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A Seven-Region GIMF Model of Colombia

Fiscal Choices, Public Debt and Country Risk

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Abstract

Colombia's fiscal challenge is to rebuild room for policy while protecting productive capacity and maintaining confidence in public finances. This paper develops a seven-region GIMF framework for studying the composition and timing of fiscal adjustment, public-debt choices and country-risk transmission. Finite planning horizons and liquidity constraints make fiscal liabilities and the distribution of taxes and transfers economically consequential; productive public capital and distortionary taxes connect stabilization to long-run supply. The model distinguishes Colombia, the United States, the euro area, China, Brazil, Mexico and the rest of the world. A six-panel fiscal history and outlook from the October 2026 IMF World Economic Outlook motivates the analysis. We evaluate seven fiscal instruments over one- and two-year horizons, compare endogenous monetary policy with sequential delays in the Colombian policy response, and examine a country-risk-premium shock. Public investment has the largest initial output effect in this calibration; targeted transfers have a larger immediate effect than general transfers. A risk-premium increase reduces investment and household spending while initially raising headline inflation through exchange-rate transmission. An illustrative lower-debt stationary equilibrium shows how reduced debt service can support lower distortionary taxes. The paper supplies the executable equations, calibrated states and replication files, and distinguishes local simulations and stationary endpoints from a fully nonlinear debt transition.

Keywords: GIMF; Colombia; fiscal policy; public debt; finite planning horizons; country risk; monetary-fiscal interactions.

JEL classification: E17, E62, F41, H63.

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1. Fiscal choices when public debt matters

Colombia's fiscal debate is about more than the size of next year's deficit. It concerns the government's capacity to finance essential services and productive infrastructure, the burden carried by future taxpayers, and the confidence of households, firms and lenders in the adjustment strategy. A policy that improves the cash balance by cutting productive investment can weaken the future tax base. A package that delays adjustment can support demand today while increasing the economy's exposure to financing shocks. A useful model must be able to examine both sides of these choices in one internally consistent framework.

The starting point of this paper is that the structure of the model matters for the questions it can answer. In a benchmark with an infinitely lived representative household, lump-sum taxation and unconstrained access to asset markets, government borrowing is offset by the household's valuation of future tax liabilities. Under those assumptions the timing of taxes is neutral. That benchmark is informative, but its neutrality property is a restrictive starting point for analyzing public-debt choices in an economy where households differ in access to finance and do not behave as a single dynasty extending indefinitely into the future.

GIMF relaxes those assumptions in a disciplined general-equilibrium setting. Optimizing households have finite planning horizons, a separate group faces liquidity constraints, taxes distort decisions, and public capital contributes to production. The model includes international trade, foreign assets, nominal rigidities and entrepreneurial balance sheets. Public debt can therefore affect private wealth, capital accumulation, financing conditions and the distribution of resources over time. Fiscal composition matters alongside the aggregate budget balance.

These features make GIMF particularly well suited to the fiscal questions considered here. The claim is about suitability for debt, composition and policy coordination, rather than a universal ranking of models. Infinite-horizon representative-agent models can also deliver meaningful fiscal effects through distortionary taxation, nominal rigidities and other departures from Ricardian equivalence. Heterogeneous-agent models can provide a richer account of household distributions. The advantage of the present framework is that several mechanisms needed for fiscal and debt analysis are already integrated with a multi-region equilibrium and an explicit government budget.

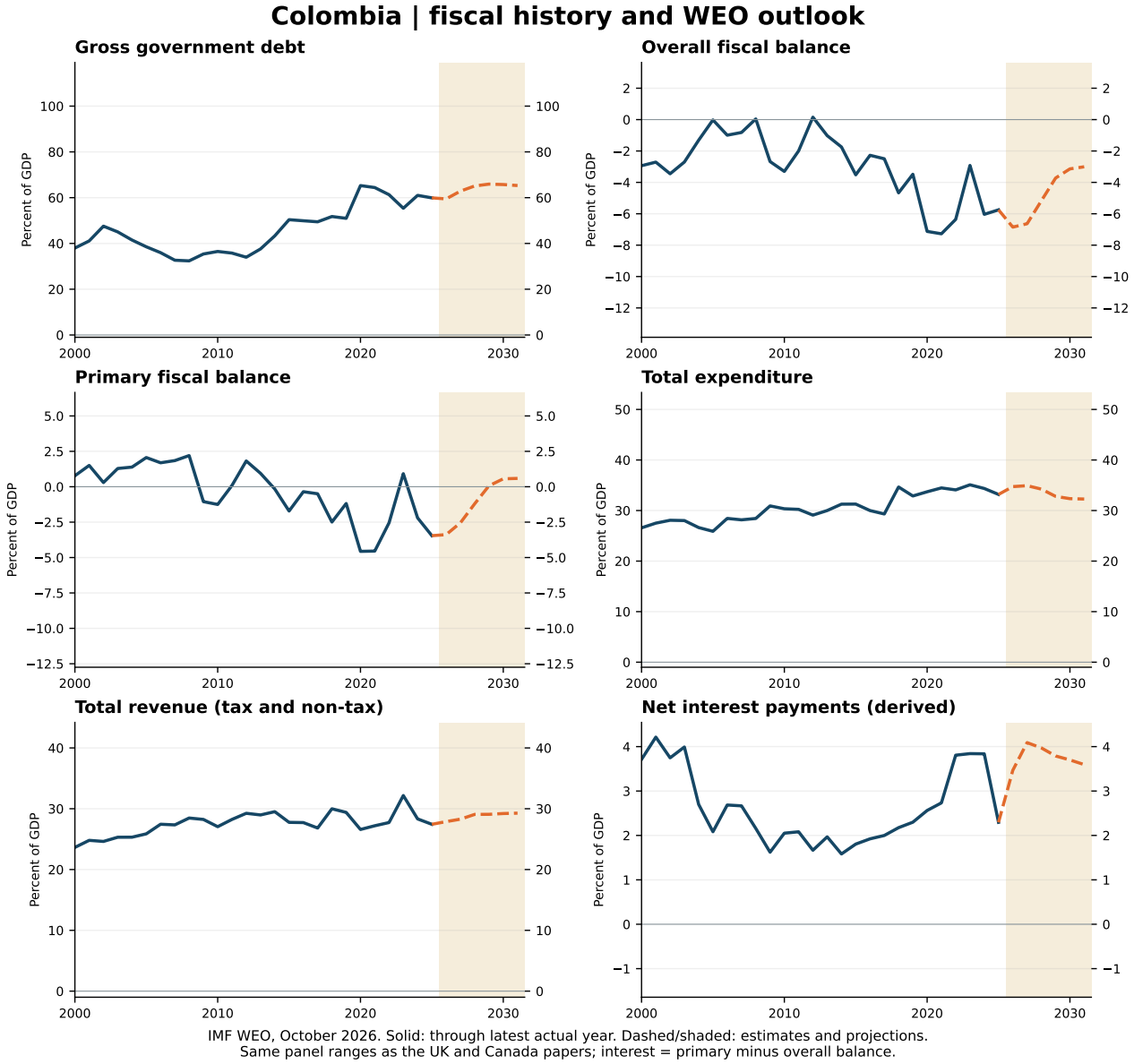
Our contribution is a Colombia-centered, executable application of this framework. The configuration identifies Colombia, the United States, the euro area, China, Brazil, Mexico and the residual world. It connects the theoretical mechanisms to the actual calibration and equations, reports seven fiscal experiments and a country-risk shock, and provides a reproducible basis for further policy analysis. The construction follows the GIMF tradition documented by Kumhof et al. (2010) and Anderson et al. (2013), and complements the BPP model papers for the United Kingdom and Canada.

Three results organize the policy discussion. First, the fiscal instrument matters: public investment, public consumption, targeted transfers and tax changes have different demand and supply consequences. Second, monetary timing matters: maintaining accommodation for another year changes the response to a two-year fiscal action, and an unexpected extension differs from a promise made at the outset. Third, a country-risk increase can weaken domestic spending while raising consumer-price inflation through depreciation. None of these trade-offs can be captured by applying a single multiplier to every fiscal measure.

2. Colombia's fiscal setting: history, outlook and measurement

The October 2026 WEO provides a common empirical reference for the Colombia, UK and Canada papers. Figure 1 reports general-government gross debt, the overall and primary balances, total expenditure, total revenue and derived net interest payments. Every panel is a share of GDP; the axes match those in the companion country papers. The figure distinguishes observations through the WEO's latest-actual metadata from subsequent estimates and projections.

Figure 1: Colombia: fiscal history and the WEO outlook



Notes: IMF WEO, October 2026. General government; percent of GDP. Solid lines run through the latest actual year in the dataset metadata; dashed lines and shading identify subsequent estimates and projections. Total revenue includes non-tax receipts. Net interest is the primary balance less the overall balance, not gross interest expenditure. The WEO metadata describe mixed reporting cutoffs within the latest actual year.

The outlook is a useful illustration of why a fiscal strategy cannot be summarized by a single year's deficit. The overall deficit narrows from about seven percent of GDP in 2026 to about three percent in 2031, while gross debt rises from about sixty to about sixty-five percent of GDP. The primary balance moves from a deficit of about three percent to a small surplus. These are conditional IMF estimates and

projections, not simulated outcomes from the model developed below.

The IMF's 2025 Article IV assessment linked widening deficits and rising debt to elevated sovereign spreads and weak private investment amid policy uncertainty. It reported that the fiscal-rule escape clause had been invoked through 2027 and emphasized the substantial consolidation needed for a return to the rule in 2028 (IMF, 2025). The challenge is therefore to restore confidence while preserving the capacity to invest and grow. The IMF's 2026 regional discussion of fiscal frameworks illustrates a related point: compliance with an operational primary-balance rule need not imply rapid convergence to a debt anchor when financing conditions and the rule's calibration have changed (IMF, 2026b). These observations motivate a framework that links composition, interest costs, growth and debt dynamics.

Measurement is central to that link. The WEO figure reports *general-government gross debt*. Colombia's fiscal-rule discussion often refers to *central-government net debt*. They are different concepts and institutional coverages. We do not place a central-government net-debt anchor on the gross general-government debt chart or treat it as the model's target. The model's baseline public-debt ratio is an inherited structural calibration, about sixty-one percent of GDP, rather than a replacement for the WEO's current estimate.

The six panels also prevent two common accounting confusions. Total revenue is not the same as tax revenue: the WEO measure includes non-tax receipts. Interest derived as the difference between primary and overall balances is *net* interest, rather than a direct series for gross coupon payments. Transfers belong in government expenditure but are not direct purchases of final output. The paper retains these distinctions when interpreting model multipliers and the fiscal accounts.

3. A model built for fiscal and debt analysis

3.1 Finite horizons and the valuation of government liabilities

The fiscal role of finite horizons is intergenerational. A household values the government bonds it holds, but does not fully internalize all taxes that may be paid by households entering the economy later. A change in public borrowing can therefore alter current perceived wealth without an exactly offsetting change in the present value of taxes faced by current decision makers. The resulting change in saving, consumption and capital accumulation is determined jointly with prices, interest rates and external assets.

