Time-Consistent Fiscal Policy and Business-Cycle Amplification in Emerging Markets

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Abstract

A small open-economy DSGE with an endogenous, time-consistent fiscal authority is solved globally and calibrated to emerging-market business-cycle moments. The Markov-perfect government chooses spending under borrowing constraints and convex adjustment costs. Perfect capital mobility and news about fundamentals shape expectations. In equilibrium, fiscal policy is procyclical and tracks the macro state where households anticipate persistent fiscal pressure and reduce saving. The mechanism operates through state-contingent level shifts in the spending rule rather than wealth-slope responses. This framework clarifies why procyclical spending is an optimal policy response under limited commitment, while demonstrating that a countercyclical fiscal stance would improve macroeconomic stability.

JEL: E32; E62; F41; F44.

Keywords: small open economy; Markov–perfect equilibrium; procyclical fiscal policy; emerging markets.

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1 Introduction

Fiscal policy in many emerging-market economies is procyclical, meaning that government spending rises in booms and contracts in recessions, which in turn amplifies rather than smooths out business-cycle fluctuations. This pattern is well documented and stands in contrast to the countercyclical stance typical of advanced economies (Frankel et al., 2013; Ilzetzki & Végh, 2008; Kaminsky et al., 2005). Explanations for procyclicality stress constrained market access in downturns and political-economy frictions that encourage overspending in booms (Alesina et al., 2008; Gavin & Perotti, 1997; Riascos & Vegh, 2003; Tornell & Lane, 1999).

We study the quantitative consequences of this procyclicality in a representative emerging economy, using the Philippines as our calibration target. Philippine discretionary fiscal policy has frequently been procyclical (Cevik, 2019). Growth has been volatile, especially in the 1980s (World Bank, 2018). Episodes like the Asian Financial Crisis (1997–1998) and the Global Financial Crisis (2008–2009) illustrate how limited fiscal space can coincide with recessions, consistent with broader Emerging Market and Developing Economies (EMDEs) evidence (Alberola et al., 2021). The Philippines' extensive IMF engagement over 1962–2000 underscores institutional and financing constraints that can foster procyclicality (International Monetary Fund Independent Evaluation Office, 2002).

Our analysis is positive and quantitative, asking: How does procyclical government spending, chosen without commitment, shape macroeconomic volatility in a typical emerging market, and what are the welfare costs of this behavior? We build a small open-economy DSGE model with a time-consistent (Markov-perfect) fiscal authority, closed through a constant public debt rule and prudential feasibility constraints (a debt-to-output ceiling and an expenditure cap), calibrated to Philippine moments. The Markov-perfect environment maps weak commitment capacity and fiscal discipline constraints (features emphasized in the empirical literature on emerging markets (Aguiar & Gopinath, 2007; García-Cicco et al., 2010)) into equilibrium fiscal behavior (Bachmann & Bai, 2013b).

In the 2,232-state baseline (with news shocks), equilibrium government purchases are procyclical (correlation with output of 0.37) and persistent, closely tracking the macro state. Fitted policy rules are largely explained by exogenous fundamentals and news about next-period fundamentals. The government places negligible weight on private asset holdings and adjusts mainly through state-contingent intercepts. A one-percent increase in current public purchases reduces next-period private assets by about 1.17 percent, quantifying the crowding-out margin. In simulated cycles, government spending (G_t) co-moves with output (Y_t) while household consumption remains smoother in levels (documented in Section 6.1).

Limited commitment and fiscal feasibility constraints jointly generate these patterns. When conditions are strong (high productivity or low world interest rates), the time-consistent government optimally raises public purchases, subject to the expenditure cap and debt-to-output ceiling. When conditions deteriorate, these constraints bind and discipline spending. News about next-period fundamentals affects current fiscal choices, as the government anticipates future resource constraints. Anticipated fiscal behavior feeds back into private savings, producing the measured crowding-out elasticity and a weak feedback from private assets to the government's rule.

Relative to the literature, we connect the procyclicality facts in emerging markets (Frankel et al., 2013; Ilzetzki & Végh, 2008; Kaminsky et al., 2005) to a structural environment that embeds fiscal feasibility constraints and time-consistent policy. Methodologically, we solve for Markov-perfect fiscal rules in a calibrated small open-economy model with news shocks and report elasticities for the private-asset and spending margins. Substantively, we quantify how much of observed spending variation can be understood as systematic, state-contingent responses to fundamentals and news about future conditions rather than idiosyncratic discretion. Finally, we compare the baseline procyclical fiscal stance with an alternative countercyclical spending scenario. This counterfactual analysis reveals that a countercyclical policy would substantially reduce output volatility and yield notable welfare gains relative to the procyclical baseline, underscoring the stabilization benefits of avoiding procyclicality.

Because the bulk of spending fluctuations arise endogenously from the macro-state in this environment, instruments that either damp the contemporaneous response of spending to the cycle or enable commitment to smoother paths are most promising. Such measures include medium-term expenditure frameworks, structural balance rules with escape clauses, stabilization funds, and independent fiscal oversight. Rules indexed to private balance-sheet variables are less effective, given the small feedback from assets to spending (elasticity of 0.0005). External validity is strongest for emerging markets with fiscal discipline constraints and limited commitment, whereas the portability of our findings to advanced economies is correspondingly narrower. In addition, to isolate the role of limited commitment, we benchmark the solved Markov-perfect allocation against a full-commitment Ramsey planner and show that the Ramsey economy markedly attenuates the fiscal response to the cycle.

The paper proceeds as follows. Section 2 relates our work to research on fiscal cyclicality and emerging-market business cycles. Section 3 documents the cyclical pattern of Philippine government expenditure. Section 4 presents the model and the government's problem. Section 5 describes the calibration. Section 6 reports the fitted policy rules, simulated business-cycle properties, and counterfactuals. Section 7 concludes with policy implications.

2 Literature Review

2.1 Procyclical Fiscal Policy in Emerging Economies: Evidence and Consequences

Emerging market economies across diverse geographical regions and development stages exhibit a striking empirical regularity, that is *procyclical* fiscal policies that amplify rather than dampen business cycle fluctuations. This pattern, documented across Latin America, Asia, Sub-Saharan Africa, and Eastern Europe, stands in sharp contrast to the countercyclical or acyclical fiscal stances typical of advanced economies (Aghion et al., 2007; Ilzetzki & Végh, 2008). While the tax-smoothing paradigm of Barro, 1979 would predict governments maintaining relatively stable spending paths, emerging market governments systematically violate this prescription by expanding expenditures during booms and contracting them during recessions.

The empirical evidence for fiscal procyclicality in emerging markets is robust across different methodologies, time periods, and country samples. Gavin and Perotti, 1997 pioneered this literature by documenting that fiscal expenditures in Latin America expanded during economic upswings and contracted during downturns. Kaminsky et al., 2005 broadened the analysis to show that macroeconomic policies in emerging markets generally follow a "when it rains, it pours" pattern, with increasing public spending, capital inflows, and credit expansion in good times followed by sharp reversals in bad times. Using a comprehensive sample of 94 countries over 1960-2003, Ilzetzki and Végh, 2008 find that the correlation between government consumption and GDP averages 0.53 in developing countries versus -0.20 in industrial countries. Talvi and Végh, 2005 report similar magnitudes using different data sources, with government spending-GDP correlations around 0.5 for emerging markets compared to nearly zero for G7 economies. More recent work by Frankel et al., 2013 documents that while about one-third of emerging economies have "graduated" from procyclicality since 2000, the majority continue to exhibit procyclical fiscal behavior.

Methodological advances have strengthened confidence in these findings. Early studies faced criticism that observed correlations might reflect reverse causality or omitted variables. Ilzetzki et al., 2013 address these concerns using instrumental variable techniques, exploiting predetermined institutional characteristics and external shocks as instruments for fiscal policy. D. Jaimovich and Panizza, 2007 employ alternative identification strategies based on forecast errors and real-time data, confirming that emerging market fiscal policy is genuinely procyclical rather than a statistical artifact. Alesina et al., 2008 use political variables as instruments, finding that countries with more corruption and less democratic accountability exhibit stronger fiscal procyclicality. These diverse identification approaches consistently confirm that emerging market governments actively pursue procyclical policies rather than simply appearing procyclical due to measurement issues.

The macroeconomic consequences of procyclical fiscal behavior extend beyond simple volatility amplification. Aghion et al., 2007 demonstrate theoretically and empirically that fiscal procyclicality reduces long-run growth rates by creating an uncertain environment that deters private investment. Using panel data from 75 countries, they find that moving from the median level of procyclicality to countercyclical policy could increase annual growth by 0.5 percentage points. Fatás and Mihov, 2013 document that policy volatility, of which fiscal procyclicality is a major component, explains up to 40% of the variation in long-term growth rates between countries. The welfare costs are substantial, Loayza and Raddatz, 2007 estimate that the excess volatility from procyclical policies reduces permanent consumption by 1-2% in typical emerging economies.

However, more recent evidence suggests that procyclicality is not an immutable fate for emerging markets. Over the last two decades, an increasing number of emerging and developing economies have managed to implement countercyclical fiscal policies—a notable departure from earlier patterns (Frankel et al., 2013; Jalles et al., 2024). Frankel et al., 2013 report that roughly one-third of developing countries ran fiscal policy countercyclically during the 2000s, up from under 10% in previous decades. This "graduation" from procyclicality is often attributed to stronger institutions and the adoption of fiscal frameworks that save windfalls during booms for use in downturns. Several Latin American economies, for example, introduced structural budget rules (Chile's being a canonical case) that enabled more stabilizing spending patterns (Céspedes & Velasco, 2014; Frankel, 2011). Emerging Asian countries have also shown signs of improvement, albeit more modest: better institutional quality and fiscal buffers have started to temper (though not eliminate) procyclicality in economies such as the Philippines and its ASEAN peers (Abdulla et al., 2020; Pandey & Patnaik, 2019). These developments motivate our focus on the macroeconomic payoff to changing fiscal cyclicality. In what follows, we compare the stabilization and welfare implications of shifting from a procyclical to a countercyclical fiscal regime in a representative emerging-market setting.

2.2 Explanations for Procyclicality: Financial Constraints and Political Economy

Two broad classes of explanations account for the prevalence of procyclical fiscal policy in emerging and developing economies: credit-market imperfections that tighten borrowing conditions in downturns, and political-economy forces that tilt discretionary spending toward booms even when countercyclical policy would be welfare improving (Frankel et al., 2013).

On the external-finance margin, state-contingent funding costs and occasional market shutdowns in recessions push governments toward contraction when stimulus would be desirable (Calvo et al., 2004; Gavin & Perotti, 1997). Models with collateral constraints or default risk formalize how binding constraints in bad times make optimal plans procyclical (Cuadra et al., 2010; Riascos & Vegh, 2003). Quantitative work that embeds sovereign risk into New Keynesian environments shows that higher default premia strengthen the empirical link between elevated spreads and more procyclical fiscal responses, with pronounced state dependence (Bianchi et al., 2023). Historical evidence also associates limited and volatile market access after debt crises with stronger procyclicality (Gavin & Perotti, 1997).

