Fiscal Triggers and Debt-Aware Macroprudential Policy

Celso J. Costa-Junior* Alejandro C. Garcia-Cintado†
Anderson Mutter Teixeira‡

Abstract

Fiscal expansions can coincide with credit booms and rising asset prices. This paper asks whether macroprudential policy should respond to fiscal conditions and whether prudential rules should condition on public debt. We study these questions in a medium-scale DSGE model with heterogeneous households, banking frictions, and an occasionally binding housing-collateral constraint solved with a piecewise-linear method. The policy analysis uses a 2×2 design that compares state-dependent versus time-invariant prudential stance, and debt-aware versus debt-blind rule design. Debt awareness lowers GDP-scaled present-value government spending multipliers but increases the welfare gains from adopting a state-dependent prudential stance (consumption-equivalent welfare). The joint design tempers leverage dynamics and reduces labor disutility in financially constrained states, implying a negative interaction for multipliers and a positive interaction for welfare.

Keywords: macroprudential policy; fiscal-macroprudential interaction; loan-to-value; capital buffers; occasionally binding constraints; DSGE.
JEL: E44, E61, E62, E63.

1 Introduction

Fiscal expansions often coincide with rising household leverage and asset prices. This is precisely the environment in which macroprudential policy is expected to lean against private balance-sheet risk, yet most macroprudential frameworks treat fiscal conditions as background. Borrower-based tools, such as loan-to-value limits, and bank-based tools, such as countercyclical capital buffers or sectoral capital requirements, are typically specified

*State University of Ponta Grossa (UEPG). E-mail: cjcjunior@uepg.br.
†Universidad Pablo de Olavide (Spain). E-mail: agcintado@upo.es (corresponding author).
‡FACE/UFG and Postgraduate Programme in Economics, Federal University of Pelotas. E-mail: andersonmutterteixeira@gmail.com.

as functions of private credit conditions rather than explicit functions of fiscal stress or public debt.

This paper asks whether that omission matters. Should macroprudential policy respond to fiscal conditions, and should prudential rules condition directly on public debt? More broadly, how do fiscally contingent and debt-aware macroprudential designs reshape fiscal transmission and welfare when collateral constraints bind only episodically?

We study these questions in a medium-scale DSGE model with heterogeneous households, banking frictions, and an occasionally binding housing-collateral constraint solved with a piecewise-linear method. Our policy analysis is organized around a transparent 2×2 design that separates two margins. The first is *fiscal contingency*: a fiscal-stress indicator shifts prudential coefficients between relaxed and tight stances. The second is *debt awareness*: prudential tools respond directly to public-debt conditions in addition to private credit conditions. Their interaction yields four policy environments, labeled A–D for expositional convenience.[1]

For any horizon-H object X_H, we summarize interactions by the difference-in-differences statistic

$$\mathcal{I}_X(H) \equiv \Big(X_{D,H} - X_{C,H}\Big) - \Big(X_{B,H} - X_{A,H}\Big). \tag{1}$$

This object measures how debt awareness changes the marginal effect of fiscally contingent switching, holding fixed the model environment, the shock sequence, and the measurement protocol.

Our quantitative results deliver a clear sign pattern in the baseline calibration. Debt-aware designs compress GDP-scaled present-value spending multipliers, but increase the welfare gains from adopting fiscally contingent macroprudential switching. In difference-in-differences terms, the interaction is negative for present-value multipliers and positive for consumption-equivalent welfare over policy-relevant horizons:

$$\mathcal{I}_M(H) < 0 \qquad \text{and} \qquad \mathcal{I}_W(H) > 0.$$

This pattern is robust in the main policy-relevant exercises around the baseline calibration, particularly along the borrower-based debt-aware margin, though it attenuates when shocks are too small to activate the model's key nonlinear margins.

This tension is economically coherent rather than problematic. In an economy with heterogeneous households, banking frictions, and occasionally binding collateral constraints, a prudential design that dampens leverage-driven output booms can nonetheless raise welfare by reducing the incidence and severity of financially tight states for constrained households. Output-based multipliers summarize the size of the aggregate expansion;

[1] For brevity in figures and tables, we occasionally use the shorthand *triggered* versus *constant*, and *debt-aware* versus *debt-blind*. These labels simply index the four environments in the 2×2 design and do not introduce an additional policy instrument.

welfare also depends on who adjusts, when the collateral wedge becomes first-order, and how costly that adjustment is at the margin.

We complement the structural analysis with local projections on quarterly U.S. data. The reduced-form evidence documents how house prices and household credit respond to identified fiscal shocks, and how those responses vary with lagged fiscal stress and lagged credit stance within the same 2×2 taxonomy used in the model. The evidence is not precise enough to sustain stand-alone causal claims about macroprudential design, but it is informative for discipline: house-price responses are more systematic than credit-quantity responses, and the housing response tends to vary more with credit stance under fiscal stress. We use these patterns as suggestive discipline for treating fiscal stress as an episodic and persistent state variable and for evaluating fiscally contingent macroprudential policy in model-based counterfactuals.

The paper makes three contributions. First, it provides a transparent 2×2 evaluation of fiscal transmission under fiscally contingent and debt-aware macroprudential policy, holding shocks and economic structure fixed across counterfactuals. Second, it shows that the joint design that raises welfare dampens GDP-scaled present-value spending multipliers, so the ranking of policy regimes depends on whether the object of interest is output transmission or welfare. Third, it connects the model's fiscal-trigger design to reduced-form evidence on housing and credit responses following fiscal shocks, and uses that evidence to discipline an episodic, persistent fiscal-stress state. As an additional robustness exercise, we also consider an alternative closure in which sovereign bonds are held by banks rather than by patient households, thereby introducing a tighter sovereign–bank nexus.

The remainder of the paper is organized as follows. Section 2 presents the empirical evidence. Section 3 develops a two-period mechanism that clarifies the state dependence of prudential transmission. Section 4 presents the DSGE model and policy rules. Section 5 discusses the calibration strategy and the empirical discipline used to pin down the fiscal trigger and the model's main steady-state targets. Section 6 reports the quantitative results, including the main 2×2 comparison of welfare and spending multipliers in Subsection 6.2. Section 7 concludes.

1.1 Relation to the literature and positioning

The paper relates to several strands of work. A large literature shows that fiscal multipliers are state dependent, with nonlinearities arising from slack, monetary accommodation, and occasionally binding constraints such as the zero lower bound (Ramey, 2011; Auerbach and Gorodnichenko, 2012; Christiano et al., 2011; Ilzetzki et al., 2013). A complementary literature emphasizes financial conditions—private leverage, credit constraints, and crisis episodes—as sources of multiplier heterogeneity (Andrés et al., 2015; Bernardini and

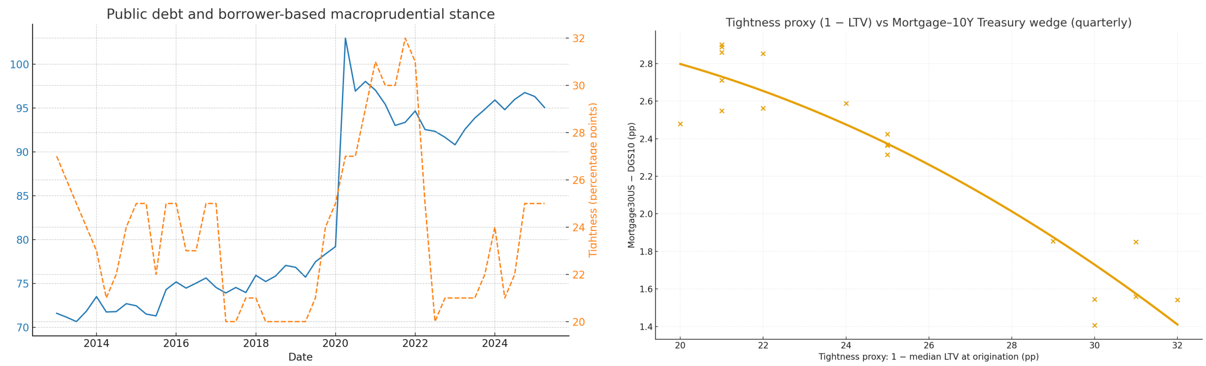
Peersman, 2018; Klein et al., 2022; Faria-e-Castro, 2024; Ghassibe and Zanetti, 2022). Our contribution to this literature is to focus on a joint fiscal–financial state: fiscal stress not only affects the economy's proximity to the binding region of a collateral constraint, but can also shift the prudential stance itself.

Our analysis also builds on work showing that collateral constraints and banking frictions generate amplification and welfare-relevant redistribution (Iacoviello, 2005; Gerali et al., 2010; Korinek, 2011; Bianchi and Mendoza, 2018). Borrower-based tools play a central role in our design, and recent empirical work finds that borrower-based macroprudential tightening has material effects on mortgage leverage and housing outcomes (van Bekkum et al., 2024; Coulier and De Schryder, 2024; Peydró et al., 2024). One implication of this literature is that stabilizing aggregate output need not raise welfare if adjustment is shifted toward high-marginal-utility agents or toward states in which financial wedges are especially costly. This logic helps rationalize why the joint policy design we study can reduce output-based multipliers while improving welfare. More broadly, our paper is also related to the literature on interactions and potential conflicts between macroprudential and other stabilization policies, especially monetary policy, in DSGE environments with financial frictions (Angelini et al., 2014; Garcia Revelo and Levieuge, 2022). Our focus differs in that we study how macroprudential design interacts with fiscal stress and public-debt conditions.

A related literature studies how sovereign conditions spill over to banks and private credit through balance-sheet exposures, sovereign premia, and feedback loops between fiscal and financial fragility (Acharya et al., 2014; Gennaioli et al., 2014; Abad, 2019; Brunnermeier et al., 2017; Hristov et al., 2026). Related contributions show that sovereign risk and bank fragility can reshape fiscal transmission and multipliers (Darracq Pariès et al., 2023; van der Kwaak and van Wijnbergen, 2014, 2025), and that macroprudential capital regulation interacts with fiscal balances and sovereign-bank conditions (Hristov et al., 2024; Boscá et al., 2025). We complement this literature by isolating a policy-design channel: rather than modeling sovereign risk as the main mechanism of interest, we ask whether prudential rules should condition on public debt as a proxy for fiscal capacity, and how that design choice changes fiscal transmission and welfare when borrowing constraints bind only episodically.

Methodologically, we solve the model with an occasionally binding collateral constraint using piecewise-linear methods in the spirit of OccBin (Guerrieri and Iacoviello, 2015). This is important for our application. The policy question is inherently state dependent, and a local always-slack approximation can miss or distort the timing and quantitative importance of regime changes. The piecewise solution allows us to compare policy regimes under identical shocks while preserving endogenous transitions between slack and binding collateral states.

A final clarification is important for interpretation. When we allow macroprudential



(a) Public debt and borrower tightness. (b) Mortgage–Treasury wedge and tightness.

Figure 1: Stylized facts (U.S.). Panel (a) plots federal debt held by the public (percent of GDP; left axis) together with borrower tightness (right axis) defined as $\text{Tight}_t \equiv 100(1 - \text{LTV}_t/100)$ (percentage points), where LTV_t is the median loan-to-value at origination (in percent). Similar debt-to-GDP levels can coexist with markedly different borrower-based conditions. Panel (b) relates the mortgage–Treasury wedge (average 30-year mortgage rate minus the 10-year Treasury yield, in percentage points) to borrower tightness. The negative association is consistent with composition, selection, and pricing effects under tighter origination standards, but we do not interpret it causally. Sources: FRED and Fannie Mae Single-Family PMD (via FRED); authors' calculations.

instruments to condition on public debt, the goal is not to estimate a historical sovereign-risk transmission mechanism. The exercise is instead a rule-design counterfactual: should prudential policy lean more aggressively against leverage when fiscal space is more limited?

Before turning to the reduced-form evidence, it is useful to document two descriptive patterns that motivate our state-contingent design and our measurement of borrower-based conditions. First, a borrower-based tightness proxy constructed as $\text{Tight}_t \equiv 100(1 - \text{LTV}_t/100)$ varies substantially over time and is not mechanically pinned down by public-debt dynamics: similar debt-to-GDP ratios can coexist with markedly different degrees of borrower tightness. Second, borrower tightness is negatively associated with mortgage pricing, as summarized by the average mortgage–Treasury wedge.

These relationships are descriptive and are not given a causal interpretation. Their role is to motivate why borrower-based tightness should be treated as a distinct state variable from public debt, why constrained and unconstrained financial states are empirically plausible, and why state-dependent macroprudential bite is a natural organizing principle for the counterfactuals we study.[2]

[2] Broad credit-risk measures such as the Baa–Treasury spread do not track borrower-based tightness closely, reinforcing the case for separate measurement of borrower-based conditions.

2 Empirical evidence

This section provides reduced-form evidence that motivates and disciplines the paper's state-contingent policy design. Our empirical objective is deliberately narrow. We estimate how house prices and household credit respond to identified government-spending shocks, and how those responses vary with lagged fiscal stress and lagged credit stance. We do not treat these local projections as stand-alone identification of an optimal macroprudential rule. Rather, we use the resulting signs, relative magnitudes, and persistence patterns as empirical discipline for two features that are central to the quantitative model: an episodic and persistent fiscal-stress state, and state-dependent propagation through housing and credit margins.

2.1 Data, variables, and transformations

We use quarterly U.S. data, with a baseline sample of approximately $T \simeq 142$ observations. The baseline fiscal shock series is a narrative government-spending shock, and we report robustness to alternative fiscal-shock measures in Appendix A.1.[3] We take the shock series as given from its underlying identification strategy and use it as an input into the LPs. The contribution here is therefore about *state-dependent propagation*, not shock identification itself.

Our main outcome variables are household credit and house prices. In the baseline, household credit is measured by household mortgage debt, while house prices are measured by a national house price index; alternative credit and housing series are considered in the robustness analysis. We also report responses of real GDP and government spending to verify transmission and scaling.

The stance variable m_t is intended to capture borrower-based or credit-tightness conditions. In the baseline, we use an SLOOS-based net-tightening measure.[4] Because any single proxy can be questioned, we re-estimate the key interaction patterns using alternative stance measures, including other SLOOS cuts, broader financial-conditions indices, and spread-based proxies where available (Appendix A.3).

To avoid look-ahead bias and to limit mechanical contemporaneous feedback between the shock and the state variables, all state variables are lagged one quarter in the baseline:

$$s_{t-1} \quad \text{and} \quad m_{t-1}.$$

[3] In the code, the baseline instrument is the column `shock`. Alternative series—including Ramey-style news shocks, narrative tax shocks, and SVAR-based identification—are used in robustness exercises. The appendix documents definitions and mapping.

[4] In the baseline, m_t is constructed from the SLOOS as a *net tightening* index, defined as tightening minus easing. Higher values of m_t therefore indicate tighter credit conditions. Accordingly, m^{τ} denotes the "tight" evaluation point and m^{ℓ} the "loose" one.

State classification at time t is thus based only on information available before the fiscal shock is realized.

Output, government spending, credit, and house prices enter the LPs in logs. The coefficients are therefore interpreted as log-point responses of the level of the variable at horizon h, which can be read approximately as percentage responses. Fiscal ratios used in constructing stress are measured in percentage points. Full data definitions, transformations, and sample choices are reported in Appendix A.

2.2 A fiscal-stress indicator

Our purpose is not to explain fiscal stress, but to summarize persistent fiscal deterioration with a single scalar that can be used both in reduced-form state dependence and as empirical discipline for the model trigger. Let $s_t \in [0, 1]$ denote fiscal stress. In the baseline, s_t is constructed from debt dynamics using a one-sided low-frequency operator and an episodic mapping designed to produce *rare but persistent* high-stress spells.

Concretely, we first compute a *debt gap* as the deviation of Debt/GDP from a slow one-sided trend, and then map that gap into a bounded stress indicator s_t using smoothing and scaling.[5] Figure 2 illustrates the construction. The resulting series spends most of the sample in low-to-moderate stress, with only a small number of prolonged high-stress episodes. This is the empirical counterpart of the fiscal regime that later governs prudential switching in the structural model.

2.3 Local projections and the 2×2 empirical design

We estimate impulse responses using Jordà local projections (Jordà, 2005) with state dependence along two continuous dimensions: lagged fiscal stress s_{t-1} and lagged credit stance m_{t-1}. For each horizon $h = 0, \ldots, H$, and for each outcome

$$z \in \{\text{GDP},\ \text{Gov. Spending},\ \text{Credit},\ \text{House Prices}\},$$

we estimate

$$z_{t+h} \ = \ \alpha_h + \beta_h \, \varepsilon_t^F + \theta_h \, \varepsilon_t^F \, (s_{t-1} - \bar{s}) + \kappa_h \, \varepsilon_t^F \, (m_{t-1} - \bar{m}) + \psi_h \, \varepsilon_t^F \, (s_{t-1} - \bar{s})(m_{t-1} - \bar{m}) + \Pi_h' X_t + u_{t+h}, \tag{2}$$

where ε_t^F is the identified fiscal shock, $\bar{s}$ and $\bar{m}$ are sample means, and X_t collects the controls used in the baseline specification. In practice, X_t includes a constant and p lags of the dependent variable z_t, real GDP, government spending, and the fiscal shock ε_t^F, with baseline $p = 4$ in line with the estimation code.

[5] This construction is implemented in the data file `us_lp_data_fiscal_DEBTGAP.csv`, which contains the series `st`. The design requirement is that s_t be persistent and enter high-stress territory only episodically, in a way consistent with the model's notion of fiscal-stress episodes.

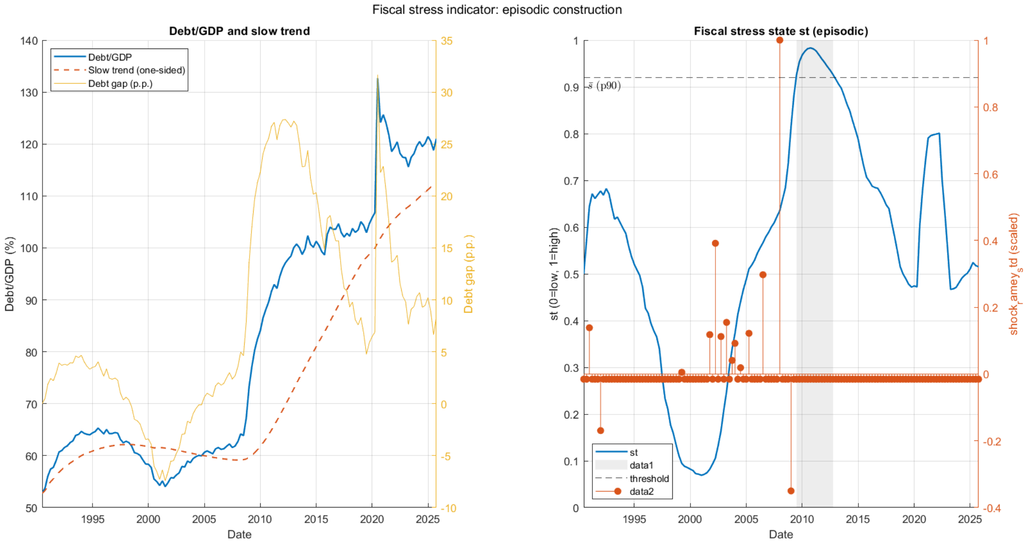


Figure 2: Fiscal stress indicator (episodic construction). The left panel plots Debt/GDP, a one-sided slow trend, and the resulting debt gap. The right panel shows the bounded fiscal-stress index $s_t \in [0, 1]$, designed to be persistent and to enter high-stress territory only episodically.

Equation (2) defines responses for any (s, m) pair. For transparent presentation, and to align the reduced-form evidence with the structural 2×2 experiments, we evaluate the implied impulse responses at two representative fiscal-stress points and two representative credit-stance points:

$$s \in \{s^L, s^H\}, \qquad m \in \{m^\ell, m^\tau\},$$

where (s^L, s^H) and (m^ℓ, m^τ) are interior quantiles of the empirical state distributions. In the baseline, these correspond to the 33rd and 67th percentiles used in the code. We use these cutoffs to preserve meaningful separation between low and high states while retaining adequate cell support. Figure 3 plots the joint distribution and the associated baseline cutoffs. Alternative percentile choices, including $p40/p60$ and $p25/p75$, are treated as robustness checks and are reported in Appendix A.6.

In the baseline sample, these cutoffs imply cell counts $LL = 9$, $HL = 19$, $LT = 21$, and $HT = 12$. This choice therefore preserves economically meaningful state separation without pushing any cell close to emptiness.

The evaluation points $(s^L, s^H, m^\ell, m^\tau)$ are computed from the empirical distributions of the *uncentered* lagged states (s_{t-1}, m_{t-1}), and the corresponding mean-centered values are then substituted into (2). This preserves the convenience of mean-centered estimation while keeping the reported 2×2 objects tied to economically interpretable points in the data.

For each horizon h, the empirical 2×2 interaction is summarized by the difference-in-

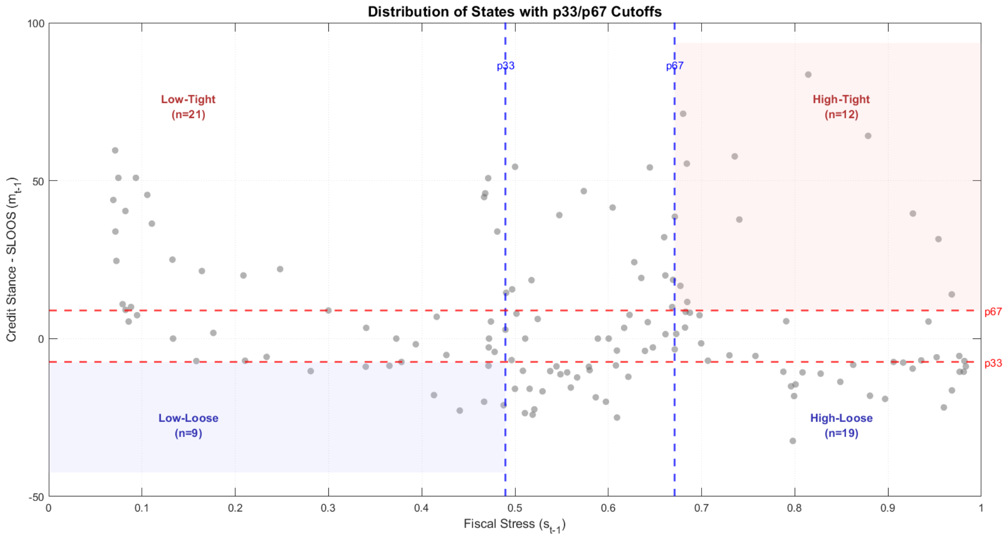


Figure 3: Joint distribution of lagged fiscal stress and lagged credit stance, with baseline $p33/p67$ cutoffs used to define evaluation points for the 2×2 IRFs. The baseline cutoff choice preserves meaningful state separation while retaining adequate cell support. The 2×2 design is obtained by evaluating (2) at (s^L, m^ℓ), (s^H, m^ℓ), (s^L, m^τ), and (s^H, m^τ).

differences object

$$\mathrm{DiD}_h \equiv \Big(\widehat{\mathrm{IRF}}_h(s^H, m^\tau) - \widehat{\mathrm{IRF}}_h(s^H, m^\ell)\Big) - \Big(\widehat{\mathrm{IRF}}_h(s^L, m^\tau) - \widehat{\mathrm{IRF}}_h(s^L, m^\ell)\Big). \quad (3)$$

This object measures whether moving from loose to tight credit conditions changes fiscal-shock propagation *more* in high-stress states than in low-stress states. It is the reduced-form counterpart of the 2×2 comparison carried out in the model.

