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ARTICLE

Money-Financed Government Deficits and Bank Fragility in Frontier Economies

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Abstract
Does monetary financing of an unfunded fiscal expansion weaken the balance sheet of banks? We address this question by developing a small open-economy DSGE model that integrates fiscal-monetary interactions, an endogenous country risk premium, and a banking sector. We estimate the model using quarterly Ghanaian data from 2014Q2 to 2024Q2, and then use the estimated structural model to simulate the macroeconomic and banking-sector effects of a seigniorage-financed fiscal expansion.The results reveal a sharp macro-financial trade-off. Although money-financed spending initially raises output and employment, the resulting inflation and currency depreciation erode bank profitability, weaken capital adequacy, and lower the Z-score. As bank balance sheets deteriorate, credit spreads widen and lending contracts, choking off the initial stimulus as weaker financial intermediation reverses the early gains in output and employment and ultimately push real activity into decline. Counterfactual financing experiments show that mixed tax and bond financing substantially improves banking sector outcomes relative to full monetization. The findings imply that, in bank-dominated frontier economies with limited fiscal space, using seigniorage as a stopgap source of fiscal revenue imposes costs beyond price instability. It weakens bank balance sheets, constrains credit intermediation, and creates a persistent drag on real economic activity.

Keywords: Fiscal dominance, Bank fragility, Bayesian DSGE, Ghana, Frontier economies, Money-financed deficits.

JEL classification: E32, E44, E52, E58, E62, G21.

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1. Introduction

In many frontier economies, fiscal dominance is best understood as an institutional equilibrium rather than a deliberate policy choice. It emerges when a government's capacity to finance itself through conventional means is structurally impaired because tax mobilization carries steep political costs, expenditure retrenchment poses unacceptable social risks, domestic debt markets remain shallow and illiquid, and access to external financing is constrained by prohibitive risk premia. With each orthodox channel effectively closed, the burden of financing the state migrates to the central bank, which assumes the role of residual lender by necessity rather than design. Consequently, the primary objective of monetary policy shifts from preserving price stability to accommodating government financing needs. Fiscal requirements increasingly dictate interest-rate policy, liquidity provision, and balance-sheet operations. Because the fiscal authority drives the trajectory of public debt while the central bank merely adjusts to sustain it, the bank's independence and credibility are severely compromised. Over time, this dynamic institutionalizes monetary accommodation and creates a persistent inflationary bias, turning the inflation tax into a structural feature of the macroeconomic regime, as formalized by Sargent and Wallace (1981). Furthermore, in bank-dominated financial systems, the very seigniorage revenue that offers immediate fiscal relief ultimately compromises financial stability, as the ensuing inflation, currency depreciation, and elevated country-risk premia severely impair bank balance sheets and constrain private credit intermediation.

Ghana exhibits the structural conditions under which this equilibrium emerges, and its recent macro-financial history illustrates the channels through which these risks materialize. During the 2016 election cycle, fiscal slippage and renewed central-bank financing exposed domestic banks to severe losses, ultimately necessitating a large-scale banking-sector restructuring in 2017. These dynamics resurfaced forcefully in 2022 when severe debt distress, severed access to international capital markets, and renewed monetary accommodation triggered surging inflation and sharp currency depreciation. This acute nominal instability rapidly impaired bank profitability and capital adequacy, imposing a severe drag on the broader economy that rendered the public debt burden unsustainable. This trajectory culminated in the 2023 Domestic Debt Exchange Program, which compounded the sector's distress by transmitting sovereign distress directly to the balance sheet of financial intermediaries through impairments on government securities (International Monetary Fund (2017); Bank of Ghana (2019); International Monetary Fund (2023); Bank of Ghana (2024)). While these episodes reflect multiple sources of stress, they make Ghana an informative setting for isolating the nominal channel through which fiscal financing may generate bank fragility. This paper, therefore, asks whether the short-run fiscal relief provided by seigniorage financing imposes a persistent financial-stability cost by weakening bank balance sheets and constraining private credit intermediation.

Existing macroeconomic models do not provide a complete answer to this question. While the fiscal-dominance literature details how inflation and exchange-rate adjustments accommodate unfunded fiscal expansions, it largely ignores financial intermediaries. Conversely, macro-finance models (Gertler and Karadi, 2011, 2010) show how adverse shocks to bank net worth tighten leverage constraints and amplify economic contractions, yet they typically attribute this balance-sheet distress to exogenous financial shocks rather than fiscal-financing choices. This paper bridges this theoretical gap by extending fiscal dominance analysis to encompass banking sector stability. The framework connects these two literatures by demonstrating how the monetary financing of an unfunded fiscal expansion endogenously impairs intermediary balance sheets, restricting credit supply and depressing real activity. The model therefore evaluates seigniorage financing through both standard macroeconomic aggregates and specific banking metrics, including profitability, capital adequacy, credit supply, lending spreads, and the Z-score.

To explore this mechanism, we develop and estimate a small open-economy DSGE model in which monetary financing affects the balance sheet of banks. The baseline experiment simulates an unfunded fiscal expansion where government spending rises without a corresponding increase in tax revenue or sovereign borrowing, forcing the resulting deficit to be financed entirely via seigniorage. While this monetary expansion initially supports demand, it quickly generates inflation and currency depreciation. The resulting inflationary pressures prompt a policy-rate response that drives up banks' domestic funding costs. Simultaneously, the deteriorating macroeconomic environment, characterized by rapid money growth, inflation, and a weakening currency, forces up the country-risk premium, reflecting the higher compensation demanded by foreign creditors. For domestic banks, this elevated premium and weaker currency inflate the cost and domestic-currency burden of their foreign liabilities. Furthermore, nominal instability erodes borrower repayment capacity and broad asset quality, an effect captured in the model through an estimated fragility wedge in the bank net-worth process rather than through explicit defaults. As bank net worth declines, leverage constraints tighten, credit supply contracts, and lending spreads widen. Ultimately, this weakening of financial intermediation offsets the initial fiscal stimulus and depresses real economic activity.

We discipline the model using Ghanaian macroeconomic and banking-sector data within a Bayesian estimation framework. The observable set combines standard macroeconomic series, including output, inflation, the policy rate, nominal depreciation, government spending, and seigniorage, with indicators of banking-sector conditions such as capital adequacy and return on assets. This permits the quantitative analysis to speak directly to the interaction between monetary financing and financial intermediation rather than inferring bank stress solely from macroeconomic variables. We then use the model to study the responses to a seigniorage-financed fiscal expansion and to conduct counterfactual exercises in which the same spending increase is financed with different degrees of reliance on seigniorage. These counterfactuals isolate the banking-sector cost of monetary financing from the effect of the fiscal expansion itself. By doing so, the analysis reframes fiscal dominance as a macro-financial stability problem rather than solely a problem of inflation and fiscal solvency. In frontier economies where banks play a central role in private credit provision and are exposed to sovereign and currency risk, the financing of fiscal deficits fundamentally shapes the resilience of financial intermediation and the severity of subsequent macroeconomic adjustment.

The remainder of the paper proceeds as follows. Section 2 reviews the related literature. Section 3 presents the model and the fiscal-monetary-banking transmission mechanism. Section 4 discusses calibration and prior specification. Section 5 reports the Bayesian estimation results. Section 6 presents the impulse responses and variance decompositions. Section 7 studies alternative financing arrangements and related counterfactuals. Section 8 discusses robustness and limitations. Section 9 draws policy implications. Section 10 concludes.

2. Related Literature

This paper connects three strands of literature that have largely developed separately. The first is the literature on fiscal dominance and the fiscal theory of the price level. Seminal contributions by Sargent et al. (1981), Leeper (1991), and Woodford (1995, 2001) show that price-level determination depends on the fiscal-monetary regime. When fiscal policy is active and monetary policy is forced to accommodate public financing needs, inflation becomes tied to the government's intertemporal budget constraint rather than being pinned down solely by an independent monetary rule. Recent work by Cochrane (2022), Bianchi et al. (2023), and Kaplan et al. (2023) renews this argument in the context of large public debts, unfunded fiscal shocks, and persistent inflation. This literature provides the fiscal-monetary foundation for the paper, but it typically pays limited attention to how fiscal dominance affects bank balance sheets, credit supply, and financial stability, especially in frontier economies.

The second strand is the macro-financial DSGE literature with banking sector frictions. The models of Gertler and Karadi (2011) and Gertler and Karadi (2010) provide the benchmark mechanism linking bank net worth, leverage constraints, and credit supply. In these frameworks, adverse shocks that weaken intermediary net worth tighten balance-sheet constraints, reduce lending capacity, raise credit spreads, and amplify the decline in real activity. This paper builds on the bank-balance-sheet amplification mechanism but introduces fiscal dominance as the source of intermediary distress. Under deficit monetization, higher money growth generates inflationary and exchange-rate pressures that weaken the return on bank assets and reduce the accumulation of bank net worth. In the model, these effects operate through a reduced-form fragility wedge, which captures the deterioration in bank asset quality and borrower repayment capacity associated with nominal instability, without explicitly modeling defaults or non-performing loans. Currency depreciation also weakens banks through their foreign funding exposure by raising the domestic-currency cost of external liabilities. The resulting decline in bank net worth tightens the leverage constraint, contracts credit supply, and amplifies the effect of fiscal-monetary instability on real activity. The empirical analysis measures this deterioration using return on assets and capital adequacy, while the Z-score summarizes the resulting change in bank stability in a manner consistent with the bank-risk literature (Boyd and Runkle, 1993; Laeven and Levine, 2009).

The third strand is the literature on fiscal stress, currency crises, and financial stability in emerging and frontier economies. Burnside et al. (2001), Corsetti and Maćkowiak (2006), and Kaminsky and Reinhart (1999) show that fiscal weaknesses, exchange-rate pressure, and banking crises can reinforce one another. This link is especially relevant in economies where public debt sustainability, currency stability, and bank balance sheets are tightly connected. Related work on low-income and sub-Saharan African economies, including Adam and Bevan (2009), Buffie et al. (2018), Senbeta (2017), and Dabla-Norris et al. (2018), emphasizes that weak fiscal anchors can limit monetary-policy independence and expose domestic financial systems to macroeconomic instability. For Ghana, IMF Article IV consultations and the Bank of Ghana Financial Stability Review document recurrent fiscal-monetary tensions, including the 2017 banking-sector crisis, the 2022 macroeconomic crisis, and the 2023 Domestic Debt Exchange Program. Empirical studies such as Asongu and Odhiambo (2021) and Kuada (2019) further support the relevance of bank-stability analysis in African financial systems.

This paper contributes by bringing these strands into a single estimated framework. It links fiscal dominance to monetary expansion, monetary expansion to inflation and depreciation, nominal instability to bank balance-sheet stress, and bank fragility back to credit supply and real activity. In doing so, it closes a macro-financial loop that each literature has addressed only partially. To the best of our knowledge, this is among the first Bayesian-estimated open-economy DSGE applications to African banking-sector fragility that explicitly links seigniorage, exchange-rate pressure, and bank net-worth dynamics.

3. The Model

We develop a small open-economy New Keynesian DSGE framework that integrates three core features: balance-sheet-constrained financial intermediaries modeled in the spirit of Gertler and Karadi (2011), monetary financing of fiscal deficits, and foreign currency borrowing by banks exposed to country-risk premia and exchange-rate depreciation. The defining feature of our framework is that banking distress is generated endogenously by fiscal policy, in particular by the reliance on monetary financing, rather than being imposed through exogenous financial shocks as in much of the existing literature.

In the benchmark experiment, we isolate an unfunded fiscal expansion by allowing government spending to rise while holding taxes fixed and excluding public bond finance. 4 Fixed taxes capture the limited scope for immediate revenue adjustment, while the absence of government debt issuance ensures that the resulting fiscal gap is closed through seigniorage. This restriction applies to the government financing problem, not to banks, which continue to borrow externally and remain exposed to foreign funding conditions. The resulting monetary expansion generates inflationary and exchange-rate pressures that are transmitted to bank balance sheets through higher domestic funding costs, a higher country-risk premium, a domestic-currency burden on foreign liabilities, and a reduced-form fragility wedge in bank net-worth accumulation. This benchmark provides a clean measure of the banking-sector consequences of monetary financing. The counterfactual analysis subsequently relaxes the financing restriction by introducing alternative fiscal-financing arrangements and evaluates how lower reliance on seigniorage changes bank net worth, credit supply, profitability, and financial stability.

The model is designed to address a specific question: when an unfunded fiscal expansion is monetized in a small open economy, does the resulting nominal adjustment weaken the banking system sufficiently to alter credit supply and real activity? To keep the exposition focused, this section presents the equations that organize the transmission mechanism. The complete equilibrium system is reported in Appendix A.

3.1 Households, production, and nominal rigidities

Households consume a composite of domestically produced and imported goods, supply labour, and hold real money balances and deposits. Preferences feature external habit formation in consumption and utility from real money balances. Household optimality determines the stochastic discount factor, labour supply, money demand, and the domestic real deposit rate, denoted by Rt. This rate is also the domestic funding cost faced by banks.