Political-economy mechanisms operate alongside these financial frictions. Common pool and rent-seeking problems can generate more than proportional spending responses in booms, the 'voracity effect' (Tornell & Lane, 1999), and agency problems with imperfectly informed voters favor using windfalls today instead of saving for downturns (Alesina et al., 2008). The high volatility of the tax base intensifies these pressures (Talvi & Végh, 2005). Transparency and accountability are empirically associated with smaller political budget cycles and less cyclical bias (Alt & Lassen, 2006), while greater political polarization correlates with more procyclical policy (Woo, 2009). Structural models with rent seeking can directly produce procyclicality (Ilzetzki et al., 2013).

These channels interact. Weak institutions raise political pressures in good times and risk premia in bad times, creating a "procyclicality trap." In models with sovereign risk, higher default sensitivity to borrowing in low-income states tilts the optimal stance toward procyclicality even without myopia (Bianchi et al., 2023). Precautionary buffers are optimal in such environments but difficult to sustain politically (Mendoza & Oviedo, 2006), which helps explain why rule adoption often requires complementary gains in credibility or market access to durably alter cyclical patterns.

The commodity dependence amplifies these mechanisms. In commodity exporters, fiscal aggregates converge strongly with price cycles, and procyclicality is more pronounced where institutional constraints are weaker (Céspedes & Velasco, 2014; International Monetary Fund, 2012). Democratic and rule-based settings mitigate some of these responses, where constraints are weak, booms tend to translate into higher spending and debt dynamics that later force contraction (Arezki & Ismail, 2013).

Debates about fiscal effectiveness add nuance. Cross-country estimates point to modest average government consumption multipliers in developing economies and substantial variation between regimes and states of the cycle (Auerbach & Gorodnichenko, 2012; Kraay, 2014; Ramey & Zubairy, 2018). Composition and implementation matter: public investment can yield larger multipliers when project execution and financing conditions are favorable (Izquierdo et al., 2019).

Institutions shape both the prevalence and the consequences of procyclicality. Countries that "graduate" from procyclical behavior typically adopt flexible fiscal rules with escape clauses, independent fiscal councils, and medium-term frameworks (Frankel, 2011; Frankel et al., 2013). Large cross-country panels indicate that rule *design* matters: better-designed and more flexible rules are associated with less procyclicality on average, though rules are no panacea without broader improvements in governance (Bova et al., 2014; Guerguil et al., 2017; Schaechter et al., 2012).

2.3 Cross-regional heterogeneity in fiscal cyclicality

Cross-country evidence shows that procyclicality is the modal fiscal stance among emerging and developing economies, with its intensity varying systematically by region and by institutional capacity (Aizenman et al., 2019; Frankel et al., 2013). In emerging Asia, government expenditure typically moves with the cycle, though less than in commodity-dependent regions. Cross-country estimates report positive co-movement of discretionary outlays with output and revenues, and only limited "graduation" from procyclicality, with modest insurance from automatic stabilizers (Aizenman et al., 2019; Pandey & Patnaik, 2019).

In Sub-Saharan Africa, procyclicality is stronger on average, particularly among oil exporters. External financing conditions, aid volatility, and shallow domestic financial markets are prominent correlates of the cyclical stance (Calderón et al., 2017; Konuki & Villafuerte, 2016; Lledó et al., 2009; Thornton, 2008). Post-transition Europe saw pronounced procyclicality in the early years. However, EU accession and stronger frameworks moved plans toward acyclical norms, yet the results achieved often remain procyclical, pointing to implementation frictions even where rules exist (Gootjes & de Haan, 2022; Kabashi, 2016). Latin America exhibits the widest dispersion: several countries remain strongly procyclical, often tied to commodity revenues and financing, while adopters of cyclically adjusted rules with credible escape clauses achieved markedly more countercyclical profiles with Chile as the canonical case (Alberola et al., 2017; Klemm, 2014; Marcel, 2013).

These patterns motivate our modeling and calibration choices. Multiple mechanisms, credit constraints, political-economic pressures, and their interaction, can rationalize procyclicality, with weights that differ between settings. Institutional design conditions whether policy leans with or against the cycle. Philippine fiscal moments lie within published emerging market ranges, and therefore we use the Philippines as our calibration baseline while keeping the model structure general enough for external validity (Section 5).

2.4 Calibration baseline: why the Philippines

Cross-country work documents the widespread fiscal procyclicality in emerging markets, but testing mechanisms and evaluating counterfactual rules require a country setting that is both representative and data rich enough to discipline a structural model. We use the Philippines as our calibration baseline because it combines typical emerging–market structure and exposures with unusually long, high–frequency macro–fiscal series and transparent classifications that map cleanly into our model.

By standard benchmarks, the Philippine economy sits near the middle of the emerging–market distribution in income, openness, and external balance–sheet exposure. World Development Indicators and external wealth accounts place the country in ranges that are common among middle–income economies, and inward FDI positions are comparable to regional peers (Lane & Milesi-Ferretti, 2018; UNCTAD, 2025; World Bank, 2025a). These features matter for portability: the calibration is anchored in moments that are typical rather than extreme.

Data depth and transparency are a second reason for this choice. Quarterly national accounts begin in 1981, spanning multiple business cycles and canonical shocks (Philippine Statistics Authority, 2025). On the fiscal side, the Department of Budget and Management disseminates disaggregated public finance series that can be bridged to GFSM 2014, with linkages documented in the IMF Fiscal Transparency Evaluation (Mueller et al., 2015). Statistical dissemination for monetary and external accounts follows the IMF's SDDS standards (International Monetary Fund, 2023a). This combination of length, frequency, and classification quality is essential for identifying fiscal feedbacks and validating model counterfactuals.

Within–country variation further helps discipline mechanisms. The sample covers the early-1980s debt crisis and sudden stop, the 1997–98 Asian financial crisis, and the 2008–09 global financial crisis, each revealing different interactions between borrowing constraints and fiscal retrenchment. A long history of IMF arrangements underscores episodes of constrained market access and policy conditionality that are informative for the credit–constraint channel (International Monetary Fund Independent Evaluation Office, 2002).

Institutional characteristics also sit near the emerging–market median. Governance indicators place the Philippines in the mid-range of accountability and control–of-corruption measures, and the fiscal framework has relied on a debt anchor and headline deficit targets—an arrangement often associated with procyclical bias absent structural-balance rules (International Monetary Fund, 2023b; Transparency International, 2025; World Bank, 2025b). Finally, exposures that are emblematic of emerging markets—sudden stops, recurrent climate shocks, and sizable remittance inflows—provide a realistic environment in which to assess the interaction of fiscal rules and external conditions (Bayangos & Jansen, 2011; PAGASA, Department of Science and Technology, 2025; World Bank, 2025a).

In sum, we calibrate to the Philippines not to produce a country case study per se, but because it is a data-rich, structurally typical emerging market whose history delivers the variation needed to identify the borrowing-constraint, limited-commitment, and political-economy channels emphasized in our model. This choice supports external validity while keeping the calibration anchored in observable macro–fiscal moments and policy episodes common across emerging markets.

2.5 Endogenous fiscal policy in DSGE models: methodological foundations

Our approach follows the literature that endogenizes government spending within dynamic general equilibrium environments. Treating fiscal policy as an exogenous disturbance, the early convention of the real business cycle, cannot capture the systematic, state-contingent component of government behavior that drives fiscal volatility (Fernández-Villaverde et al., 2015). We build on Bachmann and Bai (2013a, 2013b), who model public consumption as an equilibrium choice of a time-consistent government rather than as a forcing process.

Relative to the exogenous-spending tradition (e.g., Kydland & Prescott, 1982), subsequent work showed that the design of fiscal behavior matters for propagation: simple feedback rules or constraints alter comovement and persistence (Baxter & King, 1993; Cardia et al., 2003; Schmitt-Grohé & Uribe, 1997). Parallel advances in optimal policy with limited commitment provide tractable foundations for time-consistent behavior and state-dependent dynamics (Klein et al., 2008). In this vein, Bachmann and Bai (2013b) embeds a welfare-maximizing, time-consistent authority that chooses government consumption subject to implementation frictions.

Three elements from that framework are central for the study: (i) a frictionless optimizing government generates too little volatility and persistence relative to the data; (ii) adjustment costs and implementation lags help match observed persistence; and (iii) preference (valuation) shocks to public goods rationalize residual volatility not explained by fundamentals. We retain these features and adapt the environment to an emerging-market small open economy.

The model is a small open economy with incomplete international asset markets in the spirit of Mendoza (1991) and Schmitt-Grohé and Uribe (2003). Consistent with our scope, there is no monetary policy block. The exogenous state vector comprises (i) productivity shocks disciplined by emerging-market volatility and persistence (Aguiar & Gopinath, 2007; Bachmann & Bai, 2013b), (ii) preference shocks that shift the valuation of public consumption (Bachmann & Bai, 2013b), and (iii) world interest rate shocks that follow the external-finance literature (Neumeyer & Perri, 2005; Uribe & Yue, 2006). The government chooses public consumption to maximize household welfare, taking exogenous states and private choices as given and subject to standard implementability and resource constraints. Stationarity is ensured by a debt-elastic interest-rate premium; we do not model sovereign default or additional financial frictions.

This setup is the time-consistent counterpart to Ramsey benchmarks that imply tax smoothing and countercyclical spending under complete markets (Barro, 1979; Lucas & Stokey, 1983). Our focus is on implementation frictions and emerging-market drivers (productivity, preferences, and world rates), with the goal of attributing observed fiscal comovement to policy choice under constraints versus shocks in a structure that maps cleanly to data yet remains rich enough for counterfactual fiscal rules. In this sense, the analysis complements the broader incomplete-commitment literature (e.g., Aiyagari et al., 2002) while staying within the ingredients used here.

3 Fiscal cyclicality in emerging markets: evidence from a calibration baseline

This section documents fiscal cyclicality using annual Philippine public–finance data for 1980–2020, which we use as our calibration baseline. Philippine moments fall within published emerging-market ranges, so the series provide a credible benchmark rather than an outlier (Frankel et al., 2013; Kaminsky et al., 2005; Talvi and Végh, 2005; Vegh and Vuletin, 2015). The choice aligns with the model's focus on an endogenous, time-consistent fiscal authority in a small open economy, where co-movement and persistence of spending are the moments that discipline the mechanism.

Data, construction, and mapping. We assemble aggregates from the Department of Budget and Management's *Budget of Expenditures and Sources of Financing* (BESF, various years) and map them to *Government Finance Statistics Manual* (GFSM 2014) concepts using the bridges documented in the IMF Fiscal Transparency Evaluation for the Philippines. (Department of Budget and Management, n.d.; International Monetary Fund, 2014; Mueller et al., 2015) Output is real GDP from the Philippine Statistics Authority's *National Accounts* (Philippine Statistics Authority, 2020). Moments are computed on log levels at the annual frequency with no filter in the baseline. Category definitions—government final consumption expenditure, economic services (public investment), general public services, social services, defense, net lending, and interest payments—follow GFSM 2014 conventions; line-item mapping and any splices are detailed in the Data Appendix.