This is not a statement that government borrowing creates real resources without cost. The government budget must still be satisfied, and a domestic bond is both a household asset and a government liability. The economic point is that the holders of the asset and the people ultimately bearing all future fiscal adjustments are not represented by one unconstrained, infinitely lived household. The distinction allows debt policy to affect allocations beyond the timing of lump-sum taxes, a mechanism associated with the finite-horizon tradition of Blanchard (1985).

Liquidity constraints reinforce a different channel. For a household unable to borrow freely against future income, a current transfer or tax reduction can materially change current spending even when future taxes are expected. The combination of finite horizons and liquidity constraints therefore separates persistent debt effects from immediate cash-flow effects. The two mechanisms should not be treated as interchangeable labels for the same departure from the representative-agent benchmark.

3.2 The questions this framework can answer

The model permits comparisons among tax-financed and deficit-financed measures, protected and reduced public investment, targeted and general transfers, and different paths for the fiscal balance. It can also compare stationary equilibria with different public-debt levels and construct transitions subject to explicit terminal and policy conditions. The relevant questions are conditional: which instruments close the budget, who receives transfers, how does monetary policy respond, and what assumptions are made about risk premia?

The current implementation is a working calibration rather than an estimated forecasting system. Its purpose is to expose those conditional mechanisms and quantify coherent scenarios. It does not establish an empirically optimal fiscal package, estimate the probability of a financing crisis, or replace institutional judgment about the feasibility of particular tax and expenditure reforms.

4. Regions, households and wealth

4.1 Regional structure and units

The seven non-overlapping regions are the United States (R1), Colombia (R2), the euro area (R3), China (R4), Brazil (R5), Mexico (R6) and the residual world (R7). The residual excludes all six explicit economies; the euro area is aggregated using fixed 2026 membership. The model is annual. Variables in the executable source are generally normalized by trend productivity, population and the model price numeraire. Stocks, flow ratios and gross interest rates therefore cannot be mixed without applying the source normalization.

The equations below use compact economic notation. Where a composite is introduced, its meaning is given explicitly; the complete expanded equations and auxiliary identities remain in the supplied catalog. The monetary policy equation shown below is the active rule in the fiscal experiments. The appendix maps the main relationships to actual source equation identifiers.

4.2 Finite-horizon optimizing households

Optimizing households consume out of total wealth rather than current disposable income alone:

$$C^{O}_{r,t} = m_{r,t} W_{r,t}, \tag{1}$$

$$W_{r,t} = F_{r,t} + H_{r,t} + V_{r,t}, \tag{2}$$

$$m_{r,t} = 1/M_{r,t}. \tag{3}$$

Here F is financial wealth, H is human wealth and V is the capitalized value of other household income. The exact source consumption rule is `C_OLG = MPC * TW`. The inverse propensity to consume obeys

$$M_{r,t} = \frac{P^{O}_{r,t} + \tau^{C}_{r,t} P^{C}_{r,t}}{\eta^{O}_{r}} + \theta_r \, \mathcal{D}_{r,t+1} \, J_{r,t} M_{r,t+1}. \tag{4}$$

$\mathcal{D}$ denotes the source real stochastic discount factor, and J collects the source intertemporal preference, habit and relative-price terms. This is the source recursion for `MPCINV`, not a fixed propensity assumed independently of prices and interest rates.

Human wealth has the recursion

$$H_{r,t} = y^H_{r,t} + \frac{\theta_r \chi_r G^A_{t+1}}{R_{r,t}} H_{r,t+1}. \tag{5}$$

The current flow y^H is `POPSIZE*(1-PSI)*MRS*(1-TAU_L)*SL` in the code. G^A is trend productivity growth, R is the gross real private interest rate, θ is the planning-horizon parameter and χ governs the lifetime-income profile. Future labor income is discounted more heavily than in an infinite-horizon representative-agent benchmark. Government bonds enter financial wealth, while the tax consequences faced by later generations are not fully internalized by current households. This is one reason public debt is not neutral in the model.

Financial wealth includes inherited domestic government bonds, entrepreneurial lending and the foreign-asset position, with the exchange-rate and growth adjustments specified in the source. The model closes the private and public accounts jointly; a bond is an asset to its holder and a liability of its issuer. A non-Ricardian consumption response does not remove that accounting requirement.

4.3 Liquidity-constrained households and transfers

Liquidity-constrained households consume from current after-tax resources. In compact notation their budget is

$$\left(P^L_{r,t} + \tau^C_{r,t} P^C_{r,t}\right) C^L_{r,t} = Y^{L,\text{disp}}_{r,t}, \qquad C_{r,t} = C^O_{r,t} + C^L_{r,t}. \tag{6}$$

$Y^{L,\text{disp}}$ includes the source labor-income allocation, transfers, taxes and relevant income distributions; it is not aggregate GDP. The household population share ψ is one quarter in all regions in this calibration. This common assumption helps explain similarities across country multipliers and should be subjected to sensitivity analysis when stronger country evidence is available.

General transfers are distributed under the inherited allocation rule. The targeted-transfer experiment changes the allocation so the marginal transfer reaches liquidity-constrained households. The forcing term in the transfer-allocation equation is adjusted so the marginal transfer reaches those households, while the baseline allocation remains unchanged. Reporting only the common one-percent budget cost would conceal this economically important difference.

5. Production, investment and financial amplification

5.1 Production and productive public capital

Tradable and nontradable producers combine capital and effective labor through CES technology. A compact representation of the source value-added nest is

$$Z^s_{r,t} = A^s_r \left[(1-\alpha^s_r)^{1/\sigma_s} (K^s_{r,t})^{(\sigma_s-1)/\sigma_s} + (\alpha^s_r)^{1/\sigma_s} (a^s_{r,t} U^s_{r,t})^{(\sigma_s-1)/\sigma_s} \right]^{\sigma_s/(\sigma_s-1)}, \quad s \in \{T, N\}. \tag{7}$$

Sectoral utilization, wage setting and relative prices determine factor demands. The disabled oil nest is not silently added to this production function. Final domestic output also benefits from public capital:

$$Z^D_{r,t} = Y^A_{r,t} (K^{G1}_{r,t})^{\alpha^{G1}_r} (K^{G2}_{r,t})^{\alpha^{G2}_r} S_r. \tag{8}$$

K^{G1} is productive public capital; K^{G2} is the source stock of public consumption durables. The model does not equate every unit of expenditure with an immediate addition to either stock. Their accumulation

equations are

$$G_t^A G_t^N K_{r,t}^{G1} = (1 - \delta_r^{G1}) K_{r,t-1}^{G1} + I_{r,t-1}^G, \tag{9}$$

$$G_t^A G_t^N K_{r,t}^{G2} = (1 - \delta_r^{G2}) K_{r,t-1}^{G2} + C_{r,t-1}^G. \tag{10}$$

These timing conventions are taken from `KG1` and `KG2`. The growth normalization and one-period investment lag matter when interpreting the first-year response. In this calibration, $\alpha^{G1} = 0.1$ and $\alpha^{G2} = 0$: productive public capital raises supply, while the consumption-durables stock has no active production externality. The presence of a stock in the source is not evidence that its output elasticity is positive.

5.2 Private capital and investment

For each entrepreneurial sector the installed private capital stock evolves according to

$$G_t^A G_t^N K_{r,t}^s = (1 - \delta_{r,t}^s) K_{r,t-1}^s + I_{r,t-1}^s S_{r,t-1}^{\text{acc}}. \tag{11}$$

Investment adjustment costs and the price of installed capital determine the incentive to invest. A capital tax affects the return after tax and the value of depreciation deductions; it does not have the same intertemporal effect as a lump-sum transfer. Public investment works through current demand and future productive capacity. Consequently, first-year GDP alone is insufficient to assess a permanent shift in either instrument.

5.3 Corporate net worth and the credit contract

The financial accelerator is a costly-state-verification contract between lenders and entrepreneurs. For a sector, the funding identity is summarized as

$$Q_t K_{t+1} = N_t + B_t^E. \tag{12}$$

The contract chooses a default cutoff in the distribution of idiosyncratic project returns. In standard contract notation, with F the cumulative distribution and $G(\bar{\omega}) = \int_0^{\bar{\omega}} \omega \, dF(\omega)$, define

$$\Gamma(\bar{\omega}) = G(\bar{\omega}) + \bar{\omega}[1 - F(\bar{\omega})]. \tag{13}$$

The lender's expected receipts are proportional to $\Gamma - \mu G$, where μ is the fraction of output lost in bankruptcy. This notation summarizes the mechanism; the executable cutoff, contract optimality and net-worth equations are supplied without abbreviation in the equation catalog. A decline in net worth can raise the cost of external finance and reduce investment. Fiscal measures therefore interact with private balance sheets as well as with household demand. The model contains this entrepreneurial accelerator; the presence of the accelerator should not be read as a claim that a separate commercial-bank balance-sheet model is active.

6. Trade, nominal rigidities and monetary policy

6.1 Trade and international assets

Domestic and imported goods enter final consumption and investment through nested CES aggregates. Bilateral imports also respond to relative delivered prices. In teaching notation for one nest,

$$M_{r,t} = \left[\sum_{j \neq r} \omega_{rj}^{1/\eta} (m_{rj,t})^{(\eta-1)/\eta} \right]^{\eta/(\eta-1)}, \tag{14}$$

$$m_{rj,t} = \omega_{rj} \left(P_{rj,t} / P_{r,t}^{M} \right)^{-\eta} M_{r,t}. \tag{15}$$

The full implementation includes separate intermediate and final-good import structures, distribution margins and adjustment costs. These two equations illustrate expenditure switching and are not a replacement for those source nests. Bilateral trade shares must reconcile with each region's imports, exports and size. Colombia partner shares are fitted to pooled 2022–24 merchandise observations, while foreign trade priors use 2024 observations and mirror flows. Reconciliation adjusts foreign links to satisfy the model totals. Merchandise shares proxy the geographical allocation of total goods-and-services trade.

International borrowing and lending obey source asset-accumulation equations, exchange-rate valuation and risk-premium relationships. Trade and asset positions interact: a fiscal expansion can raise imports, move the exchange rate and alter net foreign assets. The numerical sum of national GDP responses is not a world GDP response; aggregation requires the model region weights.

6.2 Price and wage adjustment

Nominal rigidities are implemented through adjustment costs. For a representative sector, a source-style price adjustment term can be written

$$\mathcal{C}_{r,t}^{P} = \frac{\phi_r^P}{2} Z_{r,t} \left[\frac{\pi_{r,t}}{\pi_{r,t-1}^{1-\iota_r}} - (\pi_r^*)^{\iota_r} \right]^2. \tag{16}$$

The source first-order conditions include forward-looking terms, indexation and sector-specific prices. The adjustment coefficients are 216 for wages, 108 for tradable, nontradable and investment prices, 3.6 for consumption retail prices and 0.72 for imported retail prices. All seven regions use this profile: forty-nine coefficients in total. These values are parameter levels, not percentages or Calvo probabilities. The updates leave the solved zero-adjustment steady state intact but change dynamic derivatives and fiscal transmission.

