.

average real rate of 0.41% per quarter. The Frisch elasticity of labor supply is set to 0.5 ($\omega_1 = 2$), a standard value in heterogeneous-agent New Keynesian (HANK) models; the disutility scale parameter ω_0 targets equilibrium labor of approximately 1/3 of the unit time endowment. Households' utility benefit from deposits ψ targets the term spread of 0.35% per quarter.

Our fiscal policy rules $(\tau_t^w, \tau_t^{div}, \gamma_t, \theta_t, \theta_t^H)$ are calibrated to match the unconditional average and cyclical properties of labor and capital income tax revenues, discretionary spending, and transfer spending. The transfer spending shock ϑ_t follows a two-state Markov chain with values $[\vartheta_l, \vartheta_h]$ chosen to target average transfer spending to GDP before 1990 (low) and after 1990 (high). We set the probability of remaining in the high state to match the high persistence of demographic and political cycles governing transfer spending, and the probability of remaining in the low state so that $\mathrm{E}[\vartheta_t] = 1$.

A particularly important fiscal policy parameter is the steepness of tax increases in austerity, parameterized by τ_A in the fiscal rule (23). Here, we choose a value that is consistent with episodes of high primary surpluses observed in other countries. In a panel of 54 advanced and emerging economies over 1974–2013, Eichengreen and Panizza (2016) find that 15% of non-overlapping five-year periods feature an average primary surplus of at least 3% of GDP; in our baseline calibration with $\tau_A = 1.65$, the corresponding share is 14%. Section 6 analyzes in detail how fiscal capacity and welfare depend on τ_A.

The parameter $\overline{\mu}$ is set to match the observed fraction of debt with maturity longer than one year (62%). We set δ^B to match the observed duration of long-term government debt of 5.02 years. We set the share of U.S. debt held by foreigners $\bar{\mu}^F$ equal to 33%. This is the observed average over the period 1980–2025. In the baseline version of the model, we assume $\bar{W}^F \to \infty$, such that the share bought by foreigners is constant at $\bar{\mu}^F$ irrespective of the outstanding debt. In a later policy experiment, we set $\bar{W}^F$ to 115% of GDP, so that foreign holdings are capped at 38% of GDP, and increases in debt beyond 115% of GDP must be absorbed by domestic agents.

The Taylor rule coefficient on inflation ϕ^π is set to 1.6, targeting the volatility of inflation in the model to match that of core CPI inflation. The coefficient on output ϕ^y is set to 0.125, a standard value in the literature.

Apart from foreign holdings, we assume that domestic savers hold all of the remaining long-

term debt and banks hold all of the remaining short-term debt. For short-term bonds, this assumption follows Lenel et al. (2019). To assess the assumption on long-term bonds, we look at Treasury holdings from the Financial Accounts of the United States. Depository institutions hold only 8.4% of long-term debt on average over the period 1980–2025.

4.2 Solution Method

The model's exogenous state variables are productivity and transfer spending. The endogenous aggregate state variables are the capital stock K_{t-1}, saver wealth W_t^S, and the market value of outstanding government debt W_t^G.[18] Appendix E discusses the transition function iteration (TFI) algorithm used to solve the model. As is common for global methods, the numerical algorithm involves finding the right interpolation grid for endogenous state variables.

The histogram from the simulated model in Figure 3 shows that government debt has a wide support, with the lowest debt/GDP ratios below 25% (in profligacy) and the highest well above 300% (in austerity). The distribution of debt/GDP is bimodal, without a clear notion of a "steady state." A key contribution of this paper is to determine the endogenous bounds, and the austerity threshold, of the government debt state variable. Unlike modeling approaches that use fiscal rules to center government debt around some deterministic steady-state value, our approach uncovers the widest permissible range of government debt realizations subject to the premise that debt remains free of default risk.

Profligacy Threshold. First, we set the profligacy threshold $\mathcal{B}^P$ such that the lowest value of debt/GDP in the simulation equals the lowest value we observe in the post-war data. This implies an annual value of $\mathcal{B}^P = 50\%$. A lower threshold does not substantially change the results of our quantitative experiments, which are mainly concerned with fiscal policy at high debt/GDP. We set the lowest point of the government debt grid, $\underline{\mathcal{B}}$, such that all simulated paths are interior.

Austerity Threshold. The austerity threshold $\mathcal{B}^*(\Omega)$, the key object in this paper, is determined endogenously, as a function of all other model parameters Ω, as explained in Section

[18] Frictionless equity issuance by banks eliminates their wealth as a state variable.

2. Unlike for the simple model, our criterion for the safety of debt and the determination of the threshold in the quantitative model is simulation-based.[19] Finding the threshold entails a joint search over $\mathcal{B}^A$ and the upper bound $\overline{\mathcal{B}}$. We accept a combination $(\mathcal{B}^A, \overline{\mathcal{B}})$ as a stationary equilibrium with safe debt if debt transitions never violate the upper bound in many long simulations of the model.[20] In particular, we simulate the model for 100,000 paths of 5,000 quarters each, discarding the initial 3,000 quarters as burn-in for each path. Thus, we essentially consider 100,000 alternative 500-year histories for which government debt must remain safe. We check for violations on the paths whose debt is below $\mathcal{B}^A$ at the start of the 500-year window, 69,733 of the 100,000 paths in the baseline; paths that start the window in austerity are not checked but remain in the denominator. We calculate the fraction of paths in the simulation that violate the upper bound $\overline{\mathcal{B}}$

$$fv\left(\mathcal{B}^A, \overline{\mathcal{B}}\right) = \frac{\#\text{explosive paths}}{\#\text{all paths}},$$

and we require $fv\left(\mathcal{B}^A, \overline{\mathcal{B}}\right) = 0$.

The austerity threshold $\mathcal{B}^*(\Omega)$ is then the largest value of $\mathcal{B}^A$ for which we can find an upper bound $\overline{\mathcal{B}}$ such that the economy satisfies the simulation criterion. To find the threshold, we develop a search algorithm that determines the upper bound $\overline{\mathcal{B}}$ for a candidate $\mathcal{B}^A$. The algorithm parameterizes the upper bound $\overline{\mathcal{B}}$ as a multiple of the austerity threshold $\overline{\mathcal{B}} = \mathcal{B}^A e^m$ with $m > 0$ determining the length of the interval $[\mathcal{B}^A, \overline{\mathcal{B}}]$. Then, for each candidate $\mathcal{B}^A$, we increase m starting from a low value, until either (i) the simulated model achieves $fv\left(\mathcal{B}^A, \overline{\mathcal{B}}\right) = 0$, or (ii) the transition function iteration algorithm fails to converge.

This algorithm allows us to determine $\mathcal{B}^*(\Omega)$ to high precision. For example, for the baseline model we find $\mathcal{B}^*(\Omega) = 2.34$ with $m = 0.53$, implying an upper bound $\overline{\mathcal{B}} = 3.98$. If we instead

[19] Computing the numerical solution to the model requires choosing sufficiently wide boundaries for all endogenous state variables, not only government debt. However, it is impossible to know the ergodic distribution of the state variables until computing the model solution. The ergodic distribution can be learned either by simulation or by inspecting the Markov transition matrix of the full model. Judd, Maliar and Maliar (2011) compare these approaches.

[20] As we did for the simple model, an alternative approach is to check all possible exogenous and endogenous Markov transitions (like in Figure 1), and to verify that they map the state variables back into the interior of the state space. While it is possible to apply this criterion to the quantitative model, we found it overly strict, since it imposes interior transitions in areas of the state space that are not in the ergodic distribution of the model. These transitions need not be interior to guarantee debt safety, since they only occur "off equilibrium." We showed for the simple model that even an extremely long simulation never came close to reaching the theoretical upper bound.

compute the model with $\mathcal{B}^A = 2.35$ and $m = 0.53$ (upper bound 3.99), we find $fv = 1/100{,}000$, i.e., one of the 100,000 simulated paths violates the upper bound. If we attempt to increase m to 0.535 for this candidate $\mathcal{B}^A$, the solution algorithm fails to converge, prompting us to reject $\mathcal{B}^A = 2.35$ as a valid threshold. The search algorithm uses a step size of 0.005 for m.

A distinct advantage of the simulation-based approach is that it is less sensitive to the number of discrete nodes used for productivity and transfer shocks.[21] A potential disadvantage is that the austerity threshold depends on the size of the simulation. However, with 100,000 simulated paths of 500 years each, we find this sensitivity to be small (Appendix E.2).

5 Drivers of Fiscal Capacity

In this section, we study the determinants of fiscal capacity in the main quantitative model.

5.1 Fiscal Adjustment in the Baseline Economy

Figure 3 shows histogram plots of the debt/GDP ratio for the quantitative model, echoing Figure 2 for the simple model. The austerity threshold $\mathcal{B}^*$, the level of debt/GDP at which surpluses must be increased in order to guarantee that government debt is a safe asset, is found to be 234% of GDP. If tax increases were to start at higher levels of debt/GDP, some histories of shocks would lead debt onto a path that the tax rule can no longer reverse, so the safety of debt could not be guaranteed. Put simply, if austerity kicks in "too late" in terms of debt/GDP, then government debt is not guaranteed to remain stationary and is no longer risk-free.

Since debt/GDP is in the inaction region most of the time, the model generates long time paths where tax rates do not respond to debt/GDP changes. Fiscal policy stabilizes the business cycle; it is active. This is a realistic feature of the model. Appendix D.2 shows that in the post-war sample, we do not observe tax increases prompted by higher debt/GDP ratios. If anything, increases in debt/GDP coincide with decreases in surplus/GDP. Our model replicates

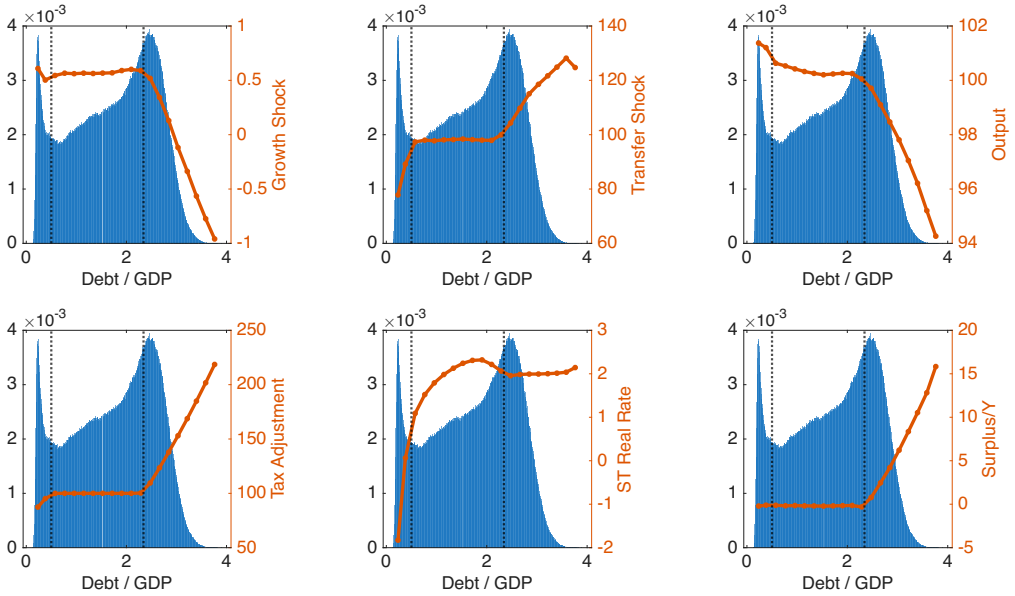
[21] For productivity shocks that are based on discretization of AR(1) processes with Gaussian innovations, using more nodes creates not only more extremely low productivity states, but also assigns rapidly declining probabilities to the most extreme nodes. We found that the simulation-based algorithm for determining the austerity threshold is robust to the number of nodes used in the discretization, while a search for the strict upper bound as specified in Definition 1 is not.

this behavior. Finally, in both the model and the data, debt/GDP is highly persistent: the quarterly autocorrelation coefficient of the debt/GDP ratio is 0.995 in the data, while in the model it is 0.999. Therefore, our model demonstrates that the lack of responsiveness of fiscal policy to changes in debt/GDP over long periods of time can still be consistent with stationary debt dynamics in the long run. Tax increases in response to debt are triggered only at debt/GDP levels never observed in the history of U.S. fiscal policy.

The first two panels of Figure 3 show that a combination of low growth and high transfer spending shocks propels the economy into the austerity region. When the economy moves past the austerity threshold, fiscal policy endogenously switches to debt stabilization; it becomes passive. The fiscal authority now sets tax rates in order to stabilize the debt/GDP ratio. The bottom left panel shows that substantial tax increases may be needed to keep the debt safe. At debt/GDP ratios above 350%, tax rates may need to double from their baseline levels. However, such high levels of debt are rarely reached. On average, tax rates in austerity are just 25% higher than their baseline value, representing an increase in the tax rate on labor income from 23% to 28.7%. Primary surpluses, plotted in the bottom right panel, rise to 2.7% of GDP on average in the austerity region. Surpluses above 10% of GDP are reached in only 3% of austerity periods.

These tax adjustments are successful in reining in debt/GDP. However, the figure reveals a clear asymmetry with respect to profligacy and austerity. This asymmetry is caused by the distortionary effect of labor income taxation, resulting in a concave "Laffer" curve of tax revenue generated from tax increases. Thus, consecutive marginal increases in tax rates yield smaller marginal increases in tax revenue in the austerity region, as labor supply gets increasingly distorted. In contrast, consecutive tax rate decreases will yield greater marginal reductions in revenue in the profligacy region. The detrimental effects of large tax hikes on the economy are evident in the top right panel. Output declines in austerity, with GDP dropping 1% on average in austerity, and occasionally as much as 5%. The real interest rate (bottom middle) is relatively constant during austerity, which reflects the balance of higher expected consumption growth increasing rates (by virtue of an expected reduction in debt) and increasing risk and precautionary forces reducing real rates. Because of the presence of trend growth shocks in the main model, precautionary forces are much stronger than in the simple model. Correspondingly,

Figure 3: Shocks and Adjustments



Note: This figure shows the histogram of debt/GDP from the simulated model overlaid with conditional means of the growth rate shock g_t (top left), the transfer spending shock ϑ_t (top middle), GDP Y_t (top right) relative to the balanced growth path, the tax profligacy f_τ^P and austerity f_τ^A factors (bottom left), the short-term real interest rate (bottom middle), and surplus/GDP S_t/Y_t (bottom right). All variables are in percent; the real rate is annualized. Vertical dashed lines indicate the profligacy threshold $\mathcal{B}^P$ and the austerity threshold $\mathcal{B}^*$, respectively.

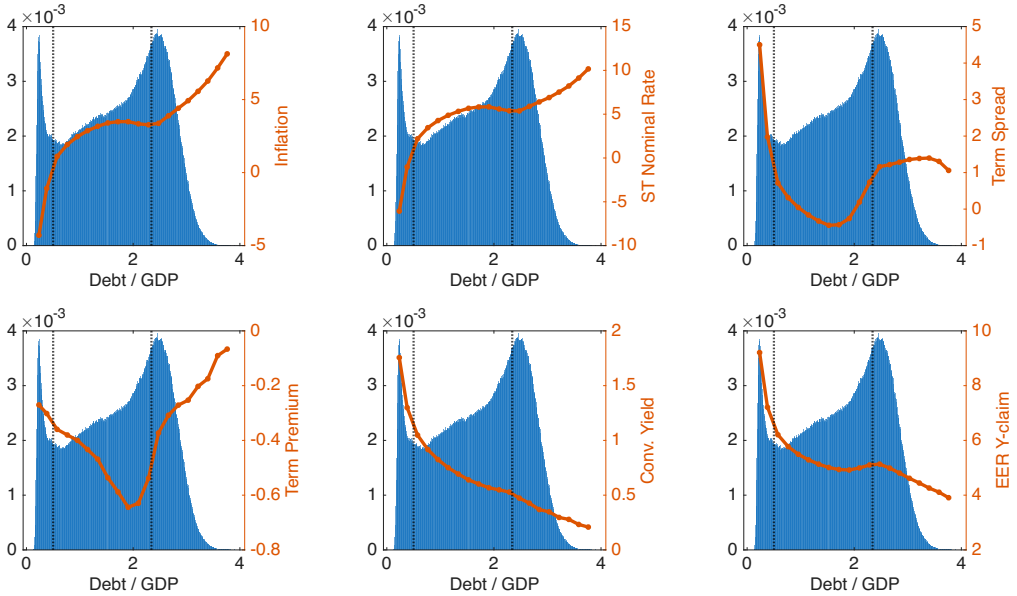
the real rate increases much less in the austerity region in the full model.

5.2 Asset Prices and Debt Dynamics

Government debt is a state variable and a key determinant of all endogenous objects. Figure 4 shows the model's asset pricing implications across debt/GDP ratios. Inflation rises strongly with debt/GDP (top left panel). Tax hikes in austerity constitute a highly inflationary negative supply shock, with inflation averaging 3.9%. Inflation also rises with debt/GDP in the inaction region between the thresholds, where higher debt crowds out investment and labor supply, an effect we explore in Section 5.4.

Yields on short-term debt are set by monetary policy and closely track inflation (top middle). By fighting inflation, the central bank increases the nominal cost of government debt service. The term spread exhibits strong non-monotonic variation in debt/GDP (top right). At low levels of debt/GDP, the convenience yield on ST debt is high (bottom middle). This causes

Figure 4: Asset Prices



Note: This figure shows the histogram of debt/GDP from the simulated model overlaid with conditional means of inflation π_t (top left), the yield on short-term debt i_t^S (top middle), the term spread $i_t^L - i_t^S$ (top right), the term premium (bottom left), the aggregate convenience yield (bottom middle), and the expected excess return on a claim to GDP (bottom right). All variables are in percent. Vertical dashed lines indicate the profligacy threshold $\mathcal{B}^P$ and the austerity threshold $\mathcal{B}^*$, respectively.

a strongly upward-sloping term structure (high term spread). The term structure flattens at intermediate levels, as convenience yields decline in debt (consistent with the empirical evidence in Krishnamurthy and Vissing-Jorgensen, 2012). The term premium, negative at moderate debt, rises toward zero in austerity, pushing up LT yields (bottom left).

Finally, the expected excess return on a claim to GDP over the ST yield (bottom right) is declining in debt/GDP, a pattern that is partially driven by declining convenience yields in ST debt and by variation in risk premia (see Appendix D.1 for a risk premium decomposition).

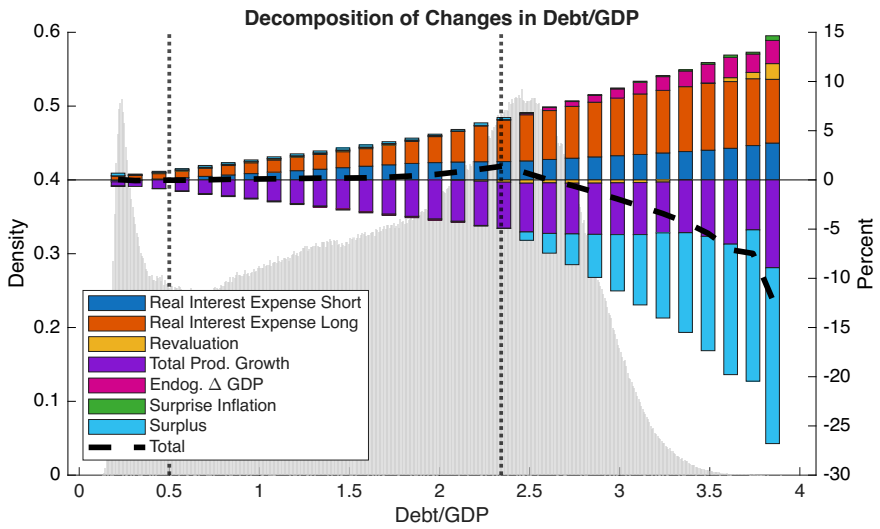
Turning to debt dynamics, Figure 5 decomposes changes in the debt/GDP ratio into its various components, at different levels of the debt/GDP ratio. Positive numbers indicate sources that increase the debt, while negative numbers indicate forces that help pay down the debt. The black line nets out the sources to show the total effect.

Productivity growth consistently helps pay down the debt. Outside austerity, the effect grows linearly in debt. Lower productivity growth in the austerity region—itself a contributor to austerity episodes—means the effect gets weaker. While surpluses contribute a negligible

amount to debt reduction in normal times, they become a key driver in austerity, as tax rates increase. Their distortionary effect can be seen in the contribution of endogenous changes in GDP, increasingly adding to the debt burden in austerity.

Real interest expenses add to the debt and grow with its level, further amplified by declining convenience yields and rising term premia in austerity. In the high-debt region, the composition of interest expense shifts toward long-term debt as term spreads rise (except in the tail, when short rates are expected to revert). Current short rates are high but are expected to decline in the future as taxation lowers debt levels, flattening the yield curve. The inflationary effect of austerity is largely expected and hence incorporated into nominal yields. Both surprise inflation and revaluation of long-term debt are minor contributors to changes in debt/GDP, except in the extreme tails when they increase the debt burden.