Representativeness. Simple moments place the Philippines near the center of emerging-market distributions: spending–output co-movement and volatility ratios lie in interquartile ranges reported by cross-country studies of fiscal cyclicality (Frankel et al., 2013; Kaminsky et al., 2005; Talvi and Végh, 2005; Vegh and Vuletin, 2015). We therefore use the Philippines as the calibration baseline rather than as a country-specific case.

Table 1: Fiscal cyclicality in the Philippines (1980–2020): Core aggregates

	GDP	GFCE	ES	GPS	SS
Standard deviation (%)	1.5	2.1	6.6	4.7	4.7
AR(1) persistence ρ	0.48	0.63	0.36	0.34	0.46
Correlation with output	1.00	0.53	0.31	0.33	0.27
Correlation with lagged output	0.44	0.46	0.17	0.06	−0.11
Correlation with output (lag 2)	−0.09	0.13	0.28	0.17	−0.10

Acronyms: GDP = Gross Domestic Product; GFCE = Government Final Consumption Expenditure (government consumption); ES = Economic Services (public investment); GPS = General Public Services; SS = Social Services.
Notes: Annual series, 1980–2020. Moments computed on log levels (no filter); robustness to HP filtering is reported in the Data Appendix. Spending categories follow GFSM 2014 mapping from BESF functional and economic classifications. Sources: DBM *Budget of Expenditures and Sources of Financing* (various years); PSA *National Accounts*.

Table 2: Fiscal cyclicality in the Philippines (1980–2019): Financing items

	DEF	NL	IP
Standard deviation (%)	5.5	69.5	8.2
AR(1) persistence ρ	0.01	−0.06	−0.01
Correlation with output	0.37	−0.23	−0.32
Correlation with lagged output	−0.06	−0.18	−0.29
Correlation with output (lag 2)	0.05	−0.07	−0.21

Acronyms: DEF = Defense; NL = Net Lending; IP = Interest Payments.
Notes: Annual series, 1980–2020. "Defense" and "General public services" follow BESF functional classifications; "Net lending" and "Interest payments" follow GFSM 2014. See the Data Appendix for reconciliation to national-accounts aggregates and for alternative filters and robustness checks.

Shift to a 2000–2020 sample. To gauge how structural reforms and macro stabilization since the late 1990s alter fiscal behavior, we recompute the moments for 2000–2020, focusing on total government expenditure. We apply two filters to annual log series: HP with the Ravn–Uhlig adjustment ($\lambda = 6.25$) and the Hamilton filter as a robustness check. (Hamilton, 2018; Ravn and Uhlig, 2002) Tables 3–6 report the resulting statistics for four five-year blocks.

Splitting the sample sharpens the contrast in the aggregate stance. Under the HP filter, 2000–2005 is mildly procyclical, consistent with macro-fiscal consolidation and revenue mobilization from the 2005 *Expanded VAT* (RA 9337), which expanded the base and raised

Table 3: Total government expenditure cyclicality (2000–2005)

	HP ($\lambda = 6.25$)	Hamilton ($h = 1, p = 1$)
Standard deviation (%)	1.61	3.04
AR(1) persistence ρ	−0.40	−0.36
Correlation with output	0.11	−0.79
Correlation with lagged output	−0.18	−0.10
Correlation with output (lag 2)	−0.47	—
Correlation with durable spending	0.84	0.97
Correlation with net lending	0.01	0.98

HP filter applied to log levels with annual smoothing parameter $\lambda = 6.25$. Hamilton filter uses $h = 1$ forward observation and $p = 1$ lag on log levels. Correlations use the filtered cycle components; "lagged output" refers to GDP at $t - 1$ and $t - 2$. Durable spending corresponds to national-accounts *Durable Equipments*; net lending follows GFSM 2014.

Table 4: Total government expenditure cyclicality (2006–2010)

	HP ($\lambda = 6.25$)	Hamilton ($h = 1, p = 1$)
Standard deviation (%)	2.54	2.14
AR(1) persistence ρ	−0.23	−0.92
Correlation with output	−0.00	−1.00
Correlation with lagged output	0.84	—
Correlation with output (lag 2)	−0.99	—
Correlation with durable spending	−0.70	−0.99
Correlation with net lending	0.29	−0.87

Same notes as Table 3.

the rate to 12 percent starting 2006 and was associated with improved fiscal balances (Arze del Granado et al., 2007; International Monetary Fund, 2006, 2008; Republic of the Philippines, 2005). For 2006–2010, contemporaneous co-movement is flat, but expenditure remains tied to earlier GDP (lag correlation 0.84), a pattern consistent with budget execution and public investment implementation lags around the 2009 *Economic Resiliency Plan* stimulus; such lags are known to alter the timing of spending's effect on activity (Bangko Sentral ng Pilipinas, 2009; Leeper et al., 2010; World Bank, 2009). In 2011–2015, correlations turn countercyclical ($\rho_{GY} = -0.67$), reflecting post-disaster reconstruction after Typhoon *Yolanda* (Haiyan) and other natural shocks that raised public spending amid weaker growth, with a temporary 2014 execution setback following the Supreme Court's *Disbursement Acceleration Program* decision

Table 5: Total government expenditure cyclicality (2011–2015)

	HP ($\lambda = 6.25$)	Hamilton ($h = 1, p = 1$)
Standard deviation (%)	3.81	6.15
AR(1) persistence ρ	−0.50	−1.18
Correlation with output	−0.67	−0.99
Correlation with lagged output	−0.03	—
Correlation with output (lag 2)	−0.00	—
Correlation with durable spending	−0.02	−0.92
Correlation with net lending	0.38	0.01

Same notes as Table 3.

Table 6: Total government expenditure cyclicality (2016–2020)

	HP ($\lambda = 6.25$)	Hamilton ($h = 1, p = 1$)
Standard deviation (%)	16.15	19.55
AR(1) persistence ρ	−0.50	−1.44
Correlation with output	0.98	0.95
Correlation with lagged output	−0.42	—
Correlation with output (lag 2)	−0.81	—
Correlation with durable spending	0.98	0.99
Correlation with net lending	−0.11	0.90

Same notes as Table 3.

(Government of the Philippines and Development Partners, 2013; Mueller et al., 2015; Senate of the Philippines, 2014; Supreme Court of the Philippines, 2014; World Bank, 2013). In 2016–2020, procyclicality returns (correlation ≈ 1) as the *Build, Build, Build* infrastructure drive lifts public outlays to around 5–7 percent of GDP, supported by the 2017 *TRAIN* tax reform, before the pandemic-induced 2020 collapse in output (Congressional Policy and Budget Research Department, 2019; Department of Budget and Management, 2019; Department of Finance, Philippines, 2017; Philippine Statistics Authority, 2021). The Hamilton filter broadly confirms these shifts—countercyclicality in 2011–2015 and renewed procyclicality after 2016—while delivering larger magnitudes in short windows, underscoring how detrending choice matters with small annual samples (Hamilton, 2018). In both cases, net lending co-movement changes sign across subsamples, pointing to opportunistic financing and project timing rather than a systematic stabilizer, consistent with diagnostics on public investment management and execution frictions (Asian Development Bank, 2015; International Monetary Fund, 2019).

Regularities and calibration targets. Two properties generalize to emerging markets and guide the calibration. First, government consumption comoves positively with output and is persistent at the annual frequency, consistent with multi-year budget processes and implementation frictions (International Monetary Fund, 2019; Kaminsky et al., 2005; Leeper et al., 2010; Talvi and Végh, 2005; Vegh and Vuletin, 2015). Second, spending is relatively volatile—government consumption's standard deviation typically exceeds that of output—with heterogeneous category responses: current spending reacts more strongly than social outlays, and public investment compresses disproportionately in downturns unless protected by rule design (Ardanaz et al., 2020; Frankel et al., 2013). These regularities map to the features we discipline (co-movement and persistence of G; intercept shifts in the fiscal rule) and to the shock processes we calibrate (productivity, world interest rates, and preference shocks), standard in emerging-market small-open-economy models (Aguiar and Gopinath, 2006; Neumeyer and Perri, 2005; Uribe and Yue, 2006).

4 Model

Environment. We study a small open economy (SOE) real business cycle model with flexible prices and wages, a representative household, competitive firms, and a government that purchases a flow of public consumption G_t. Monetary frictions and seigniorage are absent; spending and interest payments are tax financed. To close the open economy without resorting to a debt-elastic interest-rate premium (Schmitt-Grohé & Uribe, 2003), we impose a constant domestic-debt rule and two prudential feasibility constraints: a debt-to-output ceiling and an government expenditure cap. These constraints mirror widely studied fiscal-rule designs and expenditure rules that anchor public spending to output (Bohn, 1998; Caselli & Reynaud, 2020; Ghosh et al., 2013; Heinemann et al., 2018; Holm-Hadulla et al., 2012). Our quantitative analysis targets medium-run real responses to government spending; monetary policy and inflation dynamics are outside the model's scope. Data are in U. S. dollars at constant prices; cycle components are extracted using an HP filter on annual data.[1]

Modeling choices and economic rationale. By abstracting from nominal rigidities and the monetary block, we concentrate on the real transmission of changes and innovations about productivity z_t, the external interest rate r_t^*, and shifting preferences of households for private goods consumption over public goods θ. By design, the framework excludes financial intermediation or borrowing constraints, and household heterogeneity. This isolates the core open-economy RBC mechanisms: intertemporal reallocation through changes in absorption, the user cost of capital, and external accounts. We use the SOE structure to study how anticipated changes in fundamentals shift current allocations, the trade balance, and the current account (Barsky & Sims, 2011; Beaudry & Portier, 2006; Beaudry et al., 2011; N. Jaimovich & Rebelo, 2009; Kamber et al., 2017; Mendoza, 1991; Obstfeld & Rogoff, 1996; Schmitt-Grohé & Uribe, 2003; Schmitt-Grohé & Uribe, 2012). [2]

Table 7: Notation (selected symbols used in the model)

Symbol	Meaning
$\bar{B}$	Constant public debt level
K_t	Physical capital
A_t	Household asset holdings (capital and bonds)
TB_t	Trade balance (goods)
Y_t	Output; resource identity $Y_t = C_t + I_t + G_t + AC_t + TB_t$ (Eq. (19))
C_t	Private consumption
I_t	Investment
G_t	Public consumption
AC_t	Adjustment costs entering absorption
r_t^*	World real interest rate
z_t	Total factor productivity (TFP)
θ_t	Preference weight on private consumption in $u(C_t, G_t)$

All variables are real and measured at the model's base frequency.

[1] These modeling choices align with the SOE real-business-cycle and news-shock literatures, e. g., (Clarida et al., 1999; Coşkun, 2019; Galí et al., 2007; Ilzetzki et al., 2013; Mendoza, 1991; Neumeyer & Perri, 2005).

[2] We use "≡" for definitions and national-accounts identities, and "=" for equilibrium conditions.