Inference is deliberately conservative. We use horizon-dependent HAC (Newey–West) standard errors for the LP coefficients, with bandwidth increasing in the horizon as in the code, and we report moving-block bootstrap confidence bands for the DiD_h objects (baseline: $B = 999$, block size 8 quarters, 90% bands). Given the modest sample size relative to the dimensionality of a two-state interaction design, we avoid strong claims based on marginal statistical significance.

2.4 Main empirical patterns

Figure 4 reports impulse responses evaluated at the four (s, m) combinations for household credit, house prices, output, and government spending. Three patterns stand out.

First, house prices display clearer medium-horizon state separation than household credit. The housing responses are more stable across horizons, while credit responses are noisier and more sensitive to the choice of proxy and horizon.

Second, the responses display economically visible state separation, especially for house prices, but not in the form of a uniformly more negative response under the high-

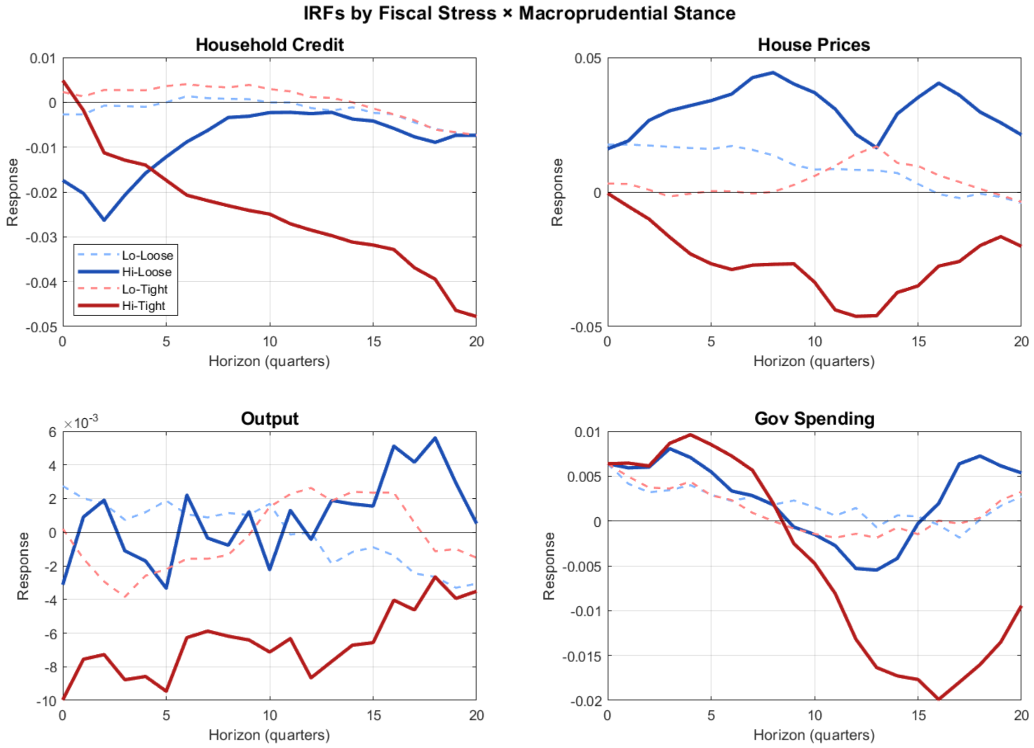


Figure 4: Impulse responses by fiscal stress × credit tightness. Each panel plots the response of a variable to the identified fiscal shock, evaluated at four (s, m) combinations: Lo-Loose (light blue, dashed), Hi-Loose (dark blue, solid), Lo-Tight (light red, dashed), and Hi-Tight (dark red, solid). Responses are in log points.

stress/tight combination. In the baseline $p33/p67$ specification, the estimated house-price interaction is positive at medium horizons, while the corresponding credit interaction remains small and noisy.

Third, statistical uncertainty is substantial. With a sample of roughly $T \simeq 142$ quarters, a two-state interaction design inevitably yields wide bands. We therefore interpret these patterns as suggestive empirical discipline rather than stand-alone identification of a structural macroprudential rule.

We also report the government-spending response as a first-stage diagnostic, to verify that the identified shock moves G_t in the expected direction.

Across specifications, house prices continue to display a clearer and more persistent medium-horizon separation across states than household credit. This is consistent with at least two features of the data: greater measurement noise in quarterly credit aggregates, and more heterogeneous adjustment dynamics in household balance sheets than in aggregate house prices.

Figure 5 reports the DiD_h interaction paths together with moving-block bootstrap confidence bands. For house prices, the point estimates of the interaction are positive in the baseline specification and remain positive across the reported robustness variants,

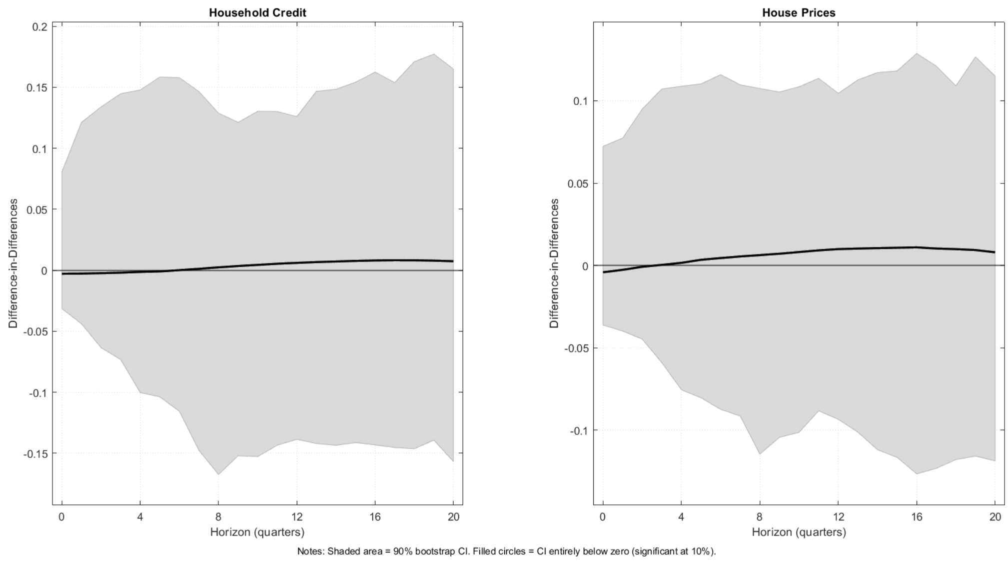


Figure 5: Difference-in-differences interaction paths with 90% moving-block bootstrap confidence bands ($B = 999$, block size 8 quarters).

but the confidence bands are wide and typically include zero. For household credit, the interaction is smaller and less stable across horizons.

In both cases, the 90% bootstrap bands frequently include zero. This reflects limited power in a two-state interaction exercise with a sample of roughly 142 quarterly observations. We therefore treat the reduced-form results as *disciplining evidence*: they support the view that fiscal stress is an episodic and persistent state and that the housing and credit margins react differently across states, but they do not by themselves identify the structural design of macroprudential policy or pin down the sign of every interaction object with precision.

2.5 Robustness checks

We consider several robustness checks addressing three broad concerns: proxy dependence, threshold dependence, and sample-design sensitivity (Appendix A.5).

First, we replace the baseline SLOOS stance proxy with alternative SLOOS cuts and broader financial-conditions indices, and examine whether the qualitative shape of the 2×2 IRFs and the sign and magnitude of DiD_h are sensitive to the stance measure.

Second, we vary the construction of fiscal stress, including alternative smoothing windows and alternative summaries of fiscal conditions, such as debt-only versus debt-and-primary-balance composites.

Third, we assess sensitivity to the empirical design itself. This includes alternative quantiles for the evaluation points (s^L, s^H) and (m^ℓ, m^τ), alternative lag lengths p, and alternative moving-block lengths in the bootstrap procedure. In particular, the baseline uses $p33/p67$ cutoffs to preserve stronger state separation, while more central cutoffs such as $p40/p60$ are treated as robustness checks that trade state separation for greater cell support. The purpose of these exercises is not to search for significance, but to verify that the broad qualitative patterns are not an artifact of a single empirical implementation.

2.6 From the data to the model: disciplining the fiscal trigger

The structural model requires a fiscal-trigger mechanism that is both *episodic* and *persistent*: activation should be infrequent, but once triggered it should remain in place long enough to matter for propagation and welfare. We use the empirical stress indicator s_t to discipline this mechanism in three ways.

First, we calibrate the trigger threshold so that the model matches the empirical fraction of high-stress quarters implied by the distribution of s_t. Second, we choose smoothing and transition parameters so that the model reproduces the serial dependence and average duration of high-stress episodes observed in the data. Third, we use the reduced-form evidence to discipline the empirical plausibility of state dependence in housing and credit margins, while recognizing that the available sample is too imprecise to pin down the sign of every interaction object with confidence.

2.7 Summary

Using quarterly U.S. data and identified fiscal shocks, we document state-dependent responses of house prices and household credit to fiscal disturbances in a 2×2 empirical design based on lagged fiscal stress and lagged credit stance. The estimated interactions are imprecise, but the evidence is informative about two features that matter for the structural analysis: fiscal stress is episodic and persistent, and housing responses display clearer state separation than household credit. We therefore treat the empirical results as discipline for the model's trigger design and state dependence, rather than as stand-alone identification of an optimal macroprudential rule.

3 The interaction channels of fiscal and macroprudential policies: A two-period model

This section develops a two-period endowment economy designed to isolate the state dependence of macroprudential transmission. Fiscal policy changes the intertemporal tax–transfer profile and can move borrowers across slack and binding states of a collateral constraint. Borrower-based macroprudential instruments then matter only when that constraint is endogenously binding, the same Karush–Kuhn–Tucker (KKT) logic that reappears in the DSGE model.

Because output is exogenous in this endowment economy, the toy model is not intended to speak to the magnitude of output spending multipliers. Its role is narrower: to clarify how fiscal policy can activate or deactivate the borrowing constraint, and how this generates state-dependent transmission of borrower-based regulation.

3.1 Environment, households, and timing

Decision dates are $t \in \{0, 1\}$, and housing services are enjoyed in periods 1 and 2. The initial housing stock $h_{i,0}$ is given. At $t = 0$ households choose $(N_{i,1}, h_{i,1})$; at $t = 1$ they choose $h_{i,2}$ and repay or settle $N_{i,1}$. We index housing stocks by the service date, so period utility depends on $(h_{i,1}, h_{i,2})$. Each household derives utility from housing services in both periods:

$$\max_{\{N_{i,1}, h_{i,1}, h_{i,2}\}} \log h_{i,1} \; + \; \beta_i \log h_{i,2}. \tag{4}$$

Housing is a durable asset with fixed real price $P^h > 0$, and the safe gross interest rate is constant at $R^N > 1$.

Each household receives exogenous income Y_t in each period. Let $\theta_P \in (0, 1)$ denote the patient household's share of aggregate endowment, so patient income is $\theta_P Y_t$ and impatient income is $(1 - \theta_P)Y_t$.

Aggregate housing is fixed. For the equilibrium discussion below, housing market clearing in each period is

$$h_{P,t} + h_{I,t} = \bar{h}, \qquad t \in \{1, 2\}. \tag{5}$$

We do not solve for P^h in the toy model. Taking it as fixed keeps the algebra focused on the borrowing margin.

3.2 Fiscal policy: taxes, purchases, and transfers

The government levies lump-sum taxes τ_t, undertakes public purchases G_t, and redistributes through lump-sum transfers $Tr_{i,t}$ to each type $i \in \{P, I\}$. Public debt B_0 is issued in period 0 and repaid in period 1 at gross rate R^N. The government budget constraints are

$$B_0 = G_0 + Tr_{P,0} + Tr_{I,0} - \tau_0, \tag{6}$$

$$0 = G_1 + Tr_{P,1} + Tr_{I,1} + R^N B_0 - \tau_1. \tag{7}$$

Because output is exogenous, public purchases do not raise GDP mechanically. When the objective is to isolate redistribution, it is useful to allow a fraction of purchases to be rebated as transfers:

$$Tr_{P,t} + Tr_{I,t} = \omega_G \, G_t, \qquad \omega_G \in [0, 1]. \tag{8}$$

The benchmark $\omega_G = 1$ corresponds to a "pure transfer" interpretation, whereas $\omega_G = 0$ corresponds to "pure purchases" with no rebate.[6]

We consider a one-time increase in period-0 purchases,

$$G_0 = \widehat{G} + \Delta G, \qquad G_1 = \widehat{G}, \qquad \Delta G > 0,$$

with $\tau_0 = \widehat{\tau}$ fixed and τ_1 adjusting to satisfy (6)–(7). Unless stated otherwise, we hold transfers $(Tr_{P,t}, Tr_{I,t})$ fixed; equivalently, we set $\omega_G = 0$ in (8). Under this baseline experiment, (6) implies that B_0 rises one-for-one with ΔG, which in turn increases period-1 fiscal pressure through (7).

3.3 Patient households

Patient households are net lenders. Their period-0 and period-1 budget constraints are

$$P^h(h_{P,1} - h_{P,0}) + N_{P,1} = \theta_P\,(Y_0 - \tau_0) + Tr_{P,0}, \qquad N_{P,0} = 0, \tag{9}$$
$$P^h(h_{P,2} - h_{P,1}) = \theta_P\,(Y_1 - \tau_1) + Tr_{P,1} + R^N N_{P,1}, \qquad N_{P,2} = 0. \tag{10}$$

Combining (9)–(10) yields the consolidated intertemporal budget constraint

$$\frac{P^h(h_{P,2} - h_{P,1})}{R^N} + P^h(h_{P,1} - h_{P,0}) = \frac{\theta_P\,(Y_1 - \tau_1) + Tr_{P,1}}{R^N} + \theta_P\,(Y_0 - \tau_0) + Tr_{P,0}. \tag{11}$$

The first-order conditions imply

$$\frac{h_{P,2}}{h_{P,1}} = \beta_P\,(R^N - 1). \tag{12}$$

Define patient intertemporal resources, including the initial housing endowment,

$$\mathcal{W}_P \equiv \theta_P\,(Y_0 - \tau_0) + Tr_{P,0} + \frac{\theta_P\,(Y_1 - \tau_1) + Tr_{P,1}}{R^N} + P^h h_{P,0}. \tag{13}$$

Substituting (12) into (11) yields

$$h_{P,1} = \left[\frac{R^N}{P^h(R^N - 1)(1 + \beta_P)}\right] \mathcal{W}_P, \tag{14}$$
$$h_{P,2} = \beta_P\,(R^N - 1)\,h_{P,1} = \left[\frac{\beta_P R^N}{P^h(1 + \beta_P)}\right] \mathcal{W}_P. \tag{15}$$

[6]Nothing in the KKT mechanism developed below depends on a specific choice of ω_G. The parameter simply clarifies whether the fiscal experiment is interpreted primarily as redistribution (ω_G close to one) or as pure public absorption (ω_G close to zero) in an endowment environment.

Net savings in period 0 then follow from (9):

$$N_{P,1} = \theta_P \left(Y_0 - \tau_0\right) + Tr_{P,0} + P^h h_{P,0} - P^h h_{P,1}. \tag{16}$$

3.4 Impatient households and a borrower-based (LTV) constraint

Impatient households borrow in period 0:

$$P^h(h_{I,1} - h_{I,0}) = (1-\theta_P)\left(Y_0 - \tau_0\right) + Tr_{I,0} + N_{I,1}, \qquad N_{I,0} = 0, \tag{17}$$

and repay in period 1:

$$P^h(h_{I,2} - h_{I,1}) + R^N N_{I,1} = (1-\theta_P)\left(Y_1 - \tau_1\right) + Tr_{I,1}, \qquad N_{I,2} = 0. \tag{18}$$

Borrowing is limited by a loan-to-value constraint,

$$R^N\, N_{I,1} \leq LTV \cdot P^h h_{I,1}. \tag{19}$$

Let $\mu \geq 0$ denote the multiplier on (19).

Combining the first-order conditions for $h_{I,1}$, $h_{I,2}$, and $N_{I,1}$ yields

$$\frac{1}{h_{I,1}} = \frac{\beta_I(R^N - 1)}{h_{I,2}} + \mu\, P^h\,(R^N - LTV). \tag{20}$$

When the constraint is slack ($\mu = 0$), impatient households satisfy the unconstrained marginal condition. When it binds ($\mu > 0$), the wedge term in (20) becomes first-order, so allocations are directly affected by borrower-based regulation.

Define the slack associated with the LTV constraint as

$$\tilde{\Psi}(\Delta G, LTV) \equiv LTV\; P^h h_{I,1} - R^N N_{I,1} \;\; \geq \;\; 0, \tag{21}$$

where $\tilde{\Psi} > 0$ corresponds to a slack constraint and $\tilde{\Psi} = 0$ to a binding one. The KKT conditions can be written compactly as

$$0 \leq \mu \;\perp\; \tilde{\Psi}(\Delta G, LTV) \geq 0. \tag{22}$$

Using (18), the same slack can be expressed as

$$\tilde{\Psi}(\Delta G, LTV) = LTV\; P^h h_{I,1} - \Big[(1-\theta_P)\left(Y_1 - \tau_1\right) + Tr_{I,1} - P^h(h_{I,2} - h_{I,1})\Big]. \tag{23}$$

Fiscal policy enters (23) through τ_1 and, in alternative specifications, through $Tr_{I,1}$, as these objects adjust with debt issuance and repayment under (6)–(7).

Holding $(h_{I,1}, N_{I,1})$ fixed,

$$\frac{\partial \tilde{\Psi}}{\partial LTV} = P^h h_{I,1} > 0, \tag{24}$$

so a higher LTV relaxes the borrowing constraint by increasing slack.

There is no primitive cross-term in (21), so $\partial^2 \tilde{\Psi}/(\partial \Delta G\, \partial LTV) = 0$. The interaction instead arises from the KKT structure in (22): fiscal policy can move the economy between regions with $\mu = 0$, in which prudential policy is irrelevant at first order, and regions with $\mu > 0$, in which prudential policy becomes first-order.

Regularity. All comparative-statics statements are local and understood to apply to perturbations that do not themselves switch the regime of the constraint unless explicitly stated otherwise.

Proposition 1 (KKT activation of borrower-based regulation). *Fix $(Y_t, \tau_0, Tr_{I,0}, Tr_{I,1}, P^h, h_{I,2})$ and consider fiscal experiments that shift the period-1 fiscal wedge through τ_1 under (6)–(7), holding transfers fixed. Then:*

1. *If the collateral constraint is slack ($\tilde{\Psi} > 0$),* local *changes in LTV have no first-order effect on allocations because $\mu = 0$.*
2. *If the constraint binds ($\tilde{\Psi} = 0$), changes in LTV affect allocations and wedges through $\mu > 0$.*

Hence fiscal policy can endogenously activate, or deactivate, the transmission channel of borrower-based regulation.

Proof. Write the impatient household's Lagrangian as

$$\begin{aligned}
\mathcal{L} = \; & \log h_{I,1} + \beta_I \log h_{I,2} \\
& + \lambda_0 \Big((1-\theta_P)(Y_0 - \tau_0) + Tr_{I,0} + N_{I,1} - P^h (h_{I,1} - h_{I,0}) \Big) \\
& + \lambda_1 \Big((1-\theta_P)(Y_1 - \tau_1) + Tr_{I,1} - P^h (h_{I,2} - h_{I,1}) - R^N N_{I,1} \Big) \\
& + \mu \Big(LTV \cdot P^h h_{I,1} - R^N N_{I,1} \Big),
\end{aligned}$$

with multipliers (λ_0, λ_1) on the budget constraints and $\mu \geq 0$ on the collateral constraint.

If $\tilde{\Psi}(\Delta G, LTV) > 0$ at the optimum, the complementarity condition $0 \leq \mu \perp \tilde{\Psi} \geq 0$ implies $\mu = 0$. Since LTV enters the Lagrangian only through the term $\mu(LTV \cdot P^h h_{I,1} - R^N N_{I,1})$, it drops out of the first-order conditions when $\mu = 0$. Therefore, for sufficiently small perturbations of LTV that keep the constraint slack, the optimality system and thus the allocation are locally invariant to LTV.

If instead $\tilde{\Psi}(\Delta G, LTV) = 0$ at the optimum, then $\mu > 0$ and LTV enters the first-order conditions through the term $\mu\, LTV \cdot P^h h_{I,1}$. In particular, the wedge term in (20) is first-order and depends on LTV, so changes in LTV generically alter the solution for

$(h_{I,1}, h_{I,2}, N_{I,1})$ and the associated wedges.

Finally, fiscal policy affects $\tilde{\Psi}$ through τ_1 under (6)–(7) when transfers are held fixed, and in alternative specifications also through $Tr_{I,1}$. Fiscal expansions can therefore move the economy across slack and binding regions, activating or deactivating the first-order relevance of borrower-based regulation. □

3.5 A capital-buffer wedge and fiscal interaction

Proposition 1 isolates an *activation channel*: fiscal policy can move the economy across slack and binding states of the collateral constraint, in which case borrower-based regulation becomes first-order through $\mu > 0$. We now consider a second channel that is distinct from, but complementary to, that mechanism. Even when the collateral constraint remains slack ($\mu = 0$), a capital-buffer wedge can affect equilibrium tightness and thereby change the sign of the stabilizing prudential response to a fiscal expansion.

To this end, we introduce a second prudential instrument: a capital-buffer wedge υ^b that raises the borrowing rate faced by impatient households.[7]

$$R^I = R^P + \upsilon^b, \qquad R^P \equiv R^N. \tag{25}$$

The toy model's role is not to reproduce the full DSGE policy rule, but to show in the simplest possible setting that the sign of the fiscal–prudential response can itself be regime dependent.

To obtain a closed-form interaction condition, assume: (i) identical discount factors, $\beta = \beta_P = \beta_I$; (ii) the LTV constraint is slack, so $\mu = 0$; and (iii) housing clears in both periods, $h_{P,1} + h_{I,1} = h_{P,2} + h_{I,2} = \bar{h}$. Under these restrictions, equilibrium can be summarized by an implicit "tightness" condition $\Omega(\Delta G, \upsilon^b) = 0$, where

$$\begin{aligned}
\Omega(\Delta G, \upsilon^b) = \Big(Y_1 - \tau_1 + Tr_{P,1} + Tr_{I,1}\Big) - \widehat{G} \;-\; R^P \Delta G \\
+ R^P\Big[\theta_P(Y_0 - \tau_0) + Tr_{P,0} + P^h h_{P,0}\Big]\Big[\tfrac{1}{R^P - 1} - \beta\Big] \\
+ R^P\Big[(1-\theta_P)(Y_0 - \tau_0) + Tr_{I,0} + P^h h_{I,0}\Big] \\
+ P^h h_{I,0}\, \upsilon^b \Big[\tfrac{1}{R^P - 1 + \upsilon^b} - \beta\Big].
\end{aligned} \tag{26}$$

From (26),

$$\frac{\partial \Omega}{\partial \Delta G} = -R^P < 0,$$

[7] For simplicity, we model the buffer as an additive wedge in gross rates. An equivalent formulation in net rates delivers the same regime-dependent sign result.

so a fiscal expansion pushes Ω downward. For the buffer wedge,

$$\frac{\partial \Omega}{\partial \upsilon^b} = P^h h_{I,0}\Big[\tfrac{R^P-1}{(R^P-1+\upsilon^b)^2} - \beta\Big].$$

Hence $\partial\Omega/\partial\upsilon^b > 0$ if and only if

$$\frac{R^P-1}{(R^P-1+\upsilon^b)^2} > \beta. \tag{27}$$

Define the threshold

$$\bar{\upsilon} \equiv \sqrt{\frac{R^P-1}{\beta}} \;-\; (R^P-1), \qquad 0<\beta<1,\ R^P>1. \tag{28}$$

Then (27) holds for $\upsilon^b < \bar{\upsilon}$ and fails for $\upsilon^b > \bar{\upsilon}$.