6.3 The active interest-rate rule

For comparability, the model assigns each regional monetary block a flexible exchange rate and the same gross-rate rule in the baseline experiments:

$$\log\left(\frac{i_{r,t}}{i_{r,t-1}}\right) = \frac{1}{2}\left[\frac{3}{4}\log\left(\frac{\pi_{r,t}}{\pi_r^*}\right) + \frac{1}{4}\log\left(\frac{\pi_{r,t+1}}{\pi_r^*}\right)\right]. \tag{17}$$

The model is annual; the lead is next-year inflation. i denotes the gross policy rate, and the inflation target is the steady source core price-index inflation. Headline CPI is reported in the fiscal results and includes the mechanical effect of the consumption tax. Gross private borrowing rates also include the source spread components. This rule is active in the shared source; the documentation exports

all expanded equations. The fixed-rate and sequential-delay comparisons replace the Colombian policy equation only in the stated periods.

The euro area is one monetary region. There is no separate oil block in this model. This common-rule benchmark is a modeling assumption, not a description of every foreign central bank's actual exchange-rate regime. Inactive oil and other source branches do not create additional calibrated channels.

7. The government budget and fiscal closure

7.1 Taxes, spending and the bond identity

The primary budget separates revenues from purchases and transfers:

$$PS_{r,t} = \mathcal{R}_{r,t} - \mathcal{G}_{r,t}, \tag{18}$$

$$\mathcal{G}_{r,t} = P^G_{r,t}(C^G_{r,t} + I^G_{r,t}) + TR_{r,t} + TR^{\text{targ}}_{r,t} + AID_{r,t} + SUB_{r,t}. \tag{19}$$

Here TR denotes general transfers and TR^{targ} the targeted-transfer program; its baseline allocation across households is given by the source rule. Revenue includes the source labor, capital, consumption and lump-sum tax components and applicable other receipts. The main tax relationship is

$$TAXREV_{r,t} = \tau^L_{r,t}\mathcal{B}^L_{r,t} + \tau^K_{r,t}\mathcal{B}^K_{r,t} + \tau^C_{r,t}\mathcal{B}^C_{r,t} + LS_{r,t}, \tag{20}$$

with tax bases defined by the source wage bill, taxable capital income and consumption expenditure. Endogenous tax bases imply that an ex-ante tax cut of one percent of GDP need not reduce realized revenue by exactly one percent after output and prices respond.

Let $\mathcal{Q}_t = \pi_{r,t}G^A_t G^N_t$ denote the source nominal normalization. The government bond and interest-cost identities are

$$B_{r,t} = B_{r,t-1}/\mathcal{Q}_t - S_{r,t}, \tag{21}$$

$$IC_{r,t} = (i^B_{r,t-1} - 1)B_{r,t-1}/\mathcal{Q}_t, \tag{22}$$

$$S_{r,t} = PS_{r,t} - IC_{r,t}, \qquad b_{r,t} = 100B_{r,t}/(\text{FREQU}\,GDP_{r,t}). \tag{23}$$

These are stationary source quantities. i^B here denotes the source gross government financing rate used in `INTCOST`; it is not a newly introduced empirical ten-year yield. The annual frequency is one. There is no stock-flow residual in this model identity; observed WEO debt changes may require one.

7.2 The inherited feedback rule

The active surplus-rule branch can be summarized as

$$s_{r,t} = s^*_r + d_y\,100(y^{gap}_{r,t} - 1) + d_\pi\,\pi^{gap}_{r,t} + d_\tau\,xs^{tax}_{r,t} + d_b(b_{r,t} - b^*_r). \tag{24}$$

The supplied state determines the feedback coefficients and switching variables. In Colombia the output-gap coefficient is $d_y = 0.34$, while $d_\pi = d_\tau = d_b = 0$. The active rule therefore has no additional direct debt-gap feedback. Its stationary debt anchor is linked to the surplus target and nominal trend growth through the identity below. In the standard deficit-financed experiments, general transfers act as the residual instrument under the inherited rule. Fiscal closure is therefore part of the experiment, not a

free choice left unspecified after a shock has been applied. A stronger debt-feedback rule would be a new policy experiment.

At a stationary equilibrium the source target relationship is

$$b_r^* = -\frac{s_r^*}{\text{FREQU}} \frac{\mathcal{Q}_r^*}{\mathcal{Q}_r^* - 1}. \tag{25}$$

Holding a deficit target fixed while declaring a different permanent debt target generally violates this relationship. For any permanent debt experiment, the terminal surplus target and residual fiscal instrument must be changed consistently. Government debt also affects the wealth and international equilibrium blocks. It cannot be changed by replacing a number in a chart while retaining all original terminal conditions.

8. Calibration and the international setting

The regional decomposition is selected from Colombia's trading relationships and the need to identify distinct sources of international shocks. The United States is a major export market; China is an important source of imports; the euro area captures European demand and financing conditions; Brazil and Mexico identify important regional links. Treating these economies separately allows the model to distinguish their shocks and policy responses instead of absorbing them into a single foreign aggregate.

Table 1: Regional calibration targets

Region	World GDP	Imports	Gov. cons.	Gov. inv.	Debt	NFA
United States	26.26	12.43	13.91	3.56	122.30	0.00
Colombia	0.38	18.16	14.83	2.37	61.30	-44.60
Euro area	14.90	26.56	21.51	3.45	87.77	-0.00
China	16.92	17.50	17.48	4.61	49.60	0.00
Brazil	1.95	17.79	18.77	4.10	87.30	-44.50
Mexico	1.64	37.71	11.62	3.10	58.30	-34.80
Rest of world	37.96	22.00	17.50	2.50	40.00	4.23

Notes: World GDP shares are percent of world GDP; other entries are percent of own-region GDP. GDP uses archived IMF 2024 dollar values. These are structural model targets, not October 2026 WEO forecasts. NFA is net foreign assets.

Colombia's domestic spending, fiscal and external-stock targets are carried over from its three-region model. Its inflation target remains three percent. The United States retains the updated block from the previous seven-region calibration. The euro-area, Brazilian and Mexican blocks use their archived model targets; China's fiscal and tax settings retain a disclosed proxy from the previous seven-region construction. The residual world's size and foreign assets are recomputed after removing the four newly explicit regions, while its import ratio retains an inherited assumption. These choices should be improved as country-specific evidence becomes available, rather than treated as estimated behavioral facts.

Colombia's export and import partner weights are fitted separately to pooled current-dollar observations over 2022–24. The US accounts for about twenty-eight percent of exports and twenty-five percent of imports. China accounts for about four percent of exports and twenty-four percent of imports; the euro area accounts for about eleven percent and thirteen percent. This asymmetry is economically relevant: an import-supply shock and a foreign-demand shock need not have the same geographical origin or

transmission.

The full bilateral matrix is reconciled to each region's import target and the trade balance implied by its foreign-asset anchor. Colombia's partner shares are held fixed. The foreign submatrix is adjusted by iterative row-and-column scaling, so one region's export is its partner's import. World foreign assets sum to zero. The geographical allocation of services is not separately observed in this build; using merchandise weights for total model trade remains an explicit approximation.

Common structural coefficients are retained to keep the regional experiment tractable and interpretable. The liquidity-constrained population share is one quarter and the production elasticity of productive public capital is one tenth. The inflation rule, wage and price adjustment costs and the source financial-accelerator structure are harmonized. Effective model tax rates represent wedges applied to modeled tax bases; they should not be confused with statutory rates or used to evaluate a particular tax amendment without a further mapping.

9. Fiscal experiments: composition, duration and monetary timing

9.1 A common fiscal normalization

We study higher government consumption, higher government investment, targeted transfers, general transfers, and cuts in labor, capital and consumption taxes. The main comparison maintains each expansion for two years, with a mechanical fiscal impulse of one percent of baseline Colombian GDP in each year. One-year experiments are retained as benchmarks. Spending shocks use the baseline purchases price; tax shocks use the corresponding baseline tax bases. The fiscal balance target is eased by one percentage point during each shock year.

General transfers act as the budget residual, so their realized change in the general-transfer experiment need not equal the ex-ante deficit-target movement. Additional targeted transfers accrue fully to liquidity-constrained households on the margin. The experiment holds the baseline household allocation fixed and changes the recipient of the incremental transfer. These financing and allocation conventions are part of the economic experiment.

Let f_t denote the mechanical fiscal impulse measured relative to baseline GDP and q_t the real GDP percentage deviation, expressed in compatible percentage units. We report

$$m_1 = \frac{q_1}{f_1}, \qquad m_H^{cum} = \frac{\sum_{t=1}^{H} q_t}{\sum_{t=1}^{H} f_t}. \tag{26}$$

The cumulative measure uses baseline normalization and no discounting. The denominator is one for a one-year action and two for a two-year action once the full impulse is included. The Year-2 GDP response to a two-year shock is not itself a two-year cumulative multiplier. All figures identify the duration and monetary regime explicitly.

9.2 Sequential delays differ from an announced commitment

Under the endogenous regime, the active monetary rule operates throughout. A first-year-fixed comparison holds the Colombian policy rate at baseline for the first year only, with the rule expected to resume in the second year. The sequential-delay experiment starts from that conditional plan. At the beginning of year two, every realized first-year variable is frozen and the remaining model is solved again with the

second-year rate also held at baseline. The policy rule then resumes from year three.

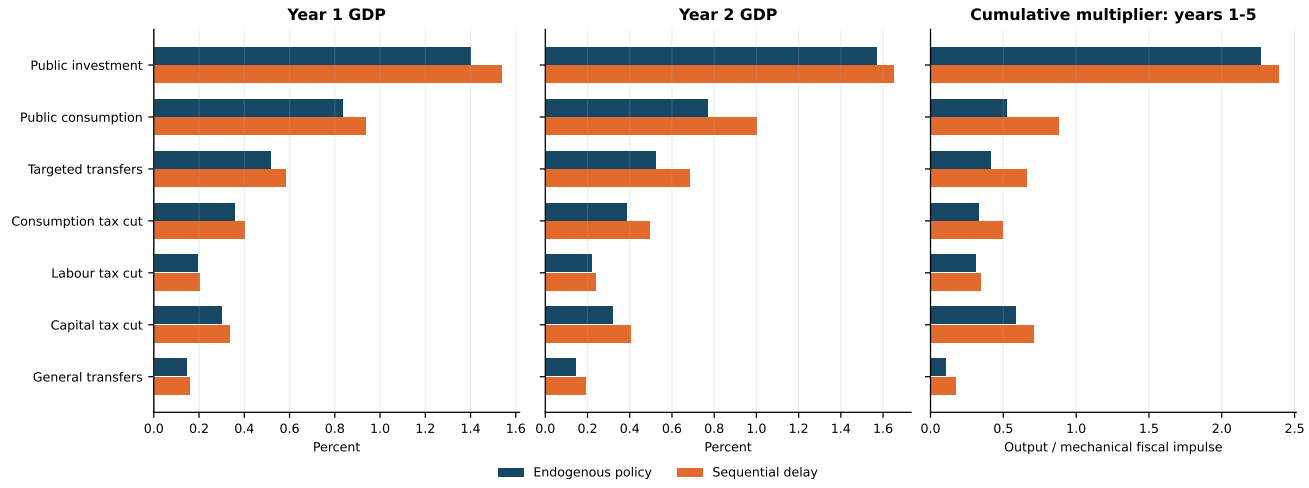
This construction preserves the chronology of decisions. The second-year extension is new information at that point, so first-year consumption, investment, inflation and exchange rates are not revised retrospectively. An announcement made at the outset that the rate will be fixed for both years would instead alter the first-year expectations and is a different experiment. Sequential paths are successive conditional forecasts, rather than a single perfect-foresight solution evaluated under information that was unavailable in the first year.