4.1 Households

Preferences. Household preferences are log–Cobb–Douglas in private and public goods,

$$u(C_t, G_t) \;=\; \theta_t \log C_t \;+\; \Big(1-\theta_t\Big)\, \log G_t, \qquad \theta_t \;=\; \bar{\theta}\,\hat{\theta}_t, \tag{1}$$

The shock θ_t tilts marginal utility between private and public consumption. When θ_t is high, households value private consumption relatively more; when it is low, the value of public purchases is higher. This parsimonious preference shifter follows the literature that uses state-dependent utility weights to capture time-variation in the stance toward public goods.

with $\hat{\theta}_t \in \{\underline{\theta}, \overline{\theta}\}$ evolving according to a symmetric two-state Markov chain,

$$\Theta \;=\; \begin{bmatrix} \rho & 1-\rho \\ 1-\rho & \rho \end{bmatrix},$$

orthogonal to technology and interest-rate processes (Bachmann & Bai, 2013b).

Budget constraint and Euler condition. We define the asset, A_t, held by the representative household, to consist of both capital and bonds. With a labor-income tax $\tau_{\ell,t}$ and a uniform asset-income tax τ_a applied to bond interest and to the rental rate on capital, the period budget can be written as

$$C_t \;+\; A_{t+1} \;=\; (1-\tau_{\ell,t})\, w_t L \;+\; \Big[1 + (1-\tau_a)\, r_t^*\Big]\, A_t. \tag{2}$$

Let λ_t denote the multiplier on the household budget and $u(C_t, G_t) = \theta_t \log C_t + (1 - \theta_t) \log G_t$. Then

$$\lambda_t \;=\; \frac{\theta_t}{C_t}. \tag{3}$$

Under perfect mobility, portfolio indifference collapses the Euler conditions to a single unified condition,

$$\frac{\theta_t}{C_t} \;=\; \beta\, \mathbb{E}_t\!\left[\frac{\theta_{t+1}}{C_{t+1}} \Big(1 + (1-\tau_a)\, r_{t+1}^*\Big)\right], \tag{4}$$

Condition (4) equates the marginal utility cost of saving one additional unit today to the discounted marginal benefit tomorrow, scaled by the gross after-tax world return. Because the next-period interest rate r^*_{t+1} is known at t under our news shocks, households perfectly foresee the payoff to saving when choosing C_t and A_{t+1}.

4.2 Firms

Technology and factor pricing. Output is produced with a Cobb–Douglas technology,

$$Y_t \;=\; z_t\, K_t^{\alpha} L^{\,1-\alpha}, \qquad \alpha \in (0,1). \tag{5}$$

Under perfect competition, inputs are paid their marginal products,

$$r_{k,t} \;=\; \frac{\partial Y_t}{\partial K_t} \;=\; \alpha\, z_t \left(\frac{K_t}{L}\right)^{\alpha-1}, \qquad w_t \;=\; \frac{\partial Y_t}{\partial L} \;=\; (1-\alpha)\, z_t \left(\frac{K_t}{L}\right)^{\alpha}. \tag{6}$$

With perfect capital mobility, the no-arbitrage condition (8) requires the rental rate net of depreciation to equal the world interest rate,

$$r_{k,t} - \delta \;=\; r^*_t. \tag{7}$$

Capital mobility and investment. Firms operate $Y_t = z_t K_t^{\alpha} L^{1-\alpha}$ in competitive factor markets, with inelastic labor supply L. Perfect capital mobility equates the user cost to the marginal product of capital:

$$\alpha\, z_t \left(\frac{K_t}{L}\right)^{\alpha-1} \;=\; r^*_t + \delta. \tag{8}$$

Equation (8) delivers a static capital demand and, in per-worker terms, $k_t \equiv K_t/L = \big(\alpha z_t/(r^*_t+\delta)\big)^{\frac{1}{1-\alpha}}$. Equivalently,

$$K_t \;=\; L \left(\frac{\alpha\, z_t}{r^*_t + \delta}\right)^{\frac{1}{1-\alpha}}. \tag{9}$$

Given our news specification, (z_{t+1}, r^*_{t+1}) are known at time t. The desired next-period stock chosen at t is therefore

$$K_{t+1} \;=\; L \left(\frac{\alpha\, z_{t+1}}{r^*_{t+1} + \delta}\right)^{\frac{1}{1-\alpha}}, \tag{10}$$

so current investment, $I_t \equiv K_{t+1} - (1-\delta)K_t$, moves one-for-one with news about (z_{t+1}, r^*_{t+1}), as in standard anticipation experiments (Beaudry and Portier, 2006; N. Jaimovich and Rebelo, 2009). The comparative statics are immediate: $\partial K_{t+1}/\partial z_{t+1} > 0$ and $\partial K_{t+1}/\partial r^*_{t+1} < 0$.[3]

[3] With convex installation costs or time-to-build, (10) pins down the *target* stock rather than the within-period realization; the signs of the comparative statics are unchanged.

Wage as function of fundamentals. From (6), $w_t = (1-\alpha)z_t(K_t/L)^\alpha$. Substituting (9) yields

$$w_t \;=\; (1-\alpha)\, z_t \left(\frac{\alpha\, z_t}{r_t^* + \delta}\right)^{\frac{\alpha}{1-\alpha}}. \tag{11}$$

Under perfect capital mobility, w_t depends only on contemporaneous fundamentals (z_t, r_t^*) through the equilibrium capital-labor ratio and is independent of the asset position A_t. Higher z_t raises w_t directly and via capital deepening; a higher r_t^* lowers w_t by reducing the equilibrium capital-labor ratio.

Stochastic environment. The exogenous processes for the next-period fundamentals are AR(1) and *known at time t* ("news" shocks):

$$r_{t+1}^* = (1-\rho_r)\,\bar{r}^* + \rho_r\, r_t^* + \varepsilon_t^r, \qquad \varepsilon_t^r \sim \mathcal{N}(0, \sigma_r^2), \tag{12}$$

$$\ln z_{t+1} = (1-\rho_z)\,\ln \bar{z} + \rho_z\,\ln z_t + \varepsilon_t^z, \qquad \varepsilon_t^z \sim \mathcal{N}(0, \sigma_z^2), \tag{13}$$

with $0 < \rho_r, \rho_z < 1$ and steady-state means $\bar{r}^*, \bar{z}$. Hence, at time t, the information set $\{z_t, r_t^*, \varepsilon_t^z, \varepsilon_t^r\}$ and (z_{t+1}, r_{t+1}^*) *are known*, a timing standard in the news-shock literature (Barsky and Sims, 2011; Beaudry and Portier, 2006; N. Jaimovich and Rebelo, 2009; Schmitt-Grohé and Uribe, 2012) that makes one-period-ahead returns *deterministic* when investment is chosen.

4.3 Government Sector and Fiscal Financing Assumptions

Budget constraint, debt rule, and tax instruments. The government purchases public consumption G_t and maintains a stock of one-period domestic bonds B_t. Its flow budget constraint is

$$B_{t+1} \;=\; (1 + r_{b,t})\, B_t \;+\; G_t \;+\; AC_t \;-\; T_t \tag{14}$$

$$T_t \equiv \tau_{\ell,t}\, w_t L \;+\; \tau_a\, r_{b,t}\, A_t, \tag{15}$$

where T_t denotes tax revenue, raised through a proportional labor-income tax $\tau_{\ell,t} \in [0, \bar{\tau}_\ell)$ and a proportional tax τ_a on private asset income. As a policy rule, the bond stock is held constant:

$$B_{t+1} = B_t \equiv \bar{B}.$$

Imposing this rule in (14) yields a period-by-period primary surplus equal to interest on the outstanding stock,

$$T_t \;=\; G_t \;+\; AC_t \;+\; r_{b,t}\,\bar{B}.$$

Given (G_t, A_t) and prices $(w_t, r_{b,t})$, a labor tax that exactly implements the constant-debt rule is

$$\tau_{\ell,t} \;=\; \frac{G_t \;+\; AC_t \;+\; r_{b,t}\,\bar{B} \;-\; \tau_a\, r_{b,t}\, A_t}{w_t\, L}, \qquad 0 \le \tau_{\ell,t} \le \bar{\tau}_\ell < 1, \tag{16}$$

with L denoting inelastic labor supply. Although labor is inelastic, financing affects disposable income and borrowing capacity (Baxter & King, 1993; Leeper, 1991).

Adjustment costs (Government). Changes in government purchases entail a convex resource cost (Bachmann & Bai, 2013b) described as follows,

$$AC_t \;=\; \frac{\Omega}{2}\left(G_{t+1} - G_t\right)^2, \qquad \Omega > 0, \tag{17}$$

This term is a pure resource use and does not enter the utility function. It therefore appears in both the government budget and the goods-market identity, without introducing intertemporal preference wedges.

Expenditure feasibility constraint. Public purchases are required to satisfy a deterministic feasibility cap relative to (expected) output,

$$G_{t+1} \;\le\; \bar{g} \cdot Y_{t+1}, \qquad \bar{g} \in (0, 1), \tag{18}$$

so that at time t the policy choice for G_{t+1} is restricted by the anticipated resource envelope. Taken together, the constant-debt rule and its implementing tax (16) imply a per-period primary surplus of $r_{b,t}\bar{B}$. The ratio cap (18) ensure feasibility, and the adjustment cost (17) is counted once, as a resource use in (14) and (19), and does not enter utility.

4.4 Market Clearing and Balance of Payments

Goods market clearing and resource constraint. Total output is allocated to private absorption, public purchases, adjustment costs, and the trade balance:

$$Y_t \;=\; C_t + I_t + G_t + AC_t + TB_t. \tag{19}$$

Equation (19) is the standard absorption identity: output is allocated to private consumption, investment, public purchases, and the resource cost AC_t, with the trade balance adjusting residually. We define I_t through (20) and use (21) to track external adjustment.

Investment is defined by capital accumulation:

$$I_t \;=\; K_{t+1} - (1-\delta)\, K_t. \tag{20}$$

The term AC_t denotes the fiscal adjustment cost specified in (17) and is treated as a resource use; it does not enter utility. Equation (19) implies:

$$TB_t \;=\; Y_t - \Big(C_t + I_t + G_t + AC_t\Big). \tag{21}$$

A positive TB_t indicates a net export of goods and services; a deficit must be financed by a reduction in net foreign assets. This is the standard absorption formulation in open-economy macroeconomics (e. g., Corsetti and Müller, 2013; Obstfeld and Rogoff, 1996).

Timing and information. At the beginning of period t, agents observe the state vector

$$\mathbf{s}_t \;\equiv\; \Big(A_t,\, G_t,\, r^*_t,\, z_t,\, \varepsilon_{r,t},\, \varepsilon_{z,t},\, \theta_t\Big).$$

For notational convenience, the state includes the "news" variables $\varepsilon_{r,t}$ and $\varepsilon_{z,t}$ generated by Equations (12) and (13). These variables reveal next-period fundamentals at date t. In detail, r^*_{t+1} and z_{t+1} are known when date-t choices are made.

Given (z_t, r^*_t), the firm's static capital-demand condition holds as in Equation (9). Because (z_{t+1}, r^*_{t+1}) are known at date t, Equation (10) determines K_{t+1} as a function of $(\varepsilon_{z,t}, \varepsilon_{r,t})$.