Applying the implicit-function theorem to $\Omega(\Delta G, \upsilon^b) = 0$ yields

$$\frac{d\upsilon^b}{d\Delta G} = -\frac{\partial\Omega/\partial\Delta G}{\partial\Omega/\partial\upsilon^b} = \frac{R^P}{\partial\Omega/\partial\upsilon^b},$$

so the sign of $d\upsilon^b/d\Delta G$ coincides with the sign of $\partial\Omega/\partial\upsilon^b$.

Proposition 2 (Capital-buffer–fiscal interaction)**.**

1. ***Complementarity in the low-buffer regime*** *($\upsilon^b < \bar{\upsilon}$). Because $\partial\Omega/\partial\upsilon^b > 0$, a fiscal expansion ($\Delta G > 0$) that lowers Ω must be offset by a* higher *buffer to restore $\Omega = 0$, so $d\upsilon^b/d\Delta G > 0$.*
2. ***Substitutability in the high-buffer regime*** *($\upsilon^b > \bar{\upsilon}$). Because $\partial\Omega/\partial\upsilon^b < 0$, the same fiscal expansion is offset by a* lower *buffer, so $d\upsilon^b/d\Delta G < 0$.*
3. ***Regime-dependent coordination.*** *The sign of $d\upsilon^b/d\Delta G$ flips at $\upsilon^b = \bar{\upsilon}$. Fiscal conditions therefore determine whether the stabilizing prudential response takes the form of tightening or easing.*

Proof. Under the maintained assumptions—identical discount factors, slack collateral constraint $\mu = 0$, and housing-market clearing—equilibrium allocations satisfy the implicit condition $\Omega(\Delta G, \upsilon^b) = 0$, where Ω is given by (26). Differentiating with respect to ΔG,

$$\frac{\partial\Omega}{\partial\Delta G} = -R^P < 0.$$

Let $a \equiv R^P - 1 > 0$. The only term in Ω that depends on υ^b is $P^h h_{I,0}\,\upsilon^b\big[(a+\upsilon^b)^{-1} - \beta\big]$, so

$$\frac{\partial\Omega}{\partial\upsilon^b} = P^h h_{I,0}\left(\frac{a}{(a+\upsilon^b)^2} - \beta\right).$$

By the implicit-function theorem, provided $\partial\Omega/\partial\upsilon^b \neq 0$,

$$\frac{d\upsilon^b}{d\Delta G} = -\frac{\partial\Omega/\partial\Delta G}{\partial\Omega/\partial\upsilon^b} = \frac{R^P}{\partial\Omega/\partial\upsilon^b}.$$

Hence,

$$\mathrm{sign}\left(\frac{d\upsilon^b}{d\Delta G}\right) = \mathrm{sign}\left(\frac{\partial\Omega}{\partial\upsilon^b}\right).$$

The threshold $\bar{\upsilon}$ is defined by $\partial\Omega/\partial\upsilon^b = 0$, that is,

$$\frac{a}{(a+\bar{\upsilon})^2} = \beta,$$

which implies

$$\bar{\upsilon} = \sqrt{\frac{a}{\beta}} - a, \qquad a = R^P - 1.$$

Therefore, if $\upsilon^b < \bar{\upsilon}$, then $\partial\Omega/\partial\upsilon^b > 0$ and $d\upsilon^b/d\Delta G > 0$. If $\upsilon^b > \bar{\upsilon}$, then $\partial\Omega/\partial\upsilon^b < 0$ and $d\upsilon^b/d\Delta G < 0$. This establishes the regime-dependent coordination result. □

3.6 From the toy model to the DSGE–OccBin results: activation and amplification

Propositions 1 and 2 deliver the central piecewise insight used in the DSGE analysis. Fiscal policy shifts the intertemporal fiscal wedge—through τ_1 under the baseline experiment with transfers held fixed, and, in variants, through $(\tau_1, Tr_{i,1})$ together with debt dynamics. In doing so, it can move borrowers across regions in which collateral constraints are either irrelevant at first order ($\mu = 0$) or first-order ($\mu > 0$). This endogenous regime change is what makes the transmission of fiscal policy through the borrowing margin state dependent.

In the quantitative model, fiscally contingent switching matters because fiscal stress is episodic and persistent. Once stress becomes sufficiently high, prudential tightening can remain active long enough to reshape the leverage cycle (LTV utilization, spreads, house prices, and credit) and to affect both the incidence and the duration of binding episodes. Debt-aware rules strengthen this mechanism by responding directly to public-debt conditions, thereby concentrating prudential bite precisely in the fiscal states in which private balance-sheet fragility is most costly.

4 Model

4.1 Environment, timing, and prices

Time is discrete, $t = 0, 1, 2, \ldots$. The economy is populated by two types of households, patient (P) and impatient (I), with discount factors $\beta_P > \beta_I$; a continuum of intermediate-good firms indexed by $j \in [0, 1]$; a perfectly competitive final-good producer; a competitive capital producer; a government; and a banking sector.

Let P_t denote the final-good price index and $\pi_t \equiv P_t/P_{t-1}$ gross inflation. Let W_t denote the nominal wage and P_t^h the nominal price of housing. The monetary authority sets the gross nominal policy rate R_t^{MB}. Banks quote a gross loan rate to impatient households, $R_t^{I,N}$, and a gross return on patient deposits (bank claims), $R_t^{P,N}$. Government bonds pay gross nominal return R_t^B.

Within period t, households observe the state, take prices and policy as given, and choose allocations. Housing carried into period t delivers utility services in t, while the end-of-period stock $h_{i,t+1}$ is purchased at price P_t^h and becomes productive in period $t+1$. Borrowing by impatient households is collateralized by next-period housing value and may therefore bind only in a subset of states.

Throughout the text, equilibrium conditions are written in nominal terms, using nominal asset positions and nominal prices (e.g., $N_{i,t}$, B_t, W_t, P_t^h). The associated multipliers $\lambda_{i,t}$ are therefore nominal, i.e. marginal utility per unit of nominal expenditure, consistent with (36). In the computational implementation, nominal variables are normalized by the price level; in that representation, intertemporal conditions can be written in real-return form (e.g., R/π). The two representations are equivalent up to a change of units. Importantly, the collateral constraint (33) is stated in nominal units in the main text, so no inflation term appears inside the constraint.

4.2 Households

4.2.1 Preferences

Households derive utility from habit-adjusted consumption, housing services, and disutility from labor. Let $C_{i,t}$ denote consumption, $L_{i,t}$ hours worked, and $h_{i,t}$ the housing stock carried into period t. Preferences are

$$\max_{\{C_{i,t}, L_{i,t}, N_{i,t+1}, h_{i,t+1}\}_{t \geq 0}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_i^t \left\{ S_t^P \frac{(C_{i,t} - \phi_c C_{i,t-1})^{1-\sigma}}{1-\sigma} + S_t^P S_t^h \, j \log h_{i,t} - S_t^P S_t^L \frac{L_{i,t}^{1+\varphi}}{1+\varphi} \right\}, \tag{29}$$

where $\phi_c \in [0, 1)$ governs external habit, $\sigma > 0$ is relative risk aversion, $\varphi > 0$ controls the Frisch elasticity, and $j > 0$ governs the preference for housing.

Preference shifters follow AR(1) processes:

$$\log S_t^P = \rho_P \log S_{t-1}^P + \varepsilon_{P,t}, \quad \log S_t^h = \rho_h \log S_{t-1}^h + \varepsilon_{h,t}, \quad \log S_t^L = \rho_L \log S_{t-1}^L + \varepsilon_{L,t}, \tag{30}$$

with i.i.d. innovations.

4.2.2 Budget constraints

Patient households are the residual holders of one-period government bonds in equilibrium. We treat this bond position as a segmented portfolio position rather than as the asset that pins down the benchmark intertemporal pricing margin. Accordingly, B_{t+1} in (31) is taken as given by the household and enters the budget constraint for accounting purposes, while the patient household's stochastic discount factor is anchored by the deposit return $R_t^{P,N}$. We therefore do not impose a separate bond Euler equation arbitraging R_t^B against $R_t^{P,N}$. This parsimonious closure captures limited participation, or segmentation, in short-term sovereign bond markets at business-cycle frequencies, with deposits acting as the marginal liquid saving instrument. The return on government bonds can nonetheless differ from the deposit return through the sovereign spread block introduced in Section 4.5.

The patient household's nominal budget constraint is

$$P_t(1+\tau_t^c)C_{P,t} + P_t^h\Big(h_{P,t+1} - h_{P,t}\Big) + N_{P,t+1} + \frac{B_{t+1}}{R_t^B} = W_t(1-\tau_t^l)L_{P,t} + R_{t-1}^{P,N} N_{P,t} + B_t - \theta_P Tr_t + \Pi_t^f, \tag{31}$$

where $N_{P,t+1}$ denotes one-period nominal bank deposits, τ_t^c and τ_t^l are consumption and labor tax rates, Tr_t is a lump-sum tax/transfer (positive means a net payment by households, split with patient share θ_P), and Π_t^f are distributed profits from intermediate-good producers.

Impatient households are net borrowers and borrow only from banks via $N_{I,t+1}$ (nominal debt). Their budget constraint is

$$P_t(1+\tau_t^c)C_{I,t} + P_t^h\Big(h_{I,t+1} - h_{I,t}\Big) + R_{t-1}^{I,N} N_{I,t} = W_t(1-\tau_t^l)L_{I,t} + N_{I,t+1} - (1-\theta_P)Tr_t. \tag{32}$$

4.2.3 Collateral constraint and KKT conditions

Impatient borrowing is limited by the expected collateral value of housing:

$$R_t^{I,N}\, N_{I,t+1} \;\le\; LTV_t\, \mathbb{E}_t\Big(P_{t+1}^h\, h_{I,t+1}\Big)\,, \tag{33}$$

where $LTV_t \in (0,1)$ is the possibly time-varying loan-to-value limit. Let $\mu_t \ge 0$ denote the multiplier on (33). Define the slack

$$\mathcal{S}_t \;\equiv\; LTV_t\, \mathbb{E}_t\Big(P_{t+1}^h\, h_{I,t+1}\Big) - R_t^{I,N} N_{I,t+1} \;\ge\; 0, \tag{34}$$

so the Kuhn–Tucker conditions are

$$\mu_t \geq 0, \qquad \mathcal{S}_t \geq 0, \qquad \mu_t\, \mathcal{S}_t = 0. \tag{35}$$

Let $\lambda_{i,t}$ denote the multiplier on household i's budget constraint. The optimality conditions include the following.

Consumption (habit) FOC. For $i \in \{P, I\}$,

$$S_t^P \Big(C_{i,t} - \phi_c C_{i,t-1}\Big)^{-\sigma} - \beta_i \phi_c\, \mathbb{E}_t \Big[S_{t+1}^P \Big(C_{i,t+1} - \phi_c C_{i,t}\Big)^{-\sigma}\Big]$$
$$= \lambda_{i,t} P_t (1 + \tau_t^c). \tag{36}$$

Labor supply. For $i \in \{P, I\}$,

$$S_t^P S_t^L\, L_{i,t}^{\varphi} = \lambda_{i,t} W_t (1 - \tau_t^l). \tag{37}$$

Let $\lambda_{P,t}$ denote the multiplier on the patient household's budget constraint. The patient household prices one-period nominal payoffs with the stochastic discount factor $\Lambda_{t,t+1} \equiv \beta_P\, \lambda_{P,t+1}/\lambda_{P,t}$. In the baseline specification, the intertemporal condition is anchored on the gross nominal return paid on bank deposits, $R_t^{P,N}$:

$$\lambda_{P,t} = \beta_P\, \mathbb{E}_t \Big[\lambda_{P,t+1}\, R_t^{P,N}\Big]. \tag{38}$$

Government bonds are one-period nominal claims with gross return R_t^B. We allow R_t^B to deviate from the deposit return $R_t^{P,N}$ through the bond–deposit wedge in (55).

The housing Euler equation is written for the choice of $h_{i,t+1}$, which yields utility services in $t+1$. For the patient household,

$$\lambda_{P,t} P_t^h = \beta_P\, \mathbb{E}_t \left[\lambda_{P,t+1} P_{t+1}^h + j\, \frac{S_{t+1}^P S_{t+1}^h}{h_{P,t+1}}\right]. \tag{39}$$

For the impatient household, collateral tightness affects the housing margin:

$$\lambda_{I,t} P_t^h = \beta_I\, \mathbb{E}_t \left[\lambda_{I,t+1} P_{t+1}^h + j\, \frac{S_{t+1}^P S_{t+1}^h}{h_{I,t+1}}\right] + \mu_t\, LTV_t\, \mathbb{E}_t \Big[P_{t+1}^h\Big]. \tag{40}$$

4.3 Firms

4.3.1 Final-good producer

A perfectly competitive firm aggregates intermediate goods into the final good:

$$Y_t = \left(\int_0^1 Y_{j,t}^{\frac{\phi-1}{\phi}} \, dj \right)^{\frac{\phi}{\phi-1}}, \tag{41}$$

where $\phi > 1$ is the elasticity of substitution. Demand for variety j is

$$Y_{j,t} = \left(\frac{P_{j,t}}{P_t} \right)^{-\phi} Y_t, \qquad P_t = \left(\int_0^1 P_{j,t}^{1-\phi} \, dj \right)^{\frac{1}{1-\phi}}. \tag{42}$$

4.3.2 Intermediate-good producers and Calvo pricing

Each intermediate firm produces with Cobb–Douglas technology:

$$Y_{j,t} = A_t K_{j,t}^{\alpha} L_{j,t}^{1-\alpha}, \tag{43}$$

with TFP following

$$\log A_t = \rho_A \log A_{t-1} + \varepsilon_{A,t}. \tag{44}$$

Let $w_t \equiv W_t/P_t$ denote the real wage and let r_t^k denote the real rental rate of capital. Given (w_t, r_t^k) and output demand $Y_{j,t}$, firm j chooses $(K_{j,t}, L_{j,t})$ to minimize $w_t L_{j,t} + r_t^k K_{j,t}$ subject to (43). Real marginal cost is

$$MC_t = \frac{1}{A_t} \left(\frac{w_t}{1-\alpha} \right)^{1-\alpha} \left(\frac{r_t^k}{\alpha} \right)^{\alpha}. \tag{45}$$

In each period, a fraction $1-\theta$ of firms can reset prices. A firm that re-optimizes in t chooses P_t^* to maximize expected discounted profits:

$$\max_{P_t^*} \ \mathbb{E}_t \sum_{k=0}^{\infty} (\beta_P \theta)^k \, \Lambda_{t,t+k} \left[P_t^* Y_{j,t+k|t} - P_{t+k} MC_{t+k} Y_{j,t+k|t} \right], \tag{46}$$

where $\Lambda_{t,t+k} \equiv \lambda_{P,t+k}/\lambda_{P,t}$ is the stochastic discount factor of the owners (patient households), and $Y_{j,t+k|t} = \left(\frac{P_t^*}{P_{t+k}} \right)^{-\phi} Y_{t+k}$. Standard manipulation delivers the reset-price condition and, around steady state, the usual New Keynesian Phillips curve.

4.4 Capital producer

A competitive capital producer chooses investment I_t to produce next-period capital subject to adjustment costs:

$$K_{t+1} = (1-\delta)K_t + I_t \left[1 - \frac{\chi}{2}\left(\frac{I_t}{S_t^I I_{t-1}} - 1\right)^2\right], \tag{47}$$

where $\delta \in (0,1)$ is depreciation and $\chi > 0$ governs investment adjustment costs. The investment-specific shock follows

$$\log S_t^I = \rho_I \log S_{t-1}^I + \varepsilon_{I,t}. \tag{48}$$

The implied real resource cost of adjustment is

$$\Phi_t^I \equiv \frac{\chi}{2}\left(\frac{I_t}{S_t^I I_{t-1}} - 1\right)^2 I_t. \tag{49}$$

4.5 Government and fiscal policy

4.5.1 Budget constraint

The government issues one-period nominal bonds B_{t+1} and satisfies

$$\frac{B_{t+1}}{R_t^B} - B_t + T_t = P_t G_t, \tag{50}$$

where G_t is public purchases and T_t denotes total revenues:

$$T_t = \tau_t^c P_t(C_{P,t} + C_{I,t}) + \tau_t^l W_t(L_{P,t} + L_{I,t}) + \tau_t^k \left(r_t^k - \delta\right) P_t K_t + Tr_t. \tag{51}$$

4.5.2 Fiscal rules

The fiscal authority controls $Z_t \in \{G_t, \tau_t^c, \tau_t^l, \tau_t^k, Tr_t\}$ through debt-feedback rules:

$$\frac{Z_t}{Z_{ss}} = \left(\frac{Z_{t-1}}{Z_{ss}}\right)^{\gamma_Z} \left(\frac{B_t/(P_{t-1}Y_{t-1})}{B_{ss}/(P_{ss}Y_{ss})}\right)^{(1-\gamma_Z)\phi_Z} S_t^Z, \tag{52}$$

where $\gamma_Z \in (0,1)$ controls inertia and ϕ_Z governs the response to the debt-to-GDP ratio. We use predetermined debt stocks scaled by lagged nominal GDP, $P_{t-1}Y_{t-1}$, to avoid contemporaneous feedback. The fiscal shock follows

$$\log S_t^Z = \rho_Z \log S_{t-1}^Z + \varepsilon_{Z,t}. \tag{53}$$

To allow the short-term government bond yield to vary with predetermined public debt conditions while keeping the model default-free, we represent the sovereign bond–deposit spread through an auxiliary shadow wedge:

$$\log \Omega_t^B = \rho_{\Omega_B} \log \Omega_{t-1}^B + (1-\rho_{\Omega_B})\, \psi_B \left(\widetilde{b}_t - 1\right), \tag{54}$$
$$R_t^B = R_t^{P,N}\, \Omega_t^B, \tag{55}$$

where

$$\widetilde{b}_t \equiv \frac{B_t/(P_{t-1}Y_{t-1})}{B_{ss}/(P_{ss}Y_{ss})}. \tag{56}$$

The state variable $\widetilde{b}_t$ uses predetermined public debt scaled by lagged nominal GDP, so the spread block is unit-free, comparable across calibrations, and avoids contemporaneous feedback between bond yields and current fiscal choices. Using debt in nominal levels would make the spread depend on the arbitrary normalization of nominal aggregates; debt-to-GDP is the natural fiscal state variable.

In the benchmark calibration, we set $\rho_{\Omega_B} = 0$. In that case,

$$\Omega_t^B = \exp\Big\{\psi_B \left(\widetilde{b}_t - 1\right)\Big\},$$

so (54)–(55) are exactly equivalent to the compact one-equation representation

$$R_t^B = R_t^{P,N} \exp\Big\{\psi_B \left(\widetilde{b}_t - 1\right)\Big\}.$$

We nevertheless keep the shadow-wedge notation as the benchmark representation because it separates the spread object from the pricing relation and provides a cleaner description of the sovereign bond–deposit block.

This sovereign spread block is kept common across policy regimes and is not the focus of the 2×2 policy-design comparison. Robustness evidence on both the quantitative role of the wedge and the invariance of the results to its equivalent one-equation representation is reported in Appendix D.

4.6 Monetary policy

The monetary authority follows a Taylor-type rule:

$$\frac{R_t^{MB}}{R_{ss}^{MB}} = \left(\frac{R_{t-1}^{MB}}{R_{ss}^{MB}}\right)^{\gamma_R} \left[\left(\frac{\pi_t}{\pi_{ss}}\right)^{\gamma_\pi} \left(\frac{Y_t}{Y_{ss}}\right)^{\gamma_Y}\right]^{1-\gamma_R} S_t^m, \tag{57}$$

with monetary shock

$$\log S_t^m = \rho_m \log S_{t-1}^m + \varepsilon_{m,t}. \tag{58}$$

4.7 Macroprudential policy: baseline, fiscal contingency, and debt awareness

The macroprudential authority uses two instruments: (i) a bank-capital requirement target v_t^b, and (ii) a loan-to-value limit LTV_t. In baseline, time-invariant form, the instruments respond to credit conditions using beginning-of-period, predetermined credit stocks:[8]

$$v_t^b = (v_{t-1}^b)^{\gamma_v} \left(\frac{M_t^B/(P_{t-1}Y_{t-1})}{M_{ss}^B/(P_{ss}Y_{ss})} \right)^{(1-\gamma_v)\phi_v} S_t^v, \qquad \phi_v > 0, \tag{59}$$

$$LTV_t = (LTV_{t-1})^{\gamma_{LTV}} \left(\frac{N_{I,t}/(P_{t-1}Y_{t-1})}{N_{I,ss}/(P_{ss}Y_{ss})} \right)^{(1-\gamma_{LTV})\phi_{LTV}} S_t^{LTV}, \qquad \phi_{LTV} < 0. \tag{60}$$

Shocks follow AR(1) processes:

$$\log S_t^v = \rho_v \log S_{t-1}^v + \varepsilon_{v,t}, \qquad \log S_t^{LTV} = \rho_{LTV} \log S_{t-1}^{LTV} + \varepsilon_{LTV,t}. \tag{61}$$

Let $Trig_t$ denote the smoothed fiscal-stress signal. Define a binary fiscal regime indicator $I_t^{\text{fisc}} \in \{0, 1\}$ via the hysteresis rule in Section 5.3, where $I_t^{\text{fisc}} = 1$ denotes the tight fiscal-stress regime and $I_t^{\text{fisc}} = 0$ the relaxed regime.

Fiscal contingency operates through discrete low- and high-stress coefficients selected by I_t^{fisc}:

$$\phi_v(I_t^{\text{fisc}}) = \phi_v^L + I_t^{\text{fisc}}\big(\phi_v^H - \phi_v^L\big), \tag{62}$$

$$\phi_{LTV}(I_t^{\text{fisc}}) = \phi_{LTV}^L + I_t^{\text{fisc}}\big(\phi_{LTV}^H - \phi_{LTV}^L\big). \tag{63}$$

In debt-aware regimes, the direct public-debt terms follow the same low/high selection:

$$\phi_{v,B}(I_t^{\text{fisc}}) = \phi_{v,B}^L + I_t^{\text{fisc}}\big(\phi_{v,B}^H - \phi_{v,B}^L\big), \tag{64}$$

$$\phi_{LTV,B}(I_t^{\text{fisc}}) = \phi_{LTV,B}^L + I_t^{\text{fisc}}\big(\phi_{LTV,B}^H - \phi_{LTV,B}^L\big). \tag{65}$$

Let $\widetilde{b}_t \equiv \frac{B_t/(P_{t-1}Y_{t-1})}{B_{ss}/(P_{ss}Y_{ss})}$ denote predetermined public debt, scaled by lagged nominal

[8] In the model's timing, M_t^B (aggregate bank loans), $N_{I,t}$ (impatient debt), and B_t (public debt) are stocks carried into period t, chosen in $t-1$ and therefore known to the macroprudential authority at the start of t. To avoid any concern that the rule depends on tomorrow's choices, these predetermined stocks are scaled by lagged nominal GDP, $P_{t-1}Y_{t-1}$.

GDP. We augment the baseline rules as

$$
v_t^b = (v_{t-1}^b)^{\gamma_v} \left(\frac{M_t^B/(P_{t-1}Y_{t-1})}{M_{ss}^B/(P_{ss}Y_{ss})} \right)^{(1-\gamma_v)\phi_v(I_t^{\text{fisc}})} \left(\widetilde{b}_t\right)^{(1-\gamma_v)\phi_{v,B}(I_t^{\text{fisc}})} S_t^v, \tag{66}
$$

$$
LTV_t = (LTV_{t-1})^{\gamma_{LTV}} \left(\frac{N_{I,t}/(P_{t-1}Y_{t-1})}{N_{I,ss}/(P_{ss}Y_{ss})} \right)^{(1-\gamma_{LTV})\phi_{LTV}(I_t^{\text{fisc}})} \left(\widetilde{b}_t\right)^{(1-\gamma_{LTV})\phi_{LTV,B}(I_t^{\text{fisc}})} S_t^{LTV}. \tag{67}
$$

Debt-blind rules impose $\phi_{v,B}(\cdot) = \phi_{LTV,B}(\cdot) = 0$. In triggered-OFF economies, we set $I_t^{\text{fisc}} \equiv 0$ by construction.