Figure 5: Decomposing Changes in Debt/GDP



Note: This figure shows the histogram of debt/GDP from the simulated model overlaid with conditional means of the various contributors to changes in the debt/GDP ratio at market values, conditional on the previous quarter's level. Contributions are one-quarter changes in debt/GDP at an annual rate, in pp of annual GDP. Positive numbers indicate forces that increase the debt while negative numbers indicate forces that reduce the debt. The black line (Total) is the sum of all contributions.

Appendix D.3 discusses the safety of government debt in terms of the covariance of the surplus claim with the stochastic discount factor (Jiang et al., 2024a). As the economy approaches austerity, the tax and surplus claims become riskier to the taxpayers, or equivalently, safer to the government. Taxpayers must absorb the negative shocks that hit the economy if the debtholders are to be spared, i.e., if debt is to remain safe.

5.3 Fiscal Capacity Bounds

An important output of the calibrated model is the level of the austerity threshold. We view the austerity threshold as a novel, natural measure of fiscal capacity. Understanding how it changes as key parameters change provides insight into the determinants of fiscal capacity.

Column (1) of Table 1 shows averages from the same simulation of the baseline economy that generated Figures 3–5. The austerity threshold $\mathcal{B}^*$ in this economy is 234% of GDP. This is significantly higher than the July 2026 debt levels of around 100% of GDP. The CBO projects that debt/GDP will reach 175% by 2056 (Congressional Budget Office, 2026). Under the baseline model's assumption of full commitment, the U.S. government can delay fiscal adjustments for the foreseeable future. Relaxing the full commitment assumption, which we do in Section 6.3, substantially affects this conclusion.

While the calibration targets moments outside of austerity, Table 1 shows unconditional averages for the full simulation including periods in which the economy is in the austerity region. The baseline economy is in the austerity region 29.4% of periods. The average debt/GDP ratio in this economy is 173%. Since austerity periods have high inflation and high term premia, these unconditional moments differ from the (conditional) calibration targets.

Column (2) shows how the austerity thresholds and simulation averages change when we increase the Frisch elasticity of labor supply from 0.5 to 1 (by lowering ω_1 from 2 to 1). When the distortionary effects from labor income taxation become stronger, the austerity threshold drops significantly to 207%. This economy has lower average debt/GDP, yet spends more time in austerity, with a steeper term structure but lower real rates and inflation. In terms of real outcomes, the high labor supply elasticity economy has slightly more capital (+0.45%), but lower labor supply by savers (−9.6%) and HtM consumers (−4.8%).

Column (3) considers a lower coefficient of risk aversion γ. This change lowers the expected excess return on the output claim by more than half, from 5.5% to 2.4%. Lower risk aversion causes a dramatic 60 pp decline in fiscal capacity relative to the baseline model, to 174%. The real rate climbs from 1.7% to 4.3% and the term spread rises from 0.7% to 1.4%. Average inflation becomes 7.1%. When savers become less risk averse, their precautionary savings demand drops and interest rates rise. The rise in rates leads to substantially higher interest

Table 1: Sensitivity of Fiscal Capacity

	(1) Base	(2) LS	(3) RA	(4) Risk	(5) NF	(6) F Cap	(7) LT 66%	(8) LT 56%	(9) H. LC
$\mathcal{B}^*$	**234**	**207**	**174**	**273**	**203**	**189**	**230**	**225**	**224**
Debt/Y	173	164	213	345	182	156	166	169	170
Frac. Austerity	29.4	36.3	93.6	98.6	48.4	40.8	28.3	30.4	30.7
Real rate	1.71	1.60	4.28	3.64	2.38	1.31	1.46	1.87	2.06
Term spread	0.701	1.24	1.36	1.05	0.713	1.91	0.929	0.542	0.219
Inflation	2.66	2.43	7.07	5.91	3.84	2.06	2.28	2.95	3.31
EER Y-claim	5.46	5.59	2.40	3.22	4.90	5.92	5.70	5.29	5.10
Conv.yield	0.698	0.704	0.634	0.341	0.472	0.664	0.680	0.740	0.548
Tax Rev./Y	18.0	18.3	23.7	25.0	19.1	18.5	17.9	18.0	18.0
Spending/Y	17.3	17.3	17.3	17.3	17.3	17.3	17.3	17.3	17.3
Surplus/Y	0.653	0.962	6.39	7.65	1.80	1.22	0.601	0.667	0.715
Output (Y)	100	*	*	*	-1.90	-0.800	0.181	-0.147	-1.34
Capital (/Y)	158	0.445	-8.72	-7.78	-4.94	-1.11	0.659	-0.575	-5.12
Labor	36.1	-9.6	-3.02	-3.85	-1.10	-0.758	0.0502	-0.028	-0.258
Labor HTM	40.5	-4.82	0.0228	-0.019	-0.015	-0.054	-0.001	0.0007	0.0031
Consump. S (/Y)	72.0	-0.139	-0.907	-1.60	-0.902	-0.666	0.117	-0.064	-0.560
Consump. HTM (/Y)	5.20	0.113	0.401	-0.423	-2.20	-1.85	0.169	-0.130	-1.27
Cons.gr Vol	1.51	3.69	31.0	-1.50	3.14	30.2	-0.138	0.213	1.15
Deposits S (/Y)	191	-0.746	3.45	22.7	10.5	0.560	-3.10	2.37	-5.61
Welfare Saver					0.865	-0.222	0.200	-0.014	-1.28
Welfare HTM					-2.36	-0.220	0.307	-0.041	-1.17

Note: This table shows moments from the simulated model across different parameterizations. The first column displays the calibrated baseline model. The other columns show moments for the following deviations from the baseline: Column (2) "LS" – higher labor supply elasticity $\omega_1 = 1$, with $\omega_0 = 3.5$ to keep total hours on target, column (3) "RA" – lower risk aversion $\gamma = 5$, column (4) "Risk" – lower volatility of productivity growth $\sigma_g = 0.85\%$, column (5) "NF" – no foreign debt holdings, column (6) "F Cap" – cap on foreign debt holdings at 38% of GDP, column (7) "LT 66%" – share of long-term debt $\bar{\mu} = 66\%$, column (8) "LT 56%" – share of long-term debt $\bar{\mu} = 56\%$, and column (9) "H. LC" – high liquidity cost $\varrho_0 = 0.16$. All variables are in percent. Columns (2)–(9) in the bottom two panels display percentage deviations relative to the baseline in column (1). Average productivity is recalibrated in economies (2)–(4) to normalize $\mathrm{E}[Y] = 1$, indicated by *. With $\mathrm{E}[Y] = 1$, (/Y) indicates that a variable can be read as a fraction of baseline GDP. Welfare effects in columns (5)–(9) are computed as the compensating variation in the stationary distribution compared to the baseline economy in column (1).

expenses for the government, leading in turn to the sharp reduction in fiscal capacity, an increase in average debt/GDP, and the economy spending a lot more time in the austerity region (94%). On the real side, the lower precautionary savings demand causes an 8.7% smaller capital stock. The economy with lower risk aversion reveals that households' precautionary savings demand to insure against aggregate risk is a key source of fiscal capacity. Realistic assessments of fiscal capacity crucially rely on including realistic aggregate risk and risk premia.

Column (4) lowers the volatility of TFP growth to $\sigma_g = 0.85\%$ from 1.2% in the baseline. This economy looks similar to the one with lower risk aversion in column (3): it has a higher risk-free rate, greater inflation, a lower excess return (3.2% compared to 5.5%), and a smaller capital stock. Since growth shocks are significantly less volatile, this economy features much lower fiscal risk and a significantly higher austerity threshold of 273%.[22] The economy spends almost all of the time (99%) in the austerity region, where it lingers due to high interest expenses on the debt; average debt/GDP is 345%. Comparing columns (3) and (4) demonstrates the importance of growth shock volatility for fiscal capacity. Both economies have lower precautionary savings and higher interest rates, yet the economy with lower risk has much greater fiscal capacity.

While columns (2)–(4) study parameter variations intended to highlight model mechanisms, columns (5)–(9) consider experiments that can be interpreted as changes in policy. Columns (5) and (6) study the role of foreign Treasury bond buyers. In column (5), we set the bond holdings of foreigners to zero. This lowers the austerity threshold significantly to 203% of GDP. Put differently, an important source of fiscal capacity in the baseline model is the willingness of foreigners to absorb a constant share of debt as it grows, without requiring large price concessions. The absence of foreign investors increases average real rates by 67 bps. Since the economy spends more time in austerity, taxes and inflation are higher. The output risk premium is lower without foreign investors since domestic savers have access to more safe Treasury debt, lowering the compensation they demand for bearing aggregate output risk. Without foreigners buying Treasuries, the long-run size of the U.S. economy would be 1.9% smaller and the capital stock 4.9% smaller. Further, the convenience yield earned by the government on its debt is around 20 bps smaller, as the debt held by domestic savers in the form of deposits is 10.5% larger. The last two rows of Table 1 report welfare changes in the stationary distribution. Savers are better off without foreign investment in U.S. Treasuries; their consumption-equivalent welfare increases by 0.87%. The welfare gain comes from a reduction in labor supply (-1.1%) caused by their gain in wealth, despite lower consumption (-0.9%) and higher aggregate consumption volatility ($+3.1\%$). HtM households are worse off (-2.36%) as they suffer larger consumption declines (-2.2%) and their labor supply decline is smaller.

Column (6) does not eliminate but merely caps foreign purchases of Treasuries. Specifically,

[22] Its debt upper bound is $\overline{\mathcal{B}} = 473\%$; $m = 0.55$, compared to 0.53 in the baseline.

foreigners buy 33% of new debt up to debt of 115% of GDP, so their holdings are capped at 38% of GDP.[23] Interestingly, restricting foreigners' purchases in high-debt periods does *more* damage to fiscal capacity than not having foreign buyers at all. The austerity threshold is 189% of GDP. The economy with "picky foreigners" becomes conditionally riskier; the term spread and output risk premium are both higher, aggregate consumption growth is substantially more volatile (+30.2%), and both savers and HtM households suffer welfare losses. The message from column (6) is that the willingness of foreigners to absorb Treasury debt in high-debt periods is particularly powerful in creating fiscal capacity. Uncapped foreign demand for Treasuries is therefore beneficial on balance. The one exception is saver welfare in column (5): without foreign buyers, savers hold all of the debt, and the resulting wealth effect lowers their labor supply.

Columns (7) and (8) explore the role of a different maturity structure of government debt. In column (7) we raise the share of long-term debt by about 5 pp relative to the baseline, whereas in column (8) we lower it by about 5 pp. Interestingly, fiscal capacity is lower in *both* cases. More short-term debt increases the short-term real rate but lowers the term spread. It increases consumption volatility (+0.21%) and reduces capital formation (−0.58%) and consumption levels. Welfare is lower for both agents. More long-term debt has the opposite effects. Maximizing welfare is not the same as maximizing fiscal capacity. The results show that the observed debt composition comes close to maximizing fiscal capacity, but that welfare would be higher with more long-term debt.

The last column explores the role of "financial repression." Column (9) tightens the liquidity coverage ratio, forcing banks to hold more reserves (short-term Treasuries) per dollar of deposits. Perhaps surprisingly, financial repression lowers fiscal capacity. Higher liquidity costs shrink the financial sector and its deposit supply (−5.6%), lower capital formation (−5.1%), and reduce the size of the economy (−1.3%). Welfare is lower for both agent types. Holding deposits constant, higher liquidity cost slightly increases the value of holding short-term debt, but it makes issuing deposits costlier. In general equilibrium, tighter liquidity regulation reduces the profitability of deposit creation and the attractiveness of bank leverage (the Lagrange multiplier on the leverage constraint). Since short-term government debt serves as collateral for deposits,

[23] With a cap, the foreign share of outstanding debt depends on past issuance, so the market value of foreign holdings W_t^F becomes an additional endogenous state variable.

the lower convenience yield – 55 bps compared to 70 bps in the baseline model – reflects the reduced attractiveness of creating deposits.

5.4 Negative Effects of High Debt

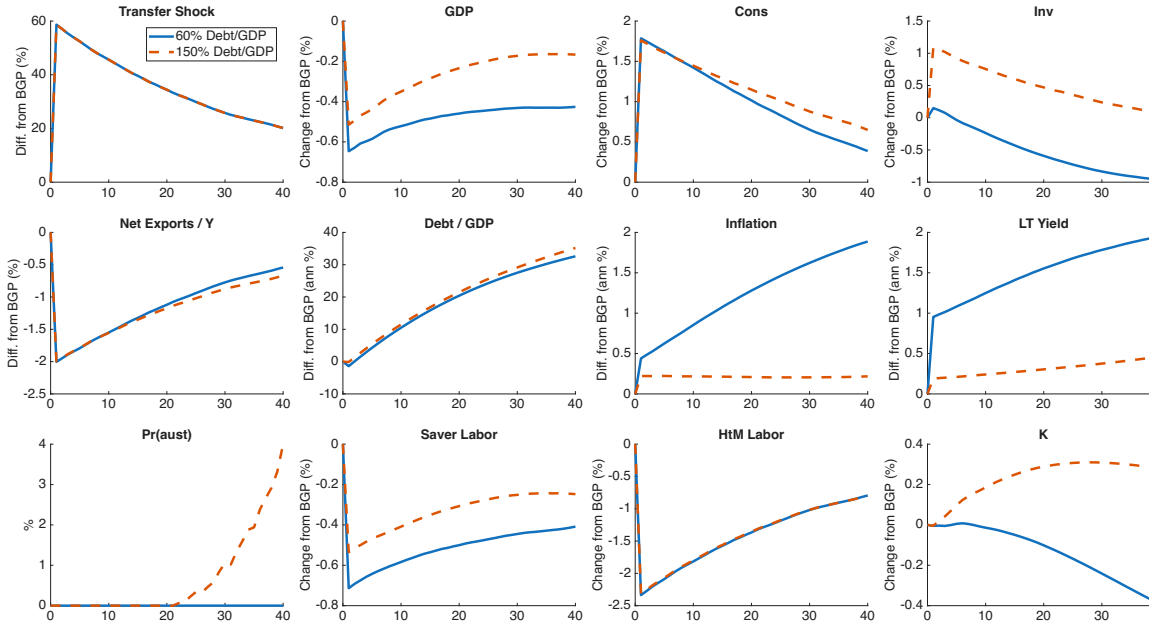
Crowding-Out Effects of Higher Transfer Spending. Even though the majority of households in the model are "Ricardian" savers, fluctuations in the quantity of debt caused by transfer spending shocks have substantial real effects. These effects of high debt are closely tied to our model's ability to generate realistic risk premia and convenience yields.

The main exogenous driver of debt dynamics in the model is the transfer spending shock ϑ_t in (22). The top row of Figure 6 shows the impulse responses of macro aggregates to a transfer spending shock. The two lines in each graph condition on different starting levels of debt/GDP. On impact, GDP declines. Foreign purchases finance a substantial share of the additional debt needed to pay for the higher transfers. This resource inflow from abroad appears as a fall in net exports and lets the domestic economy consume and invest more while working less: consumption and investment rise, at least initially, and more so for high levels of debt. The later interest payments to foreigners drain resources. The negative impact on GDP and investment (later on) is largest at low levels of debt/GDP (blue solid line, 60%). Inflation and LT bond yields (middle row) also increase the most at lower levels of debt. On impact, the latter variables jump up, causing an initial decline in the market value of government debt (middle row, second panel), before persistently high transfers cause a long-run accumulation of debt. When the transfer shock hits at an already high level of 150% debt/GDP, the likelihood that the economy ends up in austerity rises (bottom left).

The model contains two distinct channels through which high debt/GDP crowds out labor supply and investment. The first channel is standard and arises from the presence of HtM consumers. Transfers make up a considerable fraction of these agents' income, yet they pay no taxes. Thus, increased transfers cause HtM agents to work less due to a positive income effect, explaining part of the decline in GDP. The initial state of the economy at the time of the shock (the level of debt/GDP) is irrelevant for this channel.

The second channel is a wealth effect on savers that crowds out savers' labor supply. This effect is stronger for a low initial debt/GDP ratio. This wealth effect may seem surprising

Figure 6: Increased Transfer Spending: Macro Effects and Crowding Out – Baseline



Note: This figure shows generalized impulse response graphs after the economy experiences a high transfer spending shock. The two lines correspond to different initial states of debt/GDP. The lines plot the average path of the economy from a sample of 5,000 paths of 40 quarters, with the starting point set to the mean of the state variables conditional on the level of debt/GDP and the low transfer state. The paths are relative to the unconditional transition of an economy with the same starting point (the balanced growth path, BGP), except Pr(aust), which is the fraction of shocked paths in austerity, in percent.

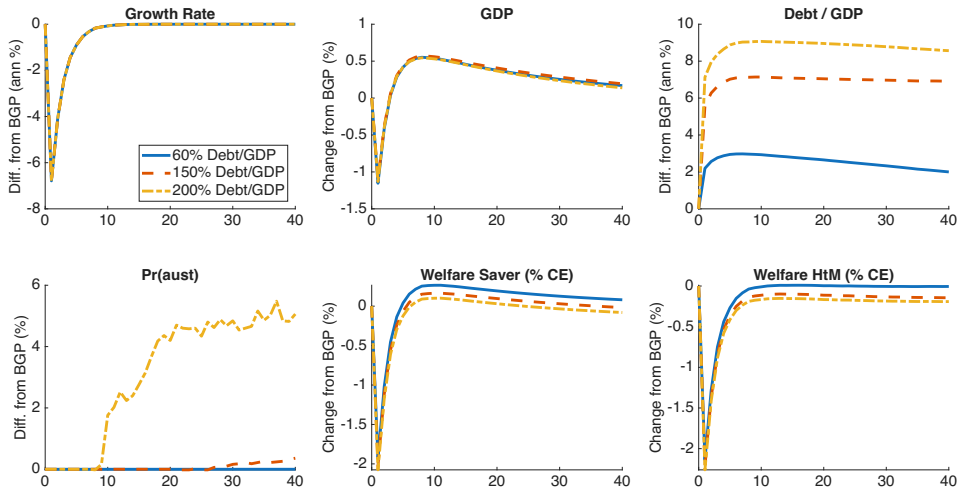
given the forward-looking, "Ricardian" nature of savers. Why is an increase in transfers not neutral for these agents? Savers are risk-averse and face substantial macro and fiscal risks. They accumulate precautionary savings to insure against such risks. When the government increases transfers, it raises the supply of debt, which increasingly satisfies this precautionary demand, and partially crowds out the saver's demand for capital. The bottom right panel of Figure 6 shows this crowd-out in the capital stock of the economy. This crowd-out effect is stronger the further the economy is away from austerity. At 60% debt/GDP, the probability of reaching austerity in the next 40 quarters is zero. The increased supply of government debt is persistent because it is unlikely to be offset by higher taxes in the medium term. However, at 150% debt/GDP, the increased debt supply is more likely to push the economy into austerity. This creates a probability of future tax increases in bad states of the world, strengthening the precautionary savings demand, while making the increased debt supply transient. As a result and together with foreign demand, the crowd-out effect becomes a crowd-in effect, pushing up

the capital stock. Appendix D.5 shows that the capital crowd-out effects are more severe absent foreign purchases of U.S. Treasuries.

This "precautionary crowding out" channel arises in our model due to realistic aggregate risks and risk premia, but it is also present in environments that emphasize idiosyncratic risks, such as Brunnermeier, Merkel and Sannikov (2024). More generally, transfers and taxes occur in different states of the world with different prices of risk, leading to real effects even in a world with forward-looking rational savers.

Fiscal Adjustment as Long-Run Risk. Our model generates endogenous long-run fiscal risk through the interaction of shocks with debt dynamics. Figure 7 illustrates this mechanism for TFP growth shocks, which have a quarterly autocorrelation of only 0.6.