Government move. The government chooses G_{t+1} subject to the spending feasibility constraint (18); the associated adjustment cost AC_t is paid at date t as in (17). Under the constant-debt rule $B_{t+1} = B_t \equiv \bar{B}$ and with $r_{b,t} = r^*_t$, the period-t sequential budget identity is

$$T_t \;\equiv\; G_t + AC_t + r^*_t\, \bar{B} \;=\; \tau_{\ell,t}\, w_t L \;+\; \tau_a\, r^*_t\, A_t \tag{22}$$

Household move. Given $\mathbf{s}_t$ and G_{t+1}, the household chooses $\{C_t, A_{t+1}\}$ subject to the unified-asset budget constraint in (2), where the asset-income tax applies to net capital income. Under perfect capital mobility, no-arbitrage implies

$$r_{k,t} - \delta \;=\; r_{b,t} \;=\; r^*_t, \tag{23}$$

and the Euler condition is given by (4).

Market clearing and state transition. Goods market clearing is given by (19) with investment defined by (20). The state evolves according to

$$\mathbf{s}_{t+1} \;\equiv\; \Big(A_{t+1},\, G_{t+1},\, r^*_{t+1},\, z_{t+1},\, \varepsilon_{r,t+1},\, \varepsilon_{z,t+1},\, \theta_{t+1}\Big),$$

where the news variables $(\varepsilon_{r,t+1}, \varepsilon_{z,t+1})$, realized at the beginning of $t+1$, are generated by (12) and (13) and reveal (r^*_{t+2}, z_{t+2}).

4.5 Markov-Perfect Equilibrium (MPE)

Public consumption is determined by the government to maximize the contemporaneous utility of the household, which depends on both private consumption and public goods, **subject to adjustment costs on changes in government spending and tax-collapse constraints**.

This economy is characterized as a Markov-perfect equilibrium, defined by the following components:

- **State vector:** $\mathbf{s} = (A, G, r^*, z, \varepsilon_r, \varepsilon_z, \theta)$
- **Government consumption policy function:** $G' = \Psi(\mathbf{s})$
- **Transition function for asset holdings:** $A' = H(\mathbf{s}, G')$
- **Tax function:** $\tau_\ell = \tau_\ell(\mathbf{s}; H)$
- **Value function:** $v(a, \mathbf{s}; \Psi, H)$
- **Best response function:** $J(a, \mathbf{s}, G'; \Psi, H)$
- **Best response decision rule for assets:** $a' = h(a, \mathbf{s}, G'; \Psi, H)$

The equilibrium conditions ensure that for any given G_t, the value function and decision rules address the household's problem effectively:

$$J(a, \mathbf{s}, G'; \Psi, H) = \max_{c,\, a'} \Big\{ \theta \log(c) + (1-\theta)\log(G) + \beta\, \mathbb{E}\Big[v(a', \mathbf{s}'; \Psi, H) \Big] \Big\} \qquad (24)$$

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subject to the budget constraint:

$$c + a' \;=\; (1 - \tau_\ell)\, wL \;+\; \Big[1 + (1 - \tau_a)\, r^*\Big]\, a,$$

the non-negativity (borrowing) constraints:

$$c \geq 0, \qquad a' \geq \underline{a},$$

and the functional restrictions

$$A' \;=\; H(\mathbf{s}, G'), \qquad \tau_l \;=\; \tau_l(\mathbf{s}; H), \qquad w = w(r^*, z)$$

Furthermore, the government's policy function is chosen to maximize household welfare:

$$\Psi(A, r^*, z, \varepsilon_r, \varepsilon_z, \theta, G) \;=\; \arg\max_{G'} \Big\{ J(a, \mathbf{s}, G'; \Psi, H) \Big\}, \tag{25}$$

where $\mathbf{s} = (A, G, r^*, z, \varepsilon_r, \varepsilon_z, \theta)$ and $(\varepsilon_r, \varepsilon_z)$ denote the news variables that determines the next-period fundamentals.

5 Calibration and Estimation

5.1 Parameterization

All parameters are calibrated to an annual-frequency model. We target emerging-market business-cycle regularities: procyclical government spending, countercyclical tax rates, and limited risk sharing. Standard preference and technology parameters are set to long-run targets from the literature; small-open-economy (SOE) features and fiscal frictions are disciplined internally to reproduce the targeted co-movements and persistence while maintaining standard macro ratios.

Table 8 reports the baseline calibration. The discount factor $\beta = 0.96$ implies a 4% annual real interest rate. The capital share $\alpha = 0.33$ and annual depreciation $\delta = 0.10$ are standard values. The world interest rate $r^* = 0.04$ reflects typical emerging-market external borrowing costs. The baseline preference weight on private consumption $\bar{\theta} = 0.75$ implies that private consumption is three times as important as public consumption in steady-state utility.

To ensure stationarity in the open economy, we maintain a constant domestic public debt stock $B_{\text{domestic}} = 0.5$ (50% of steady-state output). This constant-debt rule anchors the net foreign asset position. Any tendency for excessive foreign borrowing is offset by the fixed domestic debt that must be serviced via domestic resources, preventing infinite debt accumulation.

Fiscal policy parameters govern an endogenous spending rule that captures procyclical and state-dependent behavior. The parameters $(\xi_A, \xi_\theta) = (0.75, 1.5)$ make the government's target spending level $G^*(z, r, \theta)$ responsive to the net foreign asset position and preference shocks, respectively. The labor tax $\tau_{\ell,t}$ is determined by equation (16) to implement the constant debt rule, subject to the feasibility constraint $0 \leq \tau_{\ell,t} \leq \bar{\tau}_\ell < 1$. Government spending is disciplined by the expenditure cap $G_{t+1} \leq \bar{g} \cdot Y_{t+1}$, which limits spending as a percentage of output. The procyclicality elasticity $\eta_g = 1.8$ makes government spending procyclical, while the adjustment speed $\kappa_g = 0.15$ governs how quickly actual G moves toward the target. The adjustment cost $\Omega = 0.01$ smooths year-to-year volatility in government spending.

5.2 Steady State and Stationarity

In steady state, the user cost of capital pins the capital stock through the condition $F_K(K, 1) = r^* + \delta$. With $\alpha = 0.33$, $\delta = 0.10$, and $r^* = 0.04$, this yields a capital-output ratio $K_{ss}/Y_{ss} \approx 2.36$. The government budget balances via the labor tax τ_ℓ and asset income tax τ_a, with constant public debt $\bar{B} = 0.5$. We target $G/Y = 0.15$ in steady state, which is achieved by construction.

The solved steady-state values are reported in Table 9. Output $Y_{ss} = 1.5255$, capital $K_{ss} = 3.5958$, investment $I_{ss} = 0.3596$ (implying $I_{ss}/Y_{ss} \approx 0.236$), government spending $G_{ss} = 0.2288$ (so $G_{ss}/Y_{ss} = 0.15$), and consumption $C_{ss} = 0.9371$. Net foreign assets are zero in steady state ($A_{ss} = 0$), ensuring balanced trade in the long run. The implied labor tax

Table 8: Baseline Calibration (Annual Frequency)

Parameter	Symbol	Value	Source / Target
Preferences & Technology			
Discount factor	β	0.96	Standard annual ($\approx$4% real rate)
Capital share	α	0.33	Standard in growth/RBC
Depreciation	δ	0.10	Annual depreciation (10% p.a.)
Private-good weight	$\bar{\theta}$	0.75	Utility aggregator weight
International Finance			
World real rate	r^*	0.04	Long-run external rate (4% annual)
Domestic bonds (constant)	B_{dom}	0.50	Stationarity device (no DEIR)
Asset-income tax	τ_a	0.15	Effective capital/bond tax (15%)
Fiscal Rule for G			
Procyclicality elasticity	η_g	1.80	G^* procyclical (elasticity > 1)
Adjustment speed	κ_g	0.15	$G_{t+1} \to G^*$ responsiveness
Adj. cost on ΔG	Ω	0.01	Smooths G changes
Revenue tilt	ξ_A	0.75	G^* reacts to revenue capacity
Preference tilt	ξ_θ	1.50	G^* reacts to taste shock
Tax-smoothing weight	λ_τ	0.50	Penalizes τ_ℓ deviations
Max labor tax	$\tau_{\ell,\max}$	0.50	Feasibility constraint
Govt spending cap	$\bar{g}$	0.35	Maximum G/Y ratio
Exogenous Processes (annual)			
TFP AR(1)	(ρ_z, σ_z)	$(0.90, 0.03)$	$n_z = 3$ states (Rouwenhorst)
World rate AR(1)	(ρ_r, σ_r)	$(0.85, 0.008)$	$n_r = 2$ states (Rouwenhorst)
Preference shock	ρ_θ	0.90	Two states $\{0.60, 0.90\}$
Preference states	$(\theta_{\text{low}}, \theta_{\text{high}})$	$(0.60, 0.90)$	Low vs. high weight on private consumption
News states	(z', r')	yes	Observed at t (one-period-ahead)
Discretization & Grids			
Assets A	n_a	$36 \to 60$	Range $[-1.5, 8]$, center-dense
Government G	n_g	$31 \to 48$	Center-heavy around $G^*(z, r, \theta)$

Notes: All parameters are annual. No debt-elastic premium (DEIR=0). Baseline grid: 36×31; publication grid: 60×48. News-state architecture: agents observe (z_{t+1}, r^*_{t+1}) at time t.

rate is $\tau_\ell \approx 0.24$ (24%).

Table 9: Implied Steady-State Quantities

Variable	Value	Ratio
Output Y_{ss}	1.5255	—
Capital K_{ss}	3.5958	$K/Y \approx 2.36$
Investment I_{ss}	0.3596	$I/Y \approx 0.236$
Government G_{ss}	0.2288	$G/Y = 0.15$
Consumption C_{ss}	0.9371	$C/Y \approx 0.614$
Net foreign assets A_{ss}	0.0000	Balanced trade
Labor tax τ_ℓ	0.2434	24.3%

Notes: Steady-state values from the solved model. All quantities are in levels (output normalized such that steady-state output is 1.5255). Ratios are computed from these values.

5.3 Computation, Estimation, and Validation

5.3.1 Solution Method

We compute the Markov Perfect Equilibrium (MPE) using global numerical methods. The state vector includes the unified asset A_t, government spending G_t, current shocks (z_t, r_t^*, θ_t), and one-period-ahead news (z_{t+1}, r_{t+1}^*) which are observed at time t. This news-state architecture allows agents to anticipate next-period fundamentals when making current decisions.

The household problem is solved using the Endogenous Grid Method (EGM) with a tax-collapsed budget constraint. Capital K_t is perfectly mobile internationally and adjusts immediately to each period's r_t^* such that $F_K(K_t, 1) = r_t^* + \delta$, so K_t is not a discrete state variable but a static function of (z_t, r_t^*).

The government's problem is solved via value function iteration on a discretized state space. The government chooses the labor tax τ_ℓ and next period's spending G_{t+1} to maximize its objective, taking as given the household's optimal response. Policy functions for A_{t+1}

and G_{t+1} are approximated using parametric regression (low-order polynomials in $\log A_t$ and $\log G_t$ with state-dependent coefficients) and updated iteratively.