The coefficients $\left(\phi_{v,B}(I_t^{\text{fisc}}), \phi_{LTV,B}(I_t^{\text{fisc}})\right)$ in (66)–(67) capture a reduced-form *policy-design* choice: prudential tightness conditions on public debt as an observable proxy for fiscal capacity. When public debt is high, fiscal space to stabilize the economy or mitigate adverse tail outcomes is plausibly weaker, so leverage-driven amplification and binding collateral episodes are more costly in welfare terms. Debt-aware rules therefore provide a transparent counterfactual that tilts prudential stance toward those fiscal states.

In our implementation, fiscal contingency selects low- versus high-stress coefficient sets through $I_t^{\text{fisc}} \in \{0, 1\}$, so the debt-feedback intensity can differ across relaxed and tight fiscal states through $(\phi_{v,B}^L, \phi_{LTV,B}^L)$ and $(\phi_{v,B}^H, \phi_{LTV,B}^H)$ in Aware economies, whereas Debt-Blind economies impose these terms equal to zero in both states.

Finally, the policy experiments focus on the interaction between fiscal-contingent switching and debt-aware prudential design. Any reduced-form bond-yield wedge linked to public debt (Section 4.5) is kept common across regimes and is not part of the 2×2 policy-design comparison.

4.8 Banking sector

Banks intermediate funds between patient savers and impatient borrowers. Let D_t denote nominal deposits, M_t^B nominal loans, and K_t^b nominal bank capital (regulatory capital). All balance-sheet quantities (D_t, M_t^B, K_t^b) are beginning-of-period stocks carried into period t, so interest rates dated $t-1$ apply to these stocks in period t. The bank balance sheet is

$$
M_t^B = D_t + K_t^b. \tag{68}
$$

In equilibrium, deposits are held by patient households and loans are extended to impatient households, so that

$$
D_t = N_{P,t}, \qquad M_t^B = N_{I,t}. \tag{69}
$$

We define the regulatory capital ratio as

$$
\kappa_t^b \equiv \frac{K_t^b}{M_t^B}. \tag{70}
$$

4.8.1 Wholesale wedge and capital requirements

Let R_t^M denote the effective wholesale rate relevant for bank lending. We summarize the effect of bank capital requirements with a wedge that depends on the capital-to-loans ratio relative to its target υ_t^b:

$$R_t^M = R_t^{MB} \left(\frac{\kappa_t^b}{\upsilon_t^b} \right)^{-\kappa_{K_b}}, \tag{71}$$

where R_t^{MB} is the gross nominal policy rate. A higher requirement, i.e. a higher υ_t^b, holding fixed bank capital, raises the effective cost of wholesale funding and tightens lending conditions.

4.8.2 Retail pricing of loans and deposits

Retail branches operate under monopolistic competition. Optimal pricing implies a loan markup over the wholesale rate and a deposit markdown relative to the policy rate:

$$R_t^{I,N} = \left(\frac{\varepsilon_{I,t}}{\varepsilon_{I,t} - 1} \right) R_t^M, \qquad R_t^{P,N} = \left(\frac{\varepsilon_{P,t} - 1}{\varepsilon_{P,t}} \right) R_t^{MB}, \tag{72}$$

where $\varepsilon_{I,t} > 1$ and $\varepsilon_{P,t} > 1$ govern, respectively, the time-varying loan markup and deposit markdown.

4.8.3 Net interest income, retention, and dividends

Bank net interest income is the net interest margin:

$$j_t^b = \left(R_{t-1}^{I,N} - 1 \right) M_t^B - \left(R_{t-1}^{P,N} - 1 \right) D_t. \tag{73}$$

A fraction $\omega_b \in [0, 1]$ of net income is retained to build bank capital, and the remainder is distributed as dividends:

$$K_{t+1}^b = (1 - \delta_b) K_t^b + \omega_b \, j_t^b, \qquad \Pi_t^b = (1 - \omega_b) \, j_t^b. \tag{74}$$

In the baseline calibration we set $\omega_b = 1$, so distributed bank dividends are zero and can therefore be omitted from the patient household's budget constraint without affecting the first-order quantitative results.

4.9 Market clearing

Aggregate labor is

$$L_t = L_{P,t} + L_{I,t}. \tag{75}$$

Housing market clearing, with fixed aggregate supply $\bar{h}$, is

$$h_{P,t} + h_{I,t} = \bar{h}. \tag{76}$$

Financial markets clear:

$$D_t = N_{P,t}, \qquad M_t^B = N_{I,t}, \qquad B_t \text{ is held by patient households.} \tag{77}$$

Goods market clearing, or the resource constraint, is

$$Y_t = C_{P,t} + C_{I,t} + I_t + G_t + \Phi_t^I, \tag{78}$$

where Φ_t^I is given by (49).

4.10 Competitive equilibrium

Given initial states $\{C_{i,-1}, h_{i,0}, K_0, K_0^b, B_0, N_{i,0}\}$, exogenous processes (30), (44), (48), (53), (58), (61), and policy rules (52), (57), (66)–(67), a *competitive equilibrium* is a set of stochastic processes for quantities, prices, and multipliers such that:

1. households optimize, so allocations satisfy (31)–(40) and the KKT system (33)–(35);
2. firms optimize, so final-good and intermediate-good allocations satisfy (41)–(46), and factor demands are consistent with marginal costs (45);
3. the capital producer satisfies (47) and adjustment costs (49);
4. the government budget constraint (50) and fiscal rules (52) hold;
5. monetary policy satisfies (57);
6. macroprudential policy satisfies (66)–(67);
7. banks satisfy the balance sheet (68)–(69), the wholesale wedge (71), retail pricing (72), and the income–capital dynamics (73)–(74);
8. markets clear, as in (75)–(78).

The collateral constraint (33) can bind only in a subset of states. We therefore compute equilibrium using a piecewise-linear solution method for occasionally binding constraints (OccBin). The economic equilibrium conditions are the KKT system (33)–(35); the numerical details of regime tracking are delegated to the computational appendix.

5 Calibration and empirical discipline

This section explains how the quantitative exercises are disciplined in the data and calibrated for counterfactual analysis. Our quantitative contribution is a transparent 2×2 decomposition of fiscal transmission under alternative macroprudential designs in an environment with an occasionally binding collateral constraint. Because the main objects of interest are regime-comparative counterfactuals—and because equilibrium paths are computed with a piecewise method—we do not treat full-information estimation as a prerequisite for the analysis. Instead, we adopt a disciplined calibration strategy with three layers of empirical anchoring: (i) standard parameter values from the medium-scale DSGE literature; (ii) deterministic steady-state restrictions pinned down by U.S. long-run ratios; and (iii) a fiscal-stress indicator constructed from data and calibrated to deliver rare but persistent switching with explicit hysteresis.

5.1 Data, transformations, and steady-state targets

Quarterly U.S. macro-financial data serve two roles. First, they discipline the deterministic steady state through long-run expenditure shares and balance-sheet ratios, such as C/Y, I/Y, G/Y, household and public debt-to-GDP, and average tax rates. Second, they discipline the low-frequency behavior of the fiscal-stress indicator that governs policy switching: the smoothing and thresholding are chosen so that the trigger captures prolonged fiscal-stress episodes rather than transitory noise. Appendix A summarizes the data sources, transformations, variable constructions, and baseline empirical variables used in the empirical and calibration exercises; the exact series mnemonics used in the merged dataset are documented in the replication files.

Table 1: **Steady-state empirical targets (U.S.).** Long-run ratios used to discipline the deterministic steady state. Entries report the target values used in the baseline calibration. Debt and private credit ratios are expressed relative to annual GDP.

Target	Definition	Value	Source / role
Consumption share	$\overline{C/Y}$	0.65	NIPA
Investment share	$\overline{I/Y}$	0.20	NIPA
Government share	$\overline{G/Y}$	0.15	NIPA
Public debt ratio	$\overline{B/Y}$	0.75	Treasury/OMB/FRED
Private credit ratio	$\overline{\text{Credit}/Y}$	0.70	Flow of Funds
Labor tax rate	$\overline{\tau^l}$	0.08	NIPA/OECD
Capital tax rate	$\overline{\tau^k}$	0.05	Calibration choice
Consumption tax rate	τ^c_{ss}	0.2081	Implied by government budget closure

Notes: Expenditure shares refer to long-run U.S. flow ratios. Public debt and private credit are reported relative to annual GDP for empirical interpretability. The consumption tax rate τ^c_{ss} is not directly taken from a sample average; it is the residual value implied by government-budget closure at the calibrated steady state.

5.2 Baseline parameterization

Table 2 reports the baseline calibration. Preference, technology, and nominal-rigidity parameters follow standard quarterly benchmarks in medium-scale New Keynesian models. Financial and banking parameters follow the banking-with-capital-cost tradition and are disciplined by typical spreads and leverage dynamics. Monetary policy follows a Taylor-type rule with interest-rate smoothing and an inflation response consistent with the Taylor principle.

A key design choice is that the deterministic steady state is held fixed across policy regimes in Section 6. Counterfactual differences in multipliers and welfare therefore reflect policy design and nonlinear propagation rather than shifts in the underlying long-run environment.

5.2.1 Interpreting debt-aware coefficients in observable units

Debt awareness enters the macroprudential rules through the unit-free, predetermined public-debt state

$$\widetilde{b}_t \equiv \frac{B_t/(P_{t-1}Y_{t-1})}{B_{ss}/(P_{ss}Y_{ss})},$$

which depends only on beginning-of-period debt B_t and lagged nominal GDP $P_{t-1}Y_{t-1}$. For interpretation in annual debt-to-GDP units, again using lagged nominal GDP, define

$$b_t^{ann} \equiv \frac{B_t}{4P_{t-1}Y_{t-1}}, \qquad b_{ss}^{ann} \equiv \frac{B_{ss}}{4P_{ss}Y_{ss}}.$$

With $b_{ss}^{ann} = 0.75$, it follows that $\widetilde{b}_t = b_t^{ann}/b_{ss}^{ann}$.

To translate the debt-aware coefficients into observable magnitudes, consider a one-off

Table 2: **Baseline calibration.**

Parameter	Value	Description	Source / target (compact)
Preferences and technology			
α	0.40	Capital share	Standard quarterly benchmark
σ	1.00	CRRA (inv. IES)	Log-utility benchmark
φ	1.00	Inverse Frisch	Unit Frisch benchmark
θ_P	0.60	Patient HH share	Calibration choice; robustness in Appendix
β_P	0.9943	Patient discount	Target: steady-state nominal return
β_I	0.9750	Impatient discount	(Iacoviello, 2005; Gerali et al., 2010)
ϕ_c	0.70	Habit	(Smets and Wouters, 2007) (range)
j	0.199	Housing weight	Target: steady-state housing ratios; (Gerali et al., 2010)
Nominal rigidities and markups			
θ	0.75	Calvo stickiness	(Calvo, 1983; Smets and Wouters, 2007)
ϕ	11	Substitution elasticity	Target: markup $\mu \approx 1.10$
Monetary policy			
γ_R	0.60	Smoothing	(Taylor, 1993; Smets and Wouters, 2007)
γ_π	1.50	Inflation response	Taylor principle
γ_Y	0.10	Output response	Standard small weight
Capital accumulation / investment			
χ	10.26	Investment adjustment cost	Standard IAC benchmark (e.g., Smets and Wouters, 2007); robustness in Appendix
Banking / spreads			
κ_{K_b}	7.5	Capital req. cost	Banking DSGE calibration tradition; (Gerali et al., 2010)
δ_b	0.018	Bank cap. depreciation	(Gerali et al., 2010)
ψ_B	0.02	NET spread slope	Calibration choice; wedge kept common across regimes; robustness in Appendix
ρ_{Ω_B}	0.00	Persistence of shadow spread wedge	Benchmark specification; with $\rho_{\Omega_B} = 0$, the shadow-wedge block collapses to an equivalent one-equation spread form.
Macroprudential rules			
γ_υ	0.90	Persistence (υ)	Baseline policy inertia; robustness in Appendix
γ_{LTV}	0.95	Persistence (LTV)	Baseline policy inertia; robustness in Appendix
ϕ_υ^H	4.0	Tight response	Calibration choice; robustness in Appendix
ϕ_{LTV}^H	-4.0	Tight response	Calibration choice; robustness in Appendix
ϕ_υ^L	2.5	Relax response	Calibration choice; robustness in Appendix
ϕ_{LTV}^L	-2.5	Relax response	Calibration choice; robustness in Appendix
$\phi_{\upsilon,B}^H$	8.0	Debt-aware (tight)	Calibration choice; robustness in Appendix
$\phi_{LTV,B}^H$	-8.0	Debt-aware (tight)	Calibration choice; robustness in Appendix
$\phi_{\upsilon,B}^L$	0.75	Debt-aware (relaxed)	Calibration choice; robustness in Appendix
$\phi_{LTV,B}^L$	-0.75	Debt-aware (relaxed)	Calibration choice; robustness in Appendix

Notes: “Target” refers to steady-state U.S. ratios constructed from National Accounts, Flow of Funds, and rate/spread targets reported in the Appendix. Macroprudential coefficients are baseline policy-design values chosen to imply economically plausible instrument movements in observable units; they are informed by the rule-based macroprudential literature (e.g., Angelini et al., 2014) and stress-tested in the Appendix.

Table 3: **Debt-aware coefficients in observable units (impact mapping).** Implied one-quarter changes for a $\Delta b^{ann} = 10$pp increase in debt-to-GDP (from 75% to 85% of annual GDP), using $(\gamma_\upsilon, \gamma_{LTV}) = (0.90, 0.95)$. Percentage-point changes are computed at $\upsilon_{ref} = 10\%$ and $LTV_{ref} = 80\%$.

Fiscal state	$(\phi_{\upsilon,B}, \phi_{LTV,B})$	$\Delta \log \upsilon_t^b$	$\Delta\upsilon_t^b$ (pp)	ΔLTV_t (pp)
Relaxed (low-stress)	$(0.75, -0.75)$	$+0.0094$	$+0.09$	-0.37
Tight (high-stress)	$(8, -8)$	$+0.1001$	$+1.05$	-3.91

Notes: $\Delta\upsilon_t^b$ (pp) and ΔLTV_t (pp) are computed as $100 \times X_{ref} \times (\exp(\Delta \log X_t) - 1)$, with X_{ref} expressed in levels (e.g., 0.10 and 0.80).

increase in annual debt-to-GDP of $\Delta b^{ann} = 10$ percentage points, from 0.75 to 0.85. The implied proportional change is $\log(1 + \Delta b^{ann}/b_{ss}^{ann}) = \log(1 + 0.10/0.75) \approx 0.1252$.

Holding fixed the private-credit terms and shocks in the rules, the one-quarter impact response of instrument $X \in \{\upsilon^b, LTV\}$ is approximately

$$\Delta \log X_t \;\approx\; (1 - \gamma_X)\, \phi_{X,B} \, \log\!\left(1 + \frac{\Delta b^{ann}}{b_{ss}^{ann}}\right), \qquad \gamma_X \in \{\gamma_\upsilon, \gamma_{LTV}\}. \tag{79}$$

Thus, inertia through $(1-\gamma_X)$ attenuates the impact response. Under the baseline inertias $(\gamma_\upsilon, \gamma_{LTV}) = (0.90, 0.95)$ and debt-aware coefficients $(\phi^H_{\upsilon,B}, \phi^H_{LTV,B}) = (8, -8)$ in the tight (high-stress) state and $(\phi^L_{\upsilon,B}, \phi^L_{LTV,B}) = (0.75, -0.75)$ in the relaxed state, Table 3 reports the implied impact changes. For interpretability, we convert log changes into percentage-point adjustments using representative policy levels, $\upsilon_{ref} = 10\%$ and $LTV_{ref} = 80\%$. The mapping scales proportionally with the chosen reference levels.

The macroprudential coefficients are not estimated structural reaction parameters. They are baseline policy-design values chosen to generate economically plausible instrument movements in observable units, and are stress-tested in the robustness analysis.

Additional institutional context and references on typical policy magnitudes are provided in Appendix D.1.

5.3 Fiscal-stress indicator and trigger calibration

The trigger is constructed from observed fiscal conditions using a low-frequency transformation. Two implementation choices are essential both for empirical discipline and for numerical stability of regime switching: persistence through smoothing, and regime switching through a threshold with hysteresis.

Let x_t denote the raw fiscal condition used to measure stress. We construct a low-frequency indicator via double exponential smoothing,

$$\tilde{x}_t = (1 - \rho_1)\, x_t + \rho_1 \tilde{x}_{t-1}, \qquad s_t = (1 - \rho_2)\, \tilde{x}_t + \rho_2 s_{t-1}, \tag{80}$$

so that s_t captures fiscal episodes rather than quarter-to-quarter measurement noise. This ensures that policy switching is meaningful at the horizon at which macroprudential instruments are typically adjusted.

Switching is governed by a threshold $\bar{s}$ and a tolerance band $\bar{s}_{\text{tol}}$, implemented as a simple entry–exit rule. Let $\mathbb{I}_t \in \{0, 1\}$ denote the regime indicator, where 1 corresponds to the tight regime. Then

$$\mathbb{I}_t = \begin{cases} 1, & s_t \geq \bar{s} + \bar{s}_{\text{tol}}, \\ 0, & s_t \leq \bar{s} - \bar{s}_{\text{tol}}, \\ \mathbb{I}_{t-1}, & \text{otherwise.} \end{cases} \tag{81}$$

The tolerance band prevents mechanically frequent reversals, or chattering, and delivers rare but persistent tight-regime spells, consistent with interpreting fiscal stress as an episode variable rather than a high-frequency signal.

To discipline fiscal-state contingency, we apply the same smoothing-and-hysteresis logic in the data and in the model. In the empirical construction, x_t is an observed fiscal signal and $(s_t, \mathbb{I}_t)$ summarize episodic stress. In the model, we construct the analogue of s_t from the corresponding model-consistent fiscal object, such as a smoothed primary-deficit or debt-gap signal, and denote this smoothed trigger by $Trig_t$ (a normalized, bounded transformation; see Appendix A). The trigger is used only to shift macroprudential rule coefficients.

We calibrate the entry threshold $\bar{s}$ and tolerance band $\bar{s}_{\text{tol}}$ in the model-consistent units of the smoothed trigger to match salient regime moments in the data: (i) the unconditional frequency of high-stress quarters and (ii) the typical duration of high-stress spells. In the baseline calibration we set $(\bar{s}, \bar{s}_{\text{tol}}) = (0.0015, 0.0004)$, so that $\bar{s}_{\text{tol}}/\bar{s} \approx 0.27$. The smoothing parameters (ρ_1, ρ_2) are chosen to deliver a low-frequency stress process consistent with these spell moments. This is a moment-based strategy and does not attempt to map $(\bar{s}, \bar{s}_{\text{tol}})$ one-for-one into a single raw fiscal statistic. More broadly, the reduced-form evidence is used here to discipline the empirical plausibility of episodic fiscal stress and state-dependent housing and credit propagation, rather than to impose a precise sign target for every model-based interaction object.[9]

Appendix A reports the spell statistics, together with the full time series of x_t, s_t, and $\mathbb{I}_t$, and the associated validation plots. As an additional comparability check, Figure 11 shows that the trigger path is nearly invariant across policy regimes in the one-shock experiment, so the 2×2 comparisons are not driven by endogenous differences in trigger activation.

[9]Let s_t denote the doubly smoothed stress indicator used in the switching rule. The economy enters the tight regime when $s_t \geq \bar{s} + \bar{s}_{\text{tol}}$ and exits when $s_t \leq \bar{s} - \bar{s}_{\text{tol}}$. We calibrate $(\bar{s}, \bar{s}_{\text{tol}})$ so that, in the U.S. sample, (i) $\frac{1}{T}\sum_{t=1}^{T} \mathbb{I}_t$ matches the empirical frequency of stress quarters and (ii) the average duration of consecutive $\mathbb{I}_t = 1$ spells matches the persistence implied by s_t.

Table 4: Empirical discipline moments for the fiscal-stress trigger: targets, model fit, and validation diagnostics.

Moment / diagnostic	**Data / target**	**Model (matched)**	**Role in discipline**
Stress frequency (share of quarters in stress state)	21.25%	21.25%	Pins down rarity of episodes
Average stress spell duration (quarters)	17.00	17.00	Pins down persistence / hysteresis
Trigger-path comparability diagnostics across ON economies (B vs D; model validation)			
Cross-regime trigger-path correlation (B vs D)	—	0.999149	Checks regime invariance / endogenous-trigger concern
Maximum trigger-path gap (B vs D)	—	1.735×10^{-4}	Quantifies near-overlap of trigger paths
Regime-indicator mismatch (fiscal trigger state, B vs D)	—	0.000000	Verifies identical hysteresis timing in ON regimes

Notes: The first two rows report the empirical spell moments targeted in calibration, rarity and persistence, together with the corresponding model fit. The remaining rows report cross-regime trigger-path comparability diagnostics for the ON economies (B vs D) over the first 80 quarters. Reduced-form evidence is interpreted as suggestive discipline in the sense of episodicity, persistence, and state dependence, rather than as point identification of the sign of a structural interaction.

5.4 Policy-rule coefficients and shock processes

Parameters governing inertia and persistence in policy rules and exogenous processes are set to values that are standard in the quarterly DSGE literature and consistent with stable linear dynamics around the deterministic steady state. Our quantitative exercises focus on how fiscal-stress-triggered switching and debt-aware macroprudential responses reshape transmission conditional on a fixed baseline calibration. Our objective is not to identify a historical policy rule, but to compare internally consistent policy-design counterfactuals under a fixed, empirically disciplined baseline. Robustness to alternative values within conventional ranges is reported in Appendix D.

6 Results

This section reports two sets of quantitative results. We begin with a benchmark government spending expansion in an environment in which the fiscal-stress trigger is inactive, in order to (i) benchmark the OccBin piecewise solution against a standard linear approximation and (ii) isolate the effect of debt-aware macroprudential rules. We then turn to the main object of the paper: a transparent 2×2 design in which macroprudential policy varies with fiscal stress, allowing us to quantify the interaction between fiscal-state contingency and debt awareness.

6.1 Benchmark government spending shock: debt-blind vs. debt-aware macroprudential policy

Before turning to the 2×2 policy matrix, we consider a benchmark government spending expansion in an environment in which the fiscal-stress trigger is inactive, so macroprudential coefficients are fixed and do not vary with fiscal-stress conditions. This benchmark serves two purposes. First, it quantifies the importance of occasionally binding collateral constraints by comparing the OccBin piecewise solution with a standard linear approximation around the deterministic steady state. Second, it shows how debt-aware macroprudential rules alter the propagation of a given fiscal disturbance even when prudential policy does not adjust state-contingently to fiscal stress.

6.1.1 Debt-blind benchmark: OccBin piecewise vs. linear approximation

We begin with a benchmark government spending expansion under debt-blind macroprudential policy, that is, with no direct response of prudential instruments to public-debt conditions. Because macroprudential policy does not switch with fiscal stress in this exercise, the only source of nonlinearity is the collateral constraint, which can bind endogenously and is handled with OccBin (piecewise-linear solution). We compare the OccBin path with the standard linear approximation around the deterministic steady state.

In the deterministic steady state, the collateral constraint is slack, so the associated multiplier satisfies $\mu_{ss} = 0$. A first-order approximation around this steady state therefore corresponds to an always-slack benchmark: the collateral wedge is locally inactive at first order and the economy cannot transition into a binding episode within the linearized system. By contrast, the OccBin solution allows endogenous regime switching, so the collateral wedge becomes first-order precisely during binding spells.