Figure 7: Effect of TFP Shocks

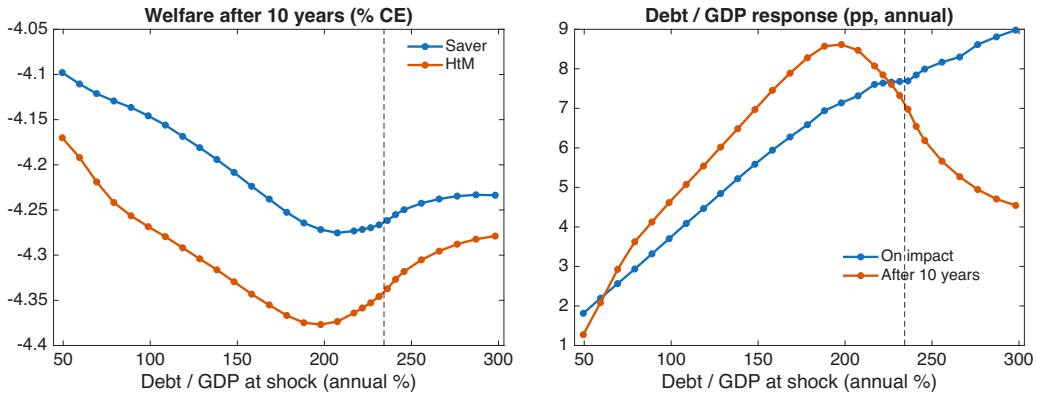


Note: This figure shows generalized impulse responses to a negative TFP growth shock, plotted in the top left panel. The three lines correspond to different initial levels of debt/GDP. Each line is the average path from 5,000 simulated paths of 40 quarters, starting at the given debt/GDP ratio and low transfers, with the other state variables at their conditional means. Paths are shown relative to the unconditional transition from the same starting point. Welfare is measured relative to the stochastic productivity trend.

The figure shows impulse responses to a negative TFP shock at different initial debt/GDP levels. Output responds similarly across debt levels (top middle panel), but debt/GDP rises persistently (top right panel), with larger increases at higher initial debt below the austerity threshold. Growth shocks raise debt/GDP by roughly the same percentage across levels, so the percentage-point increase grows with initial debt. This larger increase raises the probability of

austerity, with its higher taxes and lower output and consumption. Higher debt thus amplifies exposure to productivity shocks through their long-run effects on debt, increasing the welfare loss for both households. Although the TFP shock dies out within 10 quarters, persistent debt dynamics turn short-lived growth risk into long-run consumption risk by raising the probability of future austerity.

Figure 8: TFP Shock Impact Conditional on Debt/GDP



Note: This figure shows the effects of a negative productivity growth shock as a function of the debt/GDP ratio at the time of the shock. For each initial level of debt/GDP between 50% and 300%, we compute generalized impulse responses from 2,400 simulated paths of 40 quarters. Each path starts at the given debt/GDP ratio, with the other endogenous state variables set to their conditional means at that debt level and the economy in the average productivity growth and low transfer spending state. In the first quarter, productivity growth falls to its lowest state. All responses are differences between the shocked paths and the unconditional paths from the same starting point. The left panel shows the welfare effect after 10 years for savers and HtM households, in percent of consumption equivalent. Welfare is measured in levels, so it includes the permanent loss in productivity, which is the same at every initial debt level. The right panel shows the response of debt/GDP on impact and after 10 years, in pp of annual GDP. The vertical dashed line marks the austerity threshold $\mathcal{B}^* = 234\%$.

The left panel of Figure 8 shows the welfare effects of a negative TFP growth shock after 10 years as a function of initial debt. The shock reduces consumption-equivalent welfare by more than 4%, mainly because it permanently lowers productivity. The loss increases with initial debt and peaks just below the austerity threshold, where fiscal risk is greatest. The right panel explains why: higher initial debt leads to a larger percentage-point increase in debt/GDP. Above the threshold, this pattern reverses as austerity pulls debt down, reducing both the shock's effect on debt after 10 years and the welfare loss. Austerity thus mitigates the fiscal risk that accumulates below the threshold.

6 Modifying the Fiscal Rule

In the baseline economy, tax increases begin at the austerity threshold $\mathcal{B}^*$, the highest debt/GDP ratio at which debt remains bounded. Beyond that point, tax rates rise with debt/GDP at the elasticity τ_A. Agents also know that the government is fully committed to this rule. In this section, we change each of these features in turn.

6.1 Earlier Austerity

The austerity threshold $\mathcal{B}^*(\Omega)$ is the highest value of $\mathcal{B}^A$, the debt/GDP ratio above which taxes rise, that keeps debt bounded. Rules with lower values of $\mathcal{B}^A$ also keep debt bounded. Table 2 studies the consequences of starting tax increases at lower levels of debt/GDP.

The first panel shows welfare changes for both household types in the stationary distribution and along a transition from the baseline economy to the economy with a lower threshold, starting at 150% debt/GDP. As $\mathcal{B}^A$ falls in 10 pp steps, stationary consumption-equivalent welfare rises for both savers and HtM households. The gain exceeds 1% for both when the threshold is 50 pp lower, at 184% debt/GDP. Accounting for the transition turns this gain into a small loss for savers and a much smaller gain for HtM households.

Average debt/GDP and time spent in austerity fall as the threshold tightens, while output and capital rise. Higher consumption does not explain the welfare gain, however. The decomposition in Appendix D.4 shows that flow utility falls because savers work slightly more and receive fewer liquidity services from deposits. The gain comes primarily from lower fiscal risk, measured by a risk penalty: the difference between the expected continuation value and its certainty equivalent. With $\mathcal{B}^A = 184\%$ in column (6), this penalty is 4.15% lower than in the baseline. As Section 5.4 explained, TFP shocks generate more long-run fiscal risk at higher debt levels because they move debt/GDP by more and make austerity more likely. A lower threshold shifts the debt/GDP distribution down, reducing fiscal risk and raising welfare. The transition calculations incorporate the welfare loss from lower consumption along the path to a higher average capital stock. They also start both economies at 150% debt/GDP, removing the benefit of lower initial debt. At this level, the economy with a lower threshold is also closer to austerity, explaining savers' transition loss.

Table 2: Lower Values of $\mathcal{B}^A$

	(1) Base	(2)	(3)	(4)	(5)	(6)
$\mathcal{B}^A$	**234**	**224**	**214**	**204**	**194**	**184**
Welfare Saver		0.212	0.411	0.640	0.861	1.064
Welfare HtM		0.195	0.396	0.623	0.844	1.051
Transition Saver		-0.050	-0.100	-0.125	-0.158	-0.207
Transition HtM		0.026	0.073	0.153	0.234	0.307
Debt/Y	173	164	156	148	140	132
Frac. Austerity	29.4	28.9	28.5	28.1	27.7	27.4
Output (Y)	100	0.06	0.12	0.18	0.24	0.31
Capital (/Y)	158	0.19	0.38	0.56	0.75	0.94
Flow utility		-0.043	-0.083	-0.124	-0.165	-0.204
Risk penalty		-0.82	-1.60	-2.50	-3.38	-4.15

Note: This table shows moments for different values of $\mathcal{B}^A$, the debt/GDP threshold above which taxes rise. Column (1) is the baseline economy with the maximal threshold $\mathcal{B}^A = 234\%$; columns (2)–(6) lower $\mathcal{B}^A$ in steps of 10 pp of annual GDP. Welfare Saver and Welfare HtM are consumption-equivalent welfare gains relative to the baseline, in percent, comparing each economy's stationary distribution to that of the baseline. Transition Saver and Transition HtM are the corresponding gains when the switch to the lower threshold happens unexpectedly at a debt/GDP ratio of 150%, so they include the transition from the baseline. Debt/GDP and the fraction of time spent in austerity are in percent in all columns. Output and capital are in percent in column (1) and in percent changes relative to the baseline in columns (2)–(6). With $\mathrm{E}[Y] = 1$, (/Y) indicates that a variable can be read as a fraction of baseline GDP. Flow utility is the change in the stationary mean of period utility, in percent of consumption equivalent. The risk penalty, the difference between the expected continuation value and its certainty equivalent, is reported as the percent change in its stationary mean relative to the baseline; see Appendix D.4.

6.2 More Aggressive Austerity

The austerity threshold depends on how steeply taxes rise once the economy enters austerity, governed by the elasticity τ_A in (25). A more aggressive promised adjustment might seem to allow a later start. The opposite holds: steeper tax increases are more distortionary and make debt harder to pay down once austerity begins, so austerity must start at a lower debt level. Table 3 reports the same moments as Table 2 for values of τ_A between 1.4 and 1.9, with the baseline value of 1.65 in column (4). The austerity threshold $\mathcal{B}^*$ falls from 266% of GDP at $\tau_A = 1.4$ to 208% at $\tau_A = 1.9$. The lower threshold in turn lowers average debt/GDP, from 201% to 151%, and slightly reduces the fraction of time spent in austerity. Output and capital rise modestly with τ_A, as lower debt crowds out less capital.

Table 3: Austerity Slope

	(1) 1.4	(2) 1.55	(3) 1.60	(4) Base	(5) 1.70	(6) 1.75	(7) 1.9
$\mathcal{B}^*$	**266**	**242**	**236**	**234**	**224**	**219**	**208**
Welfare Saver	-0.723	-0.172	-0.036		0.228	0.335	0.554
Welfare HtM	-0.663	-0.166	-0.039		0.221	0.340	0.597
Transition Saver	0.069	0.014	0.011		-0.002	-0.015	-0.049
Transition HtM	-0.126	-0.042	-0.008		0.074	0.122	0.240
Debt/Y	201	179	174	173	164	160	151
Frac. Austerity	30.6	29.6	29.5	29.4	29.2	29.1	28.7
Output (Y)	-0.17	-0.04	-0.01	100	0.05	0.08	0.14
Capital (/Y)	-0.64	-0.16	-0.05	158	0.18	0.29	0.52
Flow utility	0.169	0.046	0.013		-0.049	-0.073	-0.126
Risk penalty	3.20	0.84	0.19		-1.04	-1.53	-2.53

Note: This table shows moments for different values of τ_A, the elasticity of tax increases to debt/GDP in austerity in (25). Column (4) is the baseline economy with $\tau_A = 1.65$; the other columns use the values of τ_A shown in the column headers. The first row reports the austerity threshold $\mathcal{B}^*$, the highest feasible value of $\mathcal{B}^A$, recomputed for each value of τ_A, in percent of annual GDP. All other rows are defined as in Table 2. Welfare Saver and Welfare HtM compare stationary distributions. Transition Saver and Transition HtM are the gains when the switch to the alternative value of τ_A happens unexpectedly at a debt/GDP ratio of 150%. Both are in percent of consumption equivalent relative to the baseline. Debt/GDP and the fraction of time spent in austerity are in percent in all columns. Output and capital are in percent in column (4) and in percent changes relative to the baseline in the other columns. With $\mathrm{E}[Y] = 1$, (/Y) indicates that a variable can be read as a fraction of baseline GDP. Flow utility is in percent of consumption equivalent, and the risk penalty is in percent changes relative to the baseline.

The welfare effects mirror those of lower thresholds in Table 2. In the stationary distribution, savers and HtM households gain 0.55% and 0.60% of consumption from steeper austerity at $\tau_A = 1.9$, and both lose about 0.70% at $\tau_A = 1.4$. The gains do not come from higher flow utility, which falls slightly with τ_A as savers hold fewer deposits, or from smoother consumption: consumption growth is about 1 pp more volatile at $\tau_A = 1.9$ than in the baseline. Instead, steeper austerity lowers debt and reduces the risk penalty by 2.5% at $\tau_A = 1.9$. The same growth shocks generate less long-run fiscal risk at lower debt levels. The decomposition in Appendix D.4 attributes about three-quarters of the welfare gain to the lower risk penalty.

The transition from the baseline, starting at 150% debt/GDP, changes the picture. Savers prefer gentler austerity, gaining 0.07% at $\tau_A = 1.4$ and losing 0.05% at $\tau_A = 1.9$, while HtM households gain 0.24% from steeper austerity at $\tau_A = 1.9$. Changing τ_A thus redistributes

welfare along the transition, even though both groups benefit in the long run from the lower debt that steeper austerity delivers. Since every change in this range leaves one group worse off along the transition, neither group would support a change that benefits the other at its expense. A political process that gives either group veto power at the initial debt level would therefore preserve the existing rule.

6.3 Imperfect Commitment to Austerity

In the previous sections, we focused on versions of the model that assume perfect commitment to austerity. As soon as the economy crosses the austerity threshold, tax rates increase. In this section, we contemplate the possibility that the authorities may waver in this commitment. Specifically, we envision the existence of a second "hesitation" regime ($H_t = 1$), besides the perfect commitment regime ($H_t = 0$),[24] in which austerity starts increasing tax rates not at the austerity threshold $\mathcal{B}^*$, but only at $\mathcal{B}^* + X$, with $X > 0$. We denote the unconditional probability of this regime by $\Pr(H_t = 1) = \mu_H$. We set the quarterly probability of remaining in the hesitation regime to 0.9, so hesitation spells last 2.5 years on average, and choose the probability of remaining in the commitment regime to match μ_H. As a result, the first-order autocorrelation of H_t roughly matches the persistence of the U.S. presidential political cycle since 1920. We set $X = 0.15$ in units of annual GDP. In the baseline model, $\mu_H = 0$. Table 4 shows the results for an unconditional "hesitation" regime probability μ_H that ranges from 0% to 30%. In each case, we recalibrate the economy to keep the real risk-free rate constant at its baseline value of 1.71% and normalize average GDP at 1, as indicated in the last two rows of the table.

The main result is that fiscal capacity declines dramatically when there is uncertainty about the commitment to austerity. The austerity threshold falls from 234% of GDP in the baseline case with perfect commitment to 158% of GDP in the case with a 30% probability of hesitation. An austerity threshold of 158% is a level of debt that the U.S. will cross within the next 30 years according to CBO projections.[25]

[24] The regime H_t is an additional exogenous state variable.

[25] We have verified that the austerity threshold rises again as μ_H moves toward 100%. With $\mu_H = 100\%$, hesitation becomes a deterministic shift of the austerity rule by X, with no uncertainty about the regime. What lowers the threshold is uncertainty about whether the government will hesitate.

Table 4: Fiscal Capacity with Hesitation

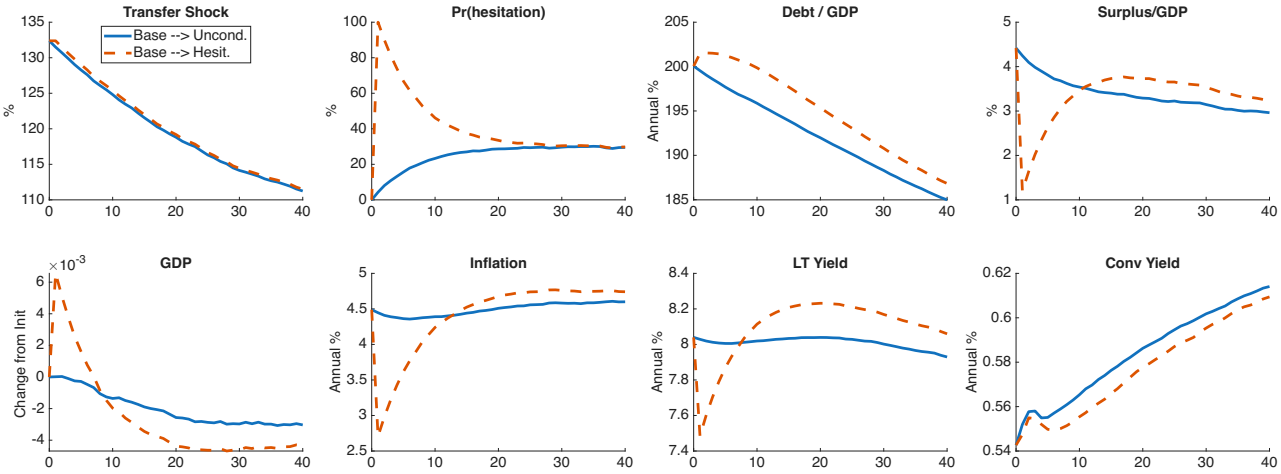
	(1) No hesit.	(2) 5%	(3) 10%	(4) 20%	(5) 30%
$\mathcal{B}^*$	**234**	**218**	**214**	**199**	**158**
Debt/Y	173	164	162	153	126
Frac. Austerity	29.4	31.1	31.5	33.2	37.2
Term spread	0.701	0.791	0.806	0.887	1.16
Inflation	2.66	2.67	2.67	2.67	2.68
EER Y-claim	5.46	5.51	5.52	5.58	5.79
Capital (/Y)	158	-0.206	-0.246	-0.465	-1.29
Consump. S (/Y)	72.0	0.0173	0.0171	0.0563	0.190
Consump. HTM (/Y)	5.20	-0.019	-0.025	-0.036	-0.071
Cons.gr Vol S	1.58	0.361	0.444	0.788	1.76
Cons.gr Vol HTM	1.33	-0.153	-0.172	-0.296	-0.492
β	0.988	-0.012	-0.014	-0.028	-0.075
$\bar{Z}$	1.47	0.0652	0.0715	0.144	0.375

Note: This table shows moments from the simulated model for different probabilities of the hesitation regime. Column (1) is the baseline economy with full commitment ($\mu_H = 0$). Columns (2)–(5) set the unconditional probability of hesitation μ_H to the values shown in the column headers. In the hesitation regime, tax increases begin only once debt/GDP exceeds the austerity threshold by $X = 15$ pp. For each value of μ_H, we recompute the austerity threshold $\mathcal{B}^*$ (first row). We also recalibrate the discount factor β and mean productivity $\bar{Z}$ so that the real risk-free rate stays at its baseline value of 1.71% and mean GDP equals 1. The first panel reports $\mathcal{B}^*$ and average debt/GDP, in percent of annual GDP, and the fraction of periods in austerity, in percent. The second panel reports the average term spread, inflation, and expected excess return on the output claim, in annual percent. The third and fourth panels report levels in column (1) and percent changes relative to column (1) in columns (2)–(5). The third panel covers average capital (in percent of annual GDP), average consumption of savers and HtM households (in percent of GDP), and the standard deviation of consumption growth. The fourth panel covers the recalibrated parameters. With $\mathrm{E}[Y] = 1$, (/Y) indicates that a variable can be read as a fraction of baseline GDP.

Hesitation increases risk premia in the economy; both the term spread and the output risk premium are higher. Regime switches cause large swings in long-term yields and in the market value of debt. These fluctuations increase the likelihood of explosive debt dynamics, forcing down the austerity threshold to keep the debt safe. A purely mechanical delay would account for much less: if hesitation only postponed tax increases, the threshold would fall by at most $X = 15$ pp, compared with the 76 pp decline in Table 4.

Figure 9 illustrates the dynamics of the economy with $\mu_H = 30\%$, starting at 200% debt/GDP, well above its austerity threshold $\mathcal{B}^* = 158\%$. The economy initially has high transfer spending and is in the commitment regime. The solid blue line shows the average path back to the

Figure 9: Regime Uncertainty: Switch to Hesitation



Note: This figure shows generalized impulse responses in the economy with an unconditional probability of hesitation of $\mu_H = 30\%$, whose austerity threshold is 158% of GDP. All paths start at 200% debt/GDP, deep in the austerity region, with high transfer spending and in the commitment regime. The solid blue line is the average path when the regime evolves according to its transition matrix Π_H. The dashed red line is the average path when the economy switches to the hesitation regime in period 1 and the regime evolves according to Π_H thereafter. Each line averages 5,000 simulated paths of 40 quarters. Pr(hesitation) is the fraction of paths in the hesitation regime. GDP is the change from its initial value. Debt/GDP is in percent of annual GDP, the surplus in percent of GDP, and inflation and the long-term and convenience yields in annual percent.

stochastic steady state as the transfer shock slowly reverts to its mean and the probability of hesitation returns to its unconditional average of 30%. Inflation and LT bond yields are high, while GDP is low, as is typical under austerity.

The dashed red line shows the response to a switch to the hesitation regime in period 1 (top middle panel). The surplus falls as the economy temporarily backs off from austerity. Inflation and LT bond yields drop on impact, while GDP jumps. Lower yields raise the market value of government debt (top row, third panel). This valuation risk explains the much lower austerity threshold in models with regime uncertainty. If the threshold is too high, a regime switch can push the value of debt beyond the point where tax increases can contain explosive debt dynamics. More generally, fluctuations in commitment to austerity cause large movements in long-term yields and bond valuations. When outstanding debt is already high, these movements increase the likelihood of shock sequences that violate the debt safety assumption. A tighter bound is therefore required to rule out such paths.

Table 4 and Figure 9 send a clear message: (political) uncertainty about whether the govern-

ment will carry out the austerity necessary to guarantee the safety of government debt is the largest threat to fiscal capacity, reducing our measure of capacity by as much as 76 pp of GDP.

7 Conclusion

This paper proposes a novel definition of the fiscal capacity of a country as the maximum debt/GDP ratio above which surpluses must begin to increase to keep government debt default-free in all future states of the world. We measure the fiscal capacity for the United States in a state-of-the-art model with realistic, nonlinear macroeconomic dynamics, fiscal and monetary policy rules, and asset prices. As long as there is perfect commitment to increasing surpluses once the austerity threshold for debt/GDP is crossed, the austerity threshold is around 235% of GDP. Imperfect commitment, which delays the onset of austerity, can reduce fiscal capacity to below 160% of GDP. The latter is a debt ratio that the Congressional Budget Office expects to be breached within the next 30 years. Our framework can be applied to other countries, historical episodes, and policy scenarios, offering a systematic way to assess how much governments can borrow before fiscal corrections become unavoidable.