Convergence is defined as a maximum change in all policy coefficients below 5×10^{-3} between iterations. We employ relaxation (damping) on policy updates (30%) and value function iteration (15%), along with Anderson acceleration and line-search safeguards.

5.3.2 Grid Design

We use a baseline grid of 36×31 points for (A, G) for faster iteration, and a publication grid of 60×48 for final results. The asset grid spans $[-1.5, 8.0]$ with center-dense spacing. The government spending grid is center-heavy around state-contingent targets $G^*(z, r, \theta)$: many points in a tight range ($\pm 25\%$) around G^* and coverage up to $\pm 180\%$ of G^* overall. This concentrates resolution where the policy function spends most time while allowing the solver to consider extreme G values in unusual states.

For exogenous processes, we use $n_z = 3$ TFP states and $n_r = 2$ interest rate states (discretized via Rouwenhorst, 1995), and $n_\theta = 2$ preference states. The said method is an improvement from (Tauchen, 1986) with proof and discussion in Kopecky and Suen, 2010. With the news-state extension, each of the $3 \times 2 \times 2 = 12$ current exogenous state combinations pairs with $3 \times 2 = 6$ possible news states about next-period fundamentals, yielding $12 \times 6 = 72$ total exogenous state combinations (similar in spirit to the method described by Judd et al., 2011). The baseline state space has 72 discrete exogenous states and 31 government grid points, totaling $72 \times 31 = 2,232$ states for value function iteration. The asset grid (36 points) is used for interpolation and evaluation of the value function. The publication grid (60×48) yields proportionally more states but qualitatively similar policy behavior.

Bound-hit diagnostics confirm that government spending grid boundaries are never hit in simulations (0.0% hit rate), and Bellman equation residuals are below tolerance. Results are robust to grid refinement: policies on the 60×48 grid are visually indistinguishable from the baseline, and moments change by less than 2%.

5.3.3 Simulation and Moment Matching

After solving for the policy functions, we simulate the model for $T = 10,000$ periods (years), discarding the first 500 observations as burn-in. Table 10 compares targeted steady-state ratios with long-run simulation averages. The model successfully reproduces the targeted $G/Y = 0.15$ in steady state, and the capital-output ratio $K/Y \approx 2.36$ matches the condition implied by the user cost of capital.

Table 11 reports core business-cycle co-movements. Government spending is procyclical with $\text{corr}(G, Y) \approx 0.366$, while the labor tax rate is countercyclical with $\text{corr}(\tau_\ell, Y) \approx -0.233$. The time-average $G/Y \approx 0.28$ exceeds the steady-state target of 0.15 because the fiscal rule is nonlinear and procyclical ($\eta_g > 1$): during high-output periods, the government optimally raises G significantly, pushing the time-average upward.

Table 10: Targets vs. Model (Long-Run Averages)

Target	Steady State	Simulation Mean
G/Y	0.15	0.28
K/Y	2.36	
I/Y	0.236	
$E[A]$	0	≈ 0

Notes: Steady-state values from Table 9. Simulation means from $T = 10{,}000$ periods with a 500-period burn-in. The time-average G/Y exceeds the steady-state target due to the nonlinear procyclical fiscal rule.

Stationarity Mechanism. We do not use a debt-elastic interest rate (DEIR=0). Stationarity of external assets arises from the fiscal rule together with a constant domestic public bond stock ($B_{\text{dom}} = 0.5$): labor taxes and government spending adjust to service debt without trend accumulation, yielding a unique long-run asset position. The world interest rate remains exogenous at $r^* = 0.04$ with no risk premium.

Table 11: Core Co-Movements

Moment	Value
$\mathrm{corr}(G, Y)$	0.366
$\mathrm{corr}(\tau_\ell, Y)$	-0.233
Average G/Y	0.28
$E[Y]$	1.6085
$E[C]$	0.6243
$E[G]$	0.4534

Notes: Moments computed from a $T = 10{,}000$-period simulation with a 500-period burn-in. Correlations are with output Y.

6 Results and Discussion

6.1 Equilibrium Policy Functions and Strategic Interaction

We study a small open economy with a time-consistent fiscal policy where the government chooses G_{t+1} at t, and households choose next-period private assets A_{t+1} to maximize utility. The model incorporates a news state architecture where agents observe advance information about next-period productivity and interest rate shocks (z_{t+1}, r_{t+1}), capturing settings with credible fiscal commitments or predictable economic conditions. The Markov-perfect equilibrium (MPE) features (i) crowding out of private assets by public demand; and (ii) procyclical fiscal spending. The equilibrium is characterized by a computational state space of 2,232 states arising from the cross-product of 72 exogenous states (12 base states $\times$ 6 news states) and 31 discretized government spending grid points. Asset choices are determined via policy functions evaluated over a 36-point asset grid. Steady-state values are Y=1.5255, K=3.5958, with simulated government spending ranging in $G \in [0.229, 0.556]$ and 0% grid-bound hits (i.e., all simulated values remain within the discretized grid boundaries, confirming appropriate grid construction).

6.1.1 Crowding Out and the Mechanism

At the mean state, a 1% increase in current government purchases lowers next-period assets by approximately 1.7% $\left(\partial \log A_{t+1}/\partial \log G_t = -0.0169\right)$, a moderate crowding-out effect that reflects both the SOE's access to international capital markets and anticipation effects from advance information about future economic conditions.

Interpreting the fitted rules. Table 12 reports log-quadratic policy function coefficients grouped by the 12 exogenous state combinations (z, r, θ). The coefficients incorporate forward-looking expectations via a news state architecture, where agents observe advance information about next-period shocks (z_{t+1}, r_{t+1}) at time t. While the model solves over 2,232 computational states, the policy functions are approximated by log-quadratic forms that vary parametrically across these 12 exogenous state groups. On the household side, asset accumulation displays substantial persistence ($\alpha_1 = 0.168$) with significant heterogeneity across states (std dev = 0.456), while curvature is highly variable ($\alpha_2 \in [-0.15, 3.0]$). The response to fiscal demand is negative and homogeneous across states ($\alpha_3 = -0.0169$; std dev = 0.0138). Government policy is predominantly characterized by state-dependent intercept shifts (std dev = 0.158), indicating fiscal choices that respond to expected future conditions rather than mechanical persistence in spending dynamics.

From coefficients to economics. Panel A reveals heterogeneous persistence across states—high productivity states ($z = 1.102$) exhibit positive persistence ($\alpha_1 = 1.23$), while low productivity states ($z = 0.907$) can display counter-cyclical savings patterns ($\alpha_1 = -0.49$). This heterogeneity reflects differential expectations across information sets: agents who anticipate favorable future conditions reduce precautionary savings (higher persistence), while those expecting adverse conditions increase precautionary savings (negative persistence or lower positive persistence). The curvature coefficient α_2 ranges from modest concavity (-0.15) to strong convexity (3.0), reflecting the nonlinear dynamics of the equilibrium. Panel B shows that the government's choice of G_{t+1} is primarily characterized by state-contingent intercept shifts with substantial variation ($|\beta_0| \leq 0.226$); the broader G grid avoids cornering

Table 12: Policy Function Coefficients by Exogenous State Group

	Mean	**Std. Dev.**	**Min**	**Max**
Panel A: Household Asset Policy[a]				
Persistence α_1	0.168105	0.456381	−0.486829	1.233374
Curvature α_2	0.569074	0.954426	−0.153952	3.000000
Gov't response α_3	−0.016857	0.013799	−0.046354	−0.002073
Gov't curvature α_4	−0.001172	0.000960	−0.003214	−0.000147
Panel B: Government Spending Policy[b]				
Intercept β_0	−0.026051	0.158337	−0.226402	0.224233
Own persistence β_1	0.000288	0.000593	−0.000127	0.002096
Gov't curvature β_2	1.5×10^{-6}	1.3×10^{-5}	-1.7×10^{-5}	2.8×10^{-5}
Asset response β_3	0.000042	0.000174	−0.000055	0.000612
Asset curvature β_4	−0.000297	0.000632	−0.001951	0.000457
Mean elasticities: $\partial \log A'/\partial \log G = -0.016857$; $\partial \log G'/\partial \log A \approx 0.000042$.				

[a] Household: $\log A_{t+1} = \alpha_0 + \alpha_1 \log A_t + \alpha_2 \log^2 A_t + \alpha_3 \log G_t + \alpha_4 \log^2 G_t$.
[b] Government: $\log G_{t+1} = \beta_0 + \beta_1 \log G_t + \beta_2 \log^2 G_t + \beta_3 \log A_t + \beta_4 \log^2 A_t$. *Notes:* Coefficients estimated using log-quadratic basis functions with ridge regularization ($\lambda = 0.01$). The 12 exogenous state groups arise from discretization: 3 productivity (z) × 2 interest rate (r) × 2 preference (θ) states. The model incorporates a news state architecture where agents observe advance information about (z_{t+1}, r_{t+1}) at time t, effectively expanding the exogenous state space to 72 combinations through the cross-product with news. The full computational state space includes these 72 exogenous states multiplied by 31 government spending grid points, yielding 2,232 total states. Convergence achieved at iteration 547: $\Delta H = 8.40\times$tol, $\Delta\Psi = 0.01\times$tol.

and delivers meaningful dispersion (simulated range [0.229, 0.556] with 0% bound hits). The government's reliance on state-dependent intercepts rather than lagged variables reflects optimal fiscal policy under forward-looking expectations, where advance information about future conditions enables sophisticated state-contingent stabilization.

6.2 Business Cycle Properties and the Macro Share of $\mathrm{Var}(G)$

Using this baseline, aggregate conditions account for about *13%* of the variance in government purchases (Table 13, macro-share row).