Figure 10 reports the 0/1 binding indicator along the OccBin path. The indicator equals one in periods in which the binding regime is active in the piecewise solution, and zero otherwise. A government spending expansion can therefore endogenously move the economy into a constrained financial regime, and the resulting binding spell is persistent enough for state dependence to matter quantitatively. By construction, this binding episode is absent in the linear always-slack benchmark.

Figures 6–7 compare impulse responses under OccBin and under linearization. Two patterns stand out. First, the piecewise dynamics display kinks and locally flat segments in variables linked to the collateral wedge—features that are mechanically absent under linearization—reflecting the KKT logic: wedges are first-order when the constraint binds and irrelevant when it is slack. Second, linearization delivers a markedly different medium-horizon profile, treating the constraint as marginal in all states and thereby misrepresenting adjustment during, and after, the binding spell.[10]

Table 5 summarizes transmission using present-value (PV) and cumulative output multipliers computed from simulated paths. Impulse responses are reported as log deviations from steady state, $(\hat{y}_t, \hat{g}_t)$, and are mapped into level ("dollar") deviations using the standard linear approximation $\Delta Y_t \equiv Y_{ss}\hat{y}_t$ and $\Delta G_t \equiv G_{ss}\hat{g}_t$. For a horizon H, the PV output multiplier is defined as

$$M_H^{PV} \equiv \frac{\sum_{t=0}^{H-1} d_t\, \Delta Y_t}{\sum_{t=0}^{H-1} d_t\, \Delta G_t} = \frac{\sum_{t=0}^{H-1} d_t\, \hat{y}_t}{(G_{ss}/Y_{ss}) \sum_{t=0}^{H-1} d_t\, \hat{g}_t}, \tag{82}$$

where the discount weights $\{d_t\}$ are proportional to the patient household's intertemporal pricing kernel and are constructed recursively from the deposit-anchored Euler equation (38):

$$d_0 = 1, \qquad d_{t+1} = d_t\, \beta_P \exp\Big(-\widehat{r}_t^{\,\mathrm{real}}\Big), \qquad \widehat{r}_t^{\,\mathrm{real}} \equiv \widehat{R}_t^{P,N} - \widehat{\pi}_{t+1}.$$

This deposit-anchored pricing condition reflects the segmented treatment of sovereign bond holdings discussed above: deposits are the marginal liquid saving instrument in the benchmark system, whereas government bonds remain an off-margin portfolio position.

The cumulative multiplier is defined analogously with $d_t \equiv 1$. Entries are GDP-scaled, that is, output per % of GDP of the spending innovation, using the steady-state spending share for scaling.

The quantitative message is clear. Although impact multipliers are similar across solution methods, the gap widens quickly with the horizon, and linearization even implies a sign reversal at medium horizons, whereas the OccBin multipliers remain positive in this calibration. This is why the policy comparisons that follow rely on the piecewise protocol.

The pattern in Table 5 reflects the economics of an occasionally binding collateral constraint. Under the piecewise (OccBin) solution, the spending expansion generates a persistent binding spell (Figure 10), during which the collateral wedge is first-order and the propagation of the shock differs sharply from the slack regime. A purely local linear approximation cannot reproduce this regime timing: it effectively spreads the collateral wedge and its feedback over all states, rather than allowing it to switch "on" only when the constraint binds and "off" once it becomes slack. As the horizon lengthens, this timing error becomes quantitatively decisive for present-value objects, which explains why the linear PV multiplier flips sign at medium horizons whereas the OccBin PV multiplier remains positive in this calibration. We therefore treat the linear solution as a diagnostic benchmark, but rely on the piecewise protocol for the policy comparisons that follow.

[10] In the piecewise solution, the collateral condition is imposed as an equality in the binding regime; hence the slack proxy (`comp_collat`) is mechanically pinned at zero during binding periods. Episode severity is therefore captured by the shadow value μ_t (reported in Appendix Table 17), not by the slack level itself.

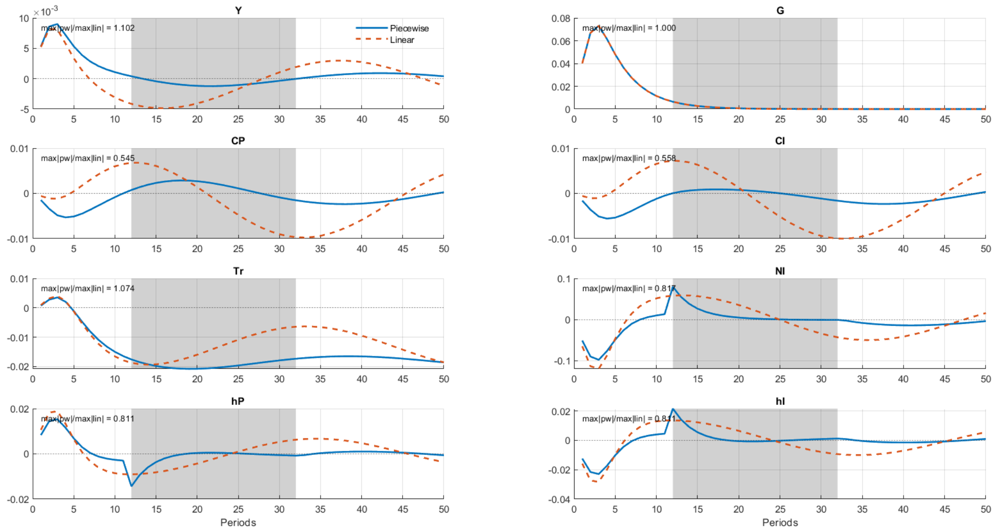


Figure 6: Debt-blind benchmark: government spending shock impulse responses (panel 1).

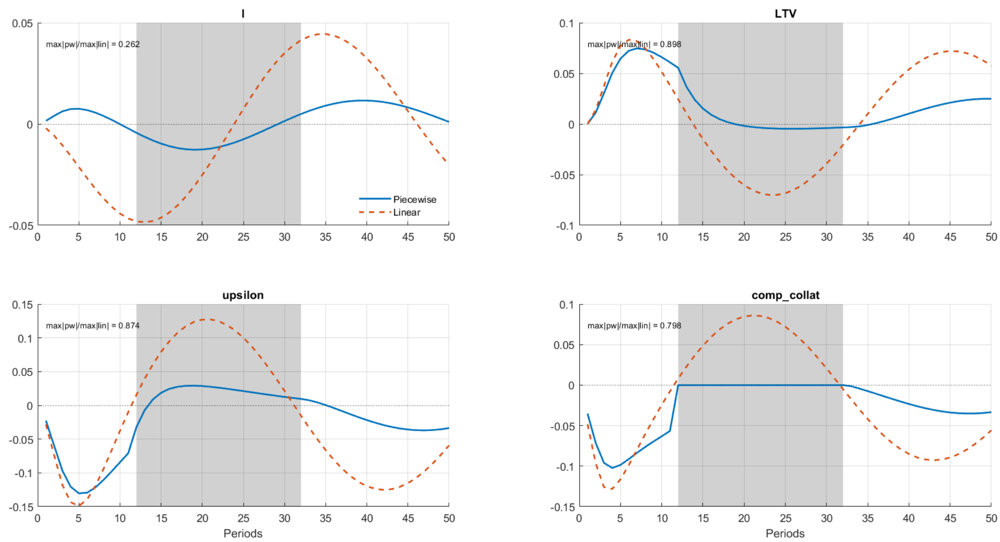


Figure 7: Debt-blind benchmark: government spending shock impulse responses (panel 2).

Table 5: **Government spending multipliers (G): OccBin piecewise vs. linear approximation (Debt-Blind, GDP-scaled).** Present-value (PV) multipliers are discounted; cumulative multipliers are undiscounted. All entries report output per % of GDP of the spending innovation.

	PV multiplier		Cumulative multiplier	
H	OccBin (piecewise)	Linear	OccBin (piecewise)	Linear
1	0.88618	0.86755	0.88618	0.86755
4	0.83053	0.75307	0.83029	0.75252
8	0.78846	0.54680	0.78753	0.54180
12	0.76920	0.29090	0.76750	0.27465
20	0.66648	-0.24661	0.65609	-0.30301
40	0.59342	-0.10659	0.57806	-0.12175

Notes: In this calibration, the linear approximation implies a sign reversal at medium horizons ($H \geq 20$), whereas the OccBin (piecewise) multipliers remain positive through $H = 40$.

Because discount weights d_t depend on equilibrium real rates and inflation, PV objects can in principle reflect differences in discounting across counterfactuals. As a robustness check, we recompute PV multipliers using (i) a regime-invariant discount sequence $d_t = \beta_P^t$ for all scenarios and (ii) a common sequence fixed to the baseline counterfactual. The PV ranking and the 2×2 interaction are unchanged (Appendix D.3).

6.1.2 Adding debt awareness

We next repeat the same government spending experiment, but switch macroprudential rules from debt-blind to debt-aware. Concretely, the prudential instruments respond directly to the public-debt-to-GDP ratio as in (66)–(67), while prudential coefficients are held state-invariant, that is, they are not allowed to vary with fiscal stress. This isolates the effect of debt awareness alone. The equilibrium is again computed using OccBin, allowing the collateral constraint to bind endogenously.

Figures 8–10 report the binding indicator and impulse responses for the debt-aware benchmark. Relative to the debt-blind case, debt-aware rules alter the endogenous tightening of borrower-based conditions following the fiscal expansion, which in turn reshapes the incidence and duration of binding episodes and compresses the medium-horizon leverage-cycle dynamics—credit, LTV utilization, and house prices—even though the government spending path is identical.

The divergence between solution methods is even more pronounced under debt-aware rules in Table 6. Debt awareness introduces an endogenous prudential feedback from public debt into borrower-based conditions, so the mapping from a fiscal shock into output becomes more state dependent and more sensitive to whether the economy is near, or inside, the binding region. The piecewise solution captures this mechanism because it allows the economy to move across slack and binding regimes and lets the prudential feedback bite most when the collateral margin is relevant. A linear approximation, by construction, cannot track these regime transitions and therefore delivers a qualitatively different medium-horizon profile of multipliers. The implication is not that linear multipliers are generically "wrong," but that with occasionally binding constraints and endogenous prudential feedback, linear present-value multipliers are not reliable quantitative guides to medium-horizon fiscal transmission.

To summarize transmission in the debt-aware benchmark, Table 7 reports GDP-scaled PV multipliers at policy-relevant horizons. Debt awareness reduces PV multipliers at medium and long horizons in this experiment, consistent with a stronger prudential leaning against fiscal-driven balance-sheet expansion.

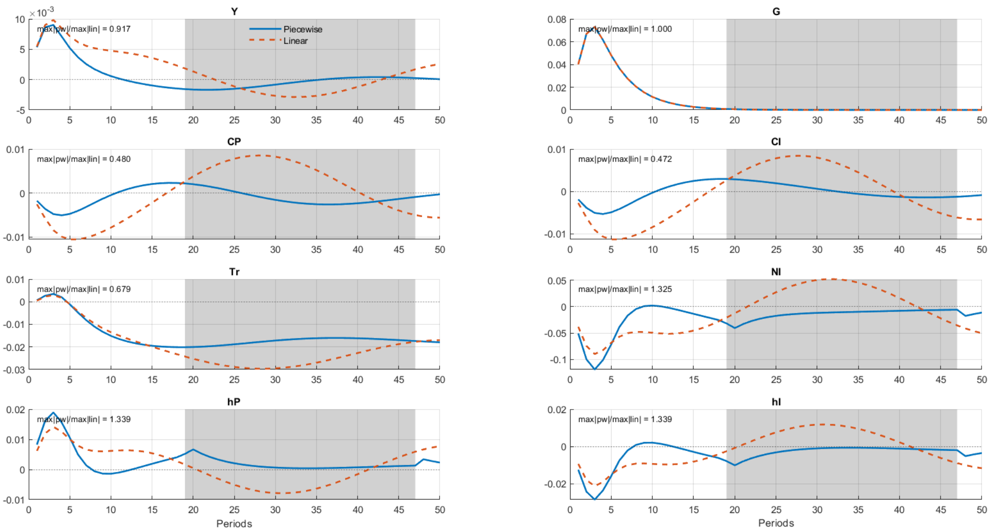


Figure 8: Debt-aware benchmark: government spending shock impulse responses (panel 1).

Table 7 isolates the effect of debt awareness within the OccBin solution. Debt-aware multipliers are lower than their debt-blind counterparts at all horizons, and the gap widens with the horizon. The mechanism is straightforward: as public debt accumulates after the spending shock, debt-aware prudential rules tighten borrower-based conditions more aggressively, compressing leverage-cycle amplification—credit, LTV utilization, and house prices—and thereby dampening the medium-run output expansion. This attenuation is a key building block for the 2×2 results, where the prudential stance is also allowed to vary with fiscal-stress conditions.

Even with the fiscal-stress trigger inactive, debt awareness materially reshapes fiscal transmission by tightening borrower-based conditions as public debt rises. This compresses medium-horizon PV multipliers in the benchmark experiment and changes nonlinear propagation through the occasionally binding collateral constraint. The next subsection allows macroprudential coefficients to vary with fiscal-stress conditions and evaluates the

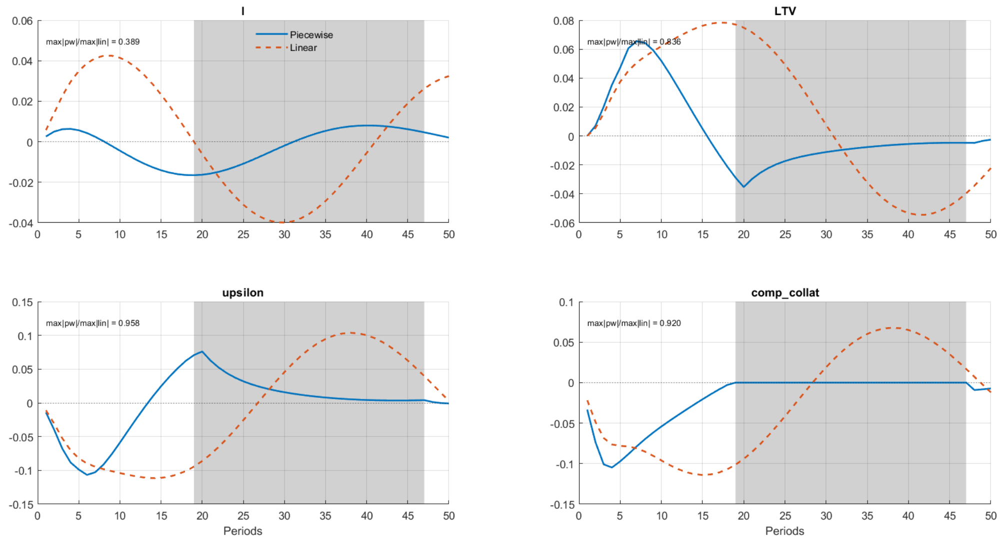
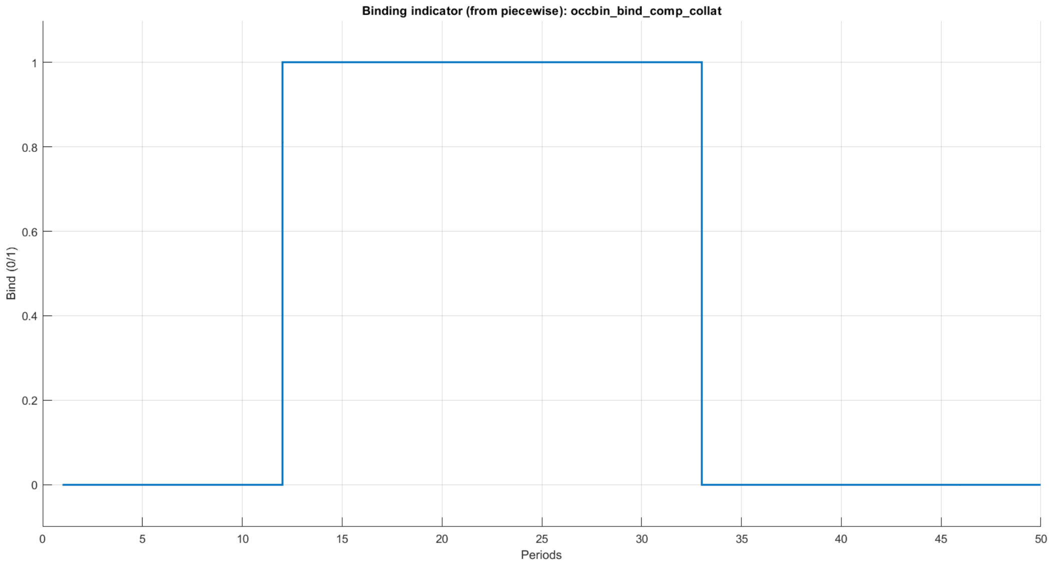


Figure 9: Debt-aware benchmark: government spending shock impulse responses (panel 2).

full 2×2 policy design: state-invariant versus state-contingent, crossed with debt-blind versus debt-aware rules.

The always-slack linearized system is determinate under the policy-rule specifications considered (Appendix Table 16). Hence, the large differences in linear multipliers across regimes reflect changes in policy feedback, not numerical instability.



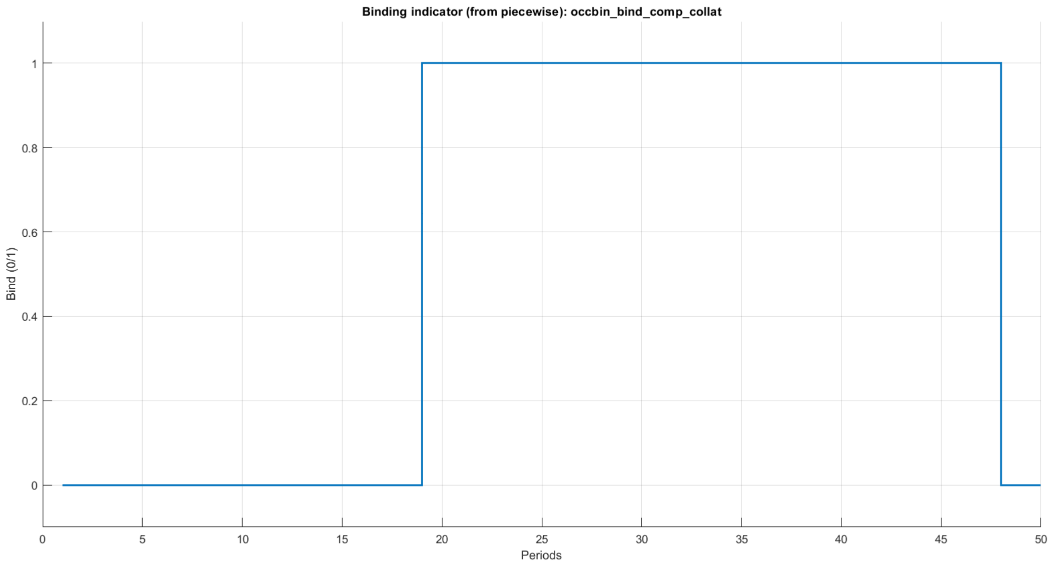


Figure 10: Binding indicator for the collateral (borrowing) constraint in the one-shock experiment. The series equals one in periods in which the collateral constraint binds along the piecewise solution, and zero otherwise. The two panels correspond to the benchmark experiments in Sections 6.1.1 and 6.1.2.

Table 6: **Government spending multipliers (G): OccBin piecewise vs. linear approximation (Debt-Aware, trigger OFF, GDP-scaled).** Present-value (PV) multipliers are discounted; cumulative multipliers are undiscounted. All entries report output per % of GDP of the spending innovation.

	PV multiplier (discounted)		Cumulative multiplier (no discount)	
H	OccBin (piecewise)	Linear	OccBin (piecewise)	Linear
1	0.88986	0.90575	0.88986	0.90575
4	0.83127	0.90423	0.83102	0.90428
8	0.77211	1.01020	0.77078	1.01250
12	0.72268	1.19940	0.71928	1.20970
20	0.56287	1.48500	0.54650	1.51750
40	0.36475	1.03060	0.32301	0.97380

Notes: "Debt-Aware" refers to activating the direct public-debt terms in the prudential rules ($\phi_{v,B} \neq 0$, $\phi_{LTV,B} \neq 0$) while keeping fiscal-stress switching OFF. Numbers are GDP-scaled.

Table 7: **Summary: GDP-scaled PV spending multipliers under OccBin (piecewise) in the benchmark G-shock.** Debt-Blind vs. Debt-Aware macroprudential rules (trigger OFF).

H	Debt-Blind (OccBin)	Debt-Aware (OccBin)	Aware − Blind
20	0.66648	0.56287	-0.10361
40	0.59342	0.36475	-0.22867
80	0.58965	0.29155	-0.29810

Notes: "Debt-Aware" activates the direct public-debt terms in the prudential rules ($\phi_{v,B} \neq 0$, $\phi_{LTV,B} \neq 0$) while keeping fiscal-stress switching OFF. PV multipliers are discounted and reported as output per % of GDP of the spending innovation (GDP-scaled).

6.2 Fiscal stress triggers and debt-aware macroprudential policy: a 2×2 experiment

6.2.1 Experimental design and regimes

We evaluate two design choices for borrower-based macroprudential policy: (i) whether the stance switches with fiscal stress (state-contingent, "triggered") and (ii) whether the rule is debt-aware. To isolate these two margins, we implement a transparent 2×2 design that combines state-contingent switching (ON vs. OFF) and debt awareness (Blind vs. Aware).

The model is log-linearized around the deterministic steady state and simulated with a piecewise-linear solution that accommodates the occasionally binding collateral constraint.[11]

[11] The piecewise path satisfies the linearized equilibrium conditions and regime-specific policy rules while allowing the collateral constraint to bind endogenously along the simulation, in the spirit of OccBin.

The four regimes are summarized by

	Debt-blind	Debt-aware
Non-triggered (OFF)	A	C
Triggered (ON)	B	D

For any horizon-H outcome $X(H)$, whether a PV multiplier or CEV welfare, this structure yields the difference-in-differences interaction

$$\mathcal{I}_X(H) \equiv \Big(X_D(H) - X_C(H)\Big) - \Big(X_B(H) - X_A(H)\Big).$$

A positive interaction indicates that switching and debt awareness are complements for $X(H)$, whereas a negative interaction indicates substitutability. We report welfare interactions $\mathcal{I}_W(H)$ in basis points (bps) of CEV and multiplier interactions $\mathcal{I}_M(H)$ in GDP-scaled PV units.

Macroprudential policy is governed by two rule coefficients, (ϕ_v, ϕ_{LTV}), which determine how the capital-requirement target and the loan-to-value limit respond to credit conditions. Low- and high-stress stances are parameterized as

$$(\phi_v^L, \phi_{LTV}^L) = (2.5, -2.5), \qquad (\phi_v^H, \phi_{LTV}^H) = (4, -4).$$

In debt-aware regimes, the direct public-debt terms also take low/high values across fiscal states:

$$(\phi_{v,B}^L, \phi_{LTV,B}^L) = (0.75, -0.75), \qquad (\phi_{v,B}^H, \phi_{LTV,B}^H) = (8, -8).$$

Debt-blind regimes impose $(\phi_{v,B}^L, \phi_{LTV,B}^L) = (\phi_{v,B}^H, \phi_{LTV,B}^H) = (0, 0)$.

Switching (ON vs. OFF) selects the low- versus high-stress coefficient sets via I_t^{fisc}. Debt awareness (Aware vs. Blind) changes only whether the public-debt terms are active: in Blind regimes $\phi_{v,B}^L = \phi_{v,B}^H = \phi_{LTV,B}^L = \phi_{LTV,B}^H = 0$, whereas in Aware regimes they take the baseline low/high values reported above.