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Online Appendix

A Simple Model

A.1 Stochastic Processes

Z_t is TFP with finite support, $Z_t \in \mathcal{Z} = \{Z_j\}_{j=1}^{N_Z}$ with transition matrix Π_Z. The government distributes transfers $\Theta_t = \theta_t Y_t$ to households, where θ_t follows a Markov process, $\theta_t \in \mathcal{T} = \{\theta_\ell, \theta_h\}$ with $\theta_\ell < \theta_h$ and transition matrix

$$\Pi_\theta = \begin{bmatrix} p_{\ell\ell} & 1 - p_{\ell\ell} \\ 1 - p_{hh} & p_{hh} \end{bmatrix}.$$

A.2 Household

The representative household has period utility function

$$u(C, n) = \frac{C^{1-\varphi}(1 - (1-\varphi)\omega_0 n^{1+\omega_1})^{\varphi}}{1-\varphi}.$$

The household maximization problem is

$$\max_{\{C_t, B_{t+1}^H, n_t\}} \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t u(C_t, n_t)$$

subject to

$$\Theta_t + B_t^H + (1-\tau_t) w_t n_t + \text{Profit}_t \geq C_t + q_t B_{t+1}^H,$$

where Profit_t are firm profits.

To simplify notation, define

$$v(n_t) = 1 - (1-\varphi)\omega_0 n_t^{1+\omega_1}.$$

A.3 Government

The government budget constraint is

$$B_t + \Theta_t = \tau_t w_t N_t + q_t B_{t+1}.$$

The tax rate is a function $\tau_t = f(B_t)$ given in (8).

A.4 Markets

Market clearing requires

$$\begin{aligned} B_{t+1}^H &= B_{t+1} \\ n_t &= N_t \\ Y_t &= C_t. \end{aligned}$$

A.5 Solution

Firms. Firm optimality gives

$$w_t = \alpha Z_t N_t^{\alpha-1}.$$

Households. The Euler equation is

$$q_t = \beta \mathrm{E}_t \left[\left(\frac{C_{t+1}}{C_t} \right)^{-\varphi} \left(\frac{v(n_{t+1})}{v(n_t)} \right)^{\varphi} \right], \tag{36}$$

and the first-order condition for labor supply

$$\frac{(1-\tau_t) w_t}{C_t} = \frac{\varphi(1+\omega_1)\omega_0 n_t^{\omega_1}}{v(n_t)}. \tag{37}$$

Equilibrium Labor, Output, and Consumption. We can solve for labor supply in equilibrium by combining the firm optimality condition with the household labor supply condition (37) and market clearing,

$$(1-\tau_t)\alpha Z_t N_t^{\alpha-1}(1-(1-\varphi)\omega_0 N_t^{1+\omega_1}) = \varphi(1+\omega_1)\omega_0 N_t^{\omega_1} Z_t N_t^{\alpha},$$

to obtain

$$N_t = \left(\frac{\alpha(1-\tau_t)}{\omega_0(\varphi(1+\omega_1) + \alpha(1-\varphi)(1-\tau_t))} \right)^{\frac{1}{1+\omega_1}}. \tag{38}$$

Note that for log utility $\varphi = 1$, this becomes

$$N_t = \left(\frac{\alpha(1-\tau_t)}{\omega_0(1+\omega_1)} \right)^{\frac{1}{1+\omega_1}},$$

which is the expression in equation (3). Since $Y_t = Z_t N_t^{\alpha}$, we can write output as

$$Y_t = Z_t \left(\frac{\alpha(1-\tau_t)}{\omega_0(\varphi(1+\omega_1) + \alpha(1-\varphi)(1-\tau_t))} \right)^{\frac{\alpha}{1+\omega_1}}.$$

And consumption is $C_t = Y_t$.

Bond Prices. We can write equilibrium bond prices based on consumption growth rates. The consumption growth rate is

$$\frac{C_{t+1}}{C_t} = \frac{Z_{t+1}}{Z_t} \left(\frac{1-\tau_{t+1}}{1-\tau_t} \right)^{\frac{\alpha}{1+\omega_1}} \left(\frac{\varphi(1+\omega_1) + \alpha(1-\varphi)(1-\tau_{t+1})}{\varphi(1+\omega_1) + \alpha(1-\varphi)(1-\tau_t)} \right)^{-\frac{\alpha}{1+\omega_1}}.$$

For the case with log utility $\varphi = 1$, this simplifies to

$$\frac{C_{t+1}}{C_t} = \frac{Z_{t+1}}{Z_t} \left(\frac{1-\tau_{t+1}}{1-\tau_t} \right)^{\frac{\alpha}{1+\omega_1}}.$$

Bond prices for the general case are

$$q_t = \beta \mathrm{E}_t \left\{ \left(\frac{Z_{t+1}}{Z_t} \right)^{-\varphi} \left(\frac{N_{t+1}}{N_t} \right)^{-\alpha\varphi} \left(\frac{v(N_{t+1})}{v(N_t)} \right)^{\varphi} \right\},$$

with N_t given in (38).

Recalling that $\tau_t = f(B_t)$, for the case with log utility $\varphi = 1$, this simplifies to

$$q_t = \beta \mathrm{E}_t \left\{ \left[\frac{Z_{t+1}}{Z_t} \left(\frac{1 - f(B_{t+1})}{1 - f(B_t)} \right)^{\frac{\alpha}{1+\omega_1}} \right]^{-1} \right\}. \tag{39}$$

Debt Transition and Upper Bound. The transition equation for government debt follows from the budget constraint

$$q_t B_{t+1} = B_t + \theta_t Y_t - \tau_t w_t N_t = B_t - Y_t(\alpha\tau_t - \theta_t).$$

Inserting the expression for output gives

$$q_t B_{t+1} = B_t - Z_t \left(\frac{\alpha(1 - f(B_t))}{\omega_0(\varphi(1+\omega_1) + \alpha(1-\varphi)(1 - f(B_t)))} \right)^{\frac{\alpha}{1+\omega_1}} (\alpha f(B_t) - \theta_t). \tag{40}$$

For the case with log utility $\varphi = 1$, this simplifies to

$$q_t B_{t+1} = B_t - Z_t \left(\frac{\alpha(1 - f(B_t))}{\omega_0(1+\omega_1)} \right)^{\frac{\alpha}{1+\omega_1}} (\alpha f(B_t) - \theta_t).$$

In the log-utility case, the upper bound is the stationary point for the worst shock combination $(Z_{\min}, \theta_h)$,

$$(1 - \bar{q})\bar{B} = \left[Z_{\min} \left(\frac{\alpha(1 - f(\bar{B}))}{\omega_0(1+\omega_1)} \right)^{\frac{\alpha}{1+\omega_1}} \right] (\alpha f(\bar{B}) - \theta_h), \tag{41}$$

with bond price

$$\bar{q} = \beta \mathrm{E} \left[\frac{Z_{\min}}{Z'} \,|\, (Z_{\min}, \theta_h) \right],$$

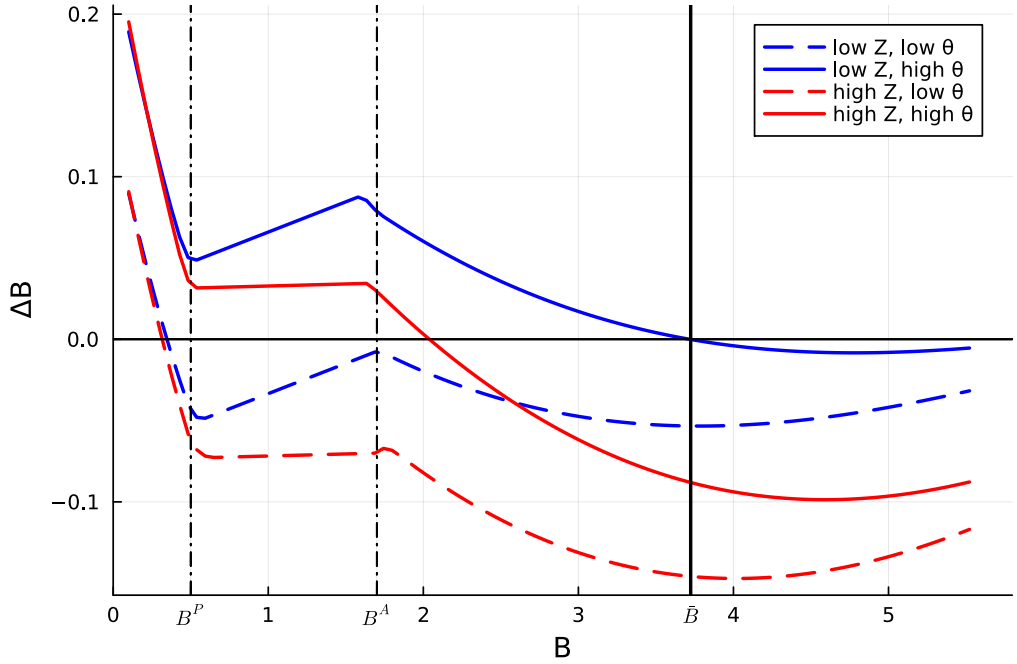
which corresponds to the expressions given in equations (6) and (7).

A.6 Debt Transitions for Lower B^A

Figure A.1 shows debt transitions for the simple model with all parameters as in the baseline, but with $B^A = 1.7$ set well below the austerity threshold of 1.86. This choice of B^A is a feasible policy that generates an upper bound of $\bar{B} = 3.72$. The worst-state transition function (solid blue, low Z, high θ) intersects zero from above at the upper bound, indicating that this level of B^A is below the austerity threshold $B^*(\Omega)$ shown in Figure 1 in the main text.

Comparison of Figures 1 and A.1 illustrates that, as the threshold B^A moves right toward $B^*(\Omega)$, the worst-state transition moves upward and the upper bound shifts right, until its intersection with zero becomes a tangency point. Intuitively, this is the algorithm by which the austerity threshold is determined. Any hypothetical increase of B^A beyond $B^*(\Omega)$ means that the worst-state transition would be strictly above zero for all levels of B_t, and the economy fails to have a stationary equilibrium.

Figure A.1: Government Debt Transition Functions



Note: This figure shows the equilibrium transition functions for government debt from equation (4) for an economy with a lower threshold $B^A = 1.7$, below the austerity threshold of 1.86. It plots the change in debt $B_{t+1} - B_t$ against the current level B_t. The dashed vertical lines are thresholds $B^P = 0.5$ and $B^A = 1.7$. The upper bound is at $\bar{B} = 3.72$.

B Quantitative Model Derivations

B.1 Preliminary Definitions

We reformulate the problems of households, firms, and intermediaries to ensure stationarity. For nominal quantities, we define the real, stationary value of any variable J_t as

$$\hat{J}_t = \frac{J_t}{Z_t^p P_t},$$

where Z_t^p is the permanent component of productivity. For real variables, we denote stationary values as

$$\hat{J}_t = \frac{J_t}{Z_t^p}.$$

We define inflation as the gross growth rate on the price level

$$\frac{P_t}{P_{t-1}} = \pi_t,$$

and the growth rate of the permanent component of productivity as

$$\frac{Z_t^p}{Z_{t-1}^p} = \exp(g_t).$$

Investment adjustment costs are $\Phi(I,K) = \frac{\phi}{2}\left(I/K - \hat{\delta}\right)^2 K$, centered at the investment rate on the balanced growth path $\hat{\delta} = \delta + e^{\bar{g}} - 1$. Finally, we let $\mathcal{S}_t = \{Z_t^r, g_t, \vartheta_t, H_t, K_{t-1}, W_t^S, W_t^G, W_t^F\}$ be the vector of aggregate state variables, where W_t^F is the market value of foreign holdings of government debt at the beginning of t and H_t is the commitment regime of Section 6.3. In the baseline, $H_t = 0$ and $W_t^F = \bar{\mu}^F W_t^G$, so neither is a separate state.

B.2 Saver Household

We write the saver problem recursively, defining real saver wealth using the payoffs to holding deposits and the long-term bond.

$$\hat{W}_t^S = \exp(-g_t)\left(\frac{\hat{D}_{t-1}^S}{\pi_t} + (c + 1 - \delta^B + \delta^B p_t^L)\frac{\hat{B}_{t-1}^{S,L}}{\pi_t}\right).$$

The value function needs to be divided through by $(Z_t^p)^{1-\varphi}$ to ensure stationarity. We denote the stationarized value function by $\hat{V}^S$:

$$\hat{V}^S(\hat{W}_t^S, \mathcal{S}_t) = \max_{\hat{C}_t, N_t, \hat{I}_t, \hat{B}_t^{S,L}, \hat{D}_t^S} (1-\beta)u(\hat{C}_t, \hat{D}_t^S, N_t) + \beta \mathrm{E}_t\left[\exp((1-\gamma)g_{t+1})(\hat{V}^S(\hat{W}_{t+1}^S, \mathcal{S}_{t+1}))^{\frac{1-\gamma}{1-\varphi}}\right]^{\frac{1-\varphi}{1-\gamma}}$$

subject to

$$\begin{aligned}\hat{C}_t = {} & \hat{W}_t^S + (1-\tau_t^w)\hat{w}_t N_t + Q_t \hat{I}_t + \hat{Div}_t^I + (1-\tau_t^{div})\hat{Div}_t^P + \hat{\Theta}_t + \hat{\text{Rebates}}_t \\ & - \hat{I}_t - \Phi(\hat{I}_t, \hat{K}_{t-1}) - p_t^D \hat{D}_t^S - p_t^L \hat{B}_t^{S,L},\end{aligned}$$

where intra-period utility is

$$u(\hat{C}_t, \hat{D}_t^S, N_t) = \frac{\left(\hat{C}_t^{1-\psi}(\hat{D}_t^S)^{\psi}\right)^{1-\varphi}(1-(1-\varphi)\omega_0 N_t^{1+\omega_1})^{\varphi}}{1-\varphi}.$$

Note that the aggregate capital stock is $\hat{K}_{t-1} = K_{t-1}/Z_t^p$, since it is chosen in $t-1$ for production in t. In general, $\hat{K}_t = K_t/Z_{t+1}^p$, whereas other stocks chosen in t are stationarized with Z_t^p.

We define the intratemporal marginal rate of substitution between deposits and consumption as

$$\text{MRS}_t^D = \frac{u_D}{u_C} = \frac{\psi \hat{C}_t}{(1-\psi)\hat{D}_t^S}.$$

Denote $\hat{V}^S(\hat{W}_t^S, \mathcal{S}_t) \equiv \hat{V}_t^S$ and the certainty equivalent as

$$CE_t = \mathrm{E}_t\left[\exp((1-\gamma)g_{t+1})(\hat{V}^S(\hat{W}_{t+1}^S, \mathcal{S}_{t+1}))^{\frac{1-\gamma}{1-\varphi}}\right]^{\frac{1-\varphi}{1-\gamma}}.$$

The partial derivative of the certainty equivalent with respect to the value function is then given by

$$\begin{aligned}\frac{\partial CE_t(\hat{V}^S_{t+1})}{\partial \hat{V}^S_{t+1}} &= \exp\big((1-\gamma)g_{t+1}\big)(\hat{V}^S_{t+1})^{\frac{\varphi-\gamma}{1-\varphi}}\mathrm{E}_t\left[\exp((1-\gamma)g_{t+1})(\hat{V}^S_{t+1})^{\frac{1-\gamma}{1-\varphi}}\right]^{\frac{1-\varphi}{1-\gamma}-1}\\ &= \exp\big((1-\gamma)g_{t+1}\big)\left(\frac{\hat{V}^S_{t+1}}{CE_t}\right)^{\frac{\varphi-\gamma}{1-\varphi}}\end{aligned}$$

We denote the partial derivative of the value function with respect to bond holdings as

$$\hat{V}^S_{B,t} \equiv \frac{\partial \hat{V}^S_t}{\partial \hat{B}^{S,L}_{t-1}} = \frac{\partial \hat{V}^S_t}{\partial \hat{W}^S_t}\frac{\exp(-g_t)}{\pi_t}\left(c+1-\delta^B+\delta^B p^L_t\right).$$

B.2.1 First-order conditions

Consumption. Attaching multiplier λ_t to the budget constraint, the FOC for consumption is given by

$$\lambda_t = \frac{(1-\beta)(1-\psi)\left(\hat{C}_t^{1-\psi}(\hat{D}^S_t)^{\psi}\right)^{1-\varphi}(1-(1-\varphi)\omega_0 N_t^{1+\omega_1})^{\varphi}}{\hat{C}_t} = \frac{(1-\beta)(1-\psi)\tilde{u}(\hat{C}_t,\hat{D}^S_t,N_t)}{\hat{C}_t},$$

where we defined $\tilde{u}(\hat{C}_t,\hat{D}^S_t,N_t) = \left(\hat{C}_t^{1-\psi}(\hat{D}^S_t)^{\psi}\right)^{1-\varphi}(1-(1-\varphi)\omega_0 N_t^{1+\omega_1})^{\varphi}$.

Envelope Condition. The envelope condition is

$$\frac{\partial \hat{V}^S_t}{\partial \hat{W}^S_t} = \lambda_t = \frac{(1-\beta)(1-\psi)\tilde{u}(\hat{C}_t,\hat{D}^S_t,N_t)}{\hat{C}_t},$$

where the last equality uses the FOC for consumption to substitute for λ_t.

Stochastic Discount Factor. The saver's intertemporal marginal rate of substitution between time t and $t+1$ is given by

$$\begin{aligned}\frac{\frac{\partial \hat{V}^S_t}{\partial C_{t+1}}}{\frac{\partial V^S_t}{\partial C_t}} &= \frac{\partial \hat{V}^S_t}{\partial \hat{V}^S_{t+1}}\exp(-g_{t+1})\frac{\partial \hat{V}^S_{t+1}/\partial \hat{W}^S_{t+1}}{\partial V^S_t/\partial \hat{W}^S_t}\\ &= \beta\exp\big(-\gamma g_{t+1}\big)\left(\frac{\hat{V}^S_{t+1}}{CE_t}\right)^{\frac{\varphi-\gamma}{1-\varphi}}\frac{\frac{1}{\hat{C}_{t+1}}(1-\beta)(1-\psi)\tilde{u}(\hat{C}_{t+1},\hat{D}^S_{t+1},N_{t+1})}{\frac{1}{\hat{C}_t}(1-\beta)(1-\psi)\tilde{u}(\hat{C}_t,\hat{D}^S_t,N_t)},\end{aligned}$$

using the envelope condition. Hence, we can define the saver stochastic discount factor (SDF) as

$$\mathcal{M}_{t,t+1} = \beta\exp(-\gamma g_{t+1})\left(\frac{\hat{C}_{t+1}}{\hat{C}_t}\right)^{-1}\left(\frac{\tilde{u}(\hat{C}_{t+1},\hat{D}^S_{t+1},N_{t+1})}{\tilde{u}(\hat{C}_t,\hat{D}^S_t,N_t)}\right)\left(\frac{\hat{V}^S_{t+1}}{CE_t}\right)^{\frac{\varphi-\gamma}{1-\varphi}}.$$

Long-Term Bonds. The FOC for long-term bonds, $\hat{B}_t^{S,L}$, is

$$-\lambda_t p_t^L + \mathrm{E}_t\left[\beta \frac{\partial \hat{V}_{t+1}^S}{\partial \hat{B}_t^{S,L}} \frac{\partial CE_t}{\partial \hat{V}_{t+1}^S}\right] = 0$$

Computing the derivatives and simplifying yields

$$p_t^L = \mathrm{E}_t\left[\beta \frac{\lambda_{t+1}}{\lambda_t} \exp\left(-\gamma g_{t+1}\right) \left(\frac{\hat{V}_{t+1}^S}{CE_t}\right)^{\frac{\varphi-\gamma}{1-\varphi}} \left(\frac{c + 1 - \delta^B + \delta^B p_{t+1}^L}{\pi_{t+1}}\right)\right].$$

By using the definition of the SDF, we get

$$p_t^L = \mathrm{E}_t\left[\mathcal{M}_{t,t+1} \left(\frac{c + 1 - \delta^B + \delta^B p_{t+1}^L}{\pi_{t+1}}\right)\right]. \tag{42}$$

Deposits. The FOC for the saver's purchases of deposits is given by

$$-\lambda_t p_t^D + \psi(1-\beta)\frac{\tilde{u}(\hat{C}_t, \hat{D}_t^S, N_t)}{\hat{D}_t^S} + \mathrm{E}_t\left[\beta \frac{\partial \hat{V}_{t+1}^S}{\partial \hat{D}_t^S} \frac{\partial CE_t}{\partial \hat{V}_{t+1}^S}\right] = 0.$$

Then using the definition of the intratemporal marginal rate of substitution between deposits and consumption, and the SDF, we have that the FOC for deposits becomes

$$p_t^D = \mathrm{MRS}_t^D + \mathrm{E}_t\left[\mathcal{M}_{t,t+1} \frac{1}{\pi_{t+1}}\right]. \tag{43}$$

Investment. Savers operate the economy's investment technology and optimally solve the intratemporal problem of producing I_t units of capital from $I_t + \Phi(I_t, K_{t-1})$ units of the consumption good. The first-order condition is given by

$$Q_t = 1 + \phi\left(\frac{\hat{I}_t}{\hat{K}_{t-1}} - \hat{\delta}\right). \tag{44}$$

Labor. The saver FOC for labor supply is given by

$$\frac{\omega_0 \varphi (1+\omega_1) N_t^{\omega_1}}{1 - (1-\varphi)\omega_0 N_t^{1+\omega_1}} = \frac{(1-\psi)(1-\tau_t^w)\hat{w}_t}{\hat{C}_t}. \tag{45}$$

In summary, the saver's optimality conditions are given by equations (42)–(45).