Table 2: Two-year fiscal expansions: Colombian GDP responses

	Endogenous rule		Sequential delay		Cumulative Y1–5	
Instrument	Y1	Y2	Y1	Y2	Rule	Delay
Government investment	1.402	1.571	1.540	1.650	2.267	2.392
Government consumption	0.835	0.770	0.936	1.000	0.527	0.882
Targeted transfers	0.516	0.522	0.581	0.684	0.412	0.661
Consumption tax cut	0.359	0.384	0.403	0.495	0.330	0.501
Labour tax cut	0.194	0.218	0.205	0.241	0.310	0.344
Capital tax cut	0.298	0.322	0.335	0.404	0.586	0.713
General transfers	0.143	0.145	0.161	0.191	0.103	0.175

Notes: GDP entries: percent deviation from baseline. Each expansion is one percent of baseline GDP in each of two years. Sequential delay freezes the first-year outcome before extending the fixed policy rate into year two. The cumulative measure divides total output effects over five years by the total two-year mechanical impulse.

Figure 2: Composition and monetary timing in the two-year experiments



Notes: Instruments are ranked by the first-year response to the one-year benchmark. The same order is retained in all panels. Blue: endogenous policy. Orange: sequential delay. The cumulative multiplier can rank instruments differently from the initial GDP response.

9.3 What drives the ranking?

Government investment generates the largest first-year output response in this calibration. It purchases goods immediately and adds to productive public capital with the source timing lag. The later supply effect matters for both private investment and the cumulative output response. This result depends on the assumed efficiency and output elasticity of public capital. The label "investment" is not enough to

establish that every real-world project has the productivity represented in the model.

Government consumption also has a substantial immediate demand effect, but its public-consumption stock has no active production externality in this calibration. Targeted transfers produce a larger initial response than general transfers because the marginal payment reaches households constrained by current resources. The aggregate effect still depends on imports, relative prices, taxation and the monetary reaction; it is not simply the household propensity to consume multiplied by the transfer.

Tax reductions operate through different margins. Labor and consumption taxes alter current disposable resources and relative prices; capital taxes change after-tax returns and investment incentives. A capital-tax reduction can rank modestly on impact but have a more persistent investment response. The consumption-tax experiment directly changes tax-inclusive consumer prices. Its initial fall in headline inflation should not be interpreted as a fall in all measures of demand or production-price pressure.

The sequential-delay comparison generally raises the output response relative to the continuously active monetary rule. It does not provide a free fiscal resource or justify fixing interest rates regardless of inflation. It is a conditional experiment showing how the timing of the monetary response changes financing costs, expenditure switching and the path of private demand. The scenario should be evaluated together with its inflation and exchange-rate consequences.

9.4 Spillovers and the limits of temporary multipliers

The domestic action also changes imports and foreign demand. All six foreign regions respond within the same international accounting system. Small Colombian GDP weight limits the size of most foreign output effects, but the geographical pattern depends on trade links rather than on equal foreign exposures. The replication files report every region and variable, including imports, the current account, the trade balance and foreign assets.

Temporary expansions are useful diagnostics of the transmission mechanism. They do not provide a sufficient ranking of permanent consolidation packages. To assess an investment cut, tax-base reform or durable transfer change, the analyst must specify its persistence, financing and credibility consequences. A large consolidation is not evaluated reliably by changing the sign of a local multiplier and scaling it by the intended debt reduction.

10. Country risk: weaker activity with initial consumer-price pressure

The country-risk experiment raises Colombia's country premium by one hundred basis points initially, with annual persistence of seven tenths. It leaves exogenous fiscal policy and the inflation target unchanged. The premium follows the source process

$$\log \Gamma_t = (1 - \rho_\Gamma) \log \bar{\Gamma} + \rho_\Gamma \log \Gamma_{t-1} + \varepsilon_t^\Gamma, \qquad \rho_\Gamma = 0.7. \tag{27}$$

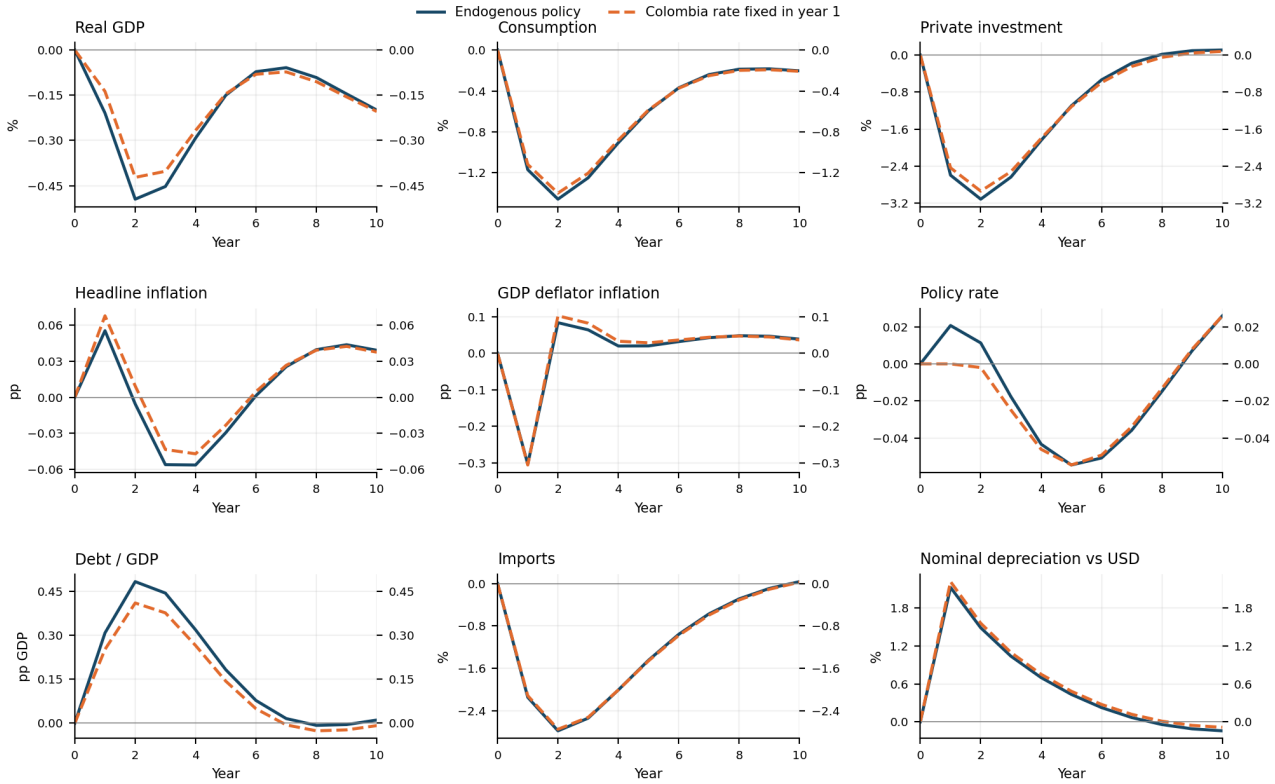
The premium enters borrowing conditions, international arbitrage and exchange-rate determination through the source relationships. It is not a direct one-for-one shock to an observed ten-year sovereign yield. The model contains smoothed financing components and an entrepreneurial accelerator, not a separately calibrated sovereign yield curve.

Table 3: Colombia country-risk shock: domestic transmission

Variable	Y1: rule	Y1: fixed	Y2: rule	Unit
Real GDP	-0.209	-0.137	-0.495	%
Consumption	-1.169	-1.118	-1.457	%
Private investment	-2.594	-2.435	-3.112	%
Headline inflation	0.055	0.068	-0.006	pp
GDP deflator inflation	-0.303	-0.305	0.083	pp
Policy rate	0.021	-0.000	0.011	pp
Borrowing rate	1.082	1.061	0.754	pp
Nominal depreciation vs USD	2.129	2.221	1.489	%
Entrepreneur net worth	-3.326	-3.012	-1.636	%
Debt / GDP	0.309	0.252	0.484	pp GDP

Notes: Pure premium shock, with no added inflation-expectations wedge. "Fixed" holds only the first-year Colombian policy rate at baseline. The domestic borrowing-rate response includes the model financing components and is not an empirical bond-yield forecast.

Figure 3: Country-risk transmission in Colombia



Notes: Blue: endogenous policy. Orange dashed: policy rate fixed in year one. Quantities are percent deviations; inflation and policy rates are percentage-point deviations; debt is a percentage-point change in debt/GDP. The country premium is increased in Colombia only.

Higher financing costs reduce household spending and private investment. The exchange rate depreciates, and entrepreneur net worth weakens as asset returns, financing costs and the value of the existing capital position adjust. The later investment response is larger than the initial response, demonstrating why impact effects alone can understate financial propagation. Entrepreneurial net worth and leverage are

reported in the appendix and data files; the results do not require publishing a model default probability as an empirical crisis probability.

Headline inflation initially rises while GDP-deflator inflation falls. Consumer and domestic-output prices have different weights and import exposure. Depreciation can raise consumer-price pressure while domestic weakness and changes in the composition of output weigh on the domestic-output deflator. The simulation therefore presents a meaningful policy trade-off: weaker demand need not be accompanied by an immediate fall in headline inflation.

The earlier three-region work also considered additional wage- and price-expectations wedges. Those are separate scenario assumptions and are set to zero here. The reported inflation response is generated by the current seven-region model and its exchange-rate and pricing channels. A study of imperfect credibility or weather-related supply expectations would require an explicit additional shock and a distinct interpretation.

11. Public debt: the endpoint and the journey

11.1 An illustrative lower-debt stationary equilibrium

The usefulness of finite horizons is particularly clear when the question shifts from a temporary fiscal impulse to a lasting change in government liabilities. We solve a stationary equilibrium with the Colombian debt ratio ten percentage points below its baseline. General transfers are held at their baseline real level. Changes in labor, capital and consumption tax rates are constrained to make equal ex-ante revenue changes, evaluated at their baseline tax bases. Other structural parameters and government-purchases settings are retained.

The calculation moves the structural model debt ratio from about 61 to about 51 percent of GDP. These endpoint levels are an illustrative model comparison, not a claim that the lower value is Colombia's legal fiscal anchor. The terminal fiscal-surplus target is updated consistently with the lower debt level. The maximum residual across the unchanged source equations is $8.2e-12$.