When switching is ON, the fiscal-stress regime indicator $I_t^{\text{fisc}} \in \{0, 1\}$ is constructed from the smoothed trigger $Trig_t$ using the hysteresis thresholds $\bar{s} \pm \bar{s}_{\text{tol}}$; see Section 5.3. We refer to the low-stress state ($I_t^{\text{fisc}} = 0$) as the relaxed stance and to the high-stress state ($I_t^{\text{fisc}} = 1$) as the tight stance.[12]

A natural concern in regime-switching counterfactuals is that the fiscal-stress trigger may itself become endogenous to policy design: if regimes A–D imply different output and debt dynamics, the trigger could shift, altering the time spent in the tight prudential stance and confounding policy effects with endogenous regime selection.

Figure 11 addresses this concern. The upper panel plots the smoothed trigger variable

[12]The fiscal-stress indicator is a smoothed trigger. The hysteresis band prevents high-frequency chattering in regime classification.

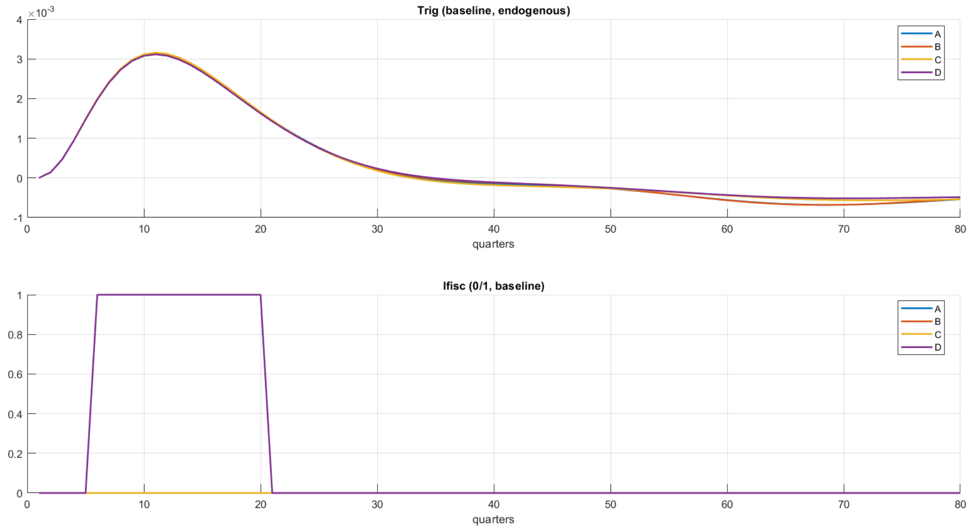


Figure 11: **Trigger endogeneity diagnostic (baseline).** Top: smoothed fiscal-stress trigger $Trig_t$ along the one-shock experiment under regimes A–D. Bottom: implied regime indicator $I_t^{fisc} \in \{0, 1\}$, equal to one when the fiscal-stress/tight-prudential regime is active. The trigger path is nearly identical across regimes, and the activation window overlaps across the ON economies, supporting regime comparability.

$Trig_t$ along the one-shock experiment under each regime A–D. The paths are nearly indistinguishable, indicating that the trigger signal is only weakly affected by policy design in this experiment. The lower panel reports the implied regime indicator $I_t^{fisc} \in \{0, 1\}$, equal to one when the fiscal-stress/tight-prudential regime is active. The OFF economies have $I_t^{fisc} \equiv 0$ by construction, while the activation window overlaps across the ON economies. Hence, the 2×2 comparisons are unlikely to be driven by differential trigger paths or endogenous regime selection.[13]

6.2.2 Shock specification and simulation horizon

We consider a persistent government spending disturbance implemented as a short sequence of surprise innovations:

$$e_{G,1} = 0.04, \qquad e_{G,2} = 0.025, \qquad e_{G,3} = 0.012, \qquad e_{G,t} = 0 \quad (t \geq 4).$$

All simulations are run for $T = 800$ periods; figures report the first 25 periods.

Figures 12–14 summarize the 2×2 comparison. Output responses are close on impact across regimes, but the paths separate as borrower leverage and financial tightness adjust endogenously. Debt awareness shifts the medium-horizon output profile downward,

[13]For completeness, Appendix Figure 15 and Table 18 show that the implied hysteresis timing is identical across the ON economies (B and D): entry and exit dates coincide, and $\mathbb{E}|I_t^{\text{fisc},D} - I_t^{\text{fisc},B}| = 0$ over the first 80 quarters. In addition, $\text{corr}(Trig_t^B, Trig_t^D) = 0.999149$ and $\max_{t \leq 80} |Trig_t^D - Trig_t^B| = 1.735 \times 10^{-4}$.

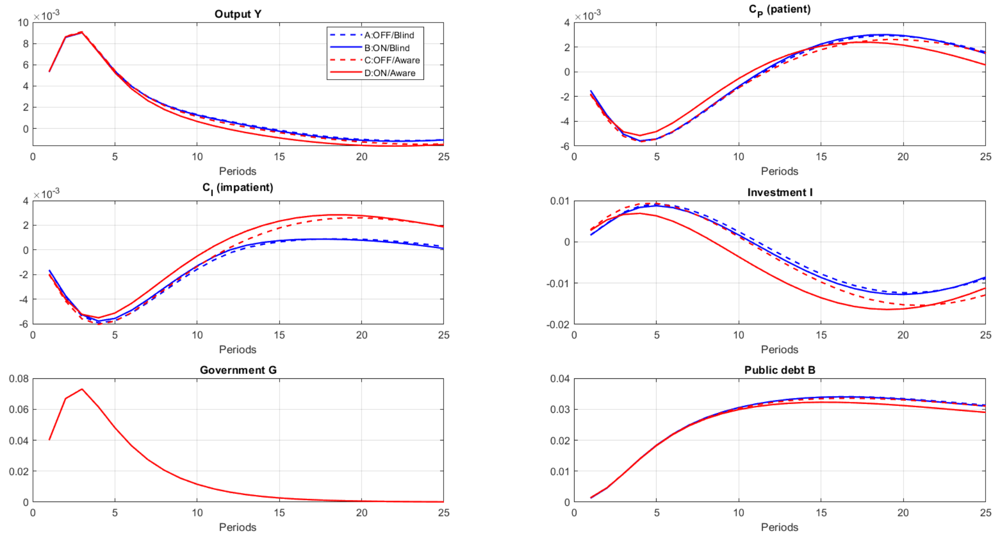


Figure 12: Impulse responses in the 2×2 experiment: macro aggregates.

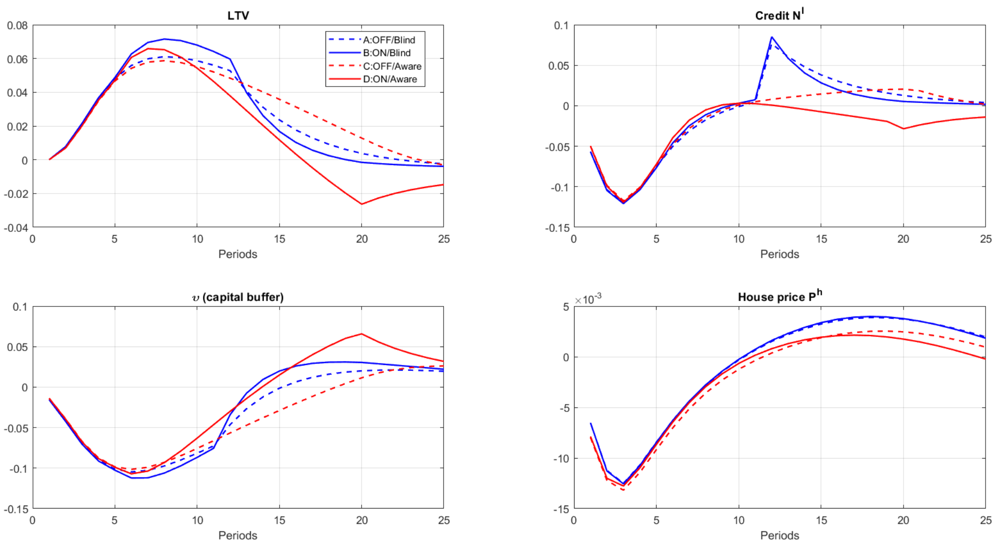


Figure 13: Impulse responses in the 2×2 experiment: housing and leverage-cycle variables.

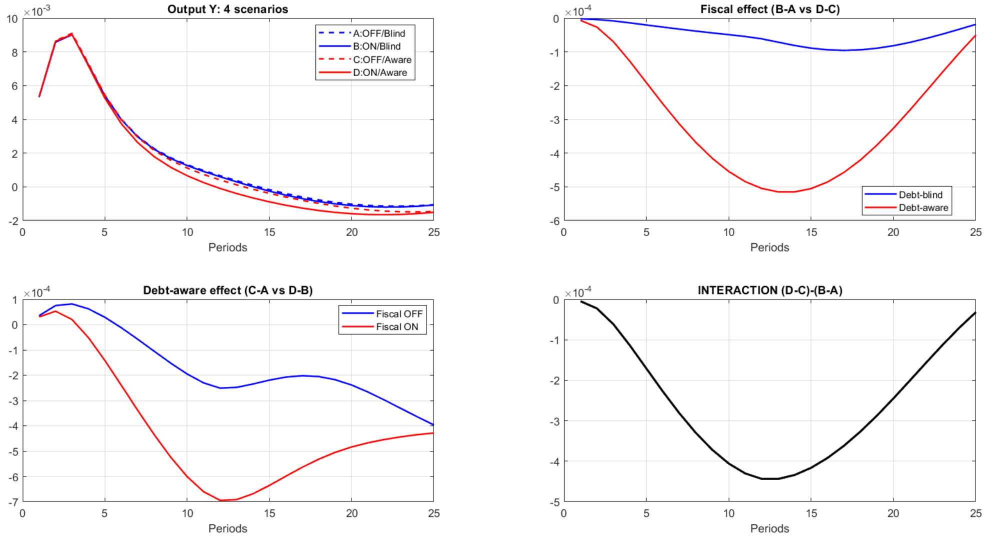


Figure 14: Impulse responses: interaction ($D - C$ minus $B - A$) across key variables.

with the largest attenuation under ON/Aware (scenario D). This ordering anticipates the multiplier evidence below: both switching and debt awareness dampen the output expansion, and their joint operation generates an economically meaningful interaction.

Relative to Blind regimes, debt-aware policy compresses leverage-cycle variables: the LTV run-up is more contained, credit expansion of constrained households is more muted, and the house-price boom is markedly smaller. These differences are strongest when switching is ON, that is, when policy tightens precisely in fiscally stressed states. The interaction plots in Figure 14 show that the joint design operates primarily through financial amplification channels rather than through the direct government spending path, which is identical across regimes.

6.2.3 Welfare metric and reporting convention

Let W_{SOC} denote social welfare, computed as the discounted sum of per-period utilities along the simulated equilibrium path, aggregating patient and impatient household utilities with fixed social weights θ_P and $1-\theta_P$. Period utility includes consumption services (with external habits), housing services, and the disutility of labor, as specified in equation (29). We report policy comparisons using the consumption-equivalent variation (CEV): the constant percentage change in both households' consumption-service paths $\{C^{svc}_{P,t}, C^{svc}_{I,t}\}_{t=1}^{H}$ that makes the planner indifferent between a given regime and the baseline regime A, holding labor supply and housing services at their equilibrium allocations. We report CEV in percent and in basis points (bps), where 1 bps $= 0.01\%$.

Welfare is evaluated over horizons $H \in \{80, 160, 240, 320, 400, 800\}$. When a tail continuation is appended, the decision is enforced symmetrically across regimes within each H: either all A/B/C/D receive the same tail treatment at that horizon or none do.

Table 8: **Welfare (CEV) in the 2×2 policy matrix** ($H = 800$; housing services included in utility).

Scenario	CEV_{SOC} vs. SS (%)	CEV vs. A (bps)
A (OFF/Blind)	-0.096095	0
B (ON/Blind)	-0.096250	-0.0155
C (OFF/Aware)	-0.096639	-0.0544
D (ON/Aware)	-0.092129	$+0.3970$

Effect (bps)	Definition	Value
Fiscal effect (Blind)	$B - A$	-0.0155
Fiscal effect (Aware)	$D - C$	$+0.4514$
Aware effect (Fiscal OFF)	$C - A$	-0.0544
Aware effect (Fiscal ON)	$D - B$	$+0.4125$
Interaction	$\mathcal{I}_W(800)$	$+0.4669$

Notes: CEV vs. A is reported in bps (1 bps = 0.01%). Housing services are included in period utility.

This keeps DiD objects free of mechanical regime-specific terminal adjustments.

6.2.4 Main welfare results

Table 8 reports welfare at the benchmark horizon $H = 800$. The central baseline result is a clear complementarity: fiscal-state-dependent switching is welfare-improving only when macroprudential policy is debt-aware.

Under debt blindness, turning switching ON has an economically negligible welfare effect: $B - A = -0.0155$ bps. Under debt awareness, the same switch yields a positive welfare gain: $D - C = +0.4514$ bps. The interaction is positive and economically non-negligible relative to the debt-blind benchmark, $\mathcal{I}_W(800) = +0.4669$ bps. Importantly, including housing services in period utility leaves these DiD objects essentially unchanged relative to a consumption-and-labor-only welfare metric.

A key advantage of our implementation is that CEV differences can be decomposed into additive contributions from consumption services, labor disutility, and housing services (Appendix C). At $H = 800$, the interaction $\mathcal{I}_W(800) = +0.4669$ bps is driven almost entirely by labor disutility:

$$\mathcal{I}_W(800) = \underbrace{(-0.0614)}_{\text{consumption}} + \underbrace{(+0.5263)}_{\text{labor}} + \underbrace{(+0.0021)}_{\text{housing}} \quad \text{(bps)}.$$

Likewise, the fiscal gain under debt awareness is primarily a labor channel:

$$D - C = \underbrace{(-0.0695)}_{\text{consumption}} + \underbrace{(+0.5199)}_{\text{labor}} + \underbrace{(+0.0010)}_{\text{housing}} \quad \text{(bps)}.$$

Housing services are quantitatively important in utility levels—contributing roughly half of patient steady-state utility and nearly 70% of impatient steady-state utility—but contribute negligibly to welfare differences in the 2×2 comparisons. The DiD objects are therefore not sensitive to whether housing services are included in the welfare accounting.

The consumption component of the interaction is negative, -0.0614 bps: debt-aware switching compresses the credit-driven consumption boom of constrained households. The welfare gain does not come from higher consumption, but from lower labor disutility in states in which hours are especially costly at the margin.

Under debt-aware switching, the macroprudential stance tightens precisely when fiscal stress rises during the spending expansion, compressing borrower leverage and dampening the credit-fueled increase in domestic demand. This moderation translates into a smaller boom in hours worked. Because labor disutility is convex ($\varphi > 0$), the welfare gain from reducing hours in high-activity states more than offsets the welfare cost from slightly lower consumption, delivering a positive DiD interaction in CEV.

The welfare gains from debt-aware switching are concentrated among constrained (impatient) households. At $H = 800$, for the fiscal gain under debt awareness,

$$D - C \;=\; \underbrace{(-0.5049)}_{\text{patient}} + \underbrace{(+0.9564)}_{\text{impatient}} \quad \text{(bps, social weights applied).}$$

The positive social gain therefore reflects a redistribution toward households most exposed to leverage-driven amplification.

Under debt blindness, $B - A$ is close to zero and can change sign across horizons (Table 13); our interpretation is therefore that switching is essentially irrelevant for welfare unless policy is debt-aware.

The welfare interaction in the 2×2 experiment is economically modest in absolute terms: $\mathcal{I}_W(800) = 0.4669$ bps in social CEV, that is, 0.004669%. We view this magnitude as a quantitative benchmark for the interaction effect in a one-shock counterfactual rather than as a full business-cycle welfare calculation. Importantly, the welfare gains are concentrated among constrained (impatient) households, while patient households experience a small welfare loss (Appendix Table 15).

6.2.5 Spending multipliers and interaction effects

We complement welfare with present-value (PV) spending multipliers computed from simulated paths. We use the same definition, timing convention, and discounting protocol as in the benchmark experiment, equation (82). In particular, discount weights are proportional to the patient household's intertemporal pricing kernel and are constructed from the deposit-anchored Euler equation. PV multipliers are reported in GDP-scaled units, that is, output per % of GDP of the spending innovation.

Table 9: **GDP-scaled PV spending multipliers: 2×2 matrix and interaction.**

H	A (OFF/Blind)	B (ON/Blind)	C (OFF/Aware)	D (ON/Aware)
20	0.71640	0.70123	0.68085	0.58144
40	0.62731	0.61950	0.47837	0.38418
80	0.64320	0.63475	0.48115	0.32949
160	0.63074	0.61931	0.47254	0.28922

H	$(B-A)$	$(D-C)$	Interaction $\mathcal{I}_M(H) = (D-C) - (B-A)$
20	-0.015168	-0.099415	-0.084248
40	-0.007807	-0.094195	-0.086387
80	-0.008456	-0.151660	-0.143200
160	-0.011426	-0.183320	-0.171900

Notes: PV multipliers are computed from piecewise paths using SDF-consistent discounting and are reported as output per % of GDP of the spending innovation. A negative interaction indicates that debt awareness amplifies the attenuation of multipliers induced by turning switching ON.

Table 9 reports GDP-scaled PV multipliers at policy-relevant horizons. Multipliers are positive in all regimes, but both debt awareness and switching reduce their magnitude. The interaction in multipliers is negative, meaning that debt awareness strengthens the attenuation of multipliers associated with switching:

$$\mathcal{I}_M(H) < 0$$

across horizons.

The 2×2 results thus deliver a disciplined tension: the joint policy that raises welfare, via a positive interaction in CEV, reduces output multipliers, via a negative interaction in PV multipliers. This contrast is economically coherent in a model with collateral constraints and heterogeneous agents. Multipliers summarize the average output response to a spending expansion; welfare internalizes the incidence of leverage-driven amplification and the distribution of adjustment across households. As the decomposition makes clear, the welfare gain comes not from a larger output boom but from reduced labor disutility in high-stress states—a margin that is invisible to output-based summary statistics.

6.2.6 Output accumulation: transparent $H = 20$ accounting

As a quantity-based summary, we report cumulative output effects over $H = 20$ along the piecewise path:

$$\sum_{t=1}^{20} \Delta Y_t : \quad A = 0.0460,\ B = 0.0450,\ C = 0.0435,\ D = 0.0367.$$

The implied differences are

$$\sum(B-A) = -0.0010, \qquad \sum(D-C) = -0.0068,$$
$$\sum(C-A) = -0.0025, \qquad \sum(D-B) = -0.0083,$$

and the interaction in cumulative output is

$$\mathcal{I}_Y \equiv \sum(D-C) - \sum(B-A) = -0.0058,$$

consistent with the multiplier evidence: ON/Aware dampens the output expansion by more than the sum of the two margins taken separately would suggest.

6.3 Robustness checks

We report four robustness exercises that distinguish among (i) *specification/closure* sensitivity, (ii) *policy-rule intensity* sensitivity, (iii) *shock-design* sensitivity, and (iv) *preference* sensitivity. Within preference sensitivity, we further separate a *normative* reweighting exercise (welfare weights only) from a *structural* preference exercise (Frisch elasticity).

Let I_W denote the welfare interaction term, in basis points of linearized CEV, and let $I_M(H)$ denote the output-multiplier interaction at horizon H, measured as the GDP-scaled PV multiplier interaction unless otherwise stated. In the tables below, "Baseline sign pattern?" is YES if and only if the specification preserves the baseline sign orientation:

$$\text{sign}(I_W) = \text{sign}(I_W^{\text{base}}) \quad \text{and} \quad \text{sign}(I_M(20)) = \text{sign}(I_M^{\text{base}}(20)).$$

Since in the baseline $I_W^{\text{base}} > 0$ and $I_M^{\text{base}}(20) < 0$, this is equivalent to $I_W > 0$ and $I_M(20) < 0$.

6.3.1 Wedge specification and quantitative role

The baseline model represents the sovereign bond–deposit spread through the shadow-wedge block (54)–(55). In the benchmark calibration, $\rho_{\Omega_B} = 0$, so this two-equation specification is exactly equivalent to a compact one-equation spread representation. We verified numerically that adopting the shadow-wedge notation leaves the 2×2 results essentially unchanged relative to its equivalent one-equation expression.

To verify that the main findings are not driven by the sovereign spread channel itself, we then shut the wedge down by setting $\psi_B = 0$ and recompute all 2×2 objects under the same shock design and calibration. The interaction signs and the regime ranking are unchanged qualitatively; supporting evidence is reported in Appendix D.

6.3.2 Banks holding sovereign bonds: a sovereign–bank nexus extension

As an additional specification check, we consider an alternative closure in which one-period government bonds are held by banks rather than by patient households. This modification is intentionally treated as a robustness exercise rather than as part of the benchmark model, because it changes the economic role of public debt: sovereign exposures move from a segmented household portfolio position into the banking block, thereby introducing a much tighter sovereign–bank nexus.

This alternative closure materially strengthens fiscal–financial feedbacks. In a standard government spending experiment with the fiscal trigger switched off and debt-blind macroprudential rules, the impact multiplier remains very similar under the linear and piecewise solutions, but medium-run propagation differs noticeably: the piecewise solution delivers more persistent support to output, whereas the linear approximation understates persistence and can even imply substantially weaker cumulative effects at longer horizons. Quantitatively, for the GDP-scaled present-value multiplier, the two solutions are close on impact, but by medium and long horizons the piecewise multiplier remains clearly larger.

The contrast becomes much sharper once debt-aware rules are activated. In that case, assigning sovereign bonds to banks generates a strong sovereign–bank–macroprudential feedback, and the linear approximation substantially overstates the medium-run fiscal multiplier relative to the piecewise solution. For example, in the debt-aware benchmark with the fiscal trigger off, the GDP-scaled present-value multiplier at $H = 20$ is about 1.22 in the piecewise solution, against roughly 3.09 in the linear approximation. This indicates that, under bank sovereign exposure, the economy becomes strongly nonlinear precisely in the states in which debt-aware policy feeds back into borrowing conditions.

The same message emerges in the full 2×2 experiment. When banks hold sovereign bonds, debt-aware regimes generate much more frequent and persistent binding collateral episodes than in the benchmark closure, and the welfare interaction turns negative rather than positive. In our simulations, the binding share rises from roughly 1% in the Blind regimes to around 18% in the Aware regimes, and the long-horizon welfare interaction becomes negative. Hence, once sovereign bonds are placed on banks' balance sheets, the policy experiment no longer isolates only fiscally contingent macroprudential design; it also loads heavily on a sovereign–bank nexus channel.

For this reason, we interpret the bank-bonds specification as a distinct sovereign–bank nexus extension rather than as part of the benchmark environment. Its main value is to show that the baseline results are not generic to all closures: once sovereign exposure is internalized by banks, fiscal transmission becomes substantially more nonlinear and the welfare ranking of debt-aware designs can change.

Table 10: Exercise 1: local refinement of the debt-aware borrower-based margin ($a_v = 1.2$).

a_{LTV}	$\phi^H_{LTV,B}$	I_W (bps)	$I_M(20)$	$I_M(40)$	$I_M(80)$	D: bind share	D: max μ
1.05	-8.40	-0.091	0.015	-0.002	-0.011	0.300	0.032
1.08	-8.64	-0.005	-0.000	-0.014	-0.032	0.313	0.033
1.10	-8.80	0.052	-0.011	-0.022	-0.047	0.313	0.036

Notes: I_W denotes the welfare interaction effect (in bps of CEV), and $I_M(H)$ the GDP-scaled PV output-multiplier interaction at horizon H. The exercise holds the debt-aware capital-buffer scaling fixed at $a_v = 1.2$ and varies only the borrower-based debt-aware scaling a_{LTV}. "D: bind share" and "D: max μ" report, respectively, the fraction of binding quarters and the peak collateral multiplier in the ON/Aware regime over the comparison window.