B.3 HtM Household

HtM households consume their entire after-tax income each period, so their stationarized budget constraint is

$$\hat{C}_t^H = (1 - \tau_t^{w,H})\hat{w}_t^H N_t^H + \hat{\Theta}_t^H.$$

The labor FOC for HtM households is analogous to that of savers, except that HtM utility does not include deposits (so the factor $1-\psi$ is absent):

$$\frac{\omega_0\varphi(1+\omega_1)(N_t^H)^{\omega_1}}{1-(1-\varphi)\omega_0(N_t^H)^{1+\omega_1}} = \frac{(1-\tau_t^{w,H})\hat{w}_t^H}{\hat{C}_t^H}. \tag{46}$$

B.4 Banks

As stated in the main text, banks maximize the present value of dividends, discounted with the saver household's stochastic discount factor, subject to the regulatory constraint (13) and no-shorting constraints. The stationarized recursive bank problem is

$$V^I(\hat{K}_{t-1}^I, \hat{B}_{t-1}^{I,S}, \hat{D}_{t-1}^I; \mathcal{S}_t) = \max_{\hat{K}_t^I, \hat{B}_t^{I,S}, \hat{D}_t^I} \hat{Div}_t^I + \mathrm{E}_t\left[\mathcal{M}_{t,t+1}\exp(g_{t+1})V^I(\hat{K}_t^I, \hat{B}_t^{I,S}, \hat{D}_t^I; \mathcal{S}_{t+1})\right],$$

where the stationarized dividend, corresponding to (15) in the main text, is

$$\begin{aligned}\hat{Div}_t^I = \exp(-g_t)&\left[\left(r_t^K + (1-\delta)Q_t\right)\hat{K}_{t-1}^I + \frac{\hat{B}_{t-1}^{I,S} - \hat{D}_{t-1}^I}{\pi_t}\right] \\ &- Q_t\hat{K}_t^I + (p_t^D - \varrho_t)\hat{D}_t^I - p_t^S\hat{B}_t^{I,S} + \hat{\mathrm{Rebates}}_t^I.\end{aligned}$$

The bank maximizes subject to

$$\begin{aligned}\hat{D}_t^I &\le \nu\left(\hat{B}_t^{I,S} + \nu_K Q_t\hat{K}_t^I\right), \\ \hat{B}_t^{I,S} &\ge 0, \\ \hat{K}_t^I &\ge 0,\end{aligned}$$

where the first constraint is the regulatory constraint and the final two are no-shorting constraints for short-term bonds and capital. The total liquidity cost is given by

$$\varrho_t\hat{D}_t^I = \varrho_0\zeta_\varrho\left(\frac{\hat{B}_t^{I,S}}{\zeta_\varrho\hat{D}_t^I}\right)^{1-\varrho_1}\hat{D}_t^I,$$

which the bank internalizes, while taking the lump-sum rebate $\hat{\mathrm{Rebates}}_t^I = \varrho_t\hat{D}_t^I$ as given. We attach multiplier λ_t^I to the regulatory constraint and multipliers $\sigma_t^{I,S}$ and $\sigma_t^{I,K}$ to the no-shorting constraints on short-term bonds and capital, respectively. Because dividends enter the objective linearly, the marginal value of resources inside the bank is one in every period, and the first-order conditions can be stated directly in terms of the saver SDF $\mathcal{M}_{t,t+1}$.

Short-Term Bonds. First, note that the partial derivative of the liquidity cost with respect to short-term debt is given by

$$\frac{\partial(\varrho_t\hat{D}_t^I)}{\partial\hat{B}_t^{I,S}} = (1-\varrho_1)\varrho_0\left(\frac{\hat{B}_t^{I,S}}{\zeta_\varrho\hat{D}_t^I}\right)^{-\varrho_1},$$

which is negative since $\varrho_1 > 1$: holding more short-term bonds lowers the liquidity cost. The first-order condition for short-term bonds is

$$p_t^S = \mathrm{E}_t\left[\mathcal{M}_{t,t+1}\frac{1}{\pi_{t+1}}\right] + (\varrho_1 - 1)\varrho_0\left(\frac{\hat{B}_t^{I,S}}{\zeta_\varrho \hat{D}_t^I}\right)^{-\varrho_1} + \lambda_t^I \nu + \sigma_t^{I,S}. \tag{47}$$

The second term on the right-hand side is the marginal reduction in liquidity costs, and the third term reflects that short-term bonds relax the regulatory constraint.

Deposits. Noting that the partial derivative of the liquidity cost with respect to deposits is given by

$$\frac{\partial(\varrho_t \hat{D}_t^I)}{\partial \hat{D}_t^I} = \varrho_0 \varrho_1 \zeta_\varrho \left(\frac{\hat{B}_t^{I,S}}{\zeta_\varrho \hat{D}_t^I}\right)^{1-\varrho_1},$$

the first-order condition for deposits is

$$p_t^D = \mathrm{E}_t\left[\mathcal{M}_{t,t+1}\frac{1}{\pi_{t+1}}\right] + \lambda_t^I + \varrho_0 \varrho_1 \zeta_\varrho \left(\frac{\hat{B}_t^{I,S}}{\zeta_\varrho \hat{D}_t^I}\right)^{1-\varrho_1}. \tag{48}$$

Capital. The first-order condition for capital is

$$Q_t = \mathrm{E}_t\left[\mathcal{M}_{t,t+1}\left(r_{t+1}^K + (1-\delta)Q_{t+1}\right)\right] + \lambda_t^I \nu \nu_K Q_t + \sigma_t^{I,K}. \tag{49}$$

Note that when the leverage constraint and no-shorting constraint on short-term debt are not binding, the Euler equations for short-term debt and deposits imply that the spread between the two *prices* is a static function of the liquidity coverage ratio:

$$p_t^S - p_t^D = \varrho_0 \left(\frac{\hat{B}_t^{I,S}}{\zeta_\varrho \hat{D}_t^I}\right)^{-\varrho_1}\left(\varrho_1 - 1 - \frac{\hat{B}_t^{I,S}}{\zeta_\varrho \hat{D}_t^I}\zeta_\varrho \varrho_1\right).$$

At 100% LCR, this reduces to $p_t^S - p_t^D = \varrho_0(\varrho_1 - 1 - \zeta_\varrho \varrho_1)$. Because $\zeta_\varrho \ll 1$, the price spread is increasing in ϱ_1. When ϱ_1 is closer to 1, short-term bonds are cheaper than deposits and have a higher rate. When ϱ_1 is high, short-term bonds are more expensive than deposits and have a lower rate. The prices are exactly equal at 100% LCR if $\varrho_1 = \frac{1}{1-\zeta_\varrho}$.

B.5 Firms

B.5.1 Final Goods Producers

Final output is

$$\hat{Y}_t = \left(\int_0^1 \hat{Y}_t(i)^{1-\frac{1}{\epsilon}} di\right)^{\frac{\epsilon}{\epsilon-1}},$$

where ϵ is the elasticity of substitution.

Final goods producers maximize profit by solving

$$\max_{\{\hat{Y}_t(i)\}} P_t \hat{Y}_t - \int_0^1 P_t(i)\hat{Y}_t(i) di,$$

where P_t is the aggregate price index and $P_t(i)$ is the price of input i.

This implies the demand functions for all i

$$\hat{Y}_t(i) = \left(\frac{P_t(i)}{P_t}\right)^{-\epsilon} \hat{Y}_t.$$

Further, perfect competition and free entry among final goods producers requires that they make zero profit in equilibrium. This in turn means $P_t\hat{Y}_t = \int_0^1 P_t(i)\hat{Y}_t(i)di$ and

$$P_t = \left(\int_0^1 P_t(i)^{1-\epsilon} di\right)^{\frac{1}{1-\epsilon}}.$$

B.5.2 Intermediate Goods Producers

We simplify notation by dropping i subscripts and writing $p_t = P_t(i)$. Then

$$y(p_t) = \left(\frac{p_t}{P_t}\right)^{-\epsilon} \hat{Y}_t.$$

The stationarized recursive problem of an intermediate goods producer is in real terms

$$V^W(p_{t-1}, \mathcal{S}_t) = \max_{p_t, n_t, \hat{k}_t} \frac{p_t}{P_t} y(p_t) - (\hat{w}_t n_t + \hat{w}_t^H n_t^H + r_t^K \hat{k}_t) - \frac{\xi}{2}\left(\frac{p_t}{\bar{\pi} p_{t-1}} - 1\right)^2 + \mathrm{E}_t\left[\mathcal{M}_{t,t+1}\exp(g_{t+1}) V^W(p_t, \mathcal{S}_{t+1})\right],$$

subject to

$$Z_t^r n_t^\alpha (n_t^H)^{\alpha_H} \hat{k}_t^{1-\alpha-\alpha_H} \geq y(p_t).$$

We first solve the cost minimization problem for given output

$$\min_{n_t, n_t^H, \hat{k}_t} \hat{w}_t n_t + \hat{w}_t^H n_t^H + r_t^K \hat{k}_t$$

subject to

$$Z_t^r n_t^\alpha (n_t^H)^{\alpha_H} \hat{k}_t^{1-\alpha-\alpha_H} \geq \bar{y}.$$

We denote the multiplier on the output constraint as m_t. Then the FOC are

$$\begin{aligned}
\hat{w}_t &= m_t Z_t^r \alpha n_t^{\alpha-1} (n_t^H)^{\alpha_H} \hat{k}_t^{1-\alpha-\alpha_H}, \\
\hat{w}_t^H &= m_t Z_t^r \alpha_H n_t^\alpha (n_t^H)^{\alpha_H - 1} \hat{k}_t^{1-\alpha-\alpha_H}, \\
r_t^K &= m_t Z_t^r (1-\alpha-\alpha_H) n_t^\alpha (n_t^H)^{\alpha_H} \hat{k}_t^{-\alpha-\alpha_H},
\end{aligned}$$

which implies

$$\begin{aligned}
(1-\alpha-\alpha_H)\hat{w}_t n_t &= \alpha r_t^K \hat{k}_t, \\
(1-\alpha-\alpha_H)\hat{w}_t^H n_t^H &= \alpha_H r_t^K \hat{k}_t, \\
\alpha_H \hat{w}_t n_t &= \alpha \hat{w}_t^H n_t^H,
\end{aligned}$$

and, using a binding production constraint, factor demands as functions of prices

$$
\begin{aligned}
n_t &= \frac{\bar{y}}{Z_t^r}\left(\frac{\alpha}{\alpha_H}\right)^{\alpha_H}\left(\frac{\alpha}{1-\alpha-\alpha_H}\right)^{1-\alpha-\alpha_H}\left(\frac{\hat{w}_t^H}{\hat{w}_t}\right)^{\alpha_H}\left(\frac{r_t^K}{\hat{w}_t}\right)^{1-\alpha-\alpha_H}, \\
n_t^H &= \frac{\bar{y}}{Z_t^r}\left(\frac{\alpha_H}{\alpha}\right)^{\alpha}\left(\frac{\alpha_H}{1-\alpha-\alpha_H}\right)^{1-\alpha-\alpha_H}\left(\frac{\hat{w}_t}{\hat{w}_t^H}\right)^{\alpha}\left(\frac{r_t^K}{\hat{w}_t^H}\right)^{1-\alpha-\alpha_H}, \\
\hat{k}_t &= \frac{\bar{y}}{Z_t^r}\left(\frac{\alpha}{1-\alpha-\alpha_H}\right)^{-\alpha}\left(\frac{\alpha_H}{1-\alpha-\alpha_H}\right)^{-\alpha_H}\left(\frac{r_t^K}{\hat{w}_t}\right)^{-\alpha}\left(\frac{r_t^K}{\hat{w}_t^H}\right)^{-\alpha_H}.
\end{aligned}
$$

Combining the factor first-order conditions with the production function gives the following expression for the multiplier, which equals marginal cost:

$$
m_t = \frac{1}{Z_t^r}(1-\alpha-\alpha_H)^{-(1-\alpha-\alpha_H)}\alpha^{-\alpha}\alpha_H^{-\alpha_H}\hat{w}_t^{\alpha}(\hat{w}_t^H)^{\alpha_H}(r_t^K)^{1-\alpha-\alpha_H}.
$$

With this solution in hand, we write the profit maximization problem

$$
V^W(p_{t-1},\mathcal{S}_t) = \max_{p_t} y(p_t)\left(\frac{p_t}{P_t}-m_t\right) - \frac{\xi}{2}\left(\frac{p_t}{\bar{\pi}p_{t-1}}-1\right)^2 + \mathrm{E}_t\left[\mathcal{M}_{t,t+1}\exp(g_{t+1})V^W(p_t,\mathcal{S}_{t+1})\right].
$$

The FOC for the price is

$$
0 = y'(p_t)\left(\frac{p_t}{P_t}-m_t\right) + \frac{y(p_t)}{P_t} - \xi\left(\frac{p_t}{\bar{\pi}p_{t-1}}-1\right)\frac{1}{\bar{\pi}p_{t-1}} + \mathrm{E}_t\left[\mathcal{M}_{t,t+1}\exp(g_{t+1})\frac{\partial V^W(p_t,\mathcal{S}_{t+1})}{\partial p_t}\right].
$$

The marginal value of today's price is given by the envelope theorem

$$
\frac{\partial V^W(p_{t-1},\mathcal{S}_t)}{\partial p_{t-1}} = \xi\left(\frac{p_t}{\bar{\pi}p_{t-1}}-1\right)\frac{p_t}{\bar{\pi}p_{t-1}^2}.
$$

In equilibrium, all firms choose the same price and we have $p_t = P_t$. Therefore $y(p_t) = \hat{Y}_t$, and $y'(p_t) = -\epsilon\hat{Y}_t/P_t$.

We can thus write the FOC as

$$
\xi\left(\frac{\pi_t}{\bar{\pi}}-1\right)\frac{\pi_t}{\bar{\pi}} = \hat{Y}_t(1-\epsilon+\epsilon m_t) + \mathrm{E}_t\left[\mathcal{M}_{t,t+1}\exp(g_{t+1})\xi\left(\frac{\pi_{t+1}}{\bar{\pi}}-1\right)\frac{\pi_{t+1}}{\bar{\pi}}\right], \tag{50}
$$

which is the New Keynesian Phillips curve.

B.6 Aggregate Capital Transition

The aggregate capital stock is a state variable of the economy contained in $\mathcal{S}_t$. It is needed to compute adjustment costs and the aggregate output of intermediate goods. Since $\hat{K}_{t-1} = \frac{K_{t-1}}{Z_t^p}$, the stationarized law of motion for capital is

$$
\begin{aligned}
\hat{K}_t &= \frac{Z_t^p}{Z_{t+1}^p}\left((1-\delta)\hat{K}_{t-1} + \hat{I}_t\right), \\
&= \exp(-g_{t+1})\left((1-\delta)\hat{K}_{t-1} + \hat{I}_t\right)
\end{aligned}
$$

B.7 Government

B.7.1 Cyclical Fiscal Rules

The cyclical components in fiscal rules (21), (22), and (23) are parameterized by loadings on output growth $\Delta \log Y_t$. To economize on a state variable, we approximate output growth with

$$z_t^A = \log(Z_t^r / \bar{Z}) + 2(g_t - \bar{g}),$$

which we combine with the variance of productivity shocks σ_z^2 into the vector

$$\mathbf{x}_t = \begin{bmatrix} z_t^A \\ \sigma_z^2 \end{bmatrix}.$$

We further define the coefficient matrix

$$\mathbf{F} = \begin{bmatrix} b_\gamma & -b_\gamma^2 \\ b_\theta & -b_\theta^2 \\ b_\tau & -b_\tau^2 \end{bmatrix}.$$

The term loading on σ_z^2 corrects the level of spending, because the nonlinearity of the cyclical loading on z_t^A would otherwise cause an upward bias (a "Jensen correction").

The cyclical rules are then

$$\hat{\gamma}(\Delta \log Y_t) = \exp\left((\mathbf{F}\mathbf{x}_t)'\mathbf{e_1}\right), \tag{51}$$

$$\hat{\theta}(\Delta \log Y_t) = \exp\left((\mathbf{F}\mathbf{x}_t)'\mathbf{e_2}\right), \tag{52}$$

$$\hat{\tau}(\Delta \log Y_t) = \exp\left((\mathbf{F}\mathbf{x}_t)'\mathbf{e_3}\right), \tag{53}$$

where $\mathbf{e}_i$ is the basis vector that selects the ith element of a vector. The tax rule for corporate payouts uses the same cyclical component $\hat{\tau}(\Delta \log Y_t)$, with loading b_τ.

B.8 Market Clearing

Foreign investors purchase the share μ_t^F of newly issued debt of both maturities, $B_t^{F,S} = \mu_t^F B_t^{G,S}$ and $B_t^{F,L} = \mu_t^F B_t^{G,L}$. The markets for short-term bonds, long-term bonds, deposits, labor, capital,

investment goods, and final goods must clear:

$$
\begin{aligned}
B_t^{G,S} &= B_t^{I,S} + B_t^{F,S}, \\
B_t^{G,L} &= B_t^{S,L} + B_t^{F,L}, \\
D_t^I &= D_t^S, \\
N_t &= \int_0^1 n_t(i)di, \\
N_t^H &= \int_0^1 n_t^H(i)di, \\
K_{t-1} &= \int_0^1 k_t(i)di, \\
K_t^I &= (1-\delta)K_{t-1} + I_t = K_t, \\
Y_t &= C_t + C_t^H + I_t + G_t + \Phi(I_t, K_{t-1}) + NX_t,
\end{aligned}
$$

where net exports equal the net financial outflow to foreign investors, $NX_t = NF_t$, as defined in the main text. Menu costs of intermediate producers are rebated lump-sum to savers, $\hat{\text{Rebates}}_t = \frac{\xi}{2}\left(\frac{\pi_t}{\bar{\pi}} - 1\right)^2$, and liquidity costs are rebated lump-sum to banks, $\hat{\text{Rebates}}_t^I = \varrho_t \hat{D}_t^I$.

C Calibration

The model is solved and calibrated at a quarterly frequency. A subset of model parameters have direct counterparts in the data. The remaining parameters are calibrated to match target moments from the data within the model. To compute model-implied moments, we simulate the model for 4,000,000 periods (quarters) in total, consisting of 400 simulation runs of 10,000 periods each (with a 3,000-period burn-in).[26] While these parameters are chosen simultaneously to match all targeted moments, Tables C.1 and C.2 list for each parameter the specific moment that is most affected by this parameter.

Whenever possible, we compute calibration targets based on aggregate data for the 1957–2024 period, since many NIPA and Flow of Funds series become available only then. For the mean real interest rate, we use a longer sample that starts in 1920. It is critical to calibrate the level of interest rates in the model, which in turn is key for the stationary distribution of government debt.

To compute corresponding moments from the model simulation, we use the conditional sample with debt/GDP ratios of 103% or less. That value is the peak of debt/GDP in the data, reached in 2020. Debt/GDP ratios in the model sample thus span the full range observed in the data in the post-WW2 period.

Aggregate Productivity. The aggregate productivity process has permanent and transitory components. The permanent productivity process, Z_t^p, is subject to a growth rate shock, g_t, which follows an AR(1) process with mean $\bar{g} = 0.005$, persistence $\rho_g = 0.6$, and unconditional volatility $\sigma_g = 1.2\%$. The volatility of this process is chosen to match the volatility of real consumption growth in the U.S. over the period 1957–2024, which is the sample period we use for most aggregate moments. We choose the persistence of this process to match the persistence of real output growth for the same period. The mean $\bar{g}$ targets an average annual growth rate of 2%. The transitory productivity process Z_t^r also follows an AR(1) in logs with unconditional volatility $\sigma_z = 1.5\%$, set so that the volatility of stationarized output $\hat{Y}$ in the model matches the volatility of detrended log real GDP in the data. Since both shocks are persistent, they become state variables. We discretize g_t and Z_t^r into 3-state Markov chains using the Rouwenhorst (1995) method. We further assume that transitory TFP innovations and growth rate shocks are perfectly positively correlated, and that Z_t^r has the same persistence $\rho_z = \rho_g$ as the growth rate process. While our model admits any correlation structure between the two shocks, a strong positive correlation between the shocks is required to get a positive term spread. We set the mean of the transitory productivity process $\bar{Z}$ to normalize average output $\bar{Y}$ to 1. Monetary policy and fiscal rules in the model are parameterized with the implicit assumption that average (detrended) output is given by a known level $\bar{Y}$. Since the unconditional mean of output in a long simulation of the nonlinearly solved model is far from the model's deterministic "steady state," this normalization leads to a fixed point: $\bar{Z}$ needs to be set such that jointly with all other parameters, $\mathrm{E}[Y_t] = 1$ in the stationarized model.