Table 4: Lower-debt stationary equilibrium: changes from the original baseline

Variable	Unit	Change
Consumption	%	0.165
Private investment	%	0.230
Government investment	%	0.000
Productive public capital	%	0.000
Labor tax rate	pp	-0.041
Capital tax rate	pp	-0.129
Consumption tax rate	pp	-0.035
Real private interest rate	pp	-0.001

Notes: Nonlinear stationary equilibria under the stated closure. Equal ex-ante tax-revenue changes use baseline tax bases. Three tax-instrument equations are replaced by the disclosed closure constraints; all other source equations are checked after the fiscal target is restored. No transition path or welfare ranking is implied.

The endpoint illustrates the distinction between financing an adjustment and living with its results. A government may need stronger primary balances during the reduction in debt, yet ultimately be able

to operate with lower distortionary taxes once debt service has fallen. Private consumption, investment and foreign asset positions also adjust. For a small economy, the effect on the world real interest rate is limited; much of the domestic benefit in this closure comes through fiscal resources and tax distortions rather than a large reduction in global rates.

The endpoint also makes the role of closure explicit. Holding taxes fixed and allowing transfers to change would distribute the fiscal dividend differently. Cutting public investment to reach a lower-debt equilibrium could reduce the productive base. An endpoint cannot be described only by its debt ratio; the associated tax, transfer and spending choices are part of the equilibrium being compared.

11.2 A transition must finance the change

A transparent debt-accounting identity is

$$b_t = \frac{1 + i^B_{t-1}}{1 + g^n_t} b_{t-1} - pb_t + \text{sfa}_t, \tag{28}$$

where pb_t is the primary surplus and sfa_t is the observed stock-flow adjustment. The structural model imposes its own complete budget identity; an empirical application must also account for valuation, coverage changes and other stock-flow factors in published debt data.

This identity is useful for diagnosing the primary balance consistent with a proposed path, but it does not determine the effects of taxes and spending on growth, inflation, financing costs or private balance sheets. The structural transition must determine those variables jointly, specify expectations and terminal conditions, and preserve fiscal solvency. Short-run fiscal costs and potential long-run gains need not occur in the same years or accrue to the same households, as emphasized in the GIMF consolidation literature (Clinton et al., 2011).

We do not present the lower-debt endpoint as a solved nonlinear transition. Nor do we combine local expansion multipliers with the endpoint to manufacture one. The model and code provide a foundation for that extension, but the transition requires its own policy path, economic closure and numerical verification. This is especially important if country-risk premia, the efficiency of investment or fiscal credibility change with the adjustment strategy.

12. A prudent risk-management approach to fiscal adjustment

A prudent fiscal strategy should be evaluated under several plausible environments, not just a central forecast. A package that appears manageable when risk premia remain low can become difficult if financing conditions deteriorate or the monetary response is delayed. The country-risk experiment and sequential fiscal experiments are useful building blocks for this analysis, while the WEO provides a separate empirical reference rather than a claim that the calibrated steady state is a forecast.

The Three Cs provide a practical organizing principle. A *comprehensive* assessment considers the composition of revenue and spending, the quality of public investment, distributional consequences, refinancing exposure and private balance sheets. A *consistent* assessment reconciles debt stocks, interest costs, primary balances, tax bases and terminal conditions. A *coordinated* assessment specifies the fiscal and monetary responses jointly while preserving the central bank's mandate and exchange-rate flexibility. Coordination means coherent assumptions and complementary policies, not a presumption that monetary policy will neutralize every fiscal cost.

The monetary prudent-risk-management approach described by Laxton, Avetisyan and Avagyan (2026) stresses alternative scenarios and the implications of uncertainty. Its fiscal application here is an analytical discipline: identify adverse states, compare packages under common assumptions, and make the financing and policy response explicit. It does not turn the illustrative scenarios into estimated probabilities.

For Colombia, a useful next application would compare packages that protect efficient public investment and well-targeted transfers while broadening tax bases and improving spending effectiveness. Their credibility and financing effects should be modeled or imposed transparently. The present country premium is exogenous; the model does not automatically award a spread reduction to a policy labeled "credible." A confidence dividend, if assumed, should be shown separately from the mechanical budget and demand effects.

13. Verification, limitations and reproducibility

The solved baseline satisfies 4,704 expanded equations, with a maximum absolute steady-state residual of $3.7e-12$. The temporary experiments have been checked at forty- and sixty-year terminal horizons. The largest difference in GDP responses over the first twenty years across the original experiments is 0.0007 percentage points; the corresponding sequential comparison is 0.0007. These are finite-horizon numerical checks, not a proof of infinite-horizon convergence.

The checks verify the temporary instrument paths, the allocation of targeted transfers, the initial risk-premium impulse and decay, and the imposed policy-rate constraints. The sequential extension freezes all realized first-year variables and evaluates the remaining conditional system. It deliberately does not re-optimize or revise history in light of the second-year policy decision. The lower-debt endpoint is checked separately under its disclosed tax closure.

The calibration has material limitations. Several fiscal targets and behavioral coefficients are inherited rather than newly estimated from Colombian microeconomic evidence. China's fiscal and tax block remains a proxy. Merchandise trade is used to allocate total model trade geographically. The common foreign monetary rule is an experimental assumption. The model does not separately identify an oil sector, commercial-bank capital, sovereign default or an observed term structure of government yields. These omissions matter for Colombia and identify priorities for further development; their absence should not be concealed by economic labels.

The replication archive contains the full expanded equations, variable dictionary, complete model state, calibration targets, raw simulation paths, scenario definitions, WEO extraction and metadata, sequential-policy implementation and lower-debt endpoint solver. The LaTeX source uses the same BPP publication design as the UK and Canada papers. The policy results are supplied in machine-readable tables, allowing the regional, instrument and monetary comparisons to be checked and extended.

14. Conclusion

Colombia's fiscal problem is simultaneously about demand, productive capacity, public liabilities and confidence. An analytical framework for that problem should allow those mechanisms to interact. GIM-F's finite planning horizons, liquidity constraints, distortionary taxes, public capital and international financial links make it a strong platform for this purpose.

The calibrated experiments show why composition and timing belong at the center of the discussion. Public investment, public consumption, transfers and taxes do not generate interchangeable output paths. Sequential monetary delays change the consequences of a two-year fiscal action. A country-risk shock can weaken activity and raise initial consumer-price pressure at the same time. Lower debt can eventually support lower distortionary taxes, but reaching that equilibrium requires an explicitly financed transition.

The contribution is therefore a transparent and reproducible basis for policy comparison. Its value lies in making assumptions and trade-offs visible, combining the fiscal accounts with economic behavior, and allowing competing strategies to be tested on common terms.

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A. Executable specification and accounting bridge

The economic equations in the text summarize the source relationships. The replication archive supplies every expanded equation with a stable row identifier, the variable dictionary and the complete state. The expansion uses seven regions, tradable and nontradable production, imports, retail distribution and the entrepreneurial financial accelerator. Oil and the special multi-region monetary-union branch are inactive because the euro area is represented as a single region.

Table 5: Selected source relationships

Source identifier	Economic role
C_OLG_R2, MPCINV_R2	Optimizing-household consumption and the inverse propensity to consume.
C_LIQ_R2, TRANSFER_LIQ_R2	Current resources and targeted-transfer allocation.
KG1_R2, KG2_R2	Growth-normalized public-capital accumulation.
NWT_R2, NWN_R2	Entrepreneurial net worth in tradable and nontradable production.
B_R2, GOVSUR_R2, INTCOST_R2	Public debt, overall balance and interest costs.
GOVSURSTAR_R2, DEBTSTAR_R2	Consistent stationary surplus and debt targets.
GBPREM_R2, RISKPREM_R2	Country premium and the financing/arbitrage composite.
INTMP_R2, PIE_R2, PIE_CONS_R2	Policy rule, underlying price-index inflation and headline CPI.
GROWTH_FISH_R2	Fisher real-output growth used to construct real GDP responses.

The WEO fiscal series are not the model's accounting residuals. The extraction preserves gross debt, net debt, total revenue, expenditure, overall balance and primary balance, together with their metadata. Net interest is derived from the last two. A comparison with the fiscal rule would require central-government net-debt definitions and the treatment of structural and cyclical components; it is not obtained by relabeling the WEO chart.

The lower-debt endpoint replaces only the three tax-instrument equations needed for its explicit closure, after setting the terminal fiscal-surplus target consistently. Its equation identifiers, original-equation checks and complete terminal state are in the replication archive. The temporary and sequential fiscal experiments use the original structural blocks with disclosed shocks and policy constraints.

B. One-year benchmarks and regional transmission

Table 6: One-year fiscal expansions: Colombia benchmark

Instrument	GDP Y1	GDP Y2	GDP Y1: fixed	CPI Y1	Deflator Y1
Government investment	1.175	0.457	1.215	0.069	0.036
Government consumption	0.855	-0.018	0.926	0.046	0.060
Targeted transfers	0.412	0.114	0.451	0.023	0.039
Consumption tax cut	0.284	0.093	0.311	-1.318	0.029
Labour tax cut	0.129	0.062	0.135	0.004	0.010
Capital tax cut	0.129	0.144	0.145	0.009	0.010
General transfers	0.110	0.033	0.120	0.006	0.016

Notes: One-percent-of-GDP impulse in year one only. GDP is percent deviation; inflation is percentage-point deviation. Fixed denotes the first-year Colombian policy-rate constraint only.