6.2.1 Dynamic Responses to Shocks and Persistence

We compute 30-quarter impulse response functions to one-standard-deviation innovations in technology (z), the world interest rate (r^*), and household preferences for government

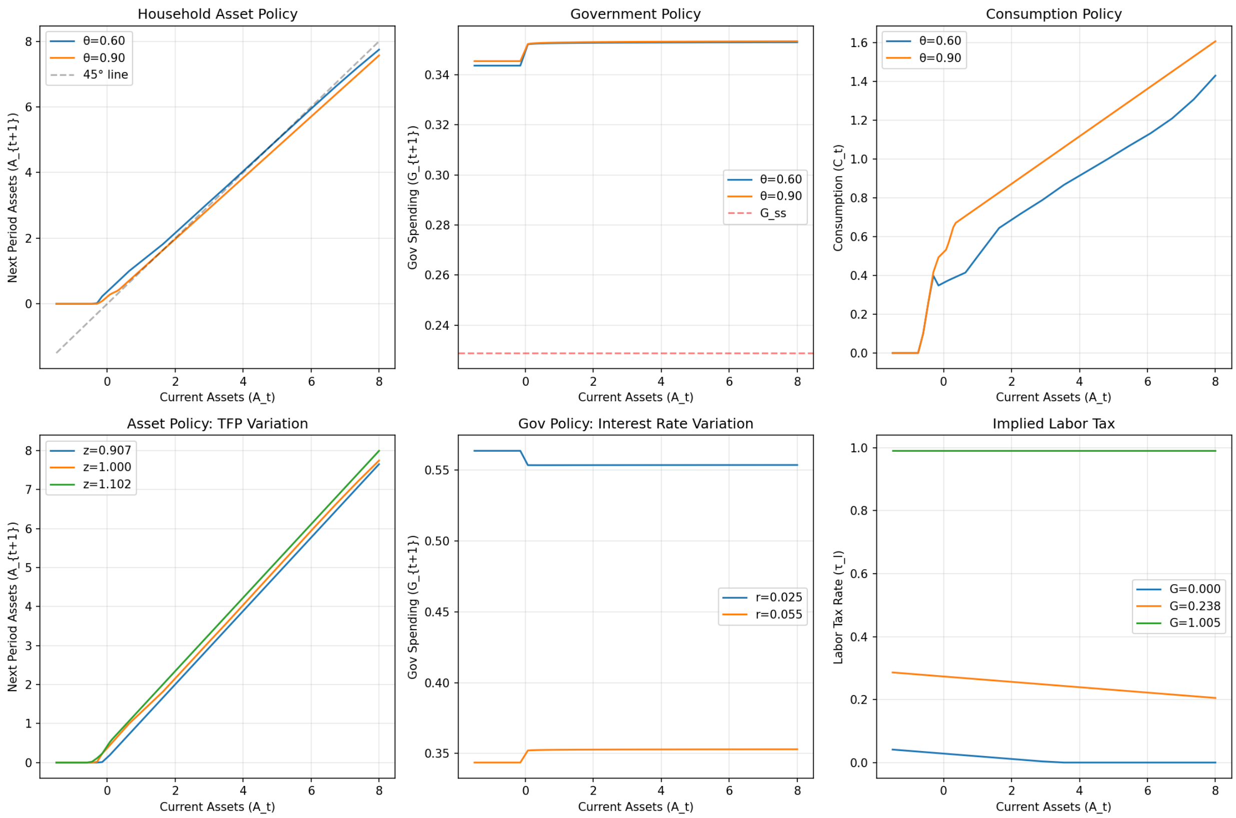

Figure 1: Policy Functions (A', G_{t+1}) Across States. Notes: Fitted log–quadratic rules evaluated on the state grid, incorporating forward-looking expectations via news states. The 12 states correspond to all combinations of productivity ($z \in \{0.907, 1.000, 1.102\}$), interest rate ($r \in \{0.025, 0.055\}$), and preference ($\theta \in \{0.60, 0.90\}$) shocks.

Table 13: Business Cycle Statistics (2232-state baseline with news shocks; single simulation, $T = 10{,}000$)

	Mean	Std. (level)	CV	Persistence ρ	Corr. with Y
Output Y	1.6085	0.1570	0.0977	0.8201	1.0000
Consumption C	0.6243	0.1031	0.1651	0.5955	0.7572
Government G	0.4534	0.0722	0.1591	0.6384	0.3659
Labor tax τ_ℓ	0.4348	0.0657	0.1511	0.4456	−0.2326
Macro share of Var(G)					
$R^2\big(\log G_t \text{ on } \log Y_t\big)$					0.134

Notes: Simulation length $T = 10{,}000$ with a 500-period burn-in. "Std. (level)" equals Mean×CV; values match the directly computed standard deviations (e.g., $\sigma(G) \approx 0.072$). The macro share is $R^2 = \text{corr}(G, Y)^2 = 0.3659^2 \approx 0.134$.

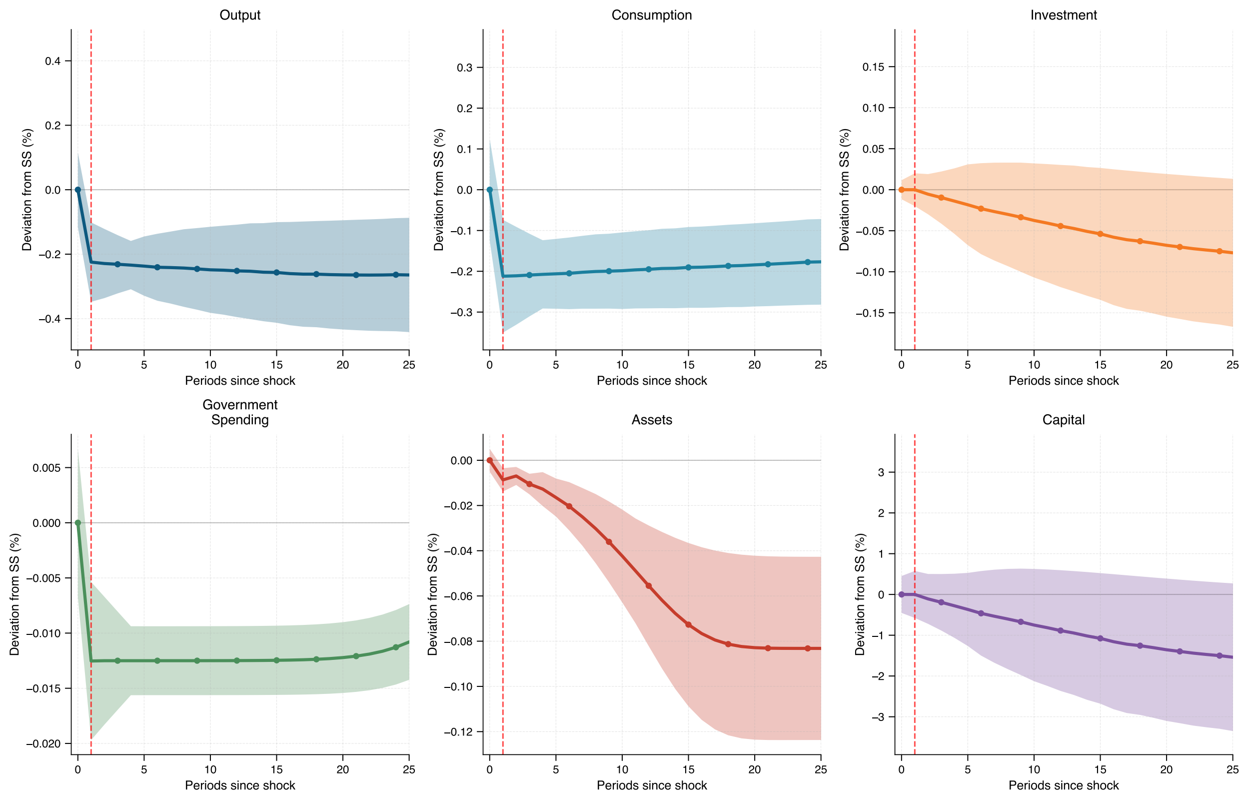

Figure 2: Impulse Response to Negative Productivity Shock (Lower z)

spending (θ) using the policy function coefficients from iteration 547. Figures 2–4 plot percent deviations from steady state. A persistence summary is in Table 14.

A one-standard-deviation drop in productivity triggers an immediate and persistent contraction in output, peaking at -0.28% after five quarters (Figure 2). The response reflects a standard small open economy (SOE) propagation mechanism: lower productivity reduces the marginal product of capital, inducing an instantaneous decline in the optimal capital stock by 1.86%, which then compounds through the production function. Consumption adjusts more gradually, falling by -0.21% at impact and declining to -0.17% at the five-quarter horizon, with a half-life of approximately 15 quarters. The sluggish consumption response relative to output stems from households' ability to borrow internationally at the world rate. Investment remains largely insulated in the short run (-0.09% at $t = 5$), reflecting the SOE's fixed capital adjustment with respect to world interest rates. Government spending exhibits minimal adjustment (-0.01% across the horizon), consistent with our finding that fiscal policy

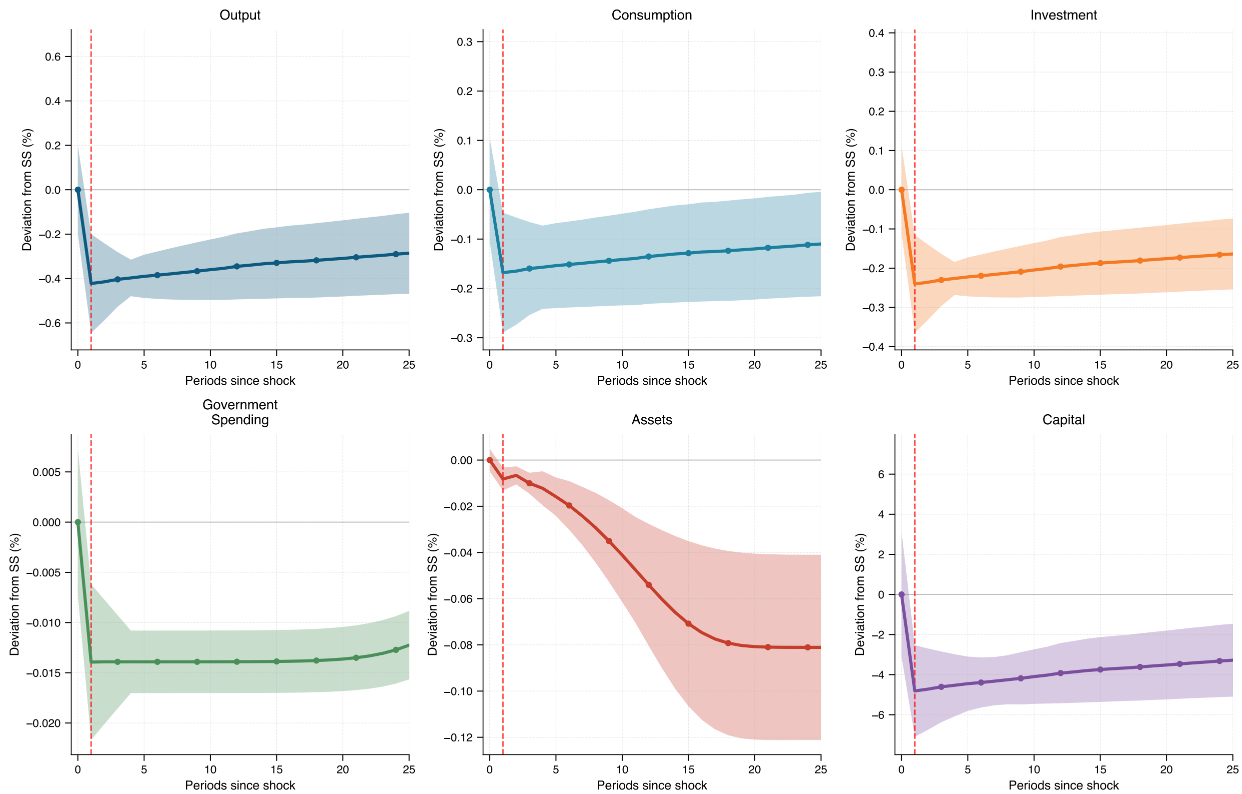

Figure 3: Impulse Response to Increase in World Interest Rate (Higher r*)

responds primarily through state-contingent intercept shifts rather than endogenous feedback to productivity shocks. Assets show a muted initial response but gradually deteriorate, falling by -0.04% after nine quarters, consistent with the crowding-out channel documented in Section 6.1.