Production. Investment adjustment costs are quadratic and centered at the investment rate on the balanced growth path $\hat{\delta} = \delta + e^{\bar{g}} - 1$, $\Phi(I, K) = \frac{\phi}{2}(I/K - \hat{\delta})^2 K$. We set the marginal cost parameter to $\phi = 10$ to match the observed volatility of the log investment rate (investment / capital) of 0.101.[27] The model slightly overshoots on this volatility, delivering 0.127. At the same time, the

[26] See Appendix E for details on the solution method and simulation approach.

[27] Unlike the level, the volatility of the log of the investment rate is not sensitive to its level. Because fixed assets data in NIPA are available only annually, we must annualize the model output to compare it with the data. We group model periods in sets of 4, take the first period's capital stock as the denominator, and add up

model undershoots on the volatility of investment / output, producing 0.77% vs. 1.31% in the data. Depreciation, δ, is set to 0.02 to match the investment-to-output ratio of 14.2% observed in the data. We set the sum of labor weights $\alpha + \alpha_H$ in the Cobb-Douglas production function equal to 0.78 to target the observed labor share of income of 61.9%. The elasticity of substitution for the wholesaler, ϵ, is set to 6.5 to target a profit share of 15.7% from van Vlokhoven (2020).

The Rotemberg adjustment cost ξ is set to 160 to target the volatility of the detrended labor share, as the degree of price stickiness governs markups over marginal costs of production. The model produces a volatility of 1.67%, somewhat overshooting the target of 1.08%.

Preferences and Household Sector. The parameter that controls risk aversion, γ, targets the unlevered risk premium on a claim to GDP. Chen, Jiang, Lustig, Van Nieuwerburgh and Xiaolan (2025) calculate a return on a claim to GDP of 4.5% per year in excess of the risk-free rate. A portion of this excess return is due to the convenience yield on short-term, risk-free debt, calculated from Nagel (2016)'s data to be 40 bps per year. We set γ to 25 so that the model produces a risk premium, i.e., negative covariance between the saver's SDF and the return on a GDP claim, of 4.1% per year or 1.02% per quarter. The calibration delivers a slightly lower number of 0.843% per quarter, or about 3.4% per year.

We set the elasticity of intertemporal substitution to $1/\varphi = 1/0.7$ to target the volatility of the short-term bond yield. The subjective discount factor of households $\beta = 0.9877$ targets the average real rate of 0.41% per quarter, based on 1920–2024 data from Jorda et al. (2016), leaving out the WWII years.

The coefficient on the disutility of labor, ω_0, is set to match the fraction of hours spent at work, based on the BLS series "Average Weekly Hours of Production and Nonsupervisory Employees, Manufacturing," which is available for the full calibration sample. The Frisch elasticity of labor supply is set to 0.5, a standard value in the literature, implying an exponent $\omega_1 = 2$.

Saver households benefit from holding deposits. The utility over deposits is modulated by ψ, which is set to 0.08 to target the average term spread of 35 bps per quarter. Since banks need short-term bonds to back deposits due to the liquidity cost, short-term debt inherits a fraction of the convenience yield of deposits. This convenience of short-term over long-term government debt increases the slope of the yield curve in the model, in addition to the perfect positive correlation between productivity level and growth shocks.

We determine the share of HtM households based on the 2022 Survey of Consumer Finances. Following the empirical macro literature (Zeldes, 1989; Kaplan et al., 2014), we define HtM households in the data as those with a ratio of net worth to monthly income below 2. Using SCF sampling weights, we find that the population share of these households is 15.2%, while their share of labor income (wages and salaries) is 6.8%. Households in this group hold only 0.3% of total net worth, justifying the assumption that they do not accumulate savings in the model. Based on these data, we set $\alpha_H/(\alpha + \alpha_H) = 0.068$.

Banks. Banks are subject to a supplementary leverage ratio (SLR) and equity capital requirements. The SLR constraint is parameterized by $\nu = 0.97$ to reflect real-world regulation on total leverage. The additional risk weight on capital $\nu_K = 0.95876 = \frac{1-\tilde{\nu}_K}{\nu}$, where $\tilde{\nu}_K = 0.07$ is the 7% Basel risk weight. Together these parameters determine the maximum leverage ratio and requirement for bank equity capital.

The liquidity cost per unit of deposits of banks, reflecting real-world liquidity coverage ratio (LCR)

the (trending) investment levels $\hat{I}_t + \hat{I}_{t+1}e^{g_{t+1}} + \ldots$ for the next 4 periods as the numerator.

Table C.1: Parameters: Shocks, Firms, Households, and Intermediaries

Par	Description	Value	Source	Data	Model
			Exogenous Shocks		
$\bar{Z}$	Average TFP	1.4699	normalize $E[Y] = 1$	-	-
$\bar{g}$	trend growth	0.005	annual growth rate 2%	-	-
ρ_g	persistence perm. TFP	0.6	AC(1) real GDP growth (1957-2024 NIPA)	0.0618	0.0951
σ_g	vol. perm. TFP	0.012	Vol. real consumption growth (57-24)	1.03%	1.40%
σ_z	trans. TFP	0.015	Vol. HP-filtered GDP (57-24)	1.53%	1.66%
			Production		
ϕ	marginal adjustment cost	10	Vol. annual log investment-to-capital ratio (57-24)	10.1%	12.7%
$\alpha + \alpha_H$	total weight on labor	0.78	labor share (57-24)	61.9%	61.0%
$\frac{\alpha_H}{\alpha+\alpha_H}$	hand-to-mouth share of labor	0.0686	HtM share of wage income (SCF)	-	-
δ	capital depreciation rate	0.02	investment-to-GDP ratio (57-24)	14.2%	15.9%
ξ	Rotemberg adjustment cost	160	Vol. HP-filtered labor share (57-24)	1.08%	1.67%
ϵ	Intermediate goods elast	6.5	Profits/Revenue (van Vlokhoven (2020))	15.7%	16.0%
			Preferences and Household Sector		
β	discount rate	0.98767	real rate (1920-2024, Jorda et al. (2016)) excl. WWII	0.410%	0.427%
γ	risk aversion coefficient	25	ex.ret. on GDP (Chen et al. (2025)) - conv. yield (Nagel (2016))	1.02%	0.843%
φ	1/EIS	0.7	Vol. of short-term yield (57-24)	0.779%	1.01%
ψ	liquidity utility	0.08	Term spread (57-24)	0.346%	0.368%
ω_0	disutility of labor	5.5	Fraction hours at work (57-24)	36.4%	36.4%
ω_1	inverse of Frisch elasticity	2	standard value	-	-
			Intermediaries		
ϱ_0	liquidity cost level	0.12	FFR - deposit spread (1987-2022 Call Reports)	0.199%	0.141%
ζ_ϱ	deposit run-off rate	0.05	BIS (2013)	-	-

regulation, is determined by the parameters ζ_ϱ, ϱ_0, and ϱ_1. ζ_ϱ represents the fraction of deposits a particular bank's depositors can be expected to withdraw per period and is set to 0.05 following BIS (2013). ϱ_0 is set to 0.12 to target the cost of liquidity. The cost of liquidity captures the observed spread between the federal funds rate and the aggregate deposit rate of 0.20%, calculated from call reports as total deposit interest expense over deposits. The parameter ϱ_1 is set to $1/(1-\zeta_\varrho)$ for parsimony – this value ensures that the liquidity-cost component of the spread is zero at an LCR of 100%.

Fiscal Policy. Our fiscal policy rules are calibrated to match the unconditional average and cyclical properties of transfer spending, discretionary spending (government consumption), and tax revenue. The exact functional forms of the fiscal policy rules in equations (52) and (51) for transfers and spending are given in Appendix B.7. These rules are parameterized by a cyclicality coefficient b_j, $j = \theta, \gamma, \tau$, that governs the correlation with output growth.

The parameters τ_0^{div}, τ_0^{w}, and $\tau_0^{w,H}$ control the base corporate tax rate and the base wage tax rates of savers and HtM households, respectively, and b_τ controls their cyclicality. τ_0^{div} is set to 17.5% to target the observed business tax revenue of 2.94% of GDP and τ_0^{w} is set to 23.084% to match the observed tax revenue from wages to GDP of 13.6%. Wage taxation of HtM agents is set to zero, $\tau_0^{w,H} = 0$, since these agents have low incomes, reflecting the progressivity of the tax system. To determine b_τ, we run a regression of tax revenue growth on GDP growth in model simulated data and in the 1957–2024 sample, excluding the 2020Q2–2021Q3 COVID period (the regression allows for a linear trend). The model matches the data coefficient with a value of $b_\tau = 0.37$.

The unconditional averages of government spending and transfers are controlled by the parameters γ_0, θ_0, and θ_0^H, respectively. We set γ_0 to 7.0% equal to the observed average ratio of government spending to GDP of 7.0%. The cyclicality of spending is governed by b_γ, which we set to match regression coefficients in model and data of spending growth on GDP growth. Average transfers/GDP of 9.5% are matched by total transfers to both types of households $\theta_0 + \theta_0^H$ of 10.3%. HtM consumers receive a share of the total transfer spending proportional to their share of labor income of 6.86%, implying a corresponding value for θ_0^H. In the 2022 SCF, HtM consumers received 6.7% of total transfers, approximately the same fraction. The cyclicality of transfer spending is again chosen to match model to data regression coefficients, yielding $b_\theta = -0.7$. Transfers are strongly countercyclical.

We calibrate the transfer spending shock ϑ_t as a two-state Markov chain. The scale parameters of the low- and high-spending states, $\vartheta_l = 0.730$ and $\vartheta_h = 1.324$, target average transfer spending of 7.9% of GDP over 1957–1990 and 12.7% over 1991–2024. In the model, transfers are 7.5% and 13.6% of GDP in the two states. We set the probability of remaining in the high state to 98.5%, reflecting the high persistence of government spending cycles. Since the shock must satisfy $\mathrm{E}[\vartheta_t] = 1$, the probability of remaining in the low state is 98.7%.

We allow for the government to issue both short-term and long-term debt. The parameter $\bar{\mu} = 0.615$ determines the constant fraction of debt being long-term (in book value terms). This parameter is chosen to reflect the average share of long-term Treasuries (over one year in maturity) of 61.7% in the 1957–2023 data.

We set δ^B to 0.958 to match the average duration of long-term debt in the data, which is 5.02 years. This duration is computed by aggregating the duration of the individual bonds. (If y is the target annual yield of the long-term bond, and d is the targeted duration in years, then the duration parameter δ^B is implied by the formula $d = 0.25/(1 - \delta^B \exp(-y/4))$.)

The coupon of the long-term debt in the model, c, is set such that the price of the long-term bond is normalized to one in the steady state of the model.

The share of debt bought by foreigners is set to $\bar{\mu}^F = 0.33$ to match the average in the data from

Table C.2: Parameters: Government

Par	Description	Value	Source	Data	Model
Government: Fiscal Policy Rules					
ϑ_l	low transfer mult.	0.72967	transfers/GDP low state (57-90)	7.93%	7.52%
ϑ_h	high transfer mult.	1.3238	transfers/GDP high state (91-24)	12.7%	13.6%
p_θ^{hh}	Prob. stay in ϑ_h	0.985	persistence of high transfers	-	-
p_θ^{ll}	Prob. stay in ϑ_l	0.98748	normalization $\mathrm{E}[\vartheta_t] = 1$	-	-
τ_0^{div}	base corp. tax rate	0.175	BEA business tax revenue to GDP (57-24)	2.94%	2.70%
τ_w^0	base labor tax rate, savers	0.23084	BEA personal tax to GDP (57-24)	13.6%	13.6%
$\tau_0^{w,H}$	base labor tax rate, HtM	0	progressivity of tax system	-	-
γ_0	base spending/output	0.07	BEA govt consumption to GDP (57-24)	6.96%	6.99%
$\theta_0 + \theta_0^H$	base total transfers/output	0.103	BEA transfers to GDP (57-24)	10.3%	9.49%
$\frac{\theta_0^H}{\theta_0+\theta_0^H}$	HtM share of transfers	0.0686	pro-rata allocation of transfers	-	-
b_τ	tax cyclicality	0.37	ols coef g(tax revenue) on g(GDP) (57-24)	1.72	1.59
b_γ	spending cyclicality	-0.45	ols coef g(spending) on g(GDP) (57-24)	0.196	0.206
b_θ	transfers cyclicality	-0.7	ols coef g(transfers) on g(GDP) (57-24)	-0.440	-0.444
$\bar{\mu}$	share of long-term debt	0.615	share of LT treasuries (57-23)	61.7%	61.5%
δ_B	duration of long-term debt	0.958	duration of LT debt (57-23)	5.02	5.39
c	long-term debt fixed coupon	0.01251	normalization $p^L = 1$ in st.st.	-	-
$\bar{\mu}^F$	foreign holdings share	0.33	Foreign share of US debt (1980-2025)	-	-
$\mathcal{B}^P$	Profligacy threshold	2	min(debt/GDP) (1974)	16.4%	16.5%
τ_A	Austerity adj. coef., tax	1.65	5-yr periods with avg. surplus $\geq$ 3% of GDP	15%	14%
τ_P	Profligacy adj. coef., tax	0.175		-	-
Government: Monetary Policy Rule					
$\bar{\Pi}$	inflation target	1.005	Fed inflation target (2% p.a.)	-	-
ϕ^π	weight on inflation	1.6	Vol of inflation (core CPI)	0.661%	0.708%
ϕ^y	weight on output	0.125	standard value	-	-
$\bar{p}^S$	natural interest rate	0.99177	normalization	-	-
Government: Financial Regulation					
ν	max. intermediary leverage	0.97	Basel regulation	-	-
ν_K	addl. risk weight on capital	0.95876	Basel regulation	-	-

1980–2025. In the baseline, the parameter $\bar{W}^F = \infty$ so that the share of debt bought by foreigners is always the same, irrespective of the amount of outstanding debt.

The profligacy threshold $\mathcal{B}^P$, below which the government lowers taxes, is set to 2 in quarterly units, corresponding to an annual debt/GDP ratio of 50%. This allows the model to match the minimum level of marketable debt/GDP observed in the data, 16.4% in 1974.

The elasticity of the debt stabilization function in profligacy, τ_P, is set to 0.175. The results are not sensitive to this choice. The elasticity of the debt stabilization function in austerity, τ_A, is set to 1.65. As explained in the main text, we choose $\tau_A = 1.65$ based on high-surplus episodes mainly in European countries (Eichengreen and Panizza, 2016) that implemented fiscal consolidation. We discuss this parameter choice and how it affects our conclusions in Section 6.

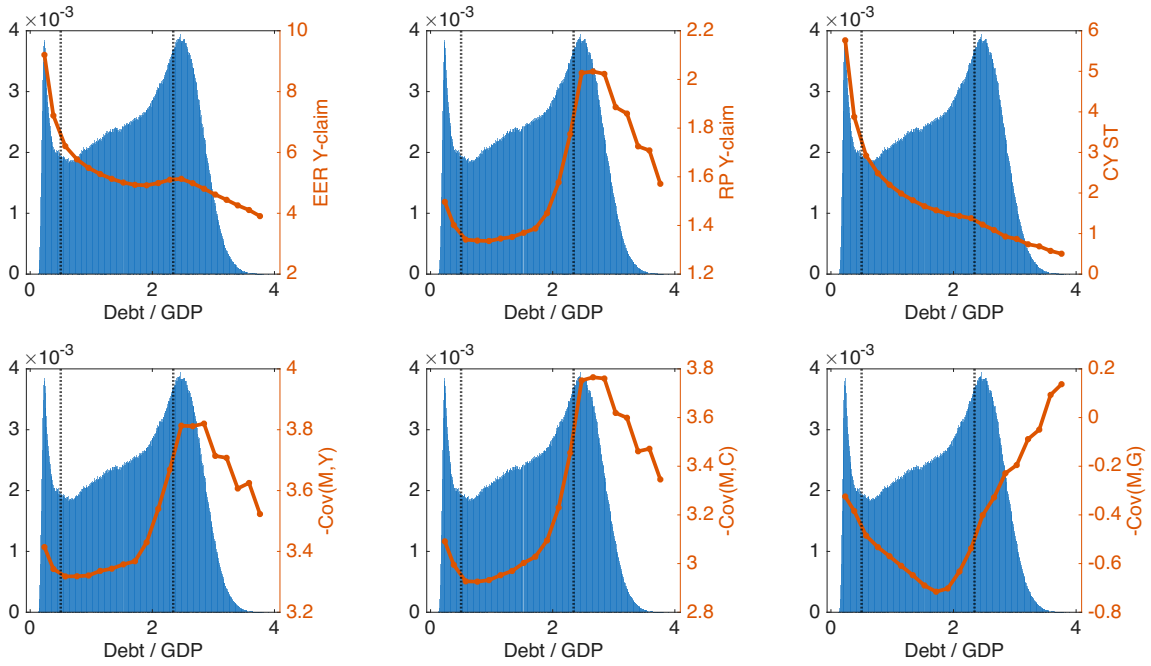
Monetary Policy. The central bank follows a Taylor rule for the interest rate on short-term government debt. The coefficient on inflation, ϕ^π, is set to 1.6 to match the volatility of inflation in the model to the volatility of core CPI inflation in the data. The coefficient on output, ϕ^y, is set to 0.125, which is a standard value in the literature. Qualitatively, results would be unchanged if we set this coefficient to zero. The inflation target $\bar{\Pi} = 1.005$ is set to deliver average inflation of 2% per year.

D Additional Results

D.1 Decomposing the Expected Excess Return on the Output Claim

Figure D.1 shows a decomposition of the expected return on a GDP claim in excess of the ST bond yield in the top left panel into several components.

Figure D.1: Risk Premium Decomposition



Note: This figure shows the histogram of debt/GDP from the simulated model overlaid with conditional means of the expected excess return on the GDP claim (top left), the risk premium on the GDP claim (top middle, measured as excess return over a hypothetical convenience-free short-term bond), the convenience yield on short-term government bonds (top right), covariance of saver SDF and output (bottom left), covariance of saver SDF and consumption (bottom middle), and covariance of saver SDF and government purchases (bottom right). The covariances are multiplied by -1 so that they can be read as risk premia.

D.2 Taxes and Debt

Since debt/GDP is in the inaction region most of the time, the model generates long time paths with changes in debt/GDP, but no adjustments in tax rates or spending in response. This is a realistic feature of the model: Table D.1 demonstrates that in the post-war sample, we do not observe tax increases prompted by higher debt/GDP ratios. Rather, column (1) shows that increases in debt/GDP coincide with decreases in the tax revenue to GDP ratio. Similarly, debt/GDP growth from $t-1$ to t is associated with decreases in the primary surplus in t in the data. These correlations in the data are likely driven by (1) long-run trends of rising debt/GDP and declining tax revenue since the early 1980s, and (2) the strong cyclicality of government spending and tax revenues: during recessions, spending rises and revenues decline, causing higher debt/GDP going forward. The model matches the data coefficient for the surplus qualitatively (columns (4) and (6)). As in the data, the cyclical responses of spending and tax revenue drive the correlations in the model. Since we have a much

Table D.1: Debt/GDP and Surplus Dynamics: Data versus Model

	Dependent variable:					
	Δ Tax Rev.	Δ Surplus	Δ Tax Rev.	Δ Surplus	Δ Tax Rev.	Δ Surplus
	Data	*Data*	*Model*	*Model*	*Model*	*Model*
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Debt/GDP	-0.120^{***}	-0.548^{**}	0.00376^{***}	-0.0131^{***}	-0.0119^{***}	-0.0299^{***}
	(0.0440)	(0.222)	(1.16×10^{-4})	(1.25×10^{-4})	(3.17×10^{-5})	(6.14×10^{-5})
Prof.					$6.37\times10^{-5\,***}$	$-3.45\times10^{-4\,***}$
					(1.78×10^{-6})	(1.12×10^{-5})
Aust.					$9.68\times10^{-5\,***}$	$6.85\times10^{-4\,***}$
					(1.78×10^{-6})	(8.30×10^{-6})
Δ Debt/GDP × Prof.					0.00111^{***}	0.0315^{***}
					(1.20×10^{-4})	(7.54×10^{-4})
Δ Debt/GDP × Aust.					0.0314^{***}	0.0332^{***}
					(3.66×10^{-5})	(8.07×10^{-5})
Observations	272	272	3,999,600	3,999,600	3,999,600	3,999,600
R^2	0.170	0.351	0.037	0.048	0.679	0.127

Note: *p<0.1; **p<0.05; ***p<0.01

This table presents the results of regressing changes in tax revenue to GDP and primary surplus to GDP on changes in the debt/GDP ratio. Columns (1) and (2) present the results from observed quarterly data for 1957–2024 for tax revenues and primary surpluses, respectively. Columns (3) and (4) present analogous results using the simulated data. Columns (5) and (6) use the simulated data and include dummy variables to compute the slopes in the austerity and profligacy regions. Columns (3)–(6) are computed using 400 different simulated sample paths of 10,000 quarters each. We include a fixed effect for, and cluster standard errors by, simulation run.

longer sample for the model-generated data, we observe visits to profligacy (the indicator variable "Prof." is one if the economy is in the profligacy region, and zero otherwise) and austerity regions (the indicator "Aust."). In austerity, and for the surplus also in profligacy, an increase in debt/GDP more than offsets the cyclical comovement. For tax revenue, growth in debt/GDP is associated with an increase in tax revenues in the austerity regime, as expected from the alternative fiscal regime in these regions of the state space. Therefore, our model demonstrates that the lack of responsiveness of fiscal policy to changes in debt/GDP is still consistent with stationary debt dynamics in the long run. This is because such fiscal adjustments can be triggered by debt/GDP reaching extreme levels, which we have not observed in the post-war history of U.S. fiscal policy.