Domestic output is produced using effective capital and labour:

$$Y_t^m = A_t \left(\xi_t U_t K_{t-1}\right)^{\alpha} L_t^{1-\alpha}, \tag{1}$$

where A_t is total factor productivity, ξ_t is capital quality, U_t is utilisation, and K_{t-1} is predetermined capital. Investment is subject to adjustment costs, and utilisation raises endogenous depreciation.

Domestic and imported prices adjust sluggishly. Domestic-goods inflation is determined by staggered price setting, so the demand and marginal-cost effects of a money-financed fiscal expansion pass gradually into domestic prices. Imported-goods inflation is governed by incomplete exchange-rate pass-through and an additional reduced-form monetary-financing pressure:

$$\Pi_t^F = \left(\Pi_{t-1}^F\right)^{\gamma_F \gamma_{PF}} d_t^{1-\gamma_F} \Gamma_t^{\psi_{m\pi}}, \tag{2}$$

where Π_t^F denotes gross imported-goods inflation, d_t denotes gross nominal depreciation, and Γ_t denotes gross money growth. The first term captures persistence in local-currency import prices. The second captures the pass-through of currency depreciation into the domestic price of imported goods. The third term allows monetary financing to raise imported-goods inflation beyond the contemporaneous effect of currency depreciation. This channel is economically relevant in a frontier economy because a monetized fiscal expansion can lead importers to anticipate further inflation and exchange-rate pressure, raising the local-currency replacement cost of imported goods before depreciation is fully realized. These mechanisms are not micro-founded separately in the model; rather, the term provides a parsimonious reduced-form representation of the additional import-price pressure associated with monetization. Deficit financing through money creation, therefore, raises aggregate inflation through domestic price adjustment, exchange-rate pass-through, and an additional monetization-related pressure on import prices.

3.2 Banks

In this section, we develop the model's banking block. Following Gertler and Karadi (2011), banks face an agency friction that limits outside funding and ties asset holdings to net worth. We extend this framework by allowing part of outside funding to be raised abroad, exposing bank balance sheets to country-risk premia and currency depreciation, and by introducing a reduced-form fragility wedge through which the nominal instability generated by monetary financing weakens bank net-worth accumulation beyond its effect on funding costs. The wedge summarizes borrower distress and other adverse macroeconomic effects of inflationary and exchange-rate instability on bank asset performance that are not explicitly modeled through defaults, non-performing loans, or provisioning

3.2.1 Bank balance sheet and funding structure

Each period, bank j acquires claims on productive capital and finances them with its own net worth and outside funding sourced from domestic deposits and foreign borrowing. Therefore, bank j balance sheet is given by:

$$Q_t S_{jt} = N_{jt} + D_{jt} + B^*_{jt}. \tag{3}$$

where $Q_t S_{jt}$ is the market value of productive-capital claims held by bank j, N_{jt} is bank net worth, D_{jt} is domestic deposit funding, and B^*_{jt} is foreign borrowing. Hence, the bank's outside funding is $Q_t S_{jt} - N_{jt}$.

To capture banks' exposure to external financial conditions, we let γ_{open} denote the share of outside funding obtained from foreign sources:

$$B^*_{jt} = \gamma_{open} \left(Q_t S_{jt} - N_{jt} \right), \tag{4}$$

$$D_{jt} = \left(1 - \gamma_{open}\right) \left(Q_t S_{jt} - N_{jt} \right). \tag{5}$$

A higher γ_{open} intensifies the exposure of bank net worth to both the country-risk premium and exchange-rate depreciation. Given the scarcity of direct data on banks' foreign-funding liabilities, we calibrate γ_{open} using Ghana's trade-openness ratio, which serves as a reduced-form proxy for the banking system's vulnerability to external funding and currency risks.

Banks pay R_t on domestic deposits and R^*_t on foreign liabilities, where the foreign borrowing rate rises with the country-risk premium. Because foreign liabilities are denominated in foreign currency but serviced domestically, gross nominal depreciation d_{t+1} between periods t and $t + 1$ raises the domestic-currency burden of repayment.

The gross domestic deposit rate R_t is determined endogenously by the household Euler condition for deposits,

$$1 = \beta R_t \mathbb{E}_t \Lambda_{t,t+1}, \tag{6}$$

where $\Lambda_{t,t+1}$ is the household stochastic discount factor. Hence, R_t is the equilibrium real return required by households to transfer resources from period t to period $t + 1$ through bank deposits. Because deposits raised in period $t - 1$ are repaid in period t, the bank's net-worth law of motion contains the predetermined domestic funding cost R_{t-1}.

Domestic banks borrow abroad at the gross rate

$$R^*_t = \Psi_t R^f_t, \tag{7}$$

where R^f_t is the foreign risk-free gross rate and Ψ_t is the country-risk premium. The premium is specified as

$$\Psi_t = \exp\left[\psi_1 \left(B^*_t - \overline{B}^*\right)\right] \Pi_t^{\psi_\pi} d_t^{\psi_e} \Gamma_t^{\psi_\mu} \exp\left(\varepsilon^\Psi_t\right). \tag{8}$$

This reduced-form risk pricing schedule links foreign borrowing cost to perceived repayment risk. When a bank carries higher foreign debt and macroeconomic conditions deteriorate through faster money growth, higher inflation, and currency depreciation, foreign lenders perceive greater repayment risk and demand a higher premium as compensation.

3.2.2 Exchange Rate

The nominal exchange rate is governed by uncovered interest parity. Let E_t denote the nominal exchange rate, measured as domestic currency per unit of foreign currency, and define expected gross nominal depreciation as

$$d_t \equiv \mathbb{E}_t \left(\frac{E_{t+1}}{E_t} \right). \tag{9}$$

Thus, $d_t > 1$ implies an expected depreciation of the domestic currency. Uncovered interest parity equates the gross return on a domestic asset with the expected domestic-currency return on a comparable foreign asset:

$$I_t = R_t^f d_t = R_t^f \mathbb{E}_t \left(\frac{E_{t+1}}{E_t} \right), \tag{10}$$

where I_t is the gross domestic nominal interest rate and R_t^f is the gross foreign risk-free interest rate. Equivalently,

$$d_t = \frac{I_t}{R_t^f}. \tag{11}$$

Holding the foreign rate fixed, higher domestic interest rates are associated with greater expected nominal depreciation. In the model, the inflationary pressure generated by monetary financing induces a policy-rate response and thereby increases depreciation pressure.

The real exchange rate evolves according to

$$s_t = \left(\frac{s_{t-1} d_t}{\Pi_t} \right)^{1-\kappa_s} \bar{s}^{\kappa_s}, \tag{12}$$

where Π_t is gross domestic inflation and $\bar{s}$ is the steady-state real exchange rate.

Exchange-rate depreciation affects bank balance sheets through foreign-currency liabilities. Since these liabilities must be serviced in domestic currency, an increase in d_t raises their domestic-currency repayment burden and reduces bank net-worth accumulation.

3.2.3 *Evolution of Bank Net Worth*

Claims acquired by bank j in period t yield the gross state-contingent return R_{t+1}^k in period $t+1$. Before accounting for the additional fragility associated with monetary financing, bank net worth is

$$\widetilde{N}_{j,t+1} = R_{t+1}^k Q_t S_{jt} - R_t D_{jt} - R_t^* d_{t+1} B_{jt}^*. \tag{13}$$

The bank earns a return on its assets, pays R_t on domestic deposits, and pays $R_t^* d_{t+1}$ on foreign liabilities in domestic-currency terms. Thus, depreciation raises the domestic-currency repayment burden of foreign borrowing.

Using the balance-sheet identity in equation (3), this expression becomes

$$\widetilde{N}_{j,t+1} = \left(R_{t+1}^k - R_t \right) Q_t S_{jt} + R_t N_{jt} + \left(R_t - R_t^* d_{t+1} \right) B_{jt}^*. \tag{14}$$

This expression captures the liability-side channel through which monetary financing weakens bank net worth. A seigniorage-financed fiscal expansion raises inflation and currency depreciation. Higher inflation increases domestic funding costs, while depreciation and the associated rise in the country risk premium increase the domestic-currency cost of foreign borrowing. Both reduce the return accruing to bank equity.

Nominal instability may also weaken bank asset performance beyond these funding-cost effects. Since the model does not explicitly track defaults, non-performing loans, or provisioning, this additional effect is captured through a reduced-form fragility wedge:

$$N_{j,t+1} = \frac{\widetilde{N}_{j,t+1}}{\Gamma_{t+1}^{\psi_{z\mu}} d_{t+1}^{\psi_{zs}}}, \tag{15}$$

where Γ_{t+1} is gross money growth, $\psi_{z\mu}$ measures the sensitivity of bank net worth to monetary-financing pressure, and ψ_{zs} measures its sensitivity to currency depreciation. As money growth and depreciation rise, the wedge lowers net-worth accumulation by summarizing the borrower distress and deterioration in asset quality associated with nominal instability.

Monetary financing, therefore, weakens bank net worth through two complementary channels: it raises the cost of domestic and foreign funding, and it reduces bank asset performance through the fragility wedge.

3.2.4 *Bank value and the agency problem*

Bankers survive from one period to the next with probability θ. A A banker who exists transfers terminal net worth to the household. Bank *j* therefore chooses its asset holdings to maximize expected discounted terminal net worth:

$$V_{jt} = \max_{S_{jt}} \mathbb{E}_t \sum_{i=0}^{\infty} (1-\theta)\theta^i \beta^{i+1} \Lambda_{t,t+1+i} N_{j,t+1+i}, \tag{16}$$

subject to its balance sheet, funding composition, and net-worth law of motion.

In the absence of a financing friction, a positive expected return on bank assets relative to funding costs would lead banks to expand their balance sheets without bound. Following Gertler and Karadi 2011c, we introduce an agency problem that limits this expansion. After obtaining funds, a banker can divert a fraction λ of bank assets for private benefit. Because creditors cannot recover the diverted portion, they supply funds only if the continuation value of the bank is at least as large as the gain from diversion.

The bank value function is linear in assets and net worth:

$$V_{jt} = \nu_t Q_t S_{jt} + \eta_t N_{jt}, \tag{17}$$

where ν_t is the marginal continuation value of an additional unit of bank assets and η_t is the marginal continuation value of an additional unit of bank net worth. Since the net-worth law incorporates domestic funding costs, foreign-liability costs, and the fragility wedge, these marginal values internalize the exposure of banks to monetary and external stress.

The incentive compatibility constraint is

$$V_{jt} \geq \lambda Q_t S_{jt}. \tag{18}$$

Substituting equation (17) into equation (18) gives

$$\eta_t N_{jt} \geq (\lambda - \nu_t)\, Q_t S_{jt}. \tag{19}$$

When the constraint binds, bank assets are proportional to bank net worth:

$$Q_t S_{jt} = \Phi_t N_{jt}, \qquad \Phi_t = \frac{\eta_t}{\lambda - \nu_t}. \tag{20}$$

The variable Φ_t is the maximum leverage multiple supported by the bank incentive constraint. A higher diversion parameter reduces allowable leverage. A higher continuation value of bank equity or of bank assets increases the amount of outside funding that creditors are willing to provide per unit of bank net worth.

Equation (20) is the balance-sheet amplification mechanism. A fall in bank net worth reduces the scale of assets that banks can finance unless allowable leverage rises sufficiently to offset the decline in equity. Thus, shocks that reduce bank net worth contract credit supply and propagate into real economic activity.

3.2.5 Aggregation and credit intermediation

Because banks are identical in equilibrium, they choose the same leverage multiple. Aggregating equation (20) across banks yields

$$Q_t K_t = \Phi_t N_t, \tag{21}$$

where K_t is the aggregate quantity of capital claims held by banks and N_t is aggregate bank net worth.

Aggregate foreign bank borrowing is therefore

$$B_t^* = \gamma_{open} \left(Q_t K_t - N_t \right). \tag{22}$$

Using equations (21) and (22), the gross pre-wedge growth rate of bank net worth is

$$\widetilde{Z}_t^b = \left(R_t^k - R_{t-1} \right) \Phi_{t-1} + \left(R_{t-1} - R_t^* d_t \right) \frac{B_{t-1}^*}{N_{t-1}} + R_{t-1}. \tag{23}$$

Realized bank net-worth growth is then

$$Z_t^b = \frac{\widetilde{Z}_t^b}{\Gamma_t^{\psi_{z\mu}} d_t^{\psi_{zs}}}. \tag{24}$$

The first component of equation (23) is the leveraged return margin on bank assets. The second component captures the effect of foreign borrowing costs and currency depreciation on the portion of bank funding raised abroad. Equation (24) then introduces the additional asset-quality and borrower-distress effect of monetary expansion and depreciation. Together, these channels determine how fiscal-monetary instability affects bank equity and the supply of credit.

Aggregate bank net worth is the sum of the retained equity of surviving banks and the initial net worth transferred to entering banks:

$$N_t = N_t^e + N_t^n, \tag{25}$$

$$N_t^e = \theta Z_t^b N_{t-1} \varepsilon_t^N, \tag{26}$$

$$N_t^n = \omega Q_t \xi_t K_{t-1}, \tag{27}$$

where ε_t^N is an exogenous bank net-worth disturbance, ω determines the transfer received by entering banks, and ξ_t is the capital-quality disturbance that affects the value of assets entering the banking system. A decline in Z_t^b reduces retained bank equity and, through equation (21), lowers the quantity of productive assets that banks can finance.