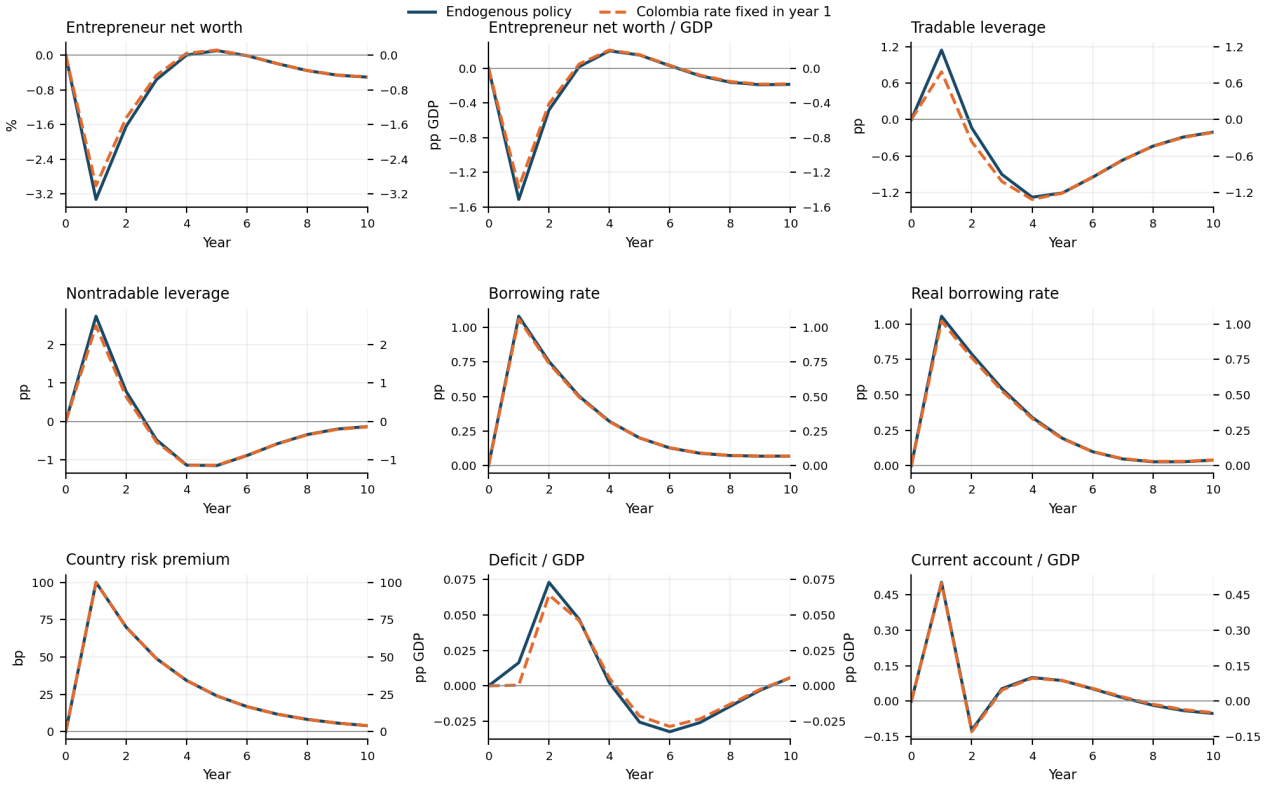
Table 7: Country-risk shock: regional GDP responses under the endogenous rule

Region	Year 1	Year 2	Year 5	Year 10
United States	-0.00418	-0.00376	0.00128	0.00042
Colombia	-0.20919	-0.49464	-0.14998	-0.19917
Euro area	-0.00423	-0.00303	0.00127	0.00071
China	-0.00406	-0.00355	0.00092	0.00074
Brazil	-0.00577	-0.00591	0.00133	0.00184
Mexico	-0.00826	-0.00632	0.00214	0.00128
Rest of world	-0.00328	-0.00251	0.00114	0.00091

Notes: Percent deviations in each region, not weighted contributions to world GDP. Higher precision is retained for small foreign responses.

C. Financial transmission of the country-risk shock

Figure 4: Colombia: net worth, leverage and financing conditions



Notes: Entrepreneur net worth aggregates the tradable and nontradable sectors. Leverage follows the source-model ratio definition. Blue: endogenous policy; orange dashed: first-year rate fixed. Probabilities of default are not interpreted as empirical crisis frequencies.

D. Two-year fiscal experiments: dynamic paths

These figures compare the endogenous policy rule, the first-year-fixed plan and sequential extension into year two. Every fiscal instrument changes for two years. Common vertical scales are used for each variable across the seven instruments, except the direct headline-price effect of the consumption tax, which requires a separate range. Quantity responses are percent deviations; inflation and policy rates are percentage-point deviations; debt is a percentage-point change in debt/GDP. Positive exchange-rate responses denote depreciation against the dollar.

The sequence of monetary decisions is summarized below. The sequential experiment uses the first-year-fixed conditional plan to determine every year-one outcome. The second policy decision is then evaluated with those outcomes treated as realized history. It does not use the two-year commitment's first-year expectations.

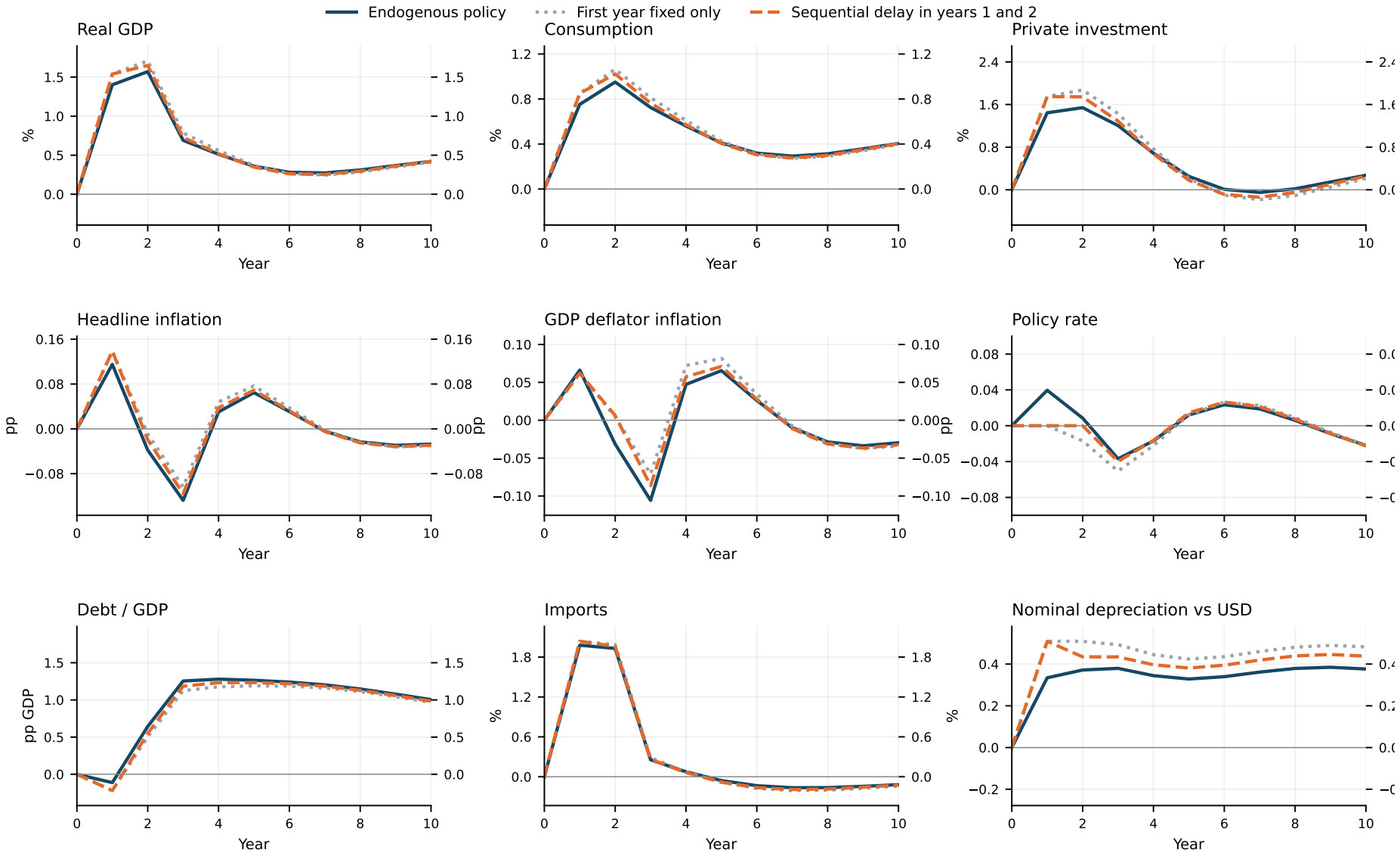
Table 8: Information and policy timing in the fiscal comparisons

Regime	Year-one policy	Information about year two in year one	Decision at the start of year two
Endogenous rule	Source rule	Source rule expected to continue	Source rule continues
First year fixed only	Rate held at baseline	Source rule expected to resume	Source rule resumes
Sequential delay	Rate held at baseline	Source rule expected to resume	Rate fixed again; realized year-one history is unchanged

All fiscal actions themselves are specified as two-year measures at the outset. The new information in the sequential comparison is the monetary extension, not a surprise second year of fiscal support. The first-year-fixed and sequential paths therefore agree exactly in year one. From year three onward, the monetary rule operates again under the conditional path chosen at the start of year two.

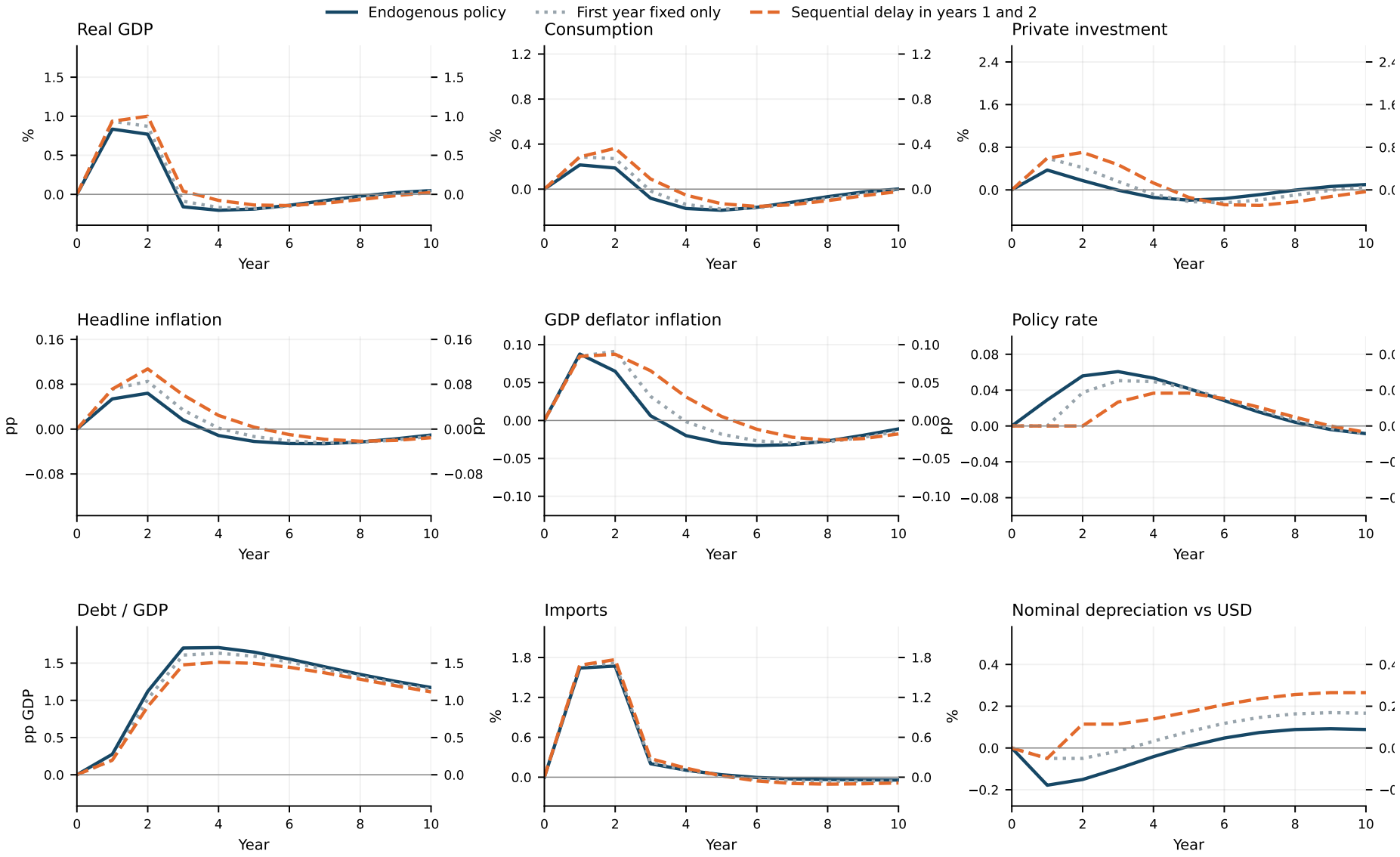
The archive also retains the separate one-year fiscal benchmarks, both baseline monetary regimes, all regional responses, and native variable paths. The appendix figures emphasize the domestic quantities, inflation, policy rate, debt, imports and exchange rate needed to interpret the two-year comparison. They are not a substitute for the complete numerical tables.