D.3 Risk and Return of Fiscal Claims

Jiang, Lustig, Van Nieuwerburgh and Xiaolan (2024a) demonstrate that we can understand the relative safety of government debt in terms of the covariance of the surplus claim with the stochastic discount factor. The surplus claim in turn is composed of the tax revenue and spending claims. Formally, denote the value of the tax revenue claim as p_t^T and the spending claim as p_t^G, where these values solve the recursions

$$p_t^T = \mathrm{E}_t[M_{t,t+1}(T_{t+1} + p_{t+1}^T)],$$
$$p_t^G = \mathrm{E}_t[M_{t,t+1}(G_{t+1} + \Theta_{t+1} + \Theta_{t+1}^H + p_{t+1}^G)],$$

and the value of the surplus claim is $p_t^{\text{Sur}} = p_t^T - p_t^G$, where $M_{t,t+1}$ is the SDF of the saver. We can further define returns on these claims as $R_t^T = \frac{T_t + p_t^T}{p_{t-1}^T}$, $R_t^G = \frac{G_t + \Theta_t + \Theta_t^H + p_t^G}{p_{t-1}^G}$ and

$$R_t^{\text{Sur}} = \frac{T_t + p_t^T - G_t - \Theta_t - \Theta_t^H - p_t^G}{p_{t-1}^T - p_{t-1}^G} = \frac{p_{t-1}^T}{p_{t-1}^{\text{Sur}}} R_t^T - \frac{p_{t-1}^G}{p_{t-1}^{\text{Sur}}} R_t^G.$$

To represent the riskiness of an asset, we can compute the conditional return beta

$$\beta_t^j = \frac{-\text{Cov}_t(M_{t,t+1}, R_{t+1}^j)}{\text{Var}_t(M_{t,t+1})},$$

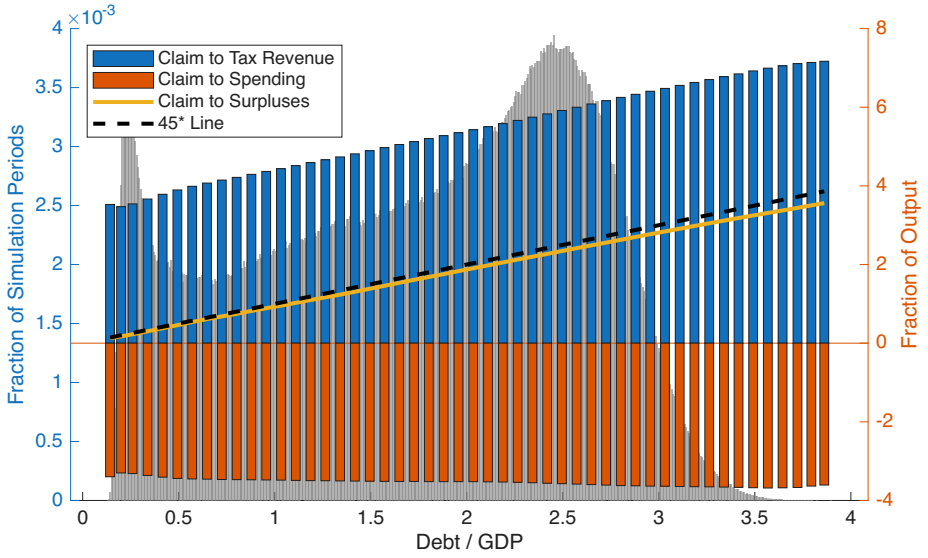
for $j = T, G, \text{Sur}$, respectively.

Assets with positive betas command a risk premium. If government debt is a safe asset in this asset pricing sense, then the surplus claim has a return beta close to zero.

Figure D.2 decomposes the market value of debt into the values of claims to tax revenues and government spending flows. We compute these values as prices of non-traded securities that deliver as payoff either total tax revenue or spending (discretionary spending plus transfers), respectively. The value of the tax claim is positive and increasing in debt/GDP. As the economy approaches austerity, the present discounted value (PDV) of tax revenue rises. The value of the spending claim is roughly constant as a fraction of GDP. Subtracting the value of the spending claim from that of the tax claim delivers the value of the claim to primary surpluses, discounted with the "convenience-free" stochastic discount factor of savers. The difference between the value of this surplus claim (in yellow) and the market value of government debt (dashed black line) stems from convenience yields, which arise because the short-term portion of the debt is held by banks to back deposit claims valued by households. The figure shows that the total value of convenience yields—the wedge between the yellow and black lines—is modest. The wedge is increasing in debt/GDP, even though the marginal convenience yield per dollar of debt declines with more debt, as shown in Figure 4.

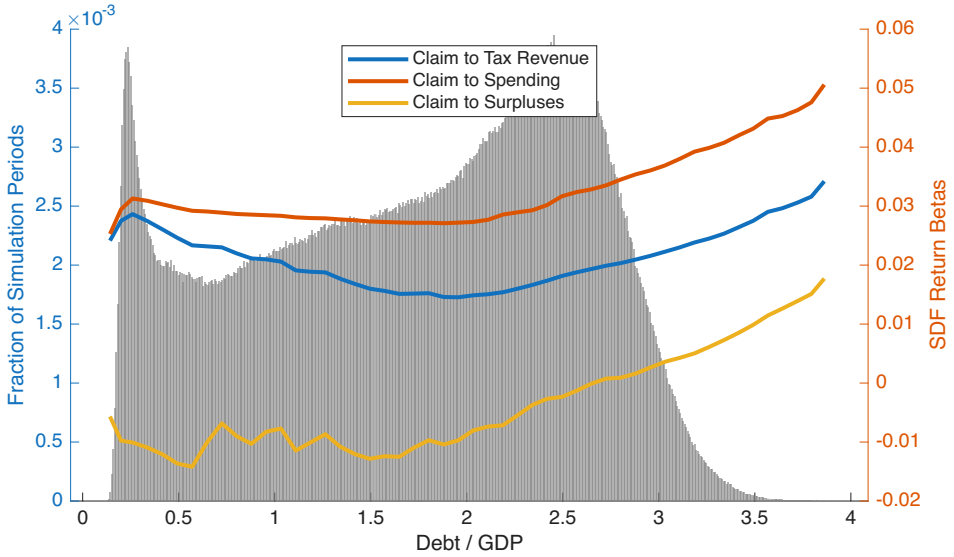
We can understand the safety of government debt through the lens of return betas on these different fiscal claims. Figure D.3 plots the return betas of the tax, spending, and surplus claims for the baseline model. We see that both tax and spending claims are risky since they have positive return betas. The return beta of the surplus claim, which is equivalent to the return beta of the market value of government debt (absent convenience yields), is close to zero, since the surplus claim represents a "long-short portfolio" of the tax and spending claims.

Figure D.2: Decomposing the Market Value of Debt



Note: This figure shows the histogram of debt/GDP from the simulated model overlaid with conditional means of the market values of the tax (blue bars), spending (red bars), and surplus (yellow line) claims as fractions of GDP. The difference between the dashed 45° line and the surplus claim is the total value of convenience yields.

Figure D.3: Return Betas of Fiscal Claims



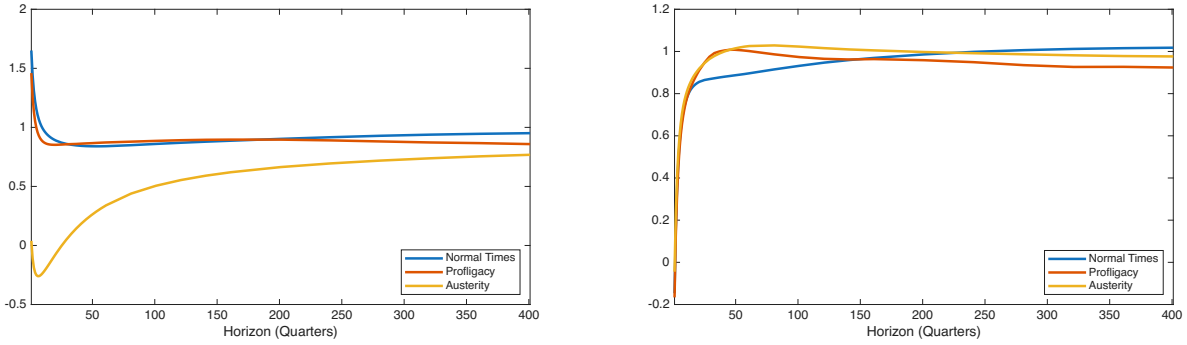
Note: This figure shows the histogram of debt/GDP from the simulated model overlaid with conditional return betas for tax, spending, and surplus claims.

The surplus claim provides insurance, with a slightly negative return beta, at low levels of debt. Since the spending claim is on average riskier than the tax claim, government debt can be a safe asset. However, the surplus claim, and hence the government bond portfolio, becomes riskier to taxpayers as the economy approaches austerity and the upper bound of sustainable debt.

To further illustrate the changing risk profile of government debt as the economy's fiscal capacity

diminishes, we also study the correlation of tax revenues and spending with output at short and long horizons (up to 100 years) in Figure D.4. Consistent with empirical patterns documented in Jiang, Lustig, Van Nieuwerburgh and Xiaolan (2026), tax revenue is procyclical in the short run and cointegrated with output in the long run. The output beta of the tax claim in normal times starts above one at short horizons and converges to one at long horizons. The high short-term tax beta indicates that the government can insulate taxpayers from adverse shocks: tax collections can be low when output is low, at least temporarily. In sharp contrast, the output beta of tax revenue turns negative once debt/GDP crosses the austerity threshold. Even at short horizons, tax policy loses its ability to insure households against adverse economic shocks. The right panel shows that spending is countercyclical in line with fiscal policy concerned with output stabilization in the short run. Like tax revenue, spending is cointegrated with output in the long run. The perfect correlation of tax revenue and spending with output in the long run explains why the claims to these cash flows command a risk premium equal in size to the output risk premium.

Figure D.4: Output Betas for Tax and Spending Cash Flows



(a) Tax Revenue (b) Spending

Note: The output beta at horizon h is the coefficient β_h in the regression

$$\sum_{j=0}^{h-1} (\Delta \log X_{t-j} - \bar{g}) = \beta_h \sum_{j=0}^{h-1} (\Delta \log Y_{t-j} - \bar{g}) + \varepsilon_t,$$

where X_t is real tax revenue (left) or real government spending and Y_t is output, both demeaned by $\bar{g}$, which is the mean growth rate of all real variables in the economy. The regression is estimated separately for normal times (inaction region), profligacy, and austerity, with each window classified by the regime in its last quarter t.

D.4 Welfare Decomposition of Low $\mathcal{B}^A$ and τ_A Economies

Table 2 in the main text shows that lowering the austerity threshold $\mathcal{B}^A$ below its maximal value raises ergodic welfare for both savers and HtM households. This appendix decomposes the saver's welfare gain into its sources. Table D.2 reports the results. Column (1) is the baseline economy; columns (2)–(6) lower $\mathcal{B}^A$ in steps of 10 pp of annual GDP. The first row reports $\mathcal{B}^A$ as debt/annual GDP, in percent.

Welfare. The first two rows report the consumption-equivalent welfare gain relative to the baseline, in percent (100× the log difference), for savers and HtM households. Each economy's value function is evaluated at the mean of its own ergodic distribution. That value is converted into the constant

Table D.2: Lower Values of $\mathcal{B}^A$: Welfare Decomposition

	(1) Base	(2)	(3)	(4)	(5)	(6)
$\mathcal{B}^A$	**234**	**224**	**214**	**204**	**194**	**184**
Welfare Saver		0.212	0.411	0.640	0.861	1.064
Welfare HtM		0.195	0.396	0.623	0.844	1.051
Flow Utility Saver		-0.043	-0.083	-0.124	-0.165	-0.204
Consumption		-126.0	-127.8	-128.1	-127.0	-127.0
Liquidity services		198.4	199.2	199.4	198.6	198.5
Labor		38.3	39.4	39.4	38.9	38.9
Fluctuations		-10.7	-10.8	-10.7	-10.5	-10.4
Risk penalty		75.4	73.3	74.4	74.8	74.3
Cyclicality twist		44.5	45.6	43.5	42.9	43.5
Growth adjustment		8.4	8.4	8.4	8.4	8.4
Flow utility		-28.6	-27.6	-26.7	-26.5	-26.5

Note: Column (1) is the baseline economy; columns (2)–(6) lower $\mathcal{B}^A$ in steps of 10 pp of annual GDP. First panel: Welfare Saver and Welfare HtM are consumption-equivalent welfare gains relative to the baseline, in percent. Flow Utility Saver is the change in the saver's mean period utility $\mathrm{E}[\hat{u}]$, also in percent of consumption equivalent. Second panel: contributions of consumption, liquidity services from deposits, and labor to that change in flow utility, in percent of the change, evaluated at the mean of each input; Fluctuations is the remainder due to the variability of the three inputs. The four rows sum to 100. Because flow utility falls, a positive share reduces flow utility and a negative share (consumption) offsets the decline. Third panel: contributions to the change in the saver's ergodic mean value $\mathrm{E}[\mathcal{V}]$, in percent of that change; see equation (58). The four rows sum to 100 up to a small numerical remainder (see text); the flow utility row is the same change as in the first panel, expressed as a share of the change in $\mathrm{E}[\mathcal{V}]$.

detrended consumption level that, growing at the mean rate of productivity growth $\bar{g}$ and combined with the economy's own mean labor supply (and, for savers, its own mean deposit holdings), yields the same lifetime utility.

Value Function in Detrended Form. Savers' preferences (17) are homogeneous of degree one in the consumption–deposit composite, so the value function scales with permanent productivity Z_t^p. Define the detrended value $\hat{V}_t = V_t^S / Z_t^p$ and its additive transformation

$$\mathcal{V}_t = \frac{\hat{V}_t^{\,1-\varphi}}{1-\varphi}, \tag{54}$$

which is in the same units as detrended period utility $\hat{u}_t$. Dividing (17) by Z_t^p and applying this transformation to both sides gives the recursion

$$\mathcal{V}_t = (1-\beta)\,\hat{u}_t + \beta\,\mathcal{C}_t, \qquad \mathcal{C}_t = \Big(\mathrm{E}_t\big[e^{(1-\gamma)g_{t+1}}\,\mathcal{V}_{t+1}^{1-\tilde{\alpha}}\big]\Big)^{\frac{1}{1-\tilde{\alpha}}}, \qquad \tilde{\alpha} \equiv \frac{\gamma-\varphi}{1-\varphi}, \tag{55}$$

where $\mathcal{C}_t$ is the certainty equivalent of next period's value. In our calibration $\tilde{\alpha} \approx 81$.

The Growth Adjustment. The weight $e^{(1-\gamma)g_{t+1}}$ in (55) appears because next period's value is measured relative to next period's productivity, $Z^p_{t+1} = Z^p_t e^{g_{t+1}}$. To be compared with today's value, it has to be scaled back into units of Z^p_t, i.e., multiplied by $e^{g_{t+1}}$, before risk is priced. This scaling has two effects. First, it shifts the level of the certainty equivalent: since $(1-\gamma)/(1-\tilde{\alpha}) = 1-\varphi$, a constant growth rate $\bar{g}$ would raise next period's value, measured in today's units, by the factor $e^{(1-\varphi)\bar{g}}$. Second, because $1-\gamma < 0$, it puts more weight on low-growth states. To separate the two, let

$$\mathcal{G}_t = \mathrm{E}_t\big[e^{(1-\gamma)g_{t+1}}\big], \qquad \tilde{\mathrm{E}}_t[x_{t+1}] = \frac{\mathrm{E}_t\big[e^{(1-\gamma)g_{t+1}}\, x_{t+1}\big]}{\mathcal{G}_t}, \qquad \tilde{\mathcal{C}}_t = \Big(\tilde{\mathrm{E}}_t\big[\mathcal{V}_{t+1}^{1-\tilde{\alpha}}\big]\Big)^{\frac{1}{1-\tilde{\alpha}}}, \tag{56}$$

so that $\mathcal{C}_t = \mathcal{G}_t^{1/(1-\tilde{\alpha})}\,\tilde{\mathcal{C}}_t$: the certainty equivalent is the level factor $\mathcal{G}_t^{1/(1-\tilde{\alpha})}$ times a certainty equivalent computed under the growth-weighted measure $\tilde{\mathrm{E}}_t$.

Decomposition. The gap between the certainty equivalent and the expected continuation value then splits exactly into three terms:

$$\mathcal{C}_t - \mathrm{E}_t\mathcal{V}_{t+1} = \underbrace{\big(\mathcal{G}_t^{\frac{1}{1-\tilde{\alpha}}} - 1\big)\,\tilde{\mathcal{C}}_t}_{\text{growth adjustment}} \; - \underbrace{\big(\tilde{\mathrm{E}}_t\mathcal{V}_{t+1} - \tilde{\mathcal{C}}_t\big)}_{\text{risk penalty}} \; + \underbrace{\big(\tilde{\mathrm{E}}_t\mathcal{V}_{t+1} - \mathrm{E}_t\mathcal{V}_{t+1}\big)}_{\text{cyclicality twist}}. \tag{57}$$

The *growth adjustment* is the level effect of expected productivity growth just described. The growth process is the same in all economies in the table, so this term changes only in proportion to $\tilde{\mathcal{C}}_t$, which is why its share is small and nearly constant across columns. The *risk penalty* is non-negative by Jensen's inequality and measures the utility cost of uncertainty about next period's value.

The *cyclicality twist* equals $\mathrm{Cov}_t\big(e^{(1-\gamma)g_{t+1}}, \mathcal{V}_{t+1}\big)/\mathcal{G}_t$; it is negative when the continuation value is low in low-growth states and less negative when that comovement is weaker.

In the ergodic distribution $\mathrm{E}[\mathrm{E}_t\mathcal{V}_{t+1}] = \mathrm{E}[\mathcal{V}_t]$, so taking unconditional expectations of (55) gives

$$\mathrm{E}[\mathcal{V}] = \mathrm{E}[\hat{u}] + \frac{\beta}{1-\beta}\,\mathrm{E}\big[\mathcal{C}_t - \mathrm{E}_t\mathcal{V}_{t+1}\big]. \tag{58}$$

The change in the saver's ergodic mean value relative to the baseline is therefore the sum of the change in mean flow utility $\mathrm{E}[\hat{u}]$ and the changes in the three terms of (57), each multiplied by $\beta/(1-\beta)$. The decomposition rows of Table D.2 report each of these four components as a percentage of the change in $\mathrm{E}[\mathcal{V}]$, with the risk penalty entering with a negative sign so that a lower penalty counts as a positive contribution.

The decomposition refers to the ergodic mean of $\mathcal{V}$, while the welfare rows evaluate the value function at the ergodic mean of the state variables. Both measures rank the economies the same way.

The decomposition in Table D.2 shows that the main source of higher welfare in economies with lower $\mathcal{B}^A$ is a smaller risk penalty component, $\tilde{\mathrm{E}}_t\mathcal{V}_{t+1} - \tilde{\mathcal{C}}_t$. The contribution of flow utility is negative, since flow utility is on average lower in the low $\mathcal{B}^A$ economies due to less liquidity production and higher labor supply. The baseline economy has a higher risk penalty than those with lower $\mathcal{B}^A$ because it features higher levels of debt/GDP.