6.3.3 Policy-intensity refinement: the borrower-based debt-aware margin

The baseline 2×2 results show that debt awareness strengthens the attenuation of spending multipliers and raises welfare through a reduction in labor disutility. A natural robustness question is whether this welfare complementarity is tightly tied to the baseline debt-aware borrower-based coefficient, or instead survives in a local neighborhood around it.

To address this question, we hold the debt-aware capital-buffer scaling fixed at $a_v = 1.2$ and vary only the borrower-based debt-aware scaling a_{LTV}. This refinement focuses on the borrower-based debt-aware margin, which is the natural candidate mechanism in the model, and asks whether the sign of the welfare interaction changes smoothly or abruptly as that response is strengthened.

Table 10 reports the resulting interaction objects. Three findings emerge. First, the welfare interaction is negative but economically small at $a_{LTV} = 1.05$, becomes essentially zero at $a_{LTV} = 1.08$, and turns positive at $a_{LTV} = 1.10$, implying a clean local threshold around $a_{LTV} \approx 1.08$. Second, the multiplier interaction is already weakly negative around the threshold and becomes more negative as a_{LTV} rises. Third, the collateral diagnostics remain well behaved across calibrations: the binding share stays in a narrow range and peak μ remains low and stable, while the multiplier attenuation strengthens monotonically.

The quantitative message is therefore not that the welfare interaction is globally sign-invariant over arbitrary policy intensities. Rather, in the economically relevant neighborhood of the baseline, the sign change is sharp, interpretable, and governed primarily by the borrower-based debt-aware margin. This makes the local threshold itself a useful object for interpretation: the welfare complementarity emerges once borrower-based debt awareness is strong enough to mitigate financially tight states without generating unstable transition dynamics.

Collectively, this refinement suggests that the welfare interaction is not globally uniform across debt-aware calibrations, but neither is it knife-edge. In the relevant neighborhood of the baseline, the transition is clean and is governed primarily by the borrower-based debt-aware margin. This motivates the remaining robustness exercises, which keep the

Table 11: Exercise 2: robustness to fiscal-shock profiles.

Shock profile	I_W (bps)	$I_M(20)$	$I_M(40)$	$I_M(80)$	Baseline sign pattern?
Baseline	0.4669	-0.0842	-0.0864	-0.1432	YES
Half-size shock (0.5×)	0.0356	0.0039	-0.0013	-0.0123	NO
Persistent shock ($\rho = 0.90$)	0.4752	-0.0752	-0.0892	-0.1460	YES

Notes: I_W is the welfare interaction (bps, linearized CEV decomposition). $I_M(H)$ is the multiplier interaction at horizon H. "Baseline sign pattern?" is YES iff the specification preserves the baseline sign orientation, i.e. $I_W > 0$ and $I_M(20) < 0$.

policy architecture fixed and instead vary the shock environment and preference structure.

6.3.4 Shock-profile robustness

We next vary the fiscal-shock profile while holding the policy architecture fixed: (i) the baseline profile, (ii) a half-size shock (0.5×), and (iii) a more persistent shock ($\rho = 0.90$). Table 11 reports the interaction in welfare and in output multipliers.

The baseline and persistent-shock cases preserve the qualitative pattern, namely a positive welfare interaction together with a negative multiplier interaction at $H = 20$. By contrast, the half-size shock weakens the output interaction substantially and can reverse the short-horizon multiplier sign. This is consistent with a nonlinear state-contingent mechanism: if the shock is too small, the model does not activate the same amplification and friction channels with sufficient intensity.

6.3.5 Preference robustness: normative vs. structural

Finally, we separate normative sensitivity, through welfare weights, from structural sensitivity, through the labor-supply elasticity or Frisch parameter. Panel A varies only the welfare weight θ_P, holding allocations fixed, whereas Panel B varies the inverse Frisch parameter φ, which changes equilibrium responses and therefore both welfare and multiplier interactions.

Panel A shows that welfare magnitudes are normatively sensitive to welfare weights even when the underlying macroeconomic transmission is unchanged: the multiplier interaction remains invariant, but the welfare interaction varies with redistributional weights. Panel B, by contrast, is informative about structural sensitivity: changing the Frisch elasticity alters equilibrium dynamics, so both I_W and I_M move. The baseline sign orientation is preserved under the lower-Frisch case considered here, but it can flip under highly elastic labor supply.

Table 12: Exercise 3: preference robustness (normative reweighting vs. structural preference changes).

Specification	I_W **(bps)**	$I_M(H{=}20)$	$I_M(H{=}40)$	$I_M(H{=}80)$	**Baseline sign pattern?**
Panel A. Welfare-weight robustness (θ_P; welfare aggregation only)					
$\theta_P = 0.50$	0.8456	-0.0842	-0.0864	-0.1432	YES
$\theta_P = 0.60$ [base]	0.4669	-0.0842	-0.0864	-0.1432	YES
$\theta_P = 0.70$	0.1644	-0.0842	-0.0864	-0.1432	YES
Panel B. Labor-supply elasticity robustness (Frisch / φ)					
Frisch = 2.0 ($\varphi = 0.5$)	-6.1472	1.1663	1.2185	1.4200	NO
Frisch = 1.0 ($\varphi = 1.0$) [base]	0.4669	-0.0842	-0.0864	-0.1432	YES
Frisch = 0.5 ($\varphi = 2.0$)	0.0808	-0.0006	-0.0114	-0.0406	YES

Notes: I_W denotes the welfare interaction effect (in bps of CEV), and $I_M(H)$ denotes the interaction effect in the GDP-scaled PV output multiplier at horizon H. In Panel A, I_M is identical across rows by construction, since varying θ_P changes only the social welfare aggregation and does not affect equilibrium allocations or simulations. Panel A is therefore a normative reweighting exercise, whereas Panel B is a structural preference robustness exercise that changes equilibrium transmission. "Baseline sign pattern?" is YES iff $I_W > 0$ and $I_M(20) < 0$.

6.3.6 Robustness summary

Overall, the robustness exercises deliver a coherent but nuanced message. The baseline 2×2 sign pattern is not mechanically invariant to every alternative closure, policy intensity, shock profile, or preference specification. However, within the policy-relevant neighborhood of the benchmark calibration, the main result remains stable and economically interpretable: debt-aware switching raises welfare while reducing GDP-scaled PV multipliers, with the borrower-based debt-aware margin playing the central role.

Two clarifications are especially important. First, shutting down the sovereign bond–deposit wedge does not alter the qualitative ranking of regimes, so the main interaction is not driven by that auxiliary pricing component. Second, the alternative closure in which banks hold sovereign bonds materially strengthens fiscal–financial feedbacks and can overturn the baseline welfare interaction. We therefore interpret that case as a distinct sovereign–bank nexus extension rather than as an alternative benchmark closure.

6.3.7 Horizon convergence of welfare DiD objects

Table 13 reports the horizon profile of the welfare difference-in-differences objects. The interaction is already close to its long-horizon value by $H = 160$ and changes little thereafter, indicating that the welfare complementarity between debt awareness and switching is not driven by a particular terminal horizon choice.

Table 13: **Convergence of welfare DiD components across horizons H.** Entries are in bps of CEV (housing services included in utility).

	$H = 80$	$H = 160$	$H = 240$	$H = 320$	$H = 400$	$H = 800$
Fiscal eff. (Blind), $B-A$	0.0321	0.0137	-0.0043	-0.0117	-0.0142	-0.0155
Fiscal eff. (Aware), $D-C$	0.5560	0.4634	0.4507	0.4508	0.4505	0.4514
Aware eff. (OFF), $C-A$	0.8461	0.7088	0.6688	0.5136	0.3394	-0.0544
Aware eff. (ON), $D-B$	1.3700	1.1586	1.1238	0.9761	0.8041	0.4125
Interaction, $\mathcal{I}_W(H)$	0.5239	0.4498	0.4550	0.4625	0.4647	0.4669

6.3.8 Headline results

The 2×2 experiment delivers four headline results:

1. **Switching is valuable only with debt awareness.** Turning switching ON has essentially no welfare benefit under Blind policy ($B-A = -0.0155$ bps), but delivers a sizable welfare gain under Aware policy ($D-C = +0.4514$ bps).
2. **At the baseline calibration, debt awareness and switching are welfare complements.** The DiD interaction is positive, $\mathcal{I}_W = +0.4669$ bps at $H = 800$, and already close to that value by $H = 160$. The policy-intensity refinement shows that this complementarity emerges through a clean local threshold in the borrower-based debt-aware margin, rather than holding uniformly over arbitrary debt-aware coefficients.
3. **The welfare interaction is a labor channel; housing is second-order for welfare differences.** The interaction is explained almost entirely by reduced labor disutility (+0.5263 bps), partly offset by consumption (−0.0614 bps), while housing contributes only +0.0021 bps. Welfare gains are concentrated among impatient households.
4. **The welfare-improving joint policy dampens output multipliers.** GDP-scaled PV multipliers fall most under ON/Aware, and the interaction in multipliers is negative at medium and long horizons.

6.3.9 Why welfare and output-based multipliers can diverge

A positive welfare interaction alongside a negative interaction in output multipliers is natural in a model with collateral constraints and heterogeneous agents.

(1) Risk containment vs. boom size. Debt-aware switching curbs leverage-driven amplification during fiscal expansions. This reduces the output boom and therefore compresses multipliers, but it can raise welfare by improving the allocation precisely in the states in which collateral constraints are most distortionary.

(2) Labor disutility dominates welfare changes. The welfare interaction is driven by lower labor disutility, even though consumption moves in the opposite direction. Debt-aware switching tightens borrower-based conditions when fiscal stress rises, compressing leverage and dampening the credit-fueled increase in domestic demand. This moderation translates into a smaller boom in hours worked. Because labor disutility is convex ($\varphi > 0$), the welfare gain from reducing hours in high-activity states more than offsets the welfare cost from slightly lower consumption.

(3) Incidence across households. Welfare gains are concentrated among constrained households (the impatient type), while patient households experience small welfare losses. The policy reduces the severity of binding episodes, as measured by lower shadow values μ, even though the constraint may bind somewhat more frequently. This redistributive channel is invisible to aggregate multipliers.

(4) State contingency. Switching is activated in fiscally stressed states. Its welfare value comes from shifting adjustment away from high-cost financial states and from mitigating leverage-cycle amplification when it matters most, not from maximizing the average output response to spending.

7 Conclusion

This paper studies how fiscal transmission depends on the joint design of macroprudential policy in an economy with heterogeneous households and an occasionally binding collateral constraint. Our quantitative contribution is a transparent 2×2 counterfactual design that separates two margins: (i) whether borrower-based macroprudential policy switches with an empirically disciplined fiscal-stress trigger (OFF vs. ON), and (ii) whether the rule is debt-aware (Blind vs. Aware). Equilibrium dynamics are computed with a piecewise solution protocol (OccBin), which is essential once the collateral constraint binds endogenously.

The main finding is that, at the baseline calibration, fiscal-state-dependent switching and debt awareness are welfare complements. Fiscal-state-dependent switching is essentially irrelevant under debt-blind macroprudential policy, but becomes welfare-improving once prudential instruments internalize public-debt conditions. In the 2×2 decomposition, the difference-in-differences interaction in consumption-equivalent welfare is positive and stable across horizons: the welfare gain from switching is concentrated in the debt-aware regime. Mechanism-wise, this welfare interaction is driven primarily by labor disutility: debt-aware switching tempers leverage-driven amplification and thereby reduces the hours boom in the states in which the marginal utility cost of work is highest. Housing services matter for utility levels, but contribute little to welfare differences in the 2×2 comparisons.

A second message is that welfare and output-based multipliers need not move together. The same joint design that raises welfare reduces present-value output multipliers: switching and debt awareness both dampen the output response to a spending expansion, and their interaction in PV multipliers is negative. This tension is economically coherent in a heterogeneous-agent model with collateral constraints. Multipliers summarize the size of the aggregate output expansion, whereas welfare also reflects the distribution of adjustment across households and the mitigation of leverage-cycle distortions faced by constrained agents.

On the empirical side, local-projection evidence provides suggestive reduced-form discipline for the state dependence that motivates the structural mechanism. Evaluated on a 2×2 grid of lagged fiscal stress and lagged credit stance, house prices, more clearly than household credit, display economically visible state separation across states, although the estimated interaction is imprecise and the confidence bands remain wide in the available sample. We therefore interpret these empirical patterns as motivation and calibration discipline rather than as stand-alone causal proof.

Viewed as a whole, the results support a cautious policy implication: macroprudential state contingency is most valuable when it is designed to internalize public-debt conditions. In fiscally stressed environments, debt-aware borrower-based policy can reduce the severity of financially tight states for constrained households even if it compresses average output multipliers.

A final robustness exercise assigns sovereign bonds to banks rather than to patient households. This alternative closure materially strengthens fiscal–financial nonlinearities and can overturn the baseline welfare interaction. We therefore interpret the bank-bonds case as a distinct sovereign–bank nexus extension rather than as part of the benchmark design.

Several limitations point to natural extensions. First, we discipline the trigger and key steady-state ratios with U.S. data rather than estimating the full model; richer estimation and alternative identification strategies are natural next steps. Second, the baseline environment abstracts from an explicit sovereign-risk channel and from open-economy feedbacks that may strengthen fiscal-stress dynamics. Incorporating endogenous sovereign spreads, fiscal limits, or an external-balance margin would allow the same 2×2 logic to speak more directly to sovereign-stress episodes and cross-country policy design. Finally, the empirical 2×2 interaction is currently power-limited; expanding sample support, improving the measurement of household credit conditions, and exploiting panel variation are natural priorities for future work.

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Table 14: **Baseline empirical variables: definitions and roles.**

Object	Baseline measure	Transformation / role	Source
Fiscal shock ε_t^F	Narrative government-spending shock (`shock`)	Exogenous fiscal innovation used in local projections	Replication dataset / underlying identification source
Fiscal stress s_t	Debt-gap-based bounded stress index (`st`)	One-sided trend gap, smoothing, normalization to $[0, 1]$	Authors' construction from U.S. public-debt data
Credit stance m_t	SLOOS net-tightening measure	Lagged state variable; higher values denote tighter credit conditions	Federal Reserve SLOOS
Household credit	Household mortgage debt	Log level in LPs; main credit outcome	Flow of Funds / replication dataset
House prices	National house-price index	Log level in LPs; main housing outcome	FHFA / replication dataset
Real GDP	Real gross domestic product	Log level in LPs; outcome and control	NIPA / FRED
Government spending	Real government spending	Log level in LPs; first-stage variable and control	NIPA / FRED

Notes: Variable names in parentheses refer to the labels used in the merged estimation dataset when applicable. Exact series mnemonics, deflators, sample alignment, and alternative proxies are documented in the replication files.

A Data definitions, sources, and empirical design

This appendix documents the data sources, transformations, state construction, and empirical design used in Section 2. Unless otherwise noted, all series are quarterly and aligned to a common sample after transformation and lag construction.

The empirical analysis uses U.S. macro-financial data for four purposes. First, it constructs the fiscal-stress indicator used to discipline the model trigger. Second, it measures lagged credit stance. Third, it provides the outcome variables used in the local projections. Fourth, it supplies long-run ratios used as calibration targets in Section 5.

Throughout the empirical section, the baseline sample length is approximately $T \simeq 142$ quarters after aligning the fiscal shock, the state variables, and the outcome series. Exact sample endpoints, together with the final merged dataset used in estimation, are reported in the replication files.

A.1 Baseline fiscal shock and alternative shock measures

The baseline fiscal shock is the narrative government-spending shock used in the main text. In the empirical code, this is the series stored in the column `shock`. We take this identification as given and use the shock as an input into the state-dependent local projections; the contribution of the empirical exercise is therefore not re-identification of fiscal shocks, but the estimation of state-dependent propagation conditional on that shock.

The appendix robustness exercises replace the baseline shock with alternative fiscal-shock measures, including news-based, narrative, and SVAR-style variants where available in the dataset. These alternatives are used only as robustness checks on the sign and relative magnitude of the 2×2 interaction paths.

A.2 Outcome variables and transformations

The main outcome variables are household credit and house prices. The baseline household-credit series is household mortgage debt, while the baseline house-price series is a national house-price index. Real GDP and government spending are also included in the empirical exercise to verify shock transmission and to provide first-stage diagnostics.

Output, government spending, household credit, and house prices enter the local projections in logs. Coefficients are therefore interpreted as log-point responses of the level of the variable at horizon h, which are approximately percent responses for moderate changes. Fiscal ratios used in constructing the stress indicator enter in percentage-point units.

The exact series mnemonics, transformations, deflators, and alignment choices used in the merged dataset are documented in the replication files associated with the empirical analysis.

A.3 Credit-stance proxy and alternative measures

The baseline credit-stance proxy, denoted m_t, is constructed from the Senior Loan Officer Opinion Survey (SLOOS) as a net-tightening measure. Higher values of m_t indicate tighter borrower-based or credit-market conditions. In the main text, the empirical evaluation points m^ℓ and m^τ correspond, respectively, to loose and tight credit conditions.

Because any single proxy can be questioned, we re-estimate the key interaction paths using alternative stance measures, including other SLOOS cuts and broader financial-conditions proxies when available. These robustness exercises are used to verify that the qualitative patterns in the house-price and credit responses are not driven by a single measure of credit tightness.

A.4 Fiscal-stress construction

Let x_t denote the raw fiscal signal used to measure fiscal conditions. In the baseline specification, we construct a debt-gap measure as the deviation of debt-to-GDP from a slow one-sided trend and map this low-frequency signal into a bounded fiscal-stress indicator $s_t \in [0, 1]$. The design objective is to obtain a stress measure that is episodic and persistent, rather than one that reacts mechanically to quarter-to-quarter noise.

The series used in the empirical code is stored in the variable `st`. Its construction combines low-frequency filtering, smoothing, and normalization so that high-stress quarters are relatively rare but occur in persistent spells. This makes the empirical stress process comparable to the model-based trigger used in Section 5.3.

A.5 Lag structure, evaluation points, and local projections

To avoid look-ahead bias and to limit mechanical contemporaneous feedback between shocks and states, all state variables enter the baseline specification lagged one quarter, as s_{t-1} and m_{t-1}. The local projections therefore estimate how the response to the fiscal shock varies with pre-determined fiscal stress and pre-determined credit stance.

For each horizon h, the baseline LP includes a constant and $p = 4$ lags of the dependent variable, real GDP, government spending, and the fiscal shock. The empirical 2×2 objects shown in the paper are obtained by evaluating the continuous interaction specification at representative low/high stress points and loose/tight credit points.

The baseline evaluation points are the $p33/p67$ quantiles of the empirical distributions of the uncentered lagged state variables. These values are then mean-centered when plugged into the LP specification reported in equation (2).

A.6 Threshold and evaluation-point sensitivity

As a robustness exercise, we vary the cutoffs used to define the low/high fiscal-stress and loose/tight credit-stance evaluation points. The baseline uses $p33/p67$ cutoffs to preserve stronger state separation while retaining adequate cell support. More central cutoffs such as $p40/p60$ are treated as robustness checks that trade state separation for greater sample support, whereas wider cutoffs such as $p25/p75$ increase separation at the cost of thinner cells. This checks that the reported 2×2 interaction paths are not an artifact of a single set of percentile choices.

A.7 Inference

Baseline impulse responses use horizon-dependent HAC (Newey–West) standard errors. Difference-in-differences paths are supplemented with moving-block bootstrap confidence bands. In the baseline specification, we use $B = 999$ bootstrap replications and a block length of 8 quarters. Alternative block lengths are considered as part of the empirical robustness checks.

B Computation and OccBin implementation details

This appendix summarizes the computational protocol used in the quantitative exercises. The DSGE model is solved with a piecewise-linear method in the spirit of OccBin, allowing the housing-collateral constraint to bind endogenously along the simulated path.

The benchmark linear solution corresponds to an always-slack approximation around the deterministic steady state. In that environment, the collateral multiplier is zero at first order and the economy cannot transition into a binding regime within the linearized system. By contrast, the piecewise solution allows endogenous switching between slack and binding regimes, which is essential for the policy comparisons in Section 6.

All regime comparisons in the 2×2 exercises are computed under identical shock sequences, identical steady-state normalization, and a common measurement protocol for multipliers and welfare. This ensures that reported differences across regimes are attributable to policy design and nonlinear propagation rather than to differences in simulation timing, shock scaling, or terminal treatment.

When welfare is evaluated over finite horizons, any tail treatment is imposed symmetrically across regimes at a given horizon. This keeps difference-in-differences welfare objects free of mechanical regime-specific terminal effects.

C Welfare decomposition: components and household incidence

Table 15 decomposes the 2×2 welfare effects into additive contributions from consumption services, labor disutility, and housing services. Panel A reports social welfare (aggregated with weights $\theta_P = 0.60$ and $1 - \theta_P = 0.40$). Panel B reports the corresponding θ_P-weighted contributions by household type. Entries are in linearized CEV basis points (bps) and are exactly additive by construction: the sum across components and household types equals the total social effect.

D Additional robustness results

This appendix collects supplementary quantitative results that support the interpretation of the main 2×2 experiments. It reports robustness to the specification and quantitative role of the sovereign bond–deposit wedge, an alternative closure in which banks hold sovereign bonds, alternative discounting conventions for PV multipliers, determinacy diagnostics for the always-slack linear benchmark, collateral-incidence and collateral-severity moments across regimes, and trigger-timing comparability across the ON economies.

In one-shock experiments, the binding indicator can remain active for extended horizons

Table 15: **Welfare decomposition by component and household type** ($H = 800$, linearized CEV bps).

Panel A: Social welfare (aggregated with weights $\theta_P = 0.60$, $1 - \theta_P = 0.40$).

	$B-A$	$D-C$	$C-A$	$D-B$	$\mathcal{I}$
Consumption	-0.0081	-0.0695	-0.1699	-0.2314	-0.0614
Labor	-0.0064	+0.5199	+0.0798	+0.6061	+0.5263
Housing	-0.0010	+0.0010	+0.0356	+0.0377	+0.0021
Total	-0.0155	+0.4514	-0.0544	+0.4125	+0.4669

Panel B: By household type (θ_P-weighted contributions).

	$B-A$	$D-C$	$C-A$	$D-B$	$\mathcal{I}$
Patient ($\theta_P = 0.60$)					
Consumption	-0.0253	-0.2449	-0.4218	-0.6415	-0.2197
Labor	-0.0807	-0.2795	-1.0402	-1.2390	-0.1988
Housing	+0.0029	+0.0195	+0.0575	+0.0741	+0.0166
Subtotal P	**-0.1031**	**-0.5049**	**-1.4045**	**-1.8064**	**-0.4019**
Impatient ($1 - \theta_P = 0.40$)					
Consumption	+0.0172	+0.1755	+0.2519	+0.4101	+0.1582
Labor	+0.0743	+0.7994	+1.1200	+1.8451	+0.7251
Housing	-0.0039	-0.0185	-0.0218	-0.0364	-0.0145
Subtotal I	**+0.0876**	**+0.9564**	**+1.3501**	**+2.2188**	**+0.8688**
Social (P+I)	**-0.0155**	**+0.4514**	**-0.0544**	**+0.4125**	**+0.4669**

Notes: Components are exactly additive by construction.

under persistent disturbances. For interpretation, we therefore focus on severity moments of the shadow value μ_t rather than on incidence alone. Debt-aware regimes feature somewhat higher binding incidence but markedly lower peak values of μ_t, consistent with more frequent yet milder tight-collateral states.