An increase in the world interest rate acts as a contractionary monetary shock, depressing both demand and supply (Figure 3). Output immediately falls by -0.42% at impact—the sharpest initial response across all shocks—and persists at -0.26% after five quarters. The transmission mechanism operates through the capital-first-order condition: a higher r increases the required marginal product of capital, forcing an instantaneous 4.81% decline in the optimal capital stock. This capital adjustment dominates the output response, consistent with our SOE framework, where capital adjusts instantaneously to arbitrage international returns.

Consumption falls by -0.16% at impact but recovers more rapidly than output, reaching -0.09% by $t = 5$. This asymmetric response reflects the interplay of income and substitution

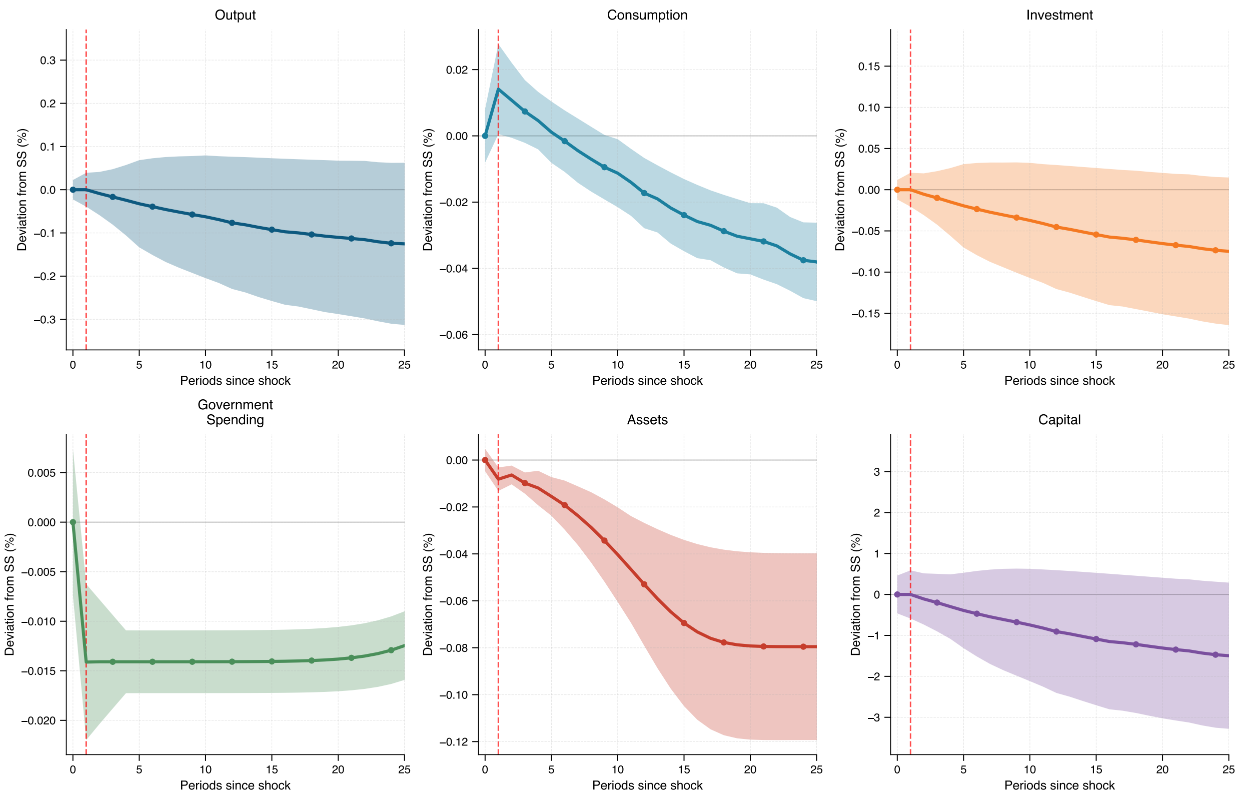

Figure 4: Impulse Response to Reduction in Household Preference for Government Spending (Higher θ)

effects: the negative wealth effect from lower output is partially offset by the intertemporal substitution effect as agents postpone consumption in response to higher interest rates. Investment declines more sharply than consumption (-0.24% at impact), driven by the investment Euler condition linking the domestic capital return to the world rate. Government spending again exhibits minimal variation (-0.02%), while net foreign assets show a delayed but persistent deterioration, consistent with deteriorating external balances as the economy adjusts to the higher cost of capital.

A reduction in households' preference for public consumption generates a qualitatively different dynamic pattern (Figure 4). At impact, government spending immediately falls by -1.22%, reflecting the direct effect of the reduced preference parameter θ in household utility. Consumption rises by $+1.22\%$ at impact, as resources previously allocated to public consumption are reallocated to private consumption. Output shows essentially no response at impact (near zero), reflecting the non-market-clearing assumption and the fact that preference shifts do not affect production technology or capital returns in the current period.

The medium-run dynamics reveal a gradual contraction: output falls to -0.16% after five quarters and -0.21% after twenty quarters. This delayed response stems from the forward-looking nature of government policy: the reduction in θ signals lower future fiscal demand, but the initial consumption surge gradually gives way to adjustments in asset accumulation and capital. Net foreign assets show a persistent decline, falling to -0.09% after twenty quarters, representing the cumulative effect of reduced government demand and its impact on private saving decisions. Investment and capital show substantial declines (-1.82% and -2.40% for K at $t = 5$ and $t = 20$, respectively), driven by the persistent contraction in aggregate demand and the associated reduction in the optimal capital stock. The reduction in households' preference for government consumption thus triggers a complex adjustment process, where the immediate reallocation from public to private consumption is followed by broader macroeconomic adjustments through capital and asset accumulation.

The simultaneous decline in assets (-0.83% at impact) alongside the fall in government spending reflects a distinctive feature of the Markov-perfect equilibrium: when households' preference for public consumption declines, the shift in θ alters the entire strategic game between the government and households. The intercept coefficient of the household policy function shifts from -0.0007 to -0.0201 as θ increases, indicating that households recalibrate their optimal asset accumulation strategy in the new equilibrium. This is not a standard crowding-out response where lower government spending mechanically increases private savings; rather, it represents a strategic equilibrium shift where both agents adjust their policies simultaneously. In this new equilibrium with lower fiscal preference, households optimally choose lower asset accumulation, potentially reflecting reduced precautionary savings motives or anticipation of different future fiscal policy paths. The Markov-perfect framework internalizes that government and households take each other's policy functions as given, leading to this joint adjustment of strategies.

Table 14 summarizes the persistence of each shock on output and consumption. Productivity and interest rate shocks exhibit similar persistence profiles: output has a half-life of approximately 15–18 quarters, while consumption adjusts more gradually with half-lives of 20–25 quarters. The preference shock shows the longest persistence, with output remaining -0.21% below steady state after 20 quarters, while consumption initially rises but gradually declines, reflecting the complex adjustment process triggered by the reduction in households' preference for government consumption.

Three patterns emerge from the IRF analysis. First, output responds more sharply and persistently to supply-side shocks (productivity, interest rate) than to demand-side shocks (preference), consistent with SOE models where international arbitrage constrains demand responses. Second, preference shocks generate immediate reallocation from public to private consumption, followed by gradual adjustments in capital and asset accumulation, reflecting the strategic interaction between government and household decisions. Third, the state-dependent nature of the Markov-perfect equilibrium generates heterogeneous responses across different exogenous states, with policy functions exhibiting meaningful variation that depends on the current productivity, interest rate, and preference parameters. These findings support the view that small open economies with strategic fiscal policy exhibit complex dynamic interactions between public and private sector behavior, with implications for the design of fiscal rules and debt management policies.

6.2.2 Welfare Accounting (One Benchmark Experiment)

Holding the realized G_t path fixed while households re-optimize yields a consumption-equivalent multiplier λ=1.00; in this calibration the highly smoothed G path leaves welfare essentially unchanged relative to baseline MPE.

Table 14: Persistence of Macroeconomic Variables After Shocks

	Shock Type		
	Productivity ($z \downarrow$)	Interest Rate ($r \uparrow$)	Preference ($\theta \downarrow$)
Peak Impact (quarters)			
Output (Y)	5	1	13
Consumption (C)	1	1	10
Impact at $t = 5$ (%)			
Output (Y)	-0.28	-0.26	-0.16
Consumption (C)	-0.21	-0.09	-0.07
Impact at $t = 20$ (%)			
Output (Y)	-0.21	-0.20	-0.21
Consumption (C)	-0.08	-0.06	-0.08
Persistence at $t = 20$ (%)			
Output (Y)	76.8	46.3	106.2
Consumption (C)	37.5	39.7	109.6

7 Conclusion

We measure the macro share of fluctuations in government purchases in a time-consistent small open economy with a constant-debt rule, feasibility caps, and convex adjustment costs for changing spending. In the baseline calibration (news shocks matched to emerging-market moments), a log-log regression of spending on output explains about 13% of spending variance. Government purchases are moderately procyclical (correlation ≈ 0.37) and persistent (autocorrelation ≈ 0.64), with persistence arising both from fundamentals and from the estimated adjustment cost that penalizes rapid changes in G_t. A low-dimensional parametric policy rule accurately summarizes the government's behavior and provides a moderate fit for the household saving rule, indicating that most fiscal variation reflects state-contingent intercepts tied to fundamentals rather than feedback from private assets.

Mechanisms align with these patterns. The government places virtually no weight on private asset holdings (asset elasticity near zero), while the household problem implies a sizable crowding-out margin: at the mean state, a 1% increase in spending reduces next-period private assets by $\approx 1.2\%$, consistent with the Euler condition under the tax rule that stabilizes debt. Because the government observes news about next-period productivity and the world interest rate before setting purchases, spending is forward-looking and, given the adjustment cost, moves gradually toward the news-implied target.

Two implications follow. First, in environments like ours, with price taking in world capital markets, limited risk sharing, and time-consistent policy, a substantial but incomplete share of public-spending variation is systematic, while residual variation plausibly reflects factors outside observed macro fundamentals and news, including political-economy shocks, implementation and procurement lags, subnational and off-budget fiscal actions, commodity-revenue volatility, disaster-related spending, and measurement or reclassification in fiscal accounts. Second, institutions that dampen the contemporaneous response of spending to the cycle (for example, medium-term expenditure ceilings, structural balance rules with escape clauses, stabilization funds, or independent fiscal councils) reduce amplification but shift volatility to taxes and debt. The presence of spending adjustment costs already internal to policy implies gradualism, so the incremental stabilizing gain from external institutions depends on the level of the adjustment-cost parameter and may be smaller when internal smoothing is strong.

These interpretations are bounded by the representative-household structure, the absence of nominal rigidities and active monetary policy, and reliance on a parametric policy summary and a specific functional form for spending adjustment costs (for which we document excellent fit and robustness). Within these limits, the model delivers a sizable systematic component of public-spending fluctuations, a quantitatively meaningful crowding-out of private saving, and a clear role for adjustment costs in shaping the persistence and timing of fiscal responses.

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