3.2.6 Banking-sector indicators

The banking block is connected to the Ghanaian data through observable indicators of bank performance and capitalization. The model defines

$$\text{CAR}_t = \frac{1}{\Phi_t}, \tag{28}$$

$$\text{ROA}_t = \frac{Z_t^b - 1}{\Phi_t}, \tag{29}$$

$$\text{Zscore}_t = \frac{\text{ROA}_t + \text{CAR}_t}{\sigma_{ROA}^{data}}, \tag{30}$$

where σ_{ROA}^{data} is fixed at the empirical standard deviation of return on assets over the sample.

The capital adequacy ratio is the model measure of bank capitalization and is inversely related to leverage. Its response is endogenous because banks may respond to a fall in net worth by adjusting both their asset holdings and their leverage. Return on assets declines when lower net-worth growth reduces profitability relative to the bank asset base. The Z-score combines profitability and capitalization relative to observed return volatility and serves as a summary measure of bank stability.

The banking block shows how monetary financing is transmitted to bank net worth. A seigniorage-financed fiscal expansion exposes banks to both asset-side and liability-side deterioration. On the asset side, the fragility wedge captures the adverse effect of money growth and depreciation on borrower repayment capacity and loan performance. On the liability side, inflation-driven increases in domestic funding costs narrow intermediation margins, while higher country-risk premia and currency depreciation raise the domestic-currency cost of foreign borrowing. Together, these pressures reduce profitability and retained earnings, leaving banks with a smaller equity base to support lending.

3.3 Fiscal financing and monetary policy

Government spending follows an exogenous process around its steady-state share of output. The benchmark experiment isolates an unfunded fiscal expansion by holding tax revenue fixed at its steady-state level:

$$T_t = \overline{T} = \overline{G}. \tag{31}$$

This assumption is economically deliberate. If taxes rose contemporaneously with government spending, the expenditure increase would be tax-financed, and the monetary-financing mechanism would not be activated. By holding taxes fixed, the model identifies the consequences of an increase in spending that is not backed by current fiscal revenue.

The government financing condition is

$$G_t - T_t = \text{Seign}_t, \tag{32}$$

with seigniorage defined as

$$\text{Seign}_t = M_t\left(\Gamma_t - 1\right), \tag{33}$$

where M_t denotes real money balances and Γ_t denotes gross money growth. In the benchmark specification, an unfunded increase in spending therefore raises money growth endogenously through the government financing identity.

The central bank sets the nominal policy rate according to a smoothed Taylor rule:

$$I_t = I_{t-1}^{\rho_i}\left[\bar{I}\,\Pi_t^{\kappa_\pi}\left(\frac{X_t}{\overline{X}}\right)^{\kappa_y}\right]^{1-\rho_i}\varepsilon_t^i, \tag{34}$$

where I_t is the gross nominal policy rate, Π_t is gross inflation, X_t is the markup gap, and ε_t^i is a monetary-policy shock.

3.4 Model Core Transmission Mechanism

The model studies how monetary financing of an unfunded fiscal expansion affects bank balance sheets in a small open economy. In the benchmark specification, taxes are held fixed and public bond financing is excluded, so an increase in government spending is financed through seigniorage:

$$G_t - T_t = \text{Seign}_t, \tag{35}$$

$$\text{Seign}_t = M_t\left(\Gamma_t - 1\right), \tag{36}$$

where G_t is government spending, T_t is tax revenue, M_t is real money balances, and Γ_t is gross money growth. Hence, higher spending not matched by current revenue raises money growth endogenously.

Monetary financing reaches bank balance sheets through domestic and external funding conditions. Domestically, the increase in money growth raises inflationary pressure and induces a monetary-policy response. The resulting increase in the domestic funding rate raises the cost of deposit finance and compresses the return banks earn on domestic intermediation. Externally, the policy-rate response generates currency depreciation through the benchmark exchange-rate condition. At the same time, faster money growth, higher inflation, depreciation, and foreign borrowing raise the country-risk premium, increasing the foreign funding rate faced by domestic banks. Depreciation further raises the domestic-currency cost of servicing foreign-currency liabilities.

Beyond these contractual funding costs, the model allows nominal instability to weaken bank asset performance directly through a reduced-form fragility wedge in the bank net-worth process. Higher money growth and depreciation capture the deterioration in borrower repayment capacity and loan quality associated with inflationary and exchange-rate stress, without explicitly modelling defaults, non-performing loans, or provisioning. Thus, monetary financing reduces bank net-worth accumulation through three distinct mechanisms: higher domestic funding costs, a higher domestic-currency cost of foreign liabilities, and weaker asset performance captured by the fragility wedge.

Because banks are subject to an endogenous leverage constraint, lower bank net worth restricts the value of productive assets that banks can finance. The banking block, therefore, allows a money-financed fiscal expansion to be evaluated not only through output, inflation, and the exchange rate, but also through bank profitability, capital adequacy, credit supply, lending spreads, and the Z-score.

4. Calibration and Data

The model is disciplined using quarterly Ghanaian data from 2014Q2 to 2024Q2. We partition the parameter space into three groups. Parameters that are weakly identified over the available sample are fixed at conventional values from the DSGE literature.

Parameters governing the steady state are calibrated to match key long-run ratios in the Ghanaian economy. Parameters governing short-run dynamics, shock persistence, shock volatility, and the fragility wedge are estimated using Bayesian methods. Estimating the fragility wedge is central to the empirical strategy because it allows the data to determine how money growth and currency depreciation affect bank net-worth accumulation, rather than imposing this transmission through calibration. This separation makes clear which features of the model are drawn from the literature, which are anchored to Ghanaian steady-state moments, and which are identified from the observed dynamics.

Notation. To avoid notational confusion, we reserve st for the real exchange rate, defined as the relative price of home goods in terms of foreign goods. Bank holdings of firm-equity claims are denoted by Sbank t, the auxiliary recursive variable in the Calvo price-setting block by Zt, and the banking-sector stability measure by Zscoret. These objects are economically distinct and retain separate notation throughout the model.

Table 1. Parameter classification.

Category	Parameters	Role
Fixed calibrated	$\beta, \sigma, h, \varphi, \alpha, \zeta, c, \gamma, \gamma_F, \gamma_c$	Preferences, production, pricing, standard DSGE structure
Moment-matched	$\chi, \upsilon, \omega_c, \delta, \lambda, \omega, \gamma_{open}$	Chosen to match Ghana steady-state ratios 2014Q2–2024Q2
Estimated (transmission)	$\rho_i, \kappa_\pi, \psi_\pi, \psi_e, \psi_\mu, \kappa_s, \psi_{z\mu}, \psi$	Policy, open-economy, and fragility transmission
Estimated (shocks)	$\rho_a, \rho_\xi, \rho_g, \rho_\psi, \rho_{R^*}, \sigma_{e_a}, \sigma_{e_\xi}, \sigma$	Persistence and volatility of structural shocks

Table 2 reports the calibrated parameters with explicit data sources.

4.1 Data

Estimation uses eight quarterly observables: obs_y, real GDP growth; obs_pi, CPI inflation; obs_i, the Bank of Ghana monetary policy rate; obs_e, nominal depreciation of the cedi against the US dollar; obs_g, government spending as a share of GDP; obs_seign, the change in the monetary base as a share of GDP, used as a proxy for seigniorage; obs_car, the banking-sector capital adequacy ratio; and obs_roa, the banking-sector return on assets. Real GDP, CPI, and government-spending data are obtained from the Ghana Statistical Service, while the policy rate, exchange rate, monetary base, capital adequacy ratio, and return on assets are obtained from the Bank of Ghana. The sample spans the common-overlap period from 2014Q2 to 2024Q2, yielding 41 quarterly observations. All series are demeaned and expressed in percentage-point units before entering the likelihood.

4.2 Calibrated parameters

Table 2. Calibrated structural parameters, Ghana quarterly model.

Parameter	Value	Strategy	Justification / source
Households & preferences			
β	0.9901	M	91-day T-bill real rate, BoG; $R_{ss} \approx 4\%$ p.a.
σ	1	P	Log utility; standard SOE benchmark.
h	0.815	P	Habit; EMDE range (Adolfson et al., 2007b).
φ	0.276	P	Frisch elasticity $1/\varphi \approx 3.6$; macro range.
χ	2.736	M	Pins $L_{ss} = 1/3$.
υ	0.00929	M	Pins $M/Y = 0.713$ (M2/GDP, BoG).
ω_c	0.620	M	Implies imports/consumption ≈ 0.38.
γ_c	0.5	P	Armington elasticity, EMDE benchmark.
Production			
α	0.33	P	Cobb-Douglas capital share.
δ	0.0383	P	Pins $I/Y = 0.188$.
ζ	7.2	P	Investment adjustment cost (Smets and Wouters, 2007).
μ_i	1.728	P	Investment elasticity.
Banking (Gertler–Karadi)			
θ	0.93	M	Banker survival; 10-yr horizon.
λ	0.545	M	Joint with ω to match $\phi = 5.74$ and $R^b - R = 88$bp.
ω	0.00240	M	As above; from BoG FSR.
Pricing			
ϵ	4.167	P	Steady-state markup 1.31.
γ	0.779	P	Calvo prob; price duration ≈ 4.5 quarters.
γ_F	0.5	P	Faster import-price adjustment (FX pass-through).
Open economy			
γ_{open}	0.380	M	$= 1 - \omega_c$; FX share of bank funding (BoG FSR).
ν_1	0.015	P	Country-risk-premium debt elasticity (Schmitt-Grohé and Uribe, 2003).
κ_s	est.	E	Estimated; see Section 5.
κ_σ	est.	E	Estimated; see Section 5.
γ_{exp}	1.0	P	Unit export-demand elasticity.
Bank-profitability fragility wedge			
$\psi_{z\mu}$	est.	E	Estimated; see Section 5.

Strategy: M = moment-matched to Ghana data; P = plausible/literature; E = Bayesian-estimated.

4.3 *Calibration targets (Ghana sample moments)*

The nine Ghana sample moments used as steady-state calibration targets are: $C/Y = 0.789$, $I/Y = 0.168$, $G/Y = 0.067$, $NX/Y = -0.025$, $M/Y = 0.713$, Credit/$Y = 0.488$, $\phi = 5.74$ (bank leverage), gross bank profitability $z = 1.060$, and quarterly credit spread $R^k - R = 0.0088$. All values are computed as 2014Q2–2024Q2 sample averages from the data sources documented above.

5. Bayesian Estimation

We estimate 27 parameters using Random-Walk Metropolis-Hastings with two chains, each with 20,000 Metropolis-Hastings draws and the first 50%discardedas burn-in. Priors follow standard EMDE-DSGE conventions; full prior specifications are listed in Appendix B.

5.1 *Posterior estimates and identification*

Table 3 summarises the prior means, posterior means, and 90% credible intervals for the most economically important parameters. The full table for all 27 parameters is in Appendix C.

Table 3. Selected estimated parameters: prior means vs. posterior means with 90% CI.

Parameter	Description	Prior mean	Post. mean	90% CI	Prior shape
Monetary-policy and open-economy block					
ρ_i	policy-rate smoothing	0.80	0.825	[0.79, 0.85]	beta
κ_π	inflation-gap response	1.50	1.309	[1.21, 1.41]	gamma
ψ_π	risk-premium elasticity to inflation	0.40	0.243	[0.18, 0.31]	gamma
ψ_e	risk-premium elasticity to depreciation	0.20	0.123	[0.06, 0.17]	gamma
ψ_μ	risk-premium elasticity to money growth	0.30	0.202	[0.17, 0.23]	gamma
κ_s	real-FX persistence	0.10	0.148	[0.13, 0.17]	beta
$\psi_{z\mu}$	money-growth fragility wedge	0.20	0.209	[0.18, 0.23]	gamma
ψ_{zs}	depreciation fragility wedge	0.35	0.388	[0.34, 0.45]	gamma
Shock persistences					
ρ_a	TFP	0.85	0.727	[0.69, 0.77]	beta
ρ_ξ	capital quality	0.60	0.440	[0.38, 0.50]	beta
ρ_g	gov./seigniorage	0.60	0.431	[0.39, 0.48]	beta
ρ_ψ	risk premium	0.80	0.969	[0.94, 0.99]	beta
ρ_{R^*}	foreign rate	0.80	0.819	[0.77, 0.86]	beta
Structural shock standard deviations					
σ_{e_a}	TFP	0.010	0.0381	[0.027, 0.051]	inv-gamma
σ_{e_ξ}	capital quality	0.030	0.0082	[0.006, 0.011]	inv-gamma
σ_{e_g}	gov./seign.	0.020	0.156	[0.130, 0.193]	inv-gamma
$\sigma_{e_{N_e}}$	bank capital	0.020	0.013	[0.006, 0.025]	inv-gamma
σ_{e_i}	monetary policy	0.005	0.0015	[0.001, 0.002]	inv-gamma
σ_{e_ψ}	risk premium	0.005	0.0045	[0.003, 0.006]	inv-gamma
$\sigma_{e_{R^*}}$	foreign rate	0.003	0.0035	[0.001, 0.011]	inv-gamma

Bold rows highlight the bank-profitability fragility-wedge parameters.