D.1 Policy realism: magnitudes of borrower-based and bank-based tools

Our macroprudential instruments are stylized counterparts of commonly used borrower-based and bank-based tools. On the bank-based side, the Basel III countercyclical capital buffer (CCyB) is typically set within a 0–2.5% range of risk-weighted assets, with jurisdictions retaining discretion to set buffers above 2.5% in their domestic context. On the borrower-based side, LTV limits are widely used and often fall in the 70–90% range, with tighter limits for specific segments and with portfolio allowances.

This institutional background motivates reporting debt-aware rule magnitudes in percentage-point units. As shown in Table 3, the high-stress calibration implies impact

Table 16: **Determinacy diagnostics for the always-slack linear benchmark.** Blanchard–Kahn conditions reported by Dynare for the linearized (always-slack) system under alternative policy-rule specifications.

Specification	BK outcome	# $\lvert\lambda\rvert > 1$	# forward-looking	Rank cond.
Always-slack (Debt-blind)	Unique	12	12	Verified
Always-slack (Debt-aware)	Unique	12	12	Verified

Notes: In both cases Dynare reports "There are 12 eigenvalues larger than 1 in modulus for 12 forward-looking variables" and "The rank condition is verified", and `model_diagnostics` detects no obvious issues. Hence, large differences in linear multipliers across specifications reflect changes in policy feedback, not model instability.

Table 17: **Collateral constraint moments across policy regimes.** Moments are computed from the shadow value μ_t along the piecewise (OccBin) paths over the first $T = 80$ quarters. "share" is the fraction of quarters with $\mu_t > 0$ (binding); "nEpisodes" counts binding spells; "meanDur" and "maxDur" are spell durations in quarters; "maxMu" is the peak μ_t in the window.

Scenario	share	nEpisodes	meanDur	maxDur	maxMu
A (OFF/Blind)	0.10375	8	10.375	16	0.09987
B (ON/Blind)	0.10500	8	10.500	16	0.10702
C (OFF/Aware)	0.14750	9	13.111	17	0.05702
D (ON/Aware)	0.15000	9	13.333	17	0.06226

Notes: Debt-aware regimes (C,D) exhibit a higher incidence of binding but substantially lower peak μ_t than debt-blind regimes (A,B), consistent with more frequent yet milder tight-collateral states.

adjustments in the range of a few LTV percentage points and about one percentage point in the capital requirement target for a 10pp deterioration in debt-to-GDP. We interpret these magnitudes as broadly consistent with the order of observed policy actions, while emphasizing that the calibration remains a rule-based counterfactual rather than an estimate of the historical reaction function of regulators.

D.2 Shutting down the bond–deposit wedge

The baseline model represents the sovereign bond–deposit spread through the shadow-wedge block (54)–(55). In the benchmark calibration, $\rho_{\Omega_B} = 0$, so this representation is exactly equivalent to the corresponding one-equation spread specification. We verified numerically that using the shadow-wedge notation instead of its compact one-equation equivalent leaves the quantitative 2×2 results essentially unchanged.

To verify that the paper's main findings are not driven by the sovereign spread channel itself, we then recompute the benchmark and policy-matrix objects after setting $\psi_B = 0$.

The qualitative results are unchanged. In particular, the welfare interaction remains positive, the PV-multiplier interaction remains negative, and the ordering of the four policy regimes is preserved. This indicates that the paper's main findings are driven by the

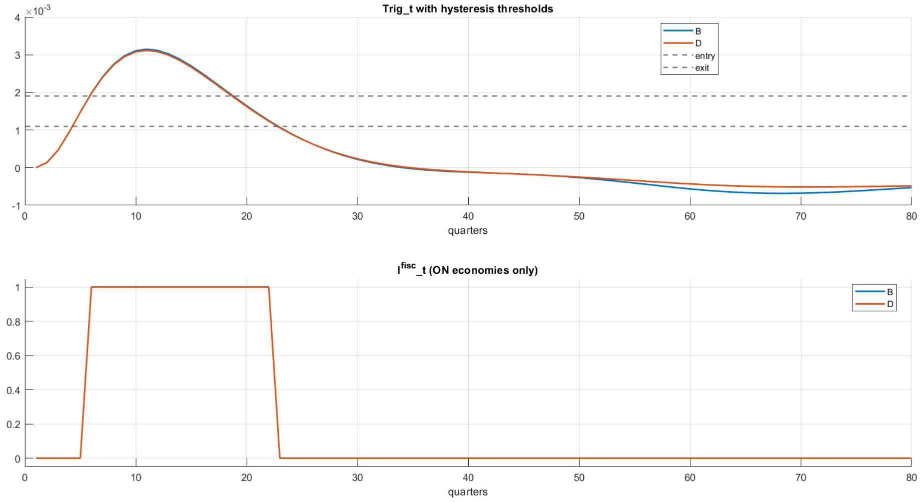

Figure 15: Trigger and hysteresis-based regime indicator for the ON economies (B and D).

interaction between fiscal contingency, debt awareness, and occasionally binding collateral dynamics, rather than by the presence of the sovereign bond–deposit wedge itself.

D.3 Discounting robustness for PV multipliers

Because present-value multipliers depend on discount weights, one potential concern is that regime comparisons may partly reflect differences in discounting rather than differences in macroeconomic transmission. To address this, we recompute PV multipliers under two alternative discounting conventions. First, we impose a regime-invariant sequence $d_t = \beta_P^t$ for all counterfactuals. Second, we use a common discount sequence fixed to the baseline economy and apply it uniformly across regimes.

In both exercises, the ranking of regimes is unchanged: debt-aware designs continue to generate lower GDP-scaled PV multipliers than their debt-blind counterparts, and the 2×2 interaction in PV multipliers remains negative. This confirms that the main multiplier results are not driven by regime-specific discounting.

Table 18: **Trigger and regime-timing comparability in the ON economies.** Hysteresis-based timing statistics computed from $Trig_t$ using the entry/exit thresholds $\bar{s} \pm \bar{s}_{\text{tol}}$ over the first 80 quarters. The implied tight-regime calendar is identical in B (ON/Blind) and D (ON/Aware), implying negligible endogenous regime-selection differences across the ON economies.

	B (ON/Blind)	D (ON/Aware)	D−B
First entry quarter (within $t \leq 80$)	6	6	0
First exit quarter (within $t \leq 80$)	22	22	0
First-spell duration (quarters)	17	17	0
Tight-regime share $\mathbb{E}[I_t^{\text{fisc}}]$ (t$\leq$ 80)	0.2125	0.2125	0.0000
# tight spells (t$\leq$ 80)	1	1	0
Mean spell duration (quarters)	17.00	17.00	0.00
Max spell duration (quarters)	17	17	0
$\max_{t\leq 80} \lvert Trig_t^D - Trig_t^B \rvert$		1.735e-04	
$\text{corr}(Trig_t^B, Trig_t^D)$ (t$\leq$ 80)		0.999149	
$\mathbb{E}\lvert I_t^{\text{fisc},D} - I_t^{\text{fisc},B} \rvert$ (t$\leq$ 80)		0.000000	

Notes: $I_t^{\text{fisc}} \in \{0,1\}$ is constructed from $Trig_t$ via the hysteresis rule in the model calibration: entry when $Trig_t \geq \bar{s} + \bar{s}_{\text{tol}}$ and exit when $Trig_t \leq \bar{s} - \bar{s}_{\text{tol}}$.

D.4 Banks holding sovereign bonds: a sovereign–bank nexus extension

As a robustness exercise, we consider an alternative closure in which one-period government bonds are held by banks rather than by patient households. This is not a minor accounting variant. It reallocates sovereign exposure from a segmented household portfolio position to the banking block and therefore introduces a materially tighter sovereign–bank nexus.

Under this closure, public debt affects the financial system not only through the sovereign spread block, but also through banks' direct bond exposure. The exercise therefore changes the interpretation of the quantitative experiments: it is no longer only about debt-aware macroprudential design, but also about how that design interacts with bank sovereign exposure.

Three results stand out. First, even without fiscal-trigger switching, the bank-bonds closure makes nonlinear propagation more important. In a standard government spending shock under debt-blind policy, the linear and piecewise solutions remain close on impact, but diverge materially at medium and long horizons. The piecewise solution generates a more persistent output response, while the linear approximation understates persistence and can imply much smaller cumulative effects. Thus, assigning sovereign bonds to banks already makes the occasionally binding financial block quantitatively relevant even in otherwise standard fiscal experiments.

Second, once debt-aware macroprudential rules are activated, the divergence between linear and piecewise dynamics becomes much larger. In the debt-aware benchmark with the fiscal trigger switched off, the GDP-scaled present-value multiplier at $H = 20$ is approximately 1.22 in the piecewise solution, compared with about 3.09 in the linear approximation. The linear solution therefore extrapolates the fiscal–financial feedback far too aggressively. The piecewise solution still delivers amplification, but of a much smaller and more credible magnitude. The underlying mechanism is a strong sovereign–bank–macroprudential loop: sovereign debt affects banks directly, debt-aware rules feed back into borrowing conditions, and the collateral block becomes regime-defining over part of the adjustment path.

Third, in the full 2×2 design, the bank-bonds closure changes the welfare ranking of the policy regimes. Relative to the benchmark closure, debt-aware regimes produce much more frequent and persistent binding episodes. In our simulations, the binding share rises from roughly 1% in the Blind regimes to around 18% in the Aware regimes, with substantially longer average binding spells. Correspondingly, the welfare interaction becomes negative at long horizons. In other words, once sovereign bonds are placed on banks' balance sheets, the debt-aware policy design no longer improves welfare relative to the debt-blind benchmark. The mechanism is intuitive: direct bank exposure to sovereign debt amplifies fiscal stress inside the financial system, so debt-aware prudential tightening becomes much more contractionary in constrained states.

Taken together, these results justify our modelling choice in the benchmark specification. Keeping sovereign bonds outside bank balance sheets allows the 2×2 experiment to isolate the interaction between fiscally contingent switching and debt-aware macroprudential design, without conflating that comparison with a strong sovereign–bank nexus channel. The bank-bonds specification is informative and economically meaningful, but it is best interpreted as a distinct extension rather than as an alternative benchmark closure.

Figures 16–18 and Figures 19–21 report the corresponding impulse responses under the bank-bonds closure. The debt-blind benchmark shows that assigning sovereign bonds to banks already makes medium-run propagation more nonlinear, even when impact responses remain similar across solution methods. The debt-aware benchmark makes this contrast much sharper: once debt-aware rules interact with direct bank sovereign exposure, the linear approximation substantially overstates medium-run fiscal amplification. Table 19 summarizes the corresponding multiplier comparisons, while Table 20 reports the full 2×2 welfare and collateral moments under this closure.

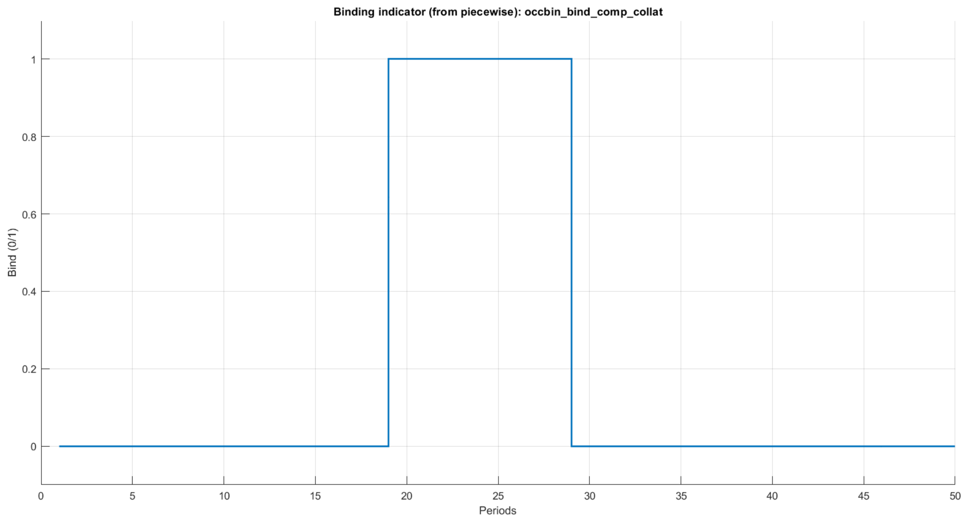

Figure 16: **Banks holding sovereign bonds, debt-blind benchmark: binding indicator for the collateral constraint.**

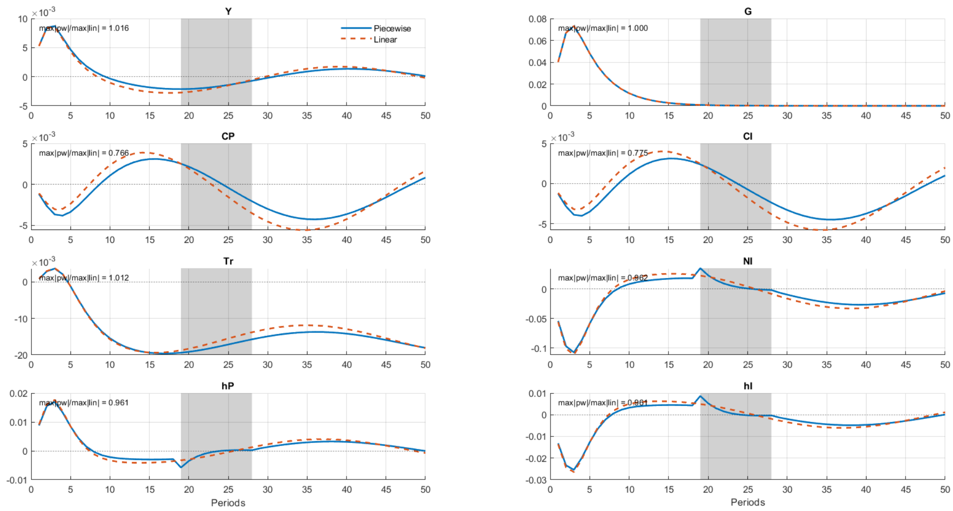

Figure 17: **Banks holding sovereign bonds, debt-blind benchmark: selected macroeconomic responses.**

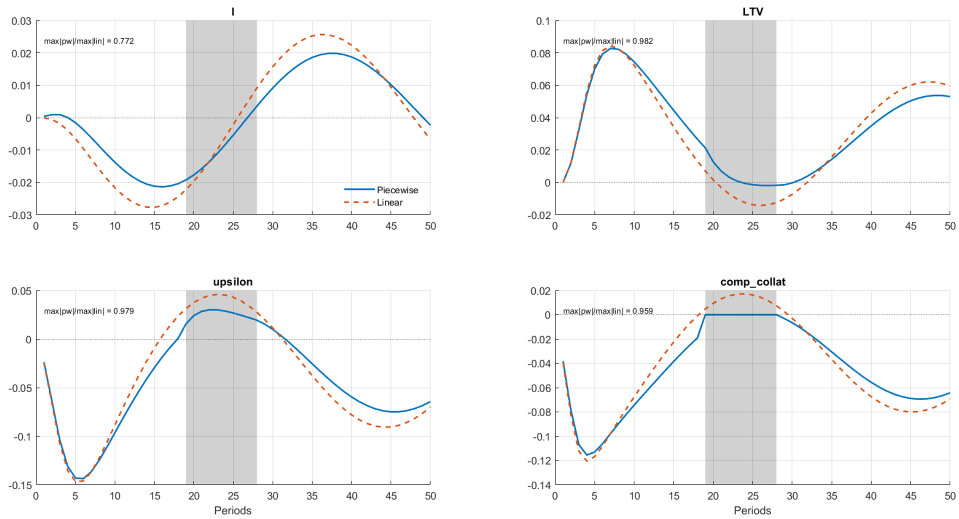

Figure 18: **Banks holding sovereign bonds, debt-blind benchmark: selected housing and financial responses.**

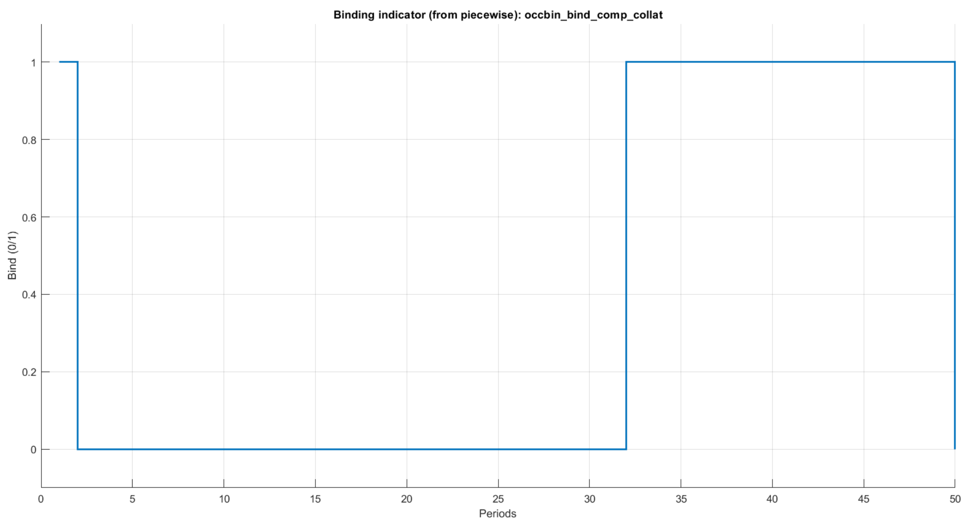

Figure 19: **Banks holding sovereign bonds, debt-aware benchmark: binding indicator for the collateral constraint.**

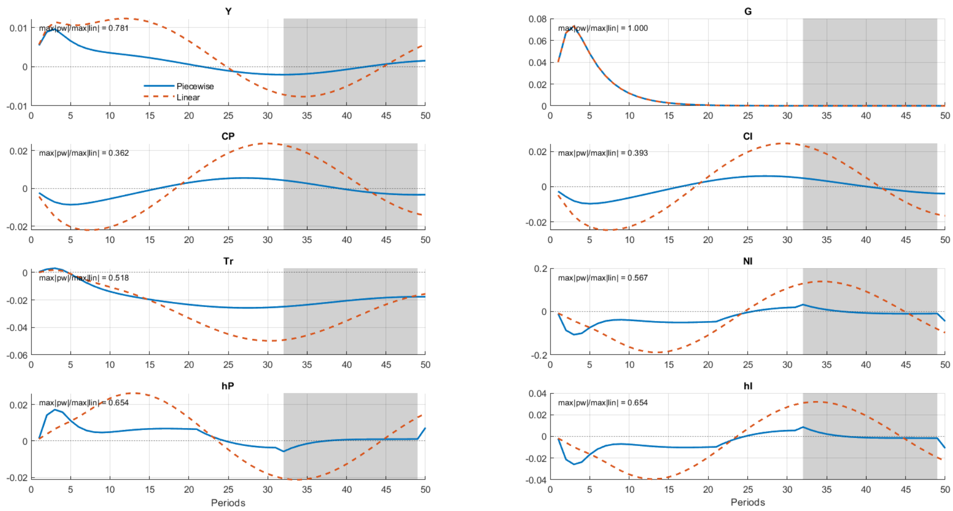

Figure 20: **Banks holding sovereign bonds, debt-aware benchmark: selected macroeconomic responses.**

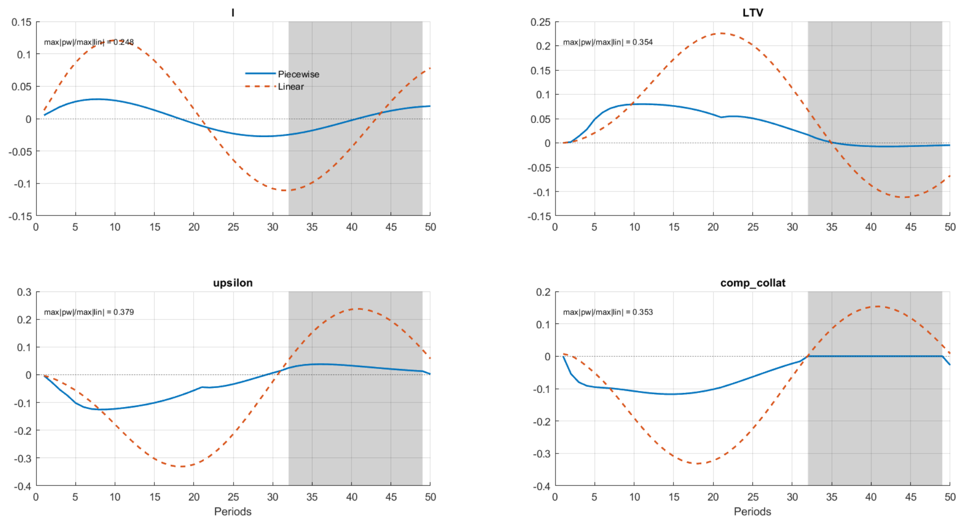

Figure 21: **Banks holding sovereign bonds, debt-aware benchmark: selected housing and financial responses.**

Table 19: **Banks holding sovereign bonds: government spending multipliers under the bank-bonds closure (fiscal trigger OFF, GDP-scaled).** Present-value (PV) multipliers are discounted; cumulative multipliers are undiscounted. All entries report output per % of GDP of the spending innovation.

	PV multiplier		Cumulative multiplier	
H	OccBin (piecewise)	Linear	OccBin (piecewise)	Linear
Panel A. Debt-blind				
1	0.87946	0.87722	0.87946	0.87722
20	0.36953	0.21072	0.34428	0.17730
40	0.31044	0.20193	0.28683	0.18066
80	0.20414	0.03958	0.12779	-0.05191
Panel B. Debt-aware				
1	0.90371	0.94077	0.90371	0.94077
20	1.22320	3.09300	1.24180	3.21460
40	0.87898	2.15630	0.83396	2.04220
80	1.05690	2.95070	1.05100	3.03090

Notes: Panel A shows that, under debt-blind policy, assigning sovereign bonds to banks already makes nonlinear propagation quantitatively relevant at medium and long horizons, even though impact multipliers remain very similar across solution methods. Panel B shows that, under debt-aware policy, the divergence becomes much larger: the linear approximation substantially overstates medium-run amplification once sovereign exposure is placed on banks' balance sheets.

Table 20: **Banks holding sovereign bonds:** 2×2 **summary under the bank-bonds closure.**

Scenario	CEV_{SOC} vs. SS (%)	CEV vs. A (bps)
A (OFF/Blind)	-0.094549	0
B (ON/Blind)	-0.092177	+0.2373
C (OFF/Aware)	-0.123570	-2.9044
D (ON/Aware)	-0.123580	-2.9063

Effect (bps)	$B - A$	$D - C$	$C - A$	$D - B$	Interaction
Welfare effect	+0.2373	-0.0019	-2.9044	-3.1436	-0.2393

Scenario	share	nEpisodes	meanDur	maxDur	maxMu
A (OFF/Blind)	0.00875	2	3.50	4	0.00380
B (ON/Blind)	0.01375	3	3.67	5	0.00392
C (OFF/Aware)	0.18125	12	12.08	14	0.05719
D (ON/Aware)	0.17875	12	11.92	13	0.05058

H	A (OFF/Blind)	B (ON/Blind)	C (OFF/Aware)	D (ON/Aware)	Interaction
20	0.72761	0.64654	1.23290	1.20580	+0.05392
80	0.54367	0.46613	1.06180	1.03540	+0.05111
160	0.55093	0.46166	1.16330	1.12760	+0.05353

Notes: The upper panels report welfare comparisons and collateral moments under the bank-bonds closure. Relative to the benchmark closure, debt-aware regimes produce much more frequent and persistent binding episodes, and the welfare interaction turns negative. The lower panel reports GDP-scaled present-value multipliers for the full 2×2 design. Under this closure, the multiplier interaction remains positive even though the welfare interaction becomes negative, underscoring that assigning sovereign bonds to banks changes the nature of the policy experiment by introducing a much tighter sovereign–bank nexus.