Figure 5: Government investment: two-year fiscal expansion



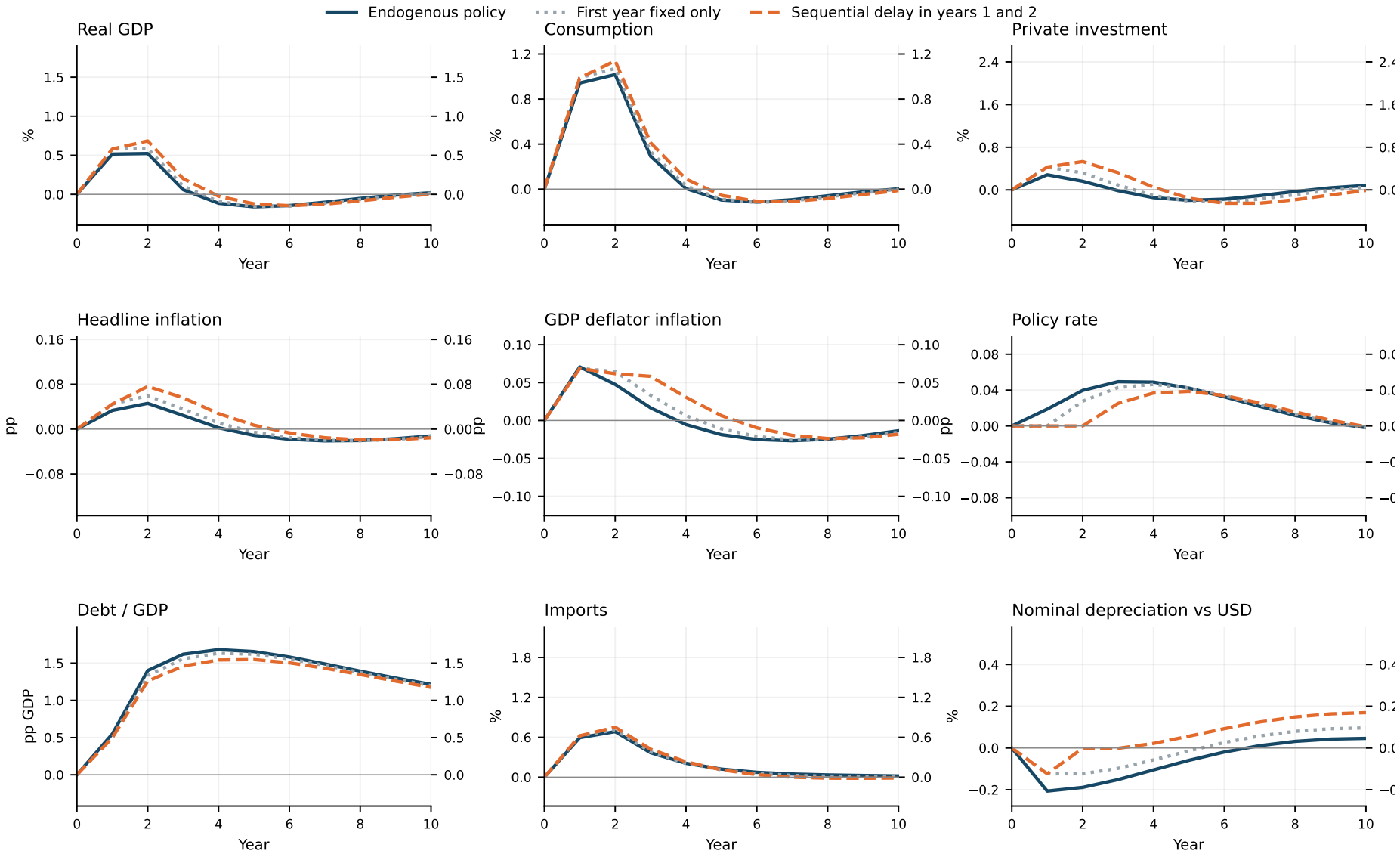
Notes: Blue: endogenous policy. Gray dotted: first-year rate fixed, with the source rule resuming in year two. Orange dashed: sequential delay; all first-year variables are frozen before the second-year rate is fixed. The source rule resumes in year three.

Figure 6: Government consumption: two-year fiscal expansion



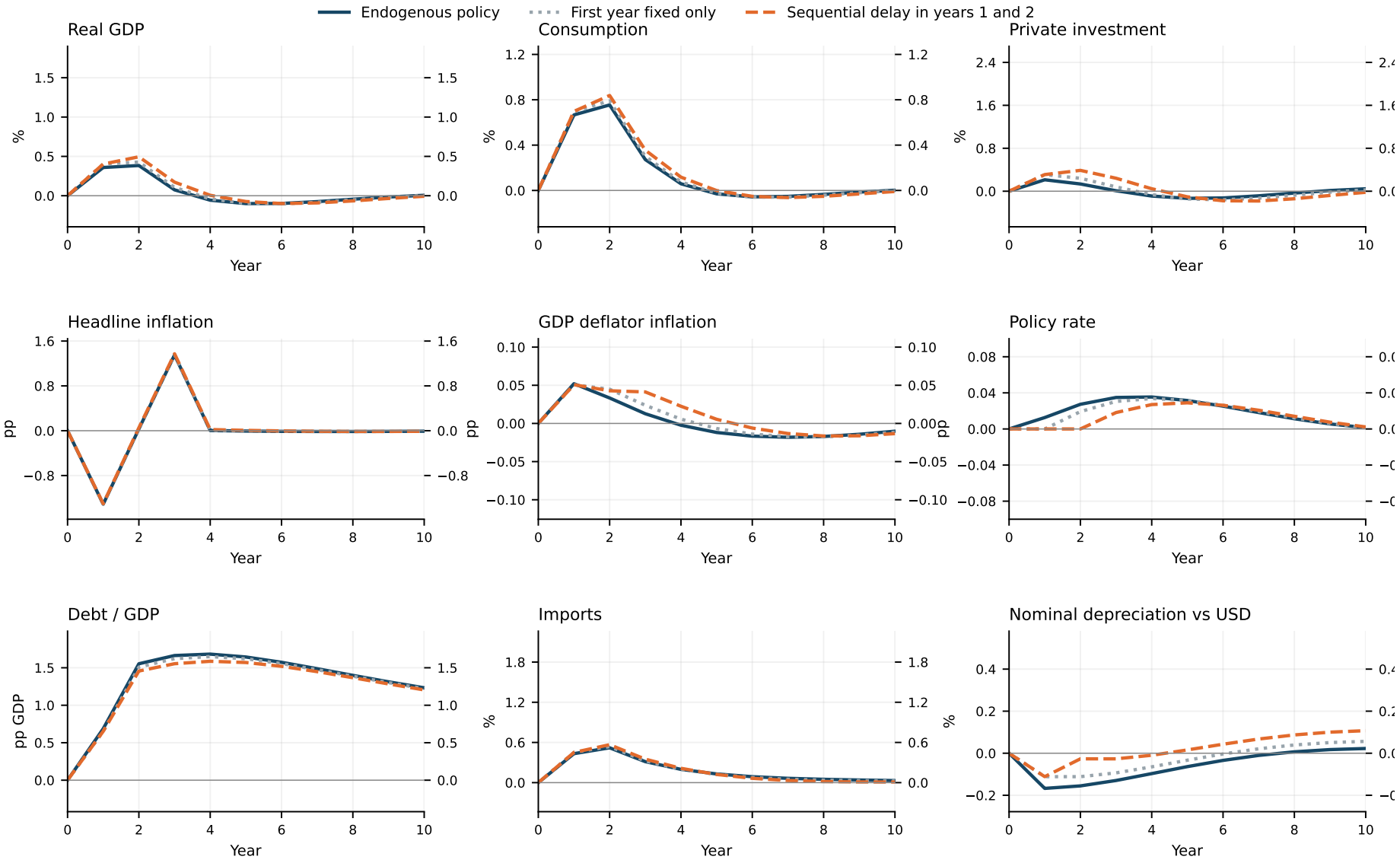
Notes: Blue: endogenous policy. Gray dotted: first-year rate fixed, with the source rule resuming in year two. Orange dashed: sequential delay; all first-year variables are frozen before the second-year rate is fixed. The source rule resumes in year three.