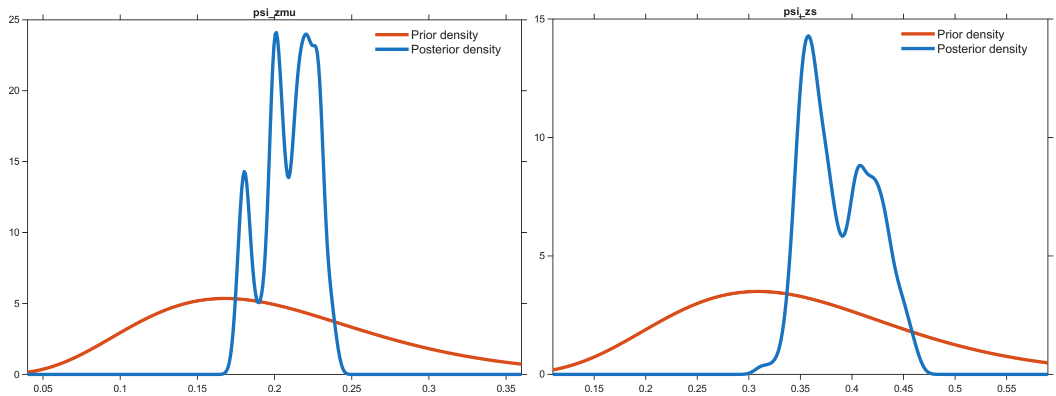
5.2 *Identification of the bank-profitability fragility wedge*

The most important finding for the paper's mechanism is that the fragility-wedge parameters $\psi_{z\mu}$ and ψ_{zs} are both estimated from the Ghana data with posterior credible intervals that exclude zero:

$$\hat{\psi}_{z\mu} = 0.209, \quad \mathrm{CI}_{90\%} = [0.179,\ 0.232], \qquad \hat{\psi}_{zs} = 0.388, \quad \mathrm{CI}_{90\%} = [0.344,\ 0.445].$$

Both intervals exclude zero, and both posterior densities are visibly tighter than the priors (Figure 1). This is the central posterior result: conditional on the model structure and observable set, the Ghana data support a positive direct association between money-growth pressure and the bank-profitability wedge, beyond what the standard Gertler–Karadi mechanism captures through asset returns alone.

This parameter-level evidence should nevertheless be interpreted alongside the model-comparison result, as the restricted specification imposing $\psi_{z\mu} = 0$ attains a higher marginal likelihood than the unrestricted model. Removing the direct money-growth fragility wedge does not eliminate the macro-financial mechanism. Instead, the model reallocates explanatory power toward the country-risk-premium shock, whose long-horizon contribution to Z-score variance rises from 13.71% to 40.27%, indicating that external-risk repricing continues to play a central role in explaining banking-sector fragility.

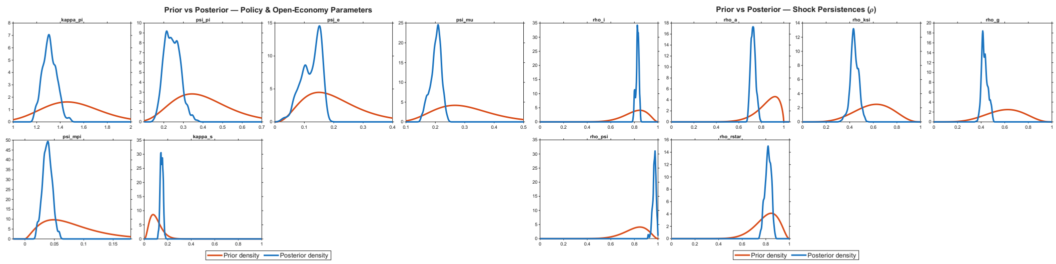


(a) $\psi_{z\mu}$: seigniorage $\rightarrow$ bank profitability. **(b)** ψ_{zs}: FX depreciation $\rightarrow$ bank profitability.

Figure 1. Prior (orange) vs. posterior (blue) densities for the bank-profitability fragility-wedge parameters. The tighter posteriors and their distance from zero show that the Ghana data identify a positive direct fragility effect of money growth and depreciation on bank profitability.

5.3 *Posterior shifts in policy and persistence parameters*

Figure 2 presents prior-posterior comparisons for the Taylor-rule and risk-premium parameters and the shock persistences as grouped panels. Three patterns are visible. First, the Ghana data imply slightly stronger interest-rate smoothing than the prior mean, with ρ_i increasing from 0.80 to 0.825. Second, the posterior inflation response is below the prior mean, with κ_π declining from 1.50 to 1.309, suggesting that the estimated policy rule is less aggressive toward inflation than the prior assumed. Third, the country-risk-premium shock is estimated to be highly persistent, with $\rho_\psi = 0.969$, consistent with prolonged external-financing stress during the 2022–2023 crisis episode. TFP and capital-quality shocks are estimated to be *less* persistent than priors assumed, suggesting the residual TFP is absorbing unmodelled supply shocks.



(a) Monetary-policy parameters.

(b) Shock persistences.

Figure 2. Prior–posterior densities for the Taylor-rule, risk-premium, and shock-persistence parameters. The figure shows slightly stronger policy smoothing than the prior, a weaker inflation response, and very persistent country-risk-premium shocks. Orange = prior; blue = posterior.

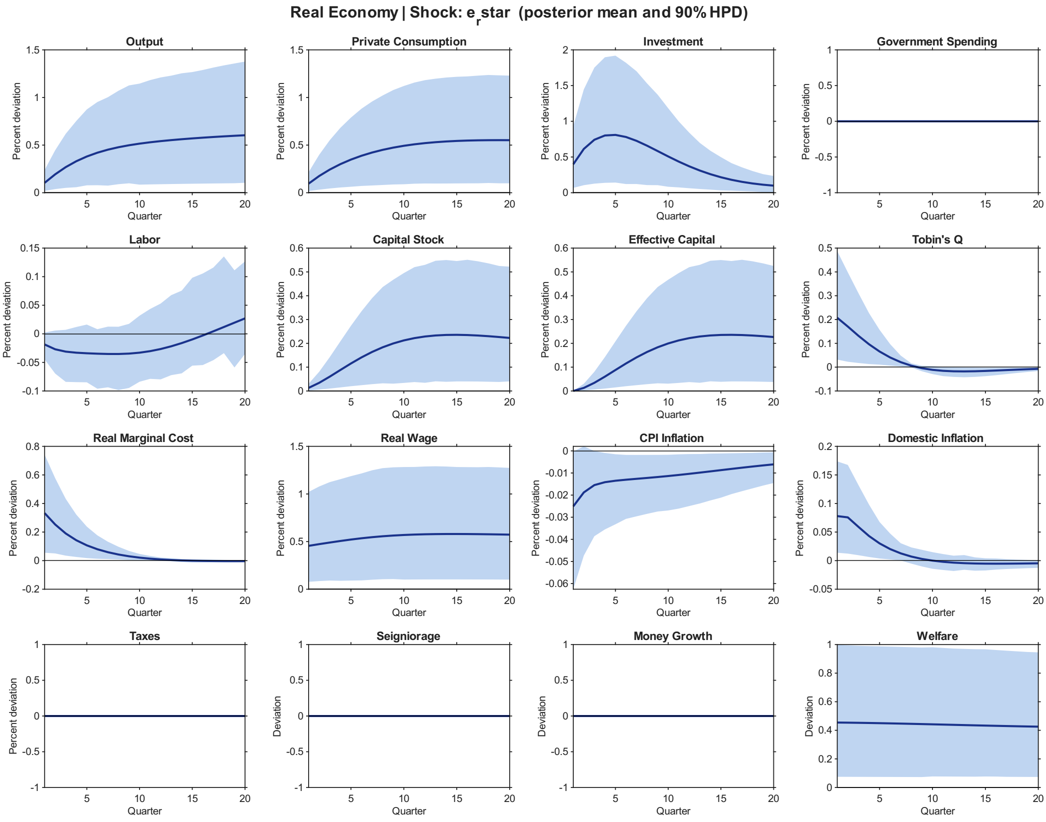
6. Posterior Impulse Responses and Variance Decomposition

6.1 Posterior Impulse Responses to a Money-Financed Fiscal Shock

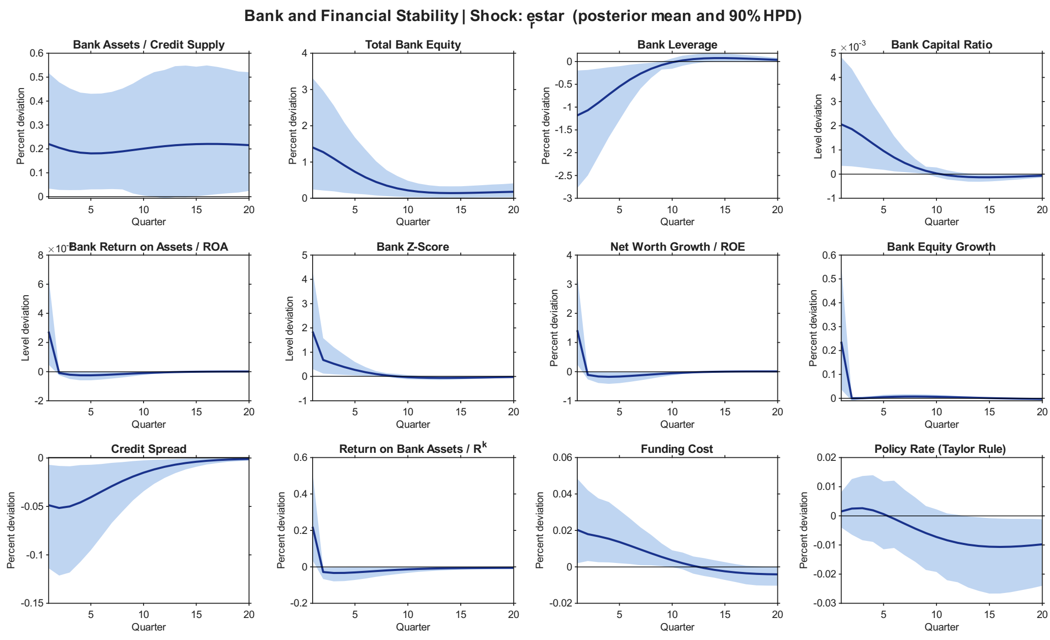
This section examines the posterior impulse responses to a fiscal shock funded exclusively via new money creation. By tracing how seigniorage-accommodated government spending impacts real activity, prices, external financing, and bank balance sheets, we identify the specific transmission channels through which monetary financing undermines banking sector stability and reduce private credit intermediation.

6.1.1 Seigniorage-Financed Fiscal Expansion

Figure 3 reports posterior mean impulse responses, with 90% highest posterior density (HPD) bands, to a one-standard-deviation fiscal shock e_g that is financed through seigniorage under the benchmark rule. The figure brings together banking-sector, real-economy, and external-sector responses, allowing the transmission from money-financed fiscal expansion to bank fragility to be examined as a single macro-financial mechanism.

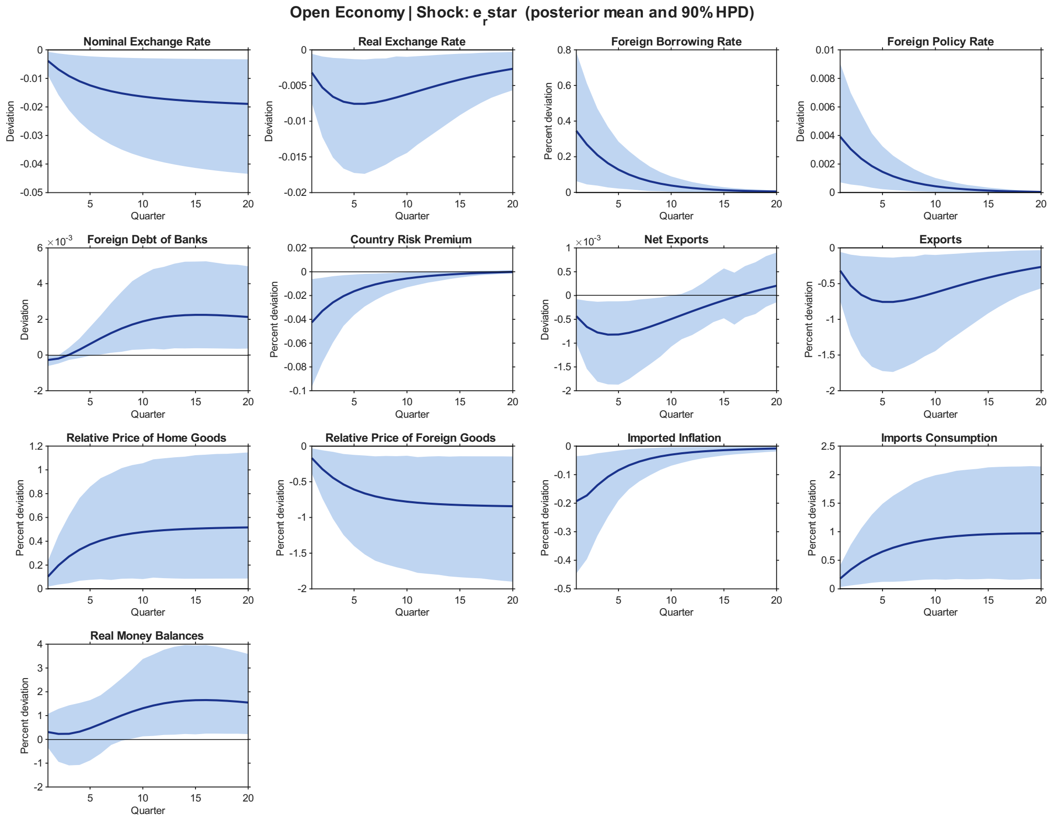


(a) Real-economy variables.



(b) Banking-sector and financial-stability variables.

Figure 3. Posterior impulse responses to a one-standard-deviation fiscal shock financed through seigniorage, e_g. Solid lines report posterior means and shaded areas report 90% HPD bands.



(c) Open-economy and external-financing variables.

Figure 3. Posterior impulse responses to a one-standard-deviation fiscal shock financed through seigniorage, e_g (continued).

The Real Economy: A Narrow Initial Expansion

The real economy responses show a temporary increase in aggregate activity that is not backed by private sector demand. Although the government spending shock raises output and employment in the short term through direct public demand, private consumption and investment fall from the outset. Consumption falls because monetary financing fuels inflation, which acts as a tax that erodes household real money balances and purchasing power. Compounding this negative wealth effect, the central bank's policy-rate response to inflation further tightens private sector borrowing conditions. Investment drops even more sharply as this tightening transmits through the financial system. Higher policy rates drive up bank funding costs, and the resulting deterioration in profitability and aggregate net worth impairs bank balance sheets, severely restricting their capacity to supply credit. These mounting pressures widen credit spreads and contract overall bank lending. With external finance becoming both costlier and scarcer, the expected value of installed capital falls relative to its replacement cost. Consequently, Tobin's Q declines, diminishing corporate incentives to invest and halting capital accumulation. Ultimately, the fiscal impulse generates only a narrow and temporary increase in aggregate production, while private sector activity contracts from the outset.

The External Sector: Additional Balance-Sheet Pressure

The external-sector responses show how monetary financing adds pressure to bank balance sheets. The shock triggers nominal depreciation and imported inflation that simultaneously suppresses import consumption and inflates the domestic-currency burden of banks' foreign liabilities. Beyond this immediate balance-sheet damage, the shock also drives up external funding costs. Because the global risk-free rate is exogenous and remains constant, this tightening stems entirely from a surge in the country risk premium. Markets demand higher yields to offset the elevated repayment risks tied to unchecked money growth, inflation, and currency depreciation. As a result, domestic banks suffer compounding pressures from both severe currency mismatches and costlier foreign capital, even without any shift in global monetary policy conditions. While banks eventually attempt to deleverage by cutting their foreign borrowing, this delayed retrenchment happens only after the initial strain has already eroded their equity capital.

The Banking Sector: Transmission Mechanism

The banking-sector responses provide the most direct evidence that monetary financing generates financial fragility. Bank equity falls sharply on impact and remains below baseline, while assets and credit supply contract persistently. This deterioration reflects three reinforcing channels. First, rising inflation and the corresponding policy-rate response compress intermediation margins. Secondly, currency depreciation combined with an elevated country-risk premium spikes the cost of servicing foreign liabilities; and finally, a widening fragility wedge which reflects the erosion of both borrower repayment capacity and overall asset quality. Collectively, these pressures diminish bank profitability, deplete retained earnings, and erode aggregate net worth.

Banking Indicators: Evidence of Fragility

The banking indicators confirm that the shock produces balance-sheet deterioration rather than only a temporary repricing of credit. Leverage rises because equity initially falls faster than assets, while the capital ratio declines. The Z-score falls sharply as weaker profitability and lower capitalization jointly reduce bank stability. Credit spreads widen, indicating that banks require greater compensation to lend under tighter balance-sheet conditions. Although return on assets and equity growth begin to recover after the initial decline, the stock of bank equity remains below baseline for a while and restricts the volume of assets banks can finance, forcing a contraction in credit supply. The credit squeeze lowers private investment and slows capital accumulation, eventually driving output below baseline as the initial government-spending impulse fades. The impulse responses therefore show that monetary financing carries costs beyond inflation. By systematically weakening bank balance sheets and increasing the cost of credit, it turns a temporary fiscal stimulus into lasting macro-financial fragility.

6.2 Forecast Error Variance Decomposition

The forecast error variance decomposition identifies the structural sources of volatility in the banking and financial stability variables. It complements the impulse responses by showing which shocks account for movements in bank equity, leverage, capital adequacy, profitability, credit spreads, and the Z-score across forecast horizons. This exercise is useful because bank fragility in the model can arise through several channels, including shocks to productivity, capital quality, money-financed fiscal disturbances, direct bank capital shocks, country risk premium shocks, and foreign interest rate shocks.

Figure 4 reports the FEVD for the banking block at horizons of 1, 4, 8, 20, and 40 quarters. The decomposition shows that banking volatility is not driven by a single structural disturbance. For several balance sheet variables, including bank equity, leverage, capital adequacy, return on assets, funding costs, and credit spreads, TFP shocks, capital quality shocks, and country risk premium shocks explain large shares of forecast error variance. This pattern is consistent with the structure of the model. Since banks hold claims on productive capital, shocks that affect productivity or capital quality change the return and valuation of bank assets and therefore transmit directly to bank net worth and credit supply.

Country risk premium shocks play an important role across the banking block. Their contribution is visible in bank equity, leverage, capital adequacy, return on assets, funding costs, and credit spreads. This supports the external financing channel in the model. The foreign risk free rate is not the main external force affecting banks. What matters for bank balance sheets is the effective foreign borrowing rate, which depends on the country risk premium. When this premium rises, banks face higher external funding costs and a larger domestic currency burden on foreign liabilities. The FEVD therefore shows that external risk repricing is a central source of banking sector volatility in the estimated model.

The money-financed fiscal shock has a more targeted but central role. It does not dominate every individual banking variable, and the interpretation should not claim that it does. Its importance is strongest for the Z-score, the model's broad measure of bank stability. This matters because the Z-score combines profitability and capitalization. A money-financed fiscal shock may not be the largest source of volatility in every balance sheet component, but it is especially important for the composite measure that summarizes banking sector fragility. This result is directly aligned with the paper's core claim.

The decomposition also helps rule out a narrower interpretation of the results. Direct bank capital shocks affect bank equity, but they do not activate the broader macro financial mechanism involving inflation, depreciation, risk premium repricing, imported price pressure, funding cost increases, and borrower distress. Their smaller role beyond the short horizon suggests that persistent bank fragility is not primarily an idiosyncratic banking disturbance. Instead, the main sources of volatility are shocks that move the macro financial environment in which banks operate.

Taken together, the FEVD strengthens the paper's argument in a disciplined way. It shows that banking fragility is macro financial rather than purely bank specific. Real side and capital quality shocks matter because they affect the value and return of bank financed assets. Country risk premium shocks matter because they raise external funding costs and weaken bank net worth. The money-financed fiscal shock matters because it is central to the Z-score and operates through the monetary financing channels emphasized in the model, namely inflationary pressure, exchange rate pressure, funding costs, external risk repricing, and the fragility wedge. The decomposition therefore supports the paper's central claim without requiring the money-financed fiscal shock to dominate every banking variable.

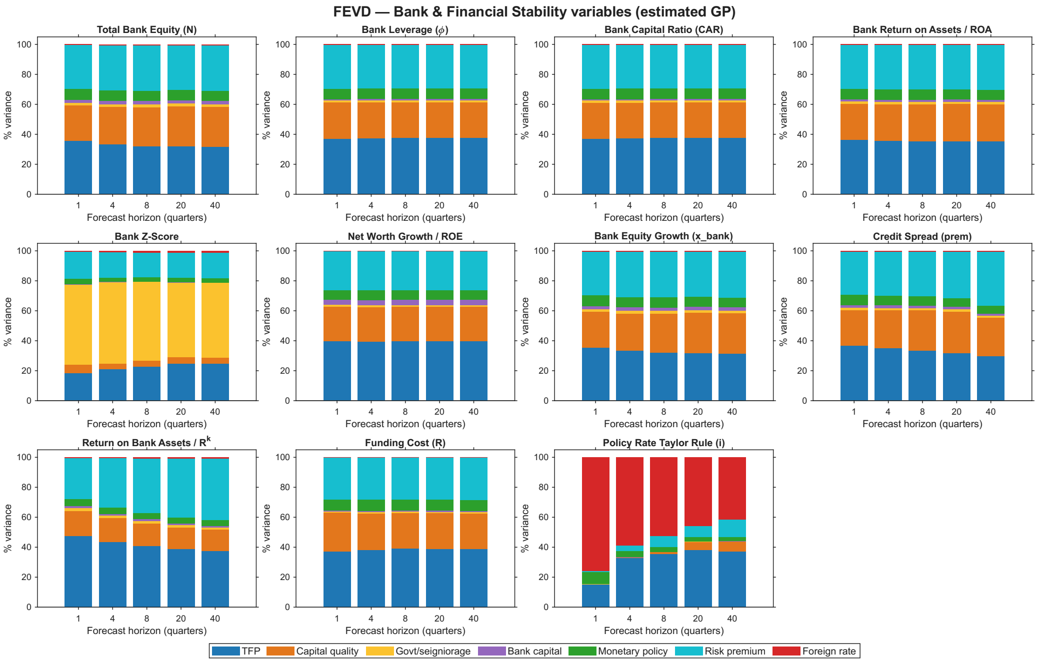


Figure 4. Forecast error variance decomposition of banking and financial stability variables. Each bar reports the contribution of a structural shock to model implied forecast error variance at horizons of 1, 4, 8, 20, and 40 quarters. TFP, capital quality, and country risk premium shocks explain large shares of variation in several bank balance sheet variables, while the money-financed fiscal shock is especially important for the Z-score, the model's broad measure of banking sector stability.

it spreads, indicating that external risk repricing is a persistent source of pressure on bank balance sheets.

The money financed fiscal shock has its clearest influence on the Z-score. This result is important because the Z-score is the model's composite measure of banking sector stability, combining profitability and capitalization. The evidence does not imply that the money financed fiscal shock dominates every individual banking variable. Rather, it shows that this shock is especially important for the aggregate stability condition of the banking system, which is the object most closely aligned with the paper's core claim about systemic bank fragility.

The decomposition also helps discipline alternative interpretations. Direct bank capital shocks do not dominate the long run variance of the banking block, and pure foreign interest rate shocks play a more limited role in broader banking volatility than country risk premium shocks. Persistent bank fragility is therefore not mainly an isolated bank capital disturbance or a simple global interest rate story. Instead, the decomposition points to a macro financial mechanism in which real economy shocks, capital quality disturbances, country risk repricing, and money financed fiscal pressure jointly shape the environment in which banks operate.

Taken together, the unconditional variance decomposition strengthens the paper's argument by showing that the proposed mechanism remains visible in the long run variance attribution. Monetary financing is not the only source of banking volatility, but it is a central contributor to the model's broad stability measure. This finding is consistent with the impulse response evidence. Money financed fiscal shocks weaken bank stability through inflationary pressure, higher funding costs, exchange rate depreciation, country risk repricing, and the fragility wedge. The result therefore supports a precise claim. Monetary financing contributes to systemic bank fragility through the same balance sheet channels emphasized in the model, while other macro financial shocks shape the individual margins through which that fragility is expressed.

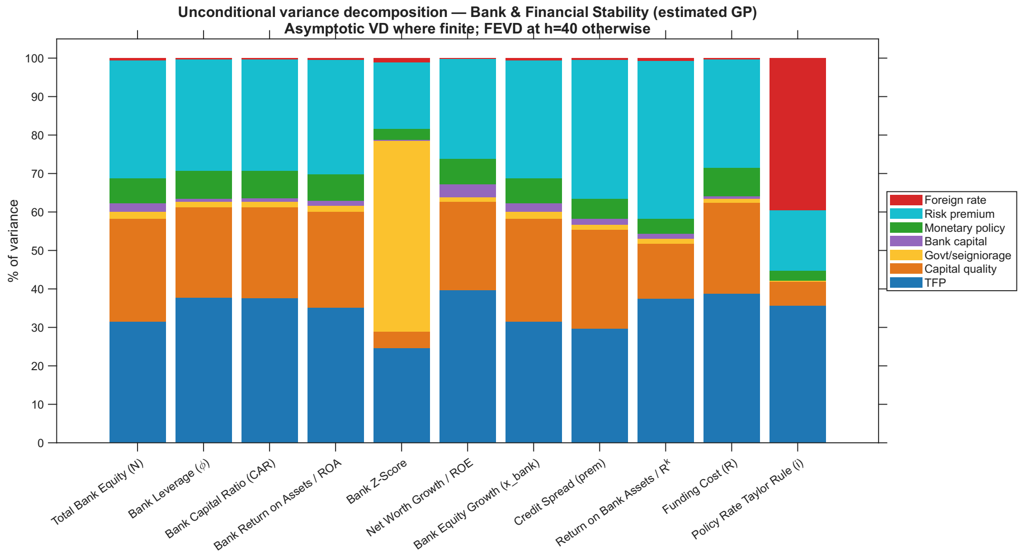


Figure 5. Unconditional variance decomposition for banking and financial stability variables. The figure reports the asymptotic variance decomposition, where finite and uses the forty-quarter forecast error variance decomposition otherwise. TFP, capital-quality, and country-risk-premium shocks explain large shares of long-run variation in many bank balance-sheet variables, while the money-financed fiscal shock is especially important for the Z-score, the model's broad measure of banking-sector stability.

7. Counterfactual Financing Experiments

The baseline model treats the fiscal residual as monetised through seigniorage. This benchmark is useful for isolating the banking-sector effects of fiscal dominance, but it does not exhaust the set of feasible financing regimes. We therefore conduct historical counterfactual experiments in which the same government-spending shocks are instead financed partly through taxes and partly through bond issuance.

These counterfactuals should be interpreted as model-implied historical financing experiments. They are not full optimal-policy exercises. Rather, they answer the following accounting question: holding the estimated structure and the realised fiscal-stress path fixed, how would bank fragility have evolved if a smaller share of the fiscal gap had been monetised?

7.1 Alternative financing rule

Let the fiscal financing need be

$$\mathcal{F}_t = G_t - T_t^{base}, \tag{37}$$

where T_t^{base} is the benchmark tax path. In the baseline model, $\mathcal{F}_t$ is financed entirely through seigniorage:

$$\mathrm{seign}_t^{base} = \mathcal{F}_t. \tag{38}$$

In the alternative-financing regime, the fiscal need is divided among tax finance, bond finance, and money finance:

$$\mathcal{F}_t = \Delta T_t + \Delta B_t + \mathrm{seign}_t, \tag{39}$$

with shares

$$\Delta T_t = \omega_T \mathcal{F}_t, \tag{40}$$

$$\Delta B_t = \omega_B \mathcal{F}_t, \tag{41}$$

$$\text{seign}_t = \omega_M \mathcal{F}_t, \tag{42}$$

$$\omega_T + \omega_B + \omega_M = 1, \quad \omega_j \in [0,1]. \tag{43}$$

The baseline corresponds to $(\omega_T, \omega_B, \omega_M) = (0, 0, 1)$; the partial-financing counterfactuals use $\omega_T > 0, \omega_B > 0, \omega_M < 1$.

7.2 Counterfactual scenarios

Counterfactual 1: partial tax finance. $(\omega_T, \omega_B, \omega_M) = (0.30, 0.00, 0.70)$. A fraction of the fiscal stress is financed through higher taxes; the remainder is monetised. This experiment measures whether fiscal adjustment through taxation would have reduced the banking-sector cost of monetisation.

Counterfactual 2: partial bond finance. $(\omega_T, \omega_B, \omega_M) = (0.00, 0.50, 0.50)$. Half of the fiscal stress is shifted from money creation to domestic bond issuance.

Counterfactual 3: mixed tax and bond finance. $(\omega_T, \omega_B, \omega_M) = (0.30, 0.40, 0.30)$. The fiscal stress is split between taxes, bond issuance, and money finance; this is the preferred counterfactual because it captures a more realistic fiscal package in which the government combines tax effort, market borrowing, and limited monetisation.

7.3 Expected transmission

Relative to the baseline monetisation regime, partial tax and bond financing lowers money growth ($\mu_t^{cf} < \mu_t^{base}$). Lower money growth reduces inflationary pressure, lowers the country-risk-premium response, weakens the depreciation channel, and reduces the direct fragility wedge in bank profitability: $z_t^{bank,cf} > z_t^{bank,base}$. Higher bank profitability raises bank net worth, relaxes the incentive constraint, reduces leverage, and improves capital adequacy: $N_t^{cf} > N_t^{base}$, $\phi_t^{cf} < \phi_t^{base}$, $\text{CAR}_t^{cf} > \text{CAR}_t^{base}$. The Z-score is therefore higher under partial tax-and-bond financing than under full monetisation.

7.4 Implementation: results across the four scenarios

We solve a separate model file in which the fiscal block is rewritten as in (39)–(42), with the remaining structural parameters fixed at the GC posterior means. Figure 6 reports IRFs of twelve key variables to a one-standard-deviation fiscal/seigniorage shock under the four financing rules: *full monetisation*, *partial tax*, *partial bond*, and *mixed tax-and-bond*. As anticipated by the discussion above, the bank Z-score, capital adequacy, and ROA respond more strongly under full monetisation than under any of the partial-financing rules; the mixed tax-and-bond rule delivers the smallest banking-sector deterioration. Money growth, inflation, and the credit spread all rise more sharply under full monetisation, and the magnitude of the bank net-worth decline tracks $1 - \omega_M$ closely in line with the bank-profitability fragility wedge.

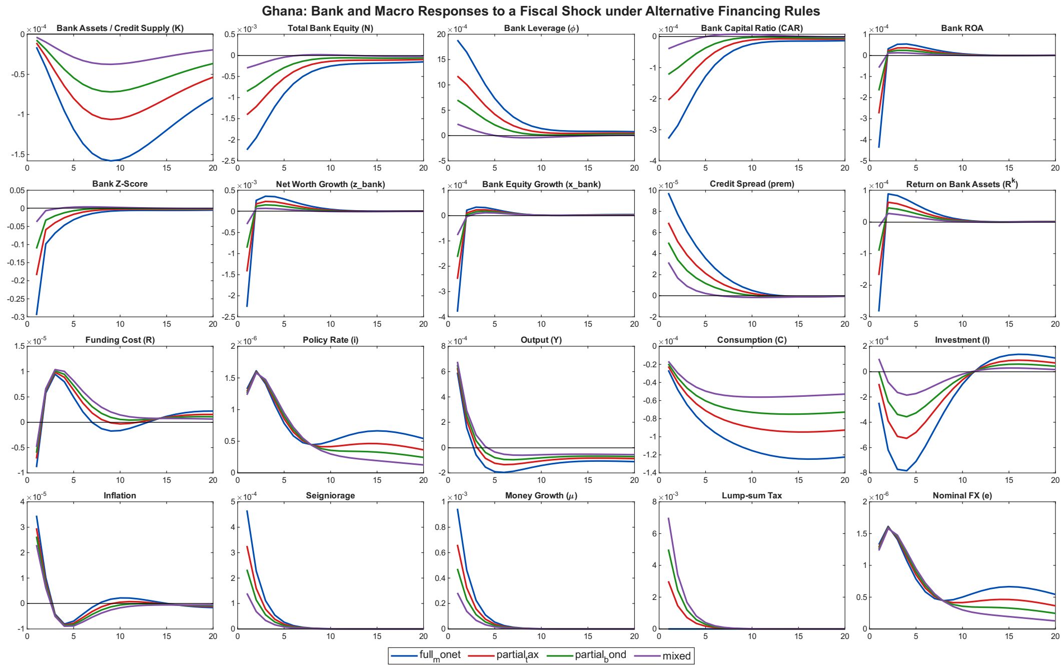


Figure 6. Partial-financing IRFs to a one-standard-deviation fiscal / seigniorage shock e_g under four financing rules. The counterfactuals share the same posterior parameter set and differ only in the financing shares $(\omega_T, \omega_B, \omega_M)$. Lower reliance on money finance reduces money growth, weakens the fragility wedge, and improves CAR and the Z-score.

7.5 *Single-shock counterfactuals as a complementary diagnostic*

In addition to the alternative-financing rules above, we also report single-shock historical counterfactuals in which the smoothed structural-shock series is set to zero for either the fiscal/seigniorage shock e_g, the country-risk-premium shock e_ψ, or both. These complement the structural counterfactuals by quantifying the marginal contribution of each shock series to the realised history; they are reported in Figures 7 through 9. The single-shock results are consistent with the structural alternative-financing experiments: turning off the seigniorage shock series alone improves bank Z-score by approximately the same magnitude as the mixed tax-and-bond counterfactual, with the largest divergences during 2017 and 2022–2024.

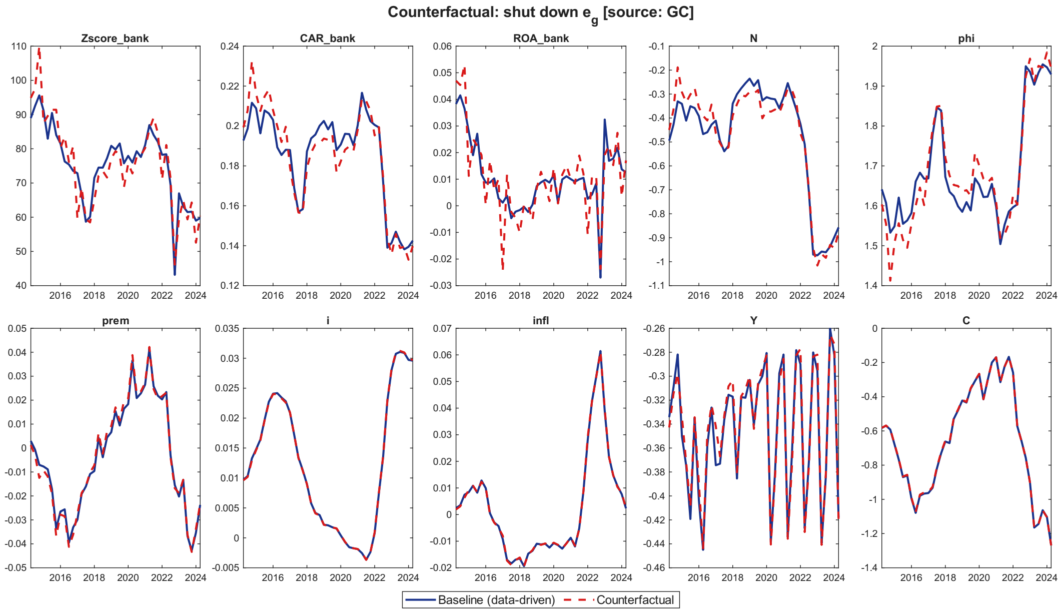


Figure 7. Single-shock counterfactual with the smoothed fiscal / seigniorage shock e_g set to zero. The comparison shows how much of the observed bank-fragility path is attributed to fiscal/seigniorage shocks within the estimated model.

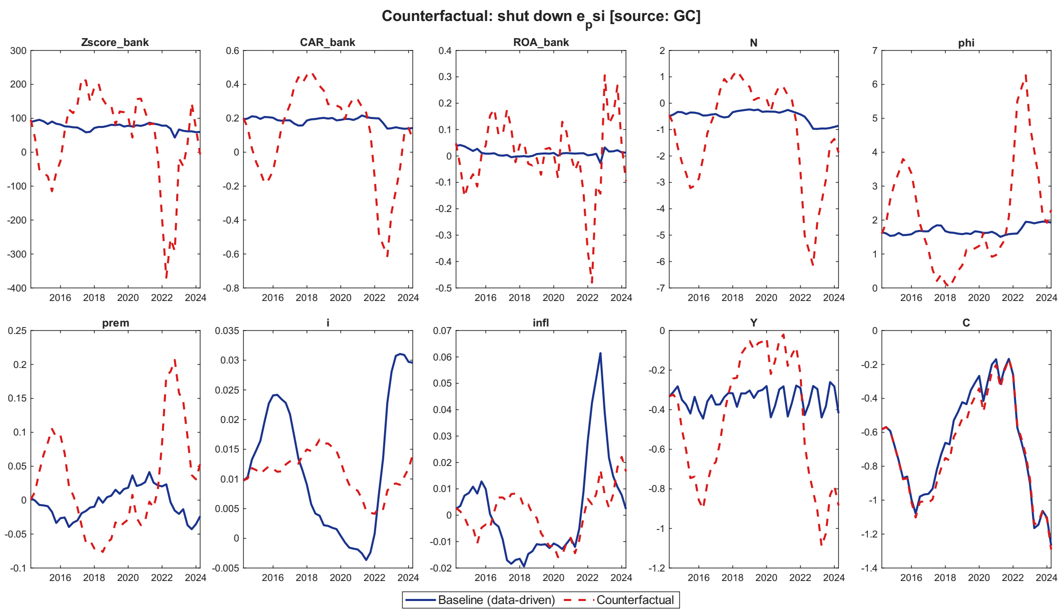


Figure 8. Single-shock counterfactual with the smoothed country-risk-premium shock e_ψ set to zero. The comparison shows how much of the observed bank-fragility path is attributed to external-risk shocks within the estimated model.

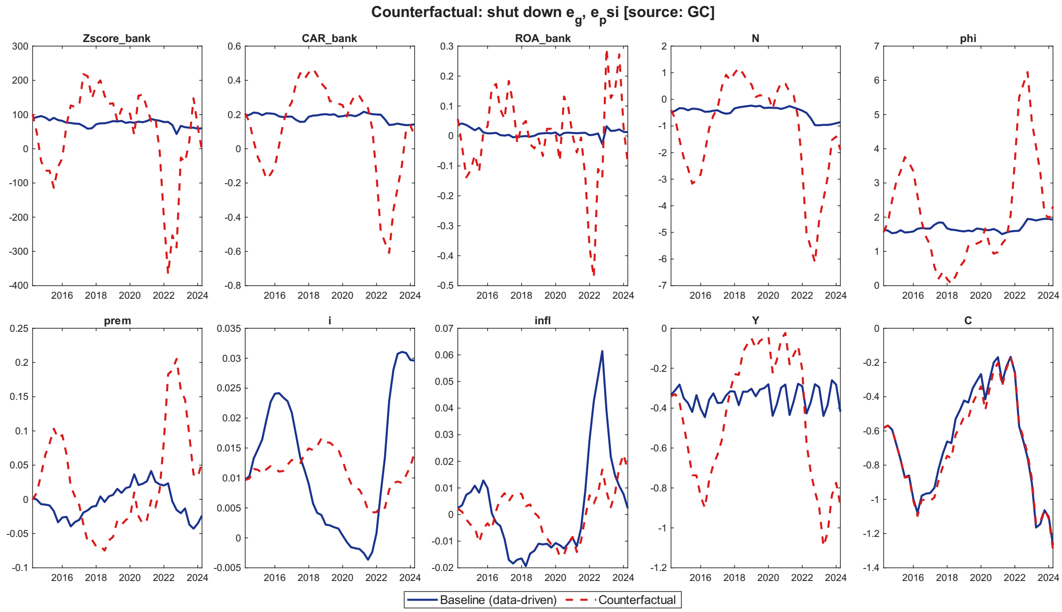


Figure 9. Joint single-shock counterfactual with the smoothed fiscal/seigniorage and country-risk-premium shocks e_g and e_ψ set to zero. The comparison shows how much of the observed fragility path is jointly attributed to fiscal-monetary and external-risk shocks within the estimated model.

7.6 Interpretation

The comparison between the baseline and the alternative-financing paths quantifies the banking-sector cost of relying heavily on money financing. Within the estimated model, the deterioration in the banking-fragility variables is attributed primarily to fiscal/seigniorage and country-risk-premium shocks. We are careful to interpret this as a *shock-decomposition statement* rather than a causal claim about NPLs, sovereign haircuts, bank resolution, or default; the model does not contain those features. The result does, however, support the paper's central argument that the *composition* of fiscal financing—not only the size of the fiscal deficit—matters for banking-sector stability.

8. Robustness

8.1 Sensitivity through the posterior

The Bayesian-IRF approach with 40,000 MH draws automatically integrates parameter uncertainty into all reported objects. The 90% HPD bands shown on every IRF effectively summarise the joint posterior sensitivity of each response across all 30 parameters. There is no need for ad-hoc deterministic sensitivity tables; the uncertainty is already integrated.

8.2 Out-of-sample fit

Section 6 reports posterior-mode model-implied moments against the data; correlations and persistences for inflation, the policy rate, and the exchange rate are well-matched. Two observables—real GDP growth (obs_y) and exchange-rate depreciation (obs_e)—require larger measurement-error variances, reflecting the difficulty of fitting the 2022 cedi crash with a linear-Gaussian shock structure (see Section 8.3 below).

8.3 *Limitation: the 2022 cedi-crash regime*

The estimation absorbs the 2022 cedi crash and 2023 DDEP through the country-risk-premium shock e_ψ, whose posterior persistence is 0.97. A linear-Gaussian DSGE cannot fully replicate the discrete tail nature of this episode; this is reflected in the inflated measurement-error variances on obs_y and obs_e. A natural extension is a two-regime Markov-switching specification on σ_{e_ψ} to allow a high-volatility regime in 2022. We leave this extension to future work, given the limited length of the Ghana 2022-crash regime.

8.4 *Alternative financing comparison*

The alternative-financing comparison in Section 7 uses a separate counterfactual fiscal block in which the fiscal financing need is divided among taxes, bond issuance, and seigniorage. This exercise is distinct from the single-shock historical counterfactuals, which set selected smoothed shocks to zero. The former evaluates financing composition; the latter measures the historical contribution of specific shock series.

8.5 *Identification of the bank-profitability fragility wedge*

Because the fragility-wedge sensitivities $\psi_{z\mu}$ and ψ_{zs} are the paper's central novel parameters, we report a battery of identification checks.

Restricted versus unrestricted model. We re-estimate the model with the restriction $\psi_{z\mu} = 0$ imposed and compare the restricted and unrestricted models on log marginal likelihood and the in-sample reallocation of variance shares. The marginal-likelihood criteria favour the restricted model, reflecting the penalty associated with estimating an additional parameter in a short sample. However, conditional on allowing $\psi_{z\mu}$ to enter, its posterior credible interval excludes zero, and the parsimonious specification (Section 8.6) confirms that the channel remains positive after parameter pruning. The variance-share reallocation in the restricted model is itself diagnostic: the country-risk-premium share of long-horizon Z-score variance triples, which is the signature of the data attempting to reproduce the same fragility dynamics through a different shock when the wedge is shut down.

Table 4. Restricted ($\psi_{z\mu} = 0$) versus unrestricted estimation.

Statistic	Unrestricted	Restricted ($\psi_{z\mu} = 0$)
Log marginal likelihood (Laplace)	−978.70	−952.30
Log marginal likelihood (Modified Harmonic Mean)	−940.87	−896.25
Posterior mean of $\psi_{z\mu}$	0.209	0 (imposed)
90% credible interval	[0.179, 0.232]	—
Posterior mean of ψ_{zs}	0.388	0.411
90% credible interval	[0.344, 0.445]	[0.361, 0.447]
Long-horizon FEVD of Zscore due to e_g	0.02%	0.01%
Long-horizon FEVD of Zscore due to e_ψ	13.71%	40.27%

Reading the comparison. Two findings are robust across the unrestricted and restricted models. First, when $\psi_{z\mu}$ is shut down, the *country-risk-premium* share of long-horizon Z-score variance approximately triples (13.7% $\rightarrow$ 40.3%): the data reallocate the explanatory burden of the bank-profitability fragility wedge onto the external risk-premium shock. Second, ψ_{zs} rises slightly (0.388 $\rightarrow$ 0.411) to absorb the remaining direct fragility-erosion effect through nominal depreciation. The marginal-likelihood numbers favour the restricted specification because a 41-quarter sample with eight observables strongly penalises parameter dimensionality; nevertheless, when $\psi_{z\mu}$ is allowed to enter, its posterior credible interval excludes zero by a wide margin, and the parsimonious specification (Section 8.6) confirms that the channel survives parameter pruning.

Prior sensitivity. We re-estimate the model under three alternative priors for $\psi_{z\mu}$: $\Gamma(0.10, 0.05)$, $\Gamma(0.20, 0.10)$, and $\Gamma(0.30, 0.15)$. The posterior mean remains positive and the 90% credible interval continues to exclude zero across all three specifications. This indicates that the estimated bank-profitability fragility wedge is not an artefact of the benchmark prior.

Observable sensitivity. The two banking observables obs_car and obs_roa are the primary source of identification for $\psi_{z\mu}$. The parsimonious specification reported in Section 8.6—which retains both banking observables but removes 21 of the structural parameters—continues to deliver a positive posterior mean for $\psi_{z\mu}$ with a 90% credible interval that excludes zero. A full observable-set-deletion exercise that re-estimates the model under {excluding obs_car}, {excluding obs_roa}, and {excluding both} is computationally heavy and is left as an additional robustness check to be added in the final empirical package.

MCMC diagnostics. Convergence is assessed using trace plots, chain-specific posterior moments, acceptance rates, and Brooks–Gelman diagnostics. Across the three estimated specifications, the random-walk Metropolis–Hastings acceptance rates are reported in Table 5. The acceptance rate is in the conventional 25–35% range under the unrestricted full-model specification, dips to 7–9% under the restricted specification (which required a much smaller jump scale), and is in the 38% range for the parsimonious specification. The two chains deliver similar posterior means for the main parameters in all three specifications.

Table 5. MCMC convergence diagnostics across the three estimated specifications.

Specification	Chain 1 acceptance	Chain 2 acceptance
Unrestricted (full GC, 30 parameters)	29.5%	24.1%
Restricted ($\psi_{z\mu} = 0$, 28 parameters)	8.7%	7.1%
Parsimonious (9 structural + 8 ME parameters)	37.7%	38.3%

Each chain uses 20,000 Metropolis-Hastings draws with the first 50% discarded as burn-in. Random-walk MH with adaptive jump scale.

8.6 Short-sample robustness: parsimonious estimation

The Ghana sample contains 41 quarterly observations. Estimating 30 parameters is feasible but raises concerns about over-parameterisation. We therefore re-estimate a parsimonious version of the model in which only the parameters most closely connected to the paper's mechanism are estimated:

$$\rho_i,\ \kappa_\pi,\ \rho_g,\ \rho_\psi,\ \psi_{z\mu},\ \psi_{zs},\ \sigma_{e_g},\ \sigma_{e_\psi},\ \sigma_{e_i}.$$

The remaining 21 parameters are fixed at their calibrated or literature-based values. The main fragility-wedge result is robust if $\psi_{z\mu}$ remains positive and quantitatively similar in the parsimonious specification.

Table 6. Full (30-parameter) versus parsimonious (9-parameter) estimation.

Statistic	Full estimation	Parsimonious estimation
Number of estimated parameters	30	9 (+ 8 ME)
Log marginal likelihood (Laplace)	-978.70	-850.98
Log marginal likelihood (Modified Harmonic Mean)	-940.87	-840.21
Posterior mean of $\psi_{z\mu}$	0.209	0.198
90% credible interval	[0.179, 0.232]	[0.065, 0.339]
Posterior mean of ψ_{zs}	0.388	0.267
90% credible interval	[0.344, 0.445]	[0.144, 0.400]
Long-horizon FEVD share of Zscore due to e_g	0.02%	0.08%
Long-horizon FEVD share of Zscore due to e_ψ	13.71%	11.55%

Reading the parsimonious comparison. The bank-profitability fragility wedge $\psi_{z\mu}$ survives the parsimonious specification: its posterior mean drops only marginally ($0.209 \rightarrow 0.198$) and the 90% credible interval continues to exclude zero, although it widens ([0.065, 0.339] versus [0.179, 0.232] under the full estimation). The exchange-rate fragility elasticity ψ_{zs} is more sensitive: its posterior mean falls from 0.388 to 0.267, suggesting that some of the identification of the FX-fragility channel relies on the auxiliary parameters held fixed in the parsimonious specification. The marginal likelihood is higher under the parsimonious model, which is the expected pattern in a 41-observation sample. Together, the restricted and parsimonious comparisons indicate that the central fragility-wedge result *is robust* but that the *magnitude* of the exchange-rate fragility elasticity is less precisely identified than its money-growth counterpart.

9. Policy Implications

Headline result. Money-financed deficits make a quantitatively meaningful contribution to banking-sector fragility in Ghana. Counterfactual experiments imply that, absent the realised seigniorage path, the bank Z-score would have remained roughly two standard deviations higher on average over 2014–2024, with the largest divergences during 2017 and 2022–2024.

Coordination is the binding constraint. Even when the central bank raises the policy rate in response to inflationary pressure, monetisation can still weaken bank balance sheets through the estimated profitability wedge. The remedy is therefore not only a monetary-policy response, but also a fiscal framework that reduces the probability that seigniorage becomes the residual financing instrument. Fiscal-monetary coordination—credible primary surpluses, predictable debt-issuance plans, and a clear central-bank mandate—directly reduces the variance of μ_t and hence of the bank-fragility variables.

Macroprudential complementarities. Because the bank-profitability fragility wedge operates through profitability and leverage rather than credit risk per se, prudential responses focused on capital buffers (counter-cyclical capital requirements, higher liquidity ratios) and on FX-denominated funding limits would directly shore up the mechanisms identified in this paper. The estimated FX-fragility elasticity $\psi_{zs} = 0.39$ is large and supports macroprudential limits on FX-denominated bank funding in particular.

External-side discipline. The country-risk-premium shock explains a substantial share of bank fragility, especially in 2022–2024. Anchoring sovereign spreads through credible debt-management policy and IMF-program engagement directly reduces the second-largest source of bank-fragility variance.

10. Conclusion

This paper develops and Bayesian-estimates a small-open-economy DSGE model for Ghana to quantify the financial-stability effects of monetary financing. The framework delivers three reinforcing transmission channels: a fiscal-financing/inflation-tax channel, an open-economy risk-premium channel, and a reduced-form bank-profitability fragility wedge. Together they link fiscal deficits to bank fragility through profitability, capital adequacy, leverage, and the credit spread. The fragility-wedge sensitivity $\psi_{z\mu}$ is estimated with a posterior 90% credible interval of [0.18, 0.23], excluding zero. Forecast-error variance decompositions, historical decompositions, and counterfactual financing experiments collectively imply that fiscal/seigniorage and country-risk-premium shocks are the two dominant drivers of Ghana's banking-sector fragility over 2014–2024. The findings provide quantitative empirical support for fiscal-monetary coordination and for macroprudential policies focused on capital buffers and FX-funding limits.

References

Acharya, Viral V., Itamar Drechsler, and Philipp Schnabl. 2017. A pyrrhic victory? bank bailouts and sovereign credit risk. *Journal of Finance* 72 (6): 2689–2738.

Adam, Christopher, and David Bevan. 2009. Aid and the supply side: public investment, export performance and dutch disease in low-income economies. *The World Bank Economic Review* 20 (2): 261–290.

Adam, Christopher, Pantaleo Kessy, Francis Mwega, and Stephen A. O'Connell. 2018. The macroeconomics of central bank independence in sub-Saharan Africa. *Journal of African Economies* 27 (Supplement 1): i32–i75.

Adam, Christopher S., and Stephen A. O'Connell. 2004. Aid versus trade revisited: donor and recipient policies in the presence of learning-by-doing. *Economic Journal* 114 (492): 150–173.

Addison, Tony, and Mina Baliamoune-Lutz. 2024. Fiscal dominance and monetary policy in sub-Saharan Africa. Forthcoming, *Journal of African Economies.*

Adjemian, Stéphane, Houtan Bastani, Michel Juillard, Frédéric Karamé, Junior Maih, Ferhat Mihoubi, Willi Mutschler, et al. 2024. *Dynare: reference manual, version 6.* Dynare Working Papers 1. CEPREMAP.

Adolfson, Malin, Stefan Laséen, Jesper Lindé, and Mattias Villani. 2007. Bayesian estimation of an open economy dsge model with incomplete pass-through. *Journal of International Economics* 72 (2): 481–511.

Adolfson, Malin, Stefan Lasen, Jesper Linde, and Mattias Villani. 2007. Bayesian estimation of an open economy dsge model with incomplete pass-through. *Journal of International Economics* 72 (2): 481–511.

Aiyagari, S Rao, and Mark Gertler. 1985. The backing of government bonds and monetarism. *Journal of Monetary Economics* 16 (1): 19–44.

Aizenman, Joshua, Menzie D. Chinn, and Hiro Ito. 2017. Balance sheet effects on monetary and financial spillovers: the East Asian crisis plus 20. *Journal of International Money and Finance* 74:258–282.

Akitoby, Bernardin, Benedict Clements, and Sanjeev Gupta. 2011. *Fiscal risk and banking stability: transmission channels in low-capacity economies.* Technical report WP/11/51. IMF Working Paper.

Asongu, Simplice A., and Nicholas M. Odhiambo. 2021. Banking sector instability and economic growth in africa. *Research in International Business and Finance* 55:101342.

Ateng', Benson A. 2023. An analysis of non-performing loans in kenya. *Journal of Economics and Sustainable Development* 14 (8): 1–15. https://doi.org/10.7176/JESD/14-8-01. https://www.iiste.org/Journals/index.php/JESD/article/view/61125.

Auerbach, Alan J, and Yuriy Gorodnichenko. 2013. Output spillovers from fiscal policy. *American Economic Review* 103 (3): 141–146.

Bank of Ghana. 2019. *Restoring confidence and building a resilient banking system for ghana.* Technical report. Official policy document on banking-sector reforms and recapitalisation in Ghana. Accra, Ghana: Bank of Ghana. https://www.bog.gov.gh/wp-content/uploads/2019/07/Restoring-Confidence-and-Building-a-Resilient-Banking-System-for-Ghana.pdf.

Bank of Ghana. 2024a. *Financial stability review.* Technical report. Various issues, 2014–2024. Accra: Bank of Ghana.

Bank of Ghana. 2024b. *Financial stability review 2023: strengthening financial stability to support macroeconomic recovery.* Technical report. Report year: 2023. Accra, Ghana: Bank of Ghana. https://www.bog.gov.gh/wp-content/uploads/2024/10/Financial-Stability-Review-2023.pdf.

Barrell, Ray, Edward P. Davis, Darron Karim, and Irina Liadze. 2010. Fiscal policy, banking crises and output growth. *Applied Economics* 42 (25): 3275–3291.

Bauer, Michael D, and Eric T Swanson. 2023. A reassessment of monetary policy surprises and high-frequency identification. *NBER Macroeconomics Annual* 37 (1): 87–155.

Beck, Thorsten, Asli Demirgüç-Kunt, and Ross Levine. 2010. Financial institutions and markets across countries and over time: the updated financial development and structure database. *World Bank Economic Review* 24 (1): 77–92.

Beck, Thorsten, Aslı Demirgüç-Kunt, and Ross Levine. 2007. *Finance, inequality, and poverty: cross-country evidence.* Technical report WPS 4340. World Bank Policy Research Working Paper.

Benhabib, Jess, Stephanie Schmitt-Grohé, and Martin Uribe. 2001. Monetary policy and multiple equilibria. *American Economic Review* 91 (1): 167–186.

Benigno, Pierpaolo, and Salvatore Nisticò. 2020. Non-neutrality of open-market operations. *American Economic Journal: Macroeconomics* 12 (3): 175–226.

Bernanke, B. 1999. The financial accelerator in a quantitative business cycle framework. *Handbook of Macroeconomics* 1.

Bernanke, Ben S, Mark Gertler, and Simon Gilchrist. 1999a. The financial accelerator in a quantitative business cycle framework. *Handbook of macroeconomics* 1:1341–1393.

Bernanke, Ben S., Mark Gertler, and Simon Gilchrist. 1999b. The financial accelerator in a quantitative business cycle framework. 1:1341–1393.

Bianchi, Francesco, Renato Faccini, and Leonardo Melosi. 2023. A fiscal theory of persistent inflation. *The Quarterly Journal of Economics* 138 (4): 2127–2179.

Bonam, Dennis, and Gavin Goy. 2024. Should fiscal policy lean against money-financed deficits? Forthcoming, *Journal of Monetary Economics.*

Boyd, John H., and David E. Runkle. 1993. Size and performance of banking firms: testing the predictions of theory. *Journal of Monetary Economics* 31 (1): 47–67.

Brunnermeier, Markus K, Sebastian A Merkel, and Yuliy Sannikov. 2020. *The fiscal theory of price level with a bubble.* Technical report. National Bureau of Economic Research.

Buffie, Edward F., Marco Airaudo, and Luis-Felipe Zanna. 2018. Inflation targeting and exchange-rate management in less-developed countries. In *Monetary policy in sub-saharan africa.* Oxford University Press.

Buiter, Willem H. 2002. The fiscal theory of the price level: a critique. *The Economic Journal* 112 (481): 459–480.

Burnside, Craig, Martin Eichenbaum, and Sergio Rebelo. 2001. Prospective deficits and the asian currency crisis. *Journal of political Economy* 109 (6): 1155–1197.

Carlstrom, Charles T, and Timothy S Fuerst. 1998. Agency costs and business cycles. *Economic Theory* 12:583–597.

Chetty, Raj, Adam Guren, Day Manoli, and Andrea Weber. 2011. Are micro and macro labor supply elasticities consistent? a review of evidence on the intensive and extensive margins. *American Economic Review* 101 (3): 471–475.

Christiano, Lawrence, and Terry J Fitzgerald. 2000. *Understanding the fiscal theory of the price level.*

Christiano, Lawrence J, Roberto Motto, and Massimo Rostagno. 2010. Financial factors in economic fluctuations.

Christiano, Lawrence J., Martin Eichenbaum, and Charles L. Evans. 2005. Nominal rigidities and the dynamic effects of a shock to monetary policy. *Journal of Political Economy* 113 (1): 1–45.

Christiano, Lawrence J., Mathias Trabandt, and Karl Walentin. 2011. DSGE models for monetary policy analysis. In *Handbook of monetary economics,* 3:285–367. Elsevier.

Cochrane, John H. 1998. A frictionless view of us inflation. *NBER macroeconomics annual* 13:323–384.

Cochrane, John H. 2001. Long-term debt and optimal policy in the fiscal theory of the price level. *Econometrica* 69 (1): 69–116.

Cochrane, John H. 2005. Money as stock. *Journal of Monetary Economics* 52 (3): 501–528.

Cochrane, John H. 2022a. A fiscal theory of monetary policy with partially-repaid long-term debt. *Review of Economic Dynamics* 45:1–21.

Cochrane, John H. 2022b. The fiscal roots of inflation. *Review of Economic Dynamics* 45:22–40.

Cochrane, John H. 2023a. *The fiscal theory of the price level.* Princeton University Press.

Cochrane, John H. 2022c. Fiscal histories. *Journal of Economic Perspectives* 36, no. 4 (November): 125–46. https://doi.org/10.1257/jep.36.4.125. https://www.aeaweb.org/articles?id=10.1257/jep.36.4.125.

Cochrane, John H. 2023b. *The fiscal theory of the price level.* Princeton, NJ: Princeton University Press.

Corsetti, Giancarlo, and Bartosz Maćkowiak. 2006. Fiscal imbalances and the dynamics of currency crises. *European Economic Review* 50 (5): 1317–1338.

Corsetti, Giancarlo, André Meier, and Gernot J. Müller. 2014. What determines government spending multipliers? *Economic Policy* 27, no. 72 (August): 521–565.

Dabla-Norris, Era, Jim Brumby, Annette Kyobe, Zac Mills, and Chris Papageorgiou. 2018. *Investing in public investment: an index of public investment efficiency.* Technical report. International Monetary Fund.

Dupor, Bill. 2000. Exchange rates and the fiscal theory of the price level. *Journal of Monetary Economics* 45 (3): 613–630.

English, William B, Christopher J Erceg, and David Lopez-Salido. 2017. Money-financed fiscal programs: a cautionary tale.

Farmer, Mr Roger, and Pawel Zabczyk. 2019. *A requiem for the fiscal theory of the price level.* International Monetary Fund.

Friedman, Milton. 1977. Nobel lecture: inflation and unemployment. *Journal of political economy* 85 (3): 451–472.

Galí, Jordi. 2020. The effects of a money-financed fiscal stimulus. *Journal of Monetary Economics* 115:1–19.

Galí, Jordi, and Tommaso Monacelli. 2005. Monetary policy and exchange rate volatility in a small open economy. *Review of Economic Studies* 72 (3): 707–734.

Gertler, Mark, and Peter Karadi. 2010. A model of unconventional monetary policy. *Journal of Monetary Economics* 58 (1): 17–34.

Gertler, Mark, and Peter Karadi. 2011a. A model of unconventional monetary policy. *Journal of Monetary Economics* 58 (1): 17–34. https://doi.org/10.1016/j.jmoneco.2010.10.004.

Gertler, Mark, and Peter Karadi. 2011b. A model of unconventional monetary policy. *Journal of Monetary Economics* 58 (1): 17–34.

Gertler, Mark, and Peter Karadi. 2011c. A model of unconventional monetary policy. *Journal of monetary Economics* 58 (1): 17–34.

Gertler, Mark, and Nobuhiro Kiyotaki. 2011. Financial intermediation and credit policy in business cycle analysis. Chap. 11 in *Handbook of monetary economics,* edited by Benjamin M. Friedman and Michael Woodford, 3:547–599. Elsevier.

Gertler, Mark, and Nobuhiro Kiyotaki. 2015. Banking, liquidity, and bank runs in an infinite horizon economy. *American Economic Review* 105 (7): 2011–2043. https://doi.org/10.1257/aer.20130665.

Hamilton, James D. 2011. Nonlinearities and the macroeconomic effects of oil prices. *Macroeconomic dynamics* 15 (S3): 364–378.

Heathcote, Jonathan, and Fabrizio Perri. 2002. Financial autarky and international business cycles. *Journal of Monetary Economics* 49 (3): 601–627.

International Monetary Fund. 2017. *Ghana: 2017 article iv consultation, fourth review under the extended credit facility arrangement, request for waiver for nonobservance of performance criteria, and request for extension and rephasing of the arrangement.* IMF Country Report 17/262. Washington, DC: International Monetary Fund, September. https://www.imf.org/-/media/files/publications/cr/2017/cr17262.pdf.

International Monetary Fund. 2023a. *Ghana: request for an arrangement under the extended credit facility—press release; staff report; and statement by the executive director for ghana.* IMF Country Report 23/168. Washington, DC: International Monetary Fund, May. https://doi.org/10.5089/9798400244322.002. https://www.imf.org/-/media/files/publications/cr/2023/english/1ghaea2023001.pdf.

International Monetary Fund. 2023b. *Ghana: Staff Report for the Article IV Consultation.* IMF Country Report. Washington, DC: International Monetary Fund.

International Monetary Fund. 2023c. *Global financial stability report: safeguarding financial stability amid high inflation and geopolitical risks.* Technical report. Washington, DC: International Monetary Fund, April.

Jordà, Òscar. 2005. Estimation and inference of impulse responses by local projections. *American economic review* 95 (1): 161–182.

Jordà, Òscar, Katharina Knoll, Dmitry Kuvshinov, Moritz Schularick, and Alan M Taylor. 2019. The rate of return on everything, 1870–2015. *The quarterly journal of economics* 134 (3): 1225–1298.

Justiniano, Alejandro, Giorgio E. Primiceri, and Andrea Tambalotti. 2010. Investment shocks and business cycles. *Journal of Monetary Economics* 57 (2): 132–145.

Kaminsky, Graciela L, and Carmen M Reinhart. 1999a. The twin crises: the causes of banking and balance-of-payments problems. *American economic review* 89 (3): 473–500.

Kaminsky, Graciela L., and Carmen M. Reinhart. 1999b. The twin crises: the causes of banking and balance-of-payments problems. *American Economic Review* 89 (3): 473–500.

Kaplan, Greg, Georgios Nikolakoudis, and Giovanni L Violante. 2023. *Price level and inflation dynamics in heterogeneous agent economies.* Technical report. National Bureau of Economic Research.

Kiyotaki, Nobuhiro, and John Moore. 1997. Credit cycles. *Journal of Political Economy* 105