Austerity Slope. Table D.3 repeats the decomposition for the economies with different austerity slopes τ_A in Table 3. The channels are the same as for lower thresholds. Steeper austerity lowers the threshold and average debt, and the resulting fall in the risk penalty accounts for about three quarters of the welfare gain in columns (5)–(7). The cyclicality twist adds about 40%, the growth adjustment about 8%, and flow utility subtracts 26–28%. The flow utility loss again stems mostly from fewer

Table D.3: Austerity Slope: Welfare Decomposition

	(1) 1.4	(2) 1.55	(3) 1.60	(4) Base	(5) 1.70	(6) 1.75	(7) 1.9
$\mathcal{B}^*$	**266**	**242**	**236**	**234**	**224**	**219**	**208**
Welfare Saver	-0.723	-0.172	-0.036		0.228	0.335	0.554
Welfare HtM	-0.663	-0.166	-0.039		0.221	0.340	0.597
Flow Utility Saver	0.169	0.046	0.013		-0.049	-0.073	-0.126
Consumption	-65.6	-38.7	-6.7		-76.7	-77.1	-73.7
Liquidity services	157.6	140.4	121.9		163.8	164.8	163.4
Labor	16.3	4.9	-10.9		21.8	21.0	18.4
Fluctuations	-8.4	-6.6	-4.3		-8.8	-8.7	-8.1
Risk penalty	82.5	84.1	100.5		74.8	75.1	75.8
Cyclicality twist	40.5	40.5	40.8		41.9	42.3	42.9
Growth adjustment	8.5	8.5	8.4		8.4	8.4	8.4
Flow utility	-31.7	-33.4	-50.1		-25.5	-26.2	-27.5

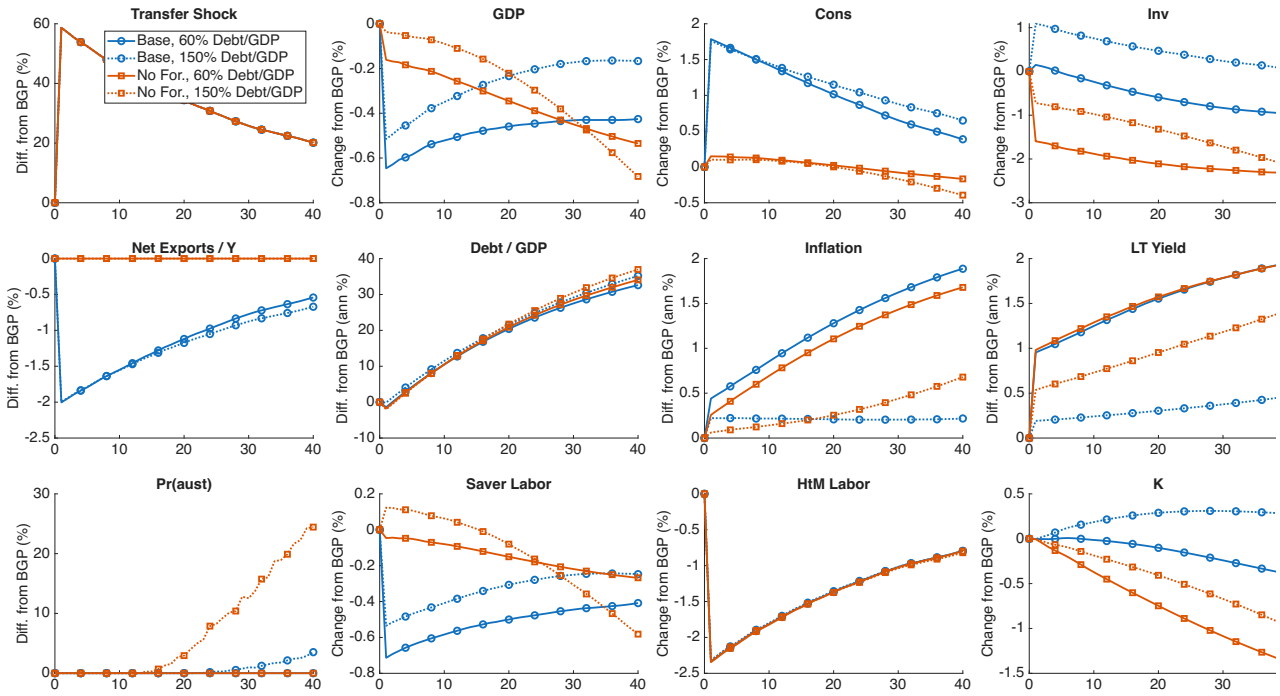
Note: Column (4) is the baseline economy with $\tau_A = 1.65$; the other columns use the values of τ_A shown in the column headers. The first row reports the austerity threshold, recomputed for each value of τ_A, in percent of annual GDP. All other rows are defined as in Table D.2. The second and third panels report shares of the change in flow utility and in the saver's ergodic mean value $\mathrm{E}[\mathcal{V}]$, respectively. The second panel sums to 100, and the third sums to 100 up to a small numerical remainder. In columns (1)–(3), flow utility rises, so in the second panel a positive share raises flow utility. Welfare is lower than in the baseline in these columns, so the third-panel shares describe the sources of the loss: a positive share means that the component lowers welfare, and a negative share means that it offsets the loss. The shares in column (3) are less informative because the total change there is close to zero.

liquidity services from deposits, partly offset by higher consumption. Gentler austerity in columns (1) and (2) works in reverse: the threshold and average debt are higher, and the higher risk penalty accounts for more than 80% of the welfare loss, while more liquidity services raise flow utility and offset part of it. The welfare effects of the austerity slope therefore operate through the same channel as those of the threshold itself: the level of debt and the fiscal risk it creates.

D.5 Real Effects of Transfer Spending: No Foreign Purchases

Figure D.5 repeats the impulse-response graphs of a shock to transfers (Figure 6 in the main text), but adds an economy without foreign purchases of U.S. Treasuries. Blue lines with circles represent the impulse responses in the baseline economy, while the red lines with squares represent the impulse responses in the economy without foreign purchases. Solid lines plot responses from an initial level of 60% debt/GDP, while dotted lines represent responses from an initial level of 150%. The net export panel indeed shows no effect of foreign purchases. This economy shows more crowding out than the baseline economy with foreign purchases (bottom right panel) at both levels of initial debt. It shows more negative investment and consumption responses (top right) but somewhat weaker saver labor supply responses, especially at low levels of debt. The implication is that the presence of foreign capital plays an important role in moderating the crowding out from higher debt, as shown in the third panel of the figure. Absent foreigners, domestic agents must absorb all the new debt, which comes at the expense of capital formation.

Figure D.5: Increased Transfer Spending: Macro Effects and Crowding Out – No Foreign Debt



Note: This figure shows generalized impulse response graphs after the economy experiences a high transfer spending shock. The two lines for each economy correspond to different initial states of debt/GDP. The lines plot the average path of the economy from a sample of 5,000 paths of 40 quarters, with the starting point set to the mean of the state variables conditional on the initial level of debt/GDP and the low transfer state. The paths are relative to the unconditional transition of an economy with the same starting point (the balanced growth path, BGP).

E Computational Methods

E.1 Numerical Solution Method

We solve the model globally using time iteration, extending the solution method of Elenev, Landvoigt and Van Nieuwerburgh (2021). Since that model is real and has no monetary policy, the nominal side of our model is new. Methodologically, this paper innovates by solving for a fixed point in key parameter values, in addition to equilibrium prices and quantities. This extension is necessary because New Keynesian models like ours specify policy rules that respond to deviations of output from trend. Trend output along the balanced growth path, i.e., the scale of the economy in the stationarized model, is endogenous, yet the policy rules that are part of the equilibrium system of equations depend on it. In New Keynesian models with small shocks that are solved with local methods, this problem has a simple solution: trend output is given by the deterministic balanced growth path, which is easy to compute. In our model with large risk premia, trend output is only known once we compute the model's solution and simulate its ergodic distribution.

For simplicity, we use the term "steady state" to refer to the deterministic balanced growth path. To see the additional computational challenge, consider the Taylor rule (29): the central bank adjusts the

interest rate based on deviations of output from its target $\bar{Y}$. Households in our model have a strong precautionary savings motive. As a result, average output in a simulation of the stochastic model is approximately 7% higher than its steady-state value. If we centered the policy rule on steady-state output, as is usually done when computing local approximations, it would be significantly "off target": the average simulated path would trigger a contractionary policy response because the economy would appear to be well above trend. The policy rule must therefore be centered on average output in the ergodic distribution, $\mathrm{E}[\hat{Y}_t]$, which in turn depends on the policy rule.

Parameter Fixed Point. We handle this dependence, together with the calibration of parameters that are pinned down by simulated moments, as one additional fixed point. Let θ collect the parameters determined inside the solution algorithm, and let $\mathcal{M}(\theta)$ denote the corresponding moments of the simulated ergodic distribution, with targets $\mathcal{M}^*$. The algorithm iterates on θ jointly with the equilibrium functions until $\mathcal{M}(\theta) = \mathcal{M}^*$. Which parameters enter θ, and which moments they target, depends on the purpose of the computation:

- *Baseline calibration.* θ contains the discount factor β and mean productivity $\bar{Z}$. The targets are the average real short-term interest rate and the normalization $\mathrm{E}[\hat{Y}_t] = 1$, with the Taylor rule target set to $\bar{Y} = 1$. We use the same scheme for the economies with hesitation in Table 4, which are therefore recalibrated to the baseline real rate and output level.
- *Productivity only.* β is fixed at its baseline value, and θ contains only $\bar{Z}$, chosen so that $\mathrm{E}[\hat{Y}_t] = 1$. We use this scheme for the parameter variations in columns (2)–(4) of Table 1, which change labor supply, risk aversion, and the volatility of growth, and would otherwise shift the scale of the economy. In column (2), we also recalibrate ω_0 from 5.5 to 3.5 to keep matching the hours-worked target.
- *Policy target only.* All structural parameters, including β and $\bar{Z}$, are fixed at their baseline values. θ contains only the Taylor rule target $\bar{Y}$, which is set equal to average output $\mathrm{E}[\hat{Y}_t]$ of the new economy. Preferences and technology are therefore identical to the baseline, which makes welfare comparisons meaningful, while monetary policy remains centered on the economy's own average output. We use this scheme for the policy experiments in columns (5)–(9) of Table 1 and for all alternatives to the baseline in Tables 2 and 3.

Algorithm. The algorithm proceeds as follows:

1. Solve the nonlinear system of equilibrium conditions at the steady state ($\sigma_g = \sigma_z = 0$), given an initial guess for θ. The steady state provides the initial guess for the equilibrium functions. For a comparison economy, the parameters held fixed are imported from the baseline solution.
2. Given the current guess $\theta^{(i)}$, solve the model using transition function iteration as in Elenev et al. (2021). Because their innovations are perfectly correlated, we discretize productivity growth and transitory productivity jointly into three states using the Rouwenhorst (1995) method, and transfer spending into two states, so that there are $N_e = 6$ exogenous states (12 with the hesitation regime H_t). The four endogenous state variables are K_{t-1}, W_t^S, W_t^G, and W_t^F. Market clearing determines saver wealth W_t^S given the other three and the price of capital, so W_t^S needs no grid of its own. We define rectangular grids for K_{t-1}, the log market value of government debt $\log \hat{W}_t^G$, and W_t^F. The grid for $\log \hat{W}^G$ is dense in and near the profligacy and austerity regions, since many equilibrium quantities, particularly labor and inflation, are highly nonlinear around the transitions into those regions.

3. After every 20 iterations, simulate the model. We start at the steady state and simulate $N = 400$ paths of $T_{\text{ini}} + T$ periods each, discarding the first T_{ini} periods to eliminate the effect of initial conditions. Government debt/GDP is highly persistent, so one long simulation may not adequately sample the ergodic distribution. To obtain robust simulation results, we set $T_{\text{ini}} = 3{,}000$ and $T = 10{,}000$.

4. Compute the moment errors $e = \mathcal{M}(\theta^{(i)}) - \mathcal{M}^*$. If all errors are smaller than $\bar{\epsilon} = 0.001$ and the equilibrium functions have converged, stop. Otherwise, update the parameters with a damped step: $\bar{Z}$ and $\bar{Y}$ move in proportion to the output error, and β moves by a damped Newton step on the interest-rate error, using the derivative of the steady-state real rate with respect to β. Continue with step 2, starting from the current equilibrium functions. We update the parameters before the functions have fully converged, so that parameters and functions converge jointly.

5. Compute impulse response functions (IRFs) starting from the average productivity and low transfer state, a fixed level of government debt, and values of the other endogenous state variables consistent with the fixed level of government debt in the simulation. We compute generalized nonlinear IRFs by simulating 5,000 paths of 40 quarters from this starting point, and calculating the mean path for each model variable.

The search for the austerity threshold in Appendix E.2 wraps this algorithm: each candidate threshold is solved with the parameter scheme of the economy under consideration.

E.2 Algorithm for Simulation-Based Austerity Threshold

The austerity threshold $\mathcal{B}^*$ is the highest value of $\mathcal{B}^A$ for which government debt remains bounded. This appendix describes how we compute it.

Upper Bound of the Debt Grid. The model is solved on a grid for government debt with a finite upper bound $\overline{\mathcal{B}}$. Debt is safe only if the equilibrium never requires it to leave this region. A path is therefore explosive if, in some quarter, the model's transition function implies a value of next-period debt beyond $\overline{\mathcal{B}}$: at that point, the fiscal rule has failed to stabilize debt within the region where the model is solved. Debt may approach $\overline{\mathcal{B}}$, but no transition may carry it past the bound. We parameterize the upper bound relative to the threshold,

$$\overline{\mathcal{B}} = \mathcal{B}^A e^m, \tag{59}$$

where $m > 0$ sets the width of the austerity region $[\mathcal{B}^A, \overline{\mathcal{B}}]$ in which taxes rise to rein in debt. For a given threshold, widening this region gives tax increases more room to stabilize debt before it reaches the upper bound. The returns to a wider region are limited, however. Taxes are distortionary, and as debt grows, the economy approaches the peak of the dynamic Laffer curve, beyond which higher tax rates no longer generate enough revenue to cover the increased debt-servicing costs. Numerically, the model solution fails to converge once the grid extends too far beyond this point. For each candidate threshold $\mathcal{B}^A$, the algorithm therefore widens the austerity region step by step until either no simulated path is explosive or the model can no longer be solved.

Explosive Paths. For given $(\mathcal{B}^A, m)$, we solve the model and simulate $N = 100{,}000$ paths, starting from the deterministic steady state. Each path runs for a burn-in of $T_{\text{ini}} = 3{,}000$ quarters, which we

discard, followed by $T = 2{,}000$ quarters, or 500 years, on which we check for violations. We check the paths whose debt is below $\mathcal{B}^A$ in the first quarter after the burn-in. Let

$$v(\mathcal{B}^A, m) = \#\{\text{checked paths with a transition beyond } \overline{\mathcal{B}} \text{ in some quarter } t \leq T\}$$

denote the number of explosive paths. Paths that start the check window in austerity are not checked, but they remain in the total of 100,000 paths. In the baseline, 69,733 of the 100,000 paths are checked, so the check covers about 1.4×10^8 quarters, or 35 million years. The shocks are drawn once with fixed seeds and reused for every candidate $(\mathcal{B}^A, m)$, so differences in v across candidates reflect the model solution, not sampling noise. Each model solution in the search includes the same parameter fixed point as the final solution of the economy (Appendix E.1).

Feasibility of a Threshold. A threshold $\mathcal{B}^A$ is *feasible* if there is a width m such that the model can be solved and $v(\mathcal{B}^A, m) = 0$, i.e., none of the checked paths is explosive. We count the model as solved at $(\mathcal{B}^A, m)$ if transition function iteration does not diverge, the largest changes in the value and transition functions in the final iteration are below 10^{-3}, and fewer than 2% of grid points fail to solve. In every search we report, these changes are below 10^{-5}. We check feasibility as follows:

1. Set $m^{(0)} = m_0$ and solve the model at $(\mathcal{B}^A, m^{(0)})$.
2. For $k = 0, 1, \ldots, K-1$:
   a. Simulate and compute $v^{(k)} = v(\mathcal{B}^A, m^{(k)})$. If $v^{(k)} = 0$, stop: $\mathcal{B}^A$ is feasible.
   b. Otherwise, set $m^{(k+1)} = m^{(k)} + \iota_m$, rebuild the debt grid with the new upper bound (59), and solve the model again, using the solution at $m^{(k)}$ as the initial guess.
   c. If the solution at $m^{(k+1)}$ does not converge, stop: $\mathcal{B}^A$ is infeasible. Widening the austerity region can no longer eliminate the explosive paths.

We set $m_0 = 0.50$ for the baseline economy, $\iota_m = 0.005$, and allow at most $K = 25$ extensions. If all K extensions are used without reaching either outcome, the candidate is treated as inconclusive rather than infeasible. No candidate in the searches we report used more than 13 extensions. The starting width m_0 is an initial guess for each economy, near the width its threshold is expected to require. Table E.1 reports the realized width m at $\mathcal{B}^*$ for every economy with a threshold search.

Search over Thresholds. We maintain the assumption that feasibility is monotone in $\mathcal{B}^A$: a lower threshold starts tax increases earlier, which should make explosive paths less likely. The assumption holds for every candidate we evaluate: in no search does a feasible candidate lie above an infeasible one. We therefore find $\mathcal{B}^*$ by bisection. All model quantities below are expressed in units of quarterly GDP, as in the model code, and converted to annual GDP when reported in the paper.

1. Evaluate a small set of candidate thresholds around an initial guess, in parallel. Each candidate runs the feasibility check above.
2. Let $\mathcal{B}_{\text{lo}}$ be the highest feasible and $\mathcal{B}_{\text{hi}}$ the lowest infeasible threshold evaluated so far. If no infeasible (feasible) candidate has been found, extend the candidate set upward (downward).
3. If $\mathcal{B}_{\text{hi}} - \mathcal{B}_{\text{lo}} < \text{tol}$, stop and set $\mathcal{B}^* = \mathcal{B}_{\text{lo}}$. Otherwise, evaluate the midpoint $(\mathcal{B}_{\text{lo}} + \mathcal{B}_{\text{hi}})/2$ and return to step 2.

We set tol $= 0.05$ in units of quarterly GDP, which equals 1.25 pp of annual GDP. Because the bracket always contains a feasible threshold from below and an infeasible one from above, the reported $\mathcal{B}^*$ is feasible by construction, and the lowest candidate above it, at most tol higher, is infeasible.

Baseline Economy. For the baseline, the first round evaluates thresholds of 232.3%, 233.6%, and 234.8% of annual GDP. The first two are feasible. At 234.8%, one of the 100,000 paths remains explosive after the austerity region has been widened to $m = 0.53$, and the model cannot be solved for a wider region. The second round evaluates the midpoint, 234.2%, which is feasible. The bracket $[234.2\%, 234.8\%]$ is narrower than tol, so $\mathcal{B}^* = 234\%$. At this threshold, the austerity region extends to $m = 0.53$, so the upper bound of the debt grid is $\overline{\mathcal{B}} = 398\%$ of annual GDP. To gauge the sensitivity to the size of the simulation, we extend the check of the baseline at $\mathcal{B}^* = 234\%$ from 100,000 to 1,000,000 paths, keeping the seeds of the first 100,000. The first explosive path appears after more than 800,000 paths, and only one of the 1,000,000 paths is explosive.

Other Economies. Every economy in Tables 1, 3, and 4 runs its own search, so $\mathcal{B}^*$ is recomputed for each parameterization. The economies in Table 2 instead set $\mathcal{B}^A$ below the baseline value of $\mathcal{B}^*$ and keep the width of the austerity region at the baseline value $m = 0.53$. Lowering the threshold only makes debt safer, so these economies require no search; none of their simulated paths is explosive.

Table E.1: Width of the Austerity Region in the Threshold Searches

	$\mathcal{B}^*$ (%)	m
Table 1		
(1) Base	234	0.530
(2) LS	207	0.465
(3) RA	174	0.570
(4) Risk	273	0.550
(5) NF	203	0.495
(6) F Cap	189	0.490
(7) LT 66%	230	0.525
(8) LT 56%	225	0.525
(9) H. LC	224	0.520
Table 3		
$\tau_A = 1.4$	266	0.655
$\tau_A = 1.55$	242	0.575
$\tau_A = 1.60$	236	0.550
$\tau_A = 1.70$	224	0.505
$\tau_A = 1.75$	219	0.485
$\tau_A = 1.9$	208	0.435
Table 4		
$\mu_H = 5\%$	218	0.525
$\mu_H = 10\%$	214	0.530
$\mu_H = 20\%$	199	0.540
$\mu_H = 30\%$	158	0.555

Note: For each economy with a threshold search, the table reports the austerity threshold $\mathcal{B}^*$ in percent of annual GDP and the width m at which $\mathcal{B}^*$ is feasible, so that $\overline{\mathcal{B}} = \mathcal{B}^* e^m$.