Figure 7: Targeted transfers: two-year fiscal expansion



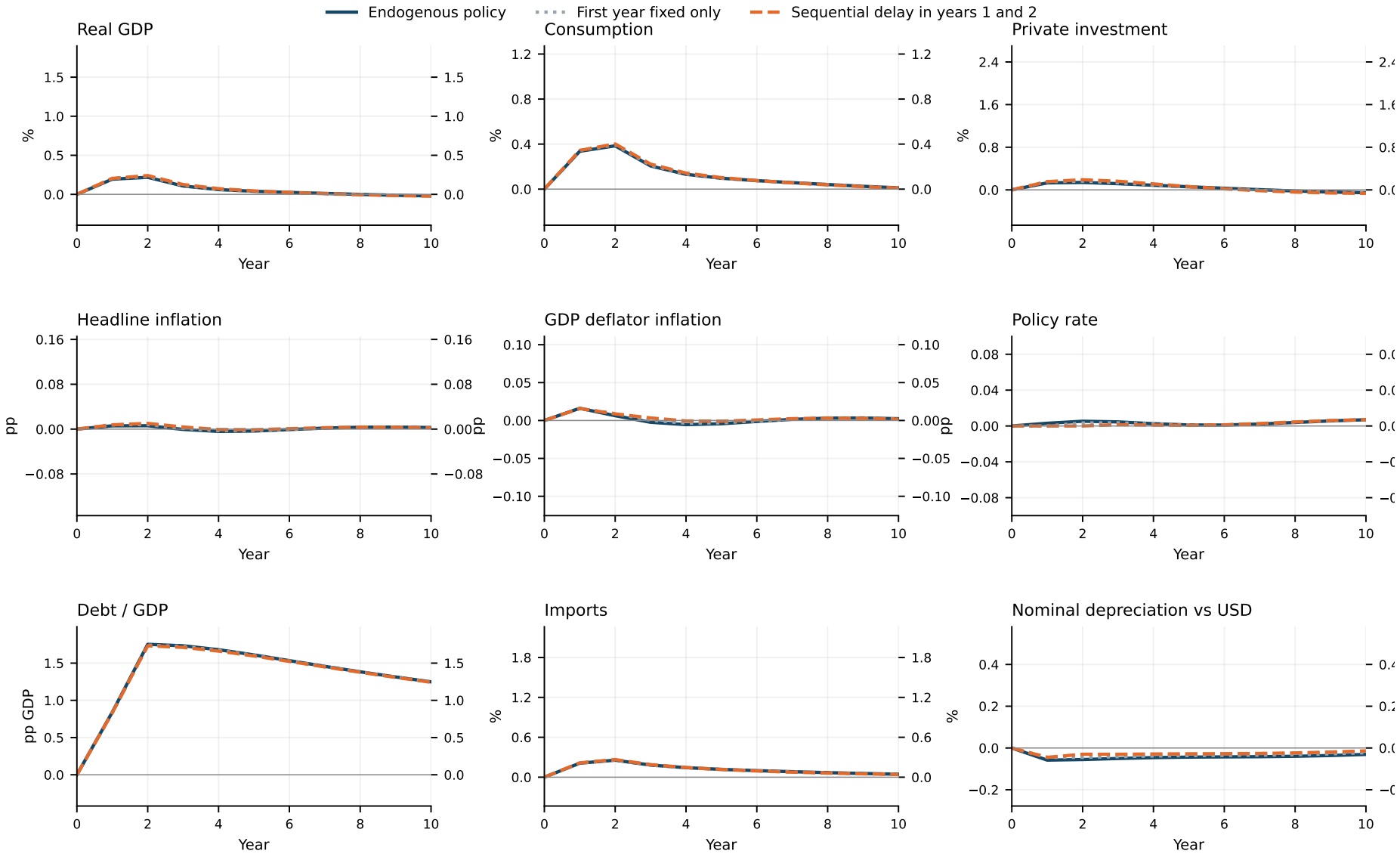
Notes: Blue: endogenous policy. Gray dotted: first-year rate fixed, with the source rule resuming in year two. Orange dashed: sequential delay; all first-year variables are frozen before the second-year rate is fixed. The source rule resumes in year three.

Figure 8: Consumption tax cut: two-year fiscal expansion



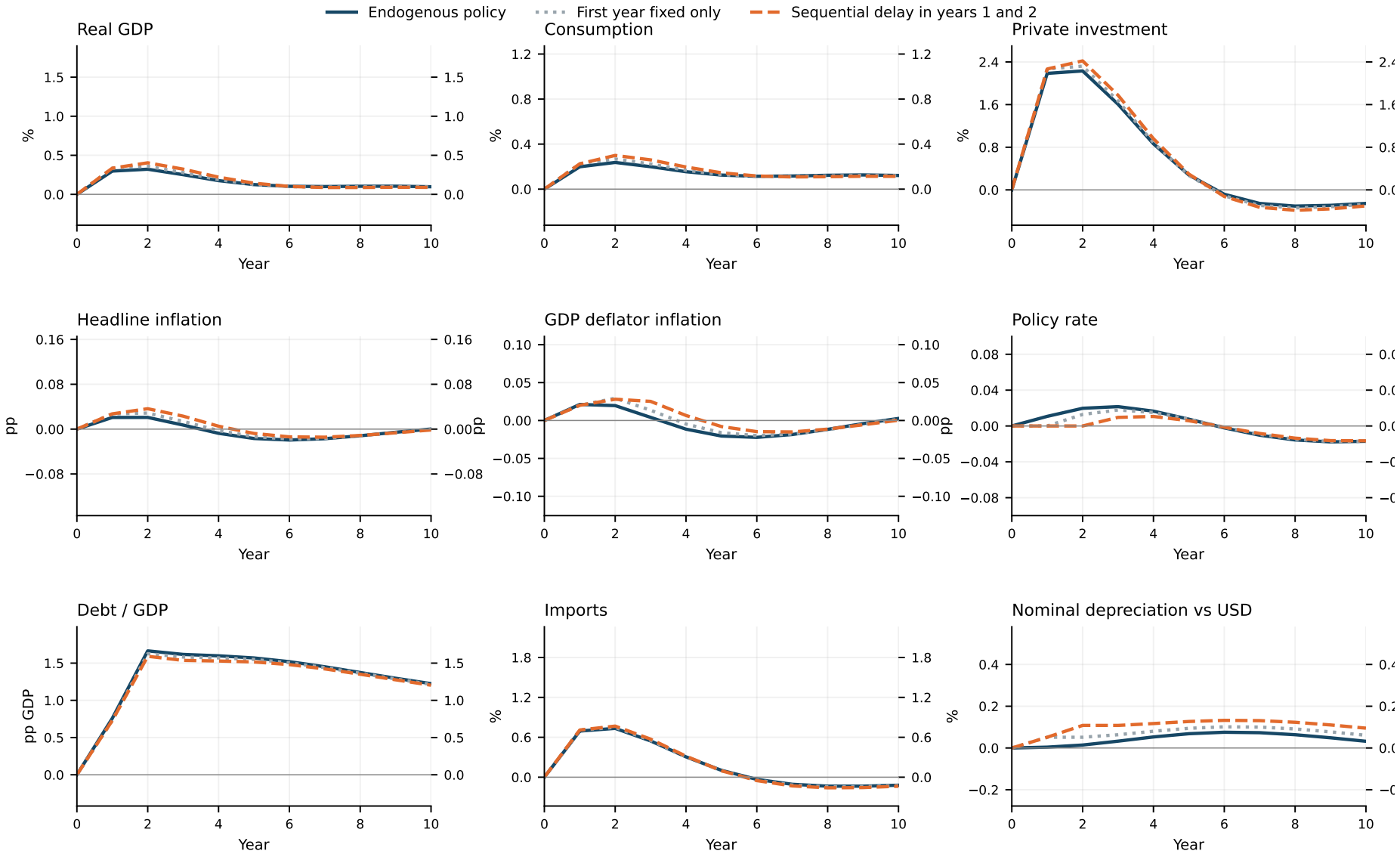
Notes: Blue: endogenous policy. Gray dotted: first-year rate fixed, with the source rule resuming in year two. Orange dashed: sequential delay; all first-year variables are frozen before the second-year rate is fixed. The source rule resumes in year three.

Figure 9: Labour tax cut: two-year fiscal expansion



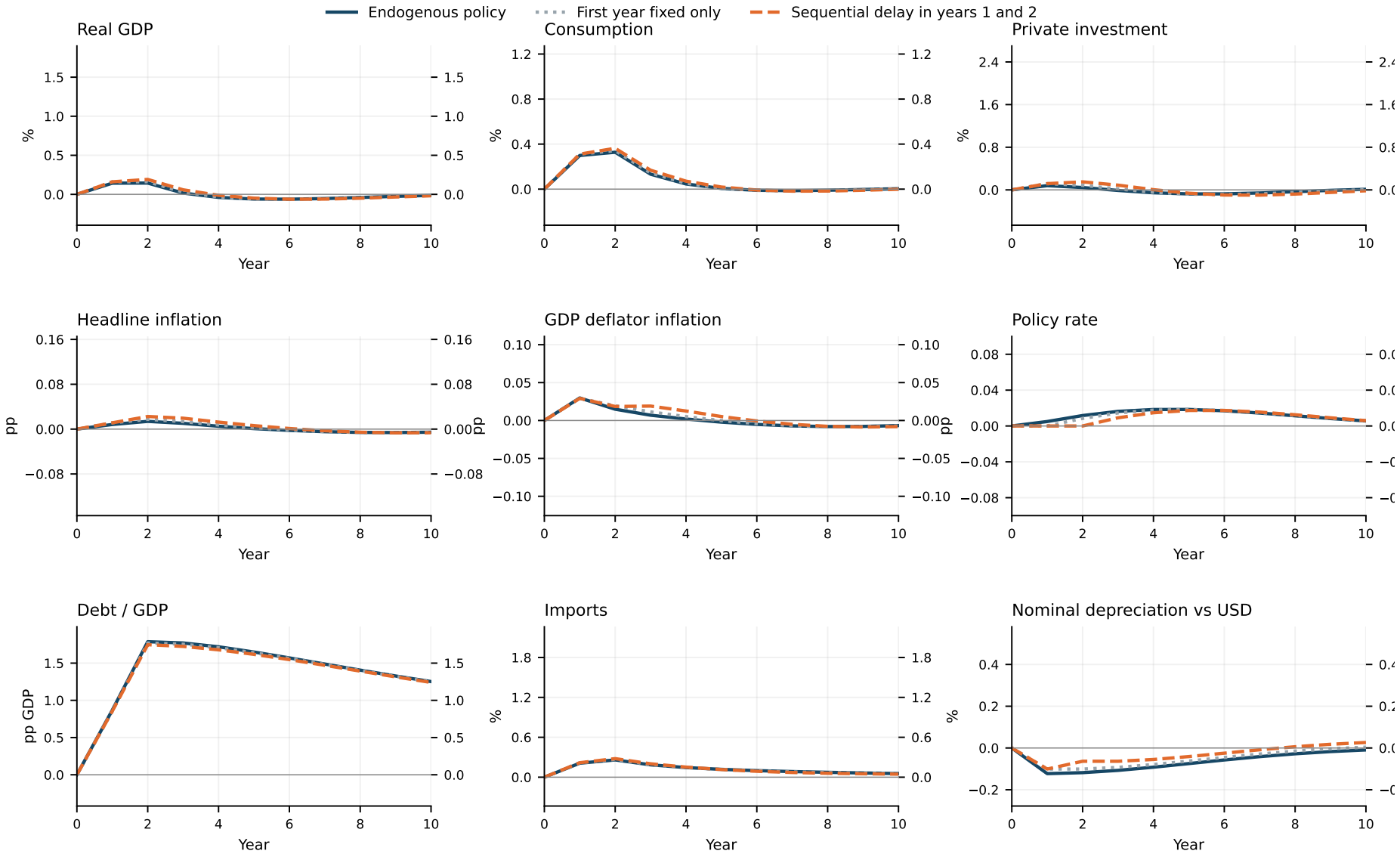
Notes: Blue: endogenous policy. Gray dotted: first-year rate fixed, with the source rule resuming in year two. Orange dashed: sequential delay; all first-year variables are frozen before the second-year rate is fixed. The source rule resumes in year three.

Figure 10: Capital tax cut: two-year fiscal expansion



Notes: Blue: endogenous policy. Gray dotted: first-year rate fixed, with the source rule resuming in year two. Orange dashed: sequential delay; all first-year variables are frozen before the second-year rate is fixed. The source rule resumes in year three.

Figure 11: General transfers: two-year fiscal expansion



Notes: Blue: endogenous policy. Gray dotted: first-year rate fixed, with the source rule resuming in year two. Orange dashed: sequential delay; all first-year variables are frozen before the second-year rate is fixed. The source rule resumes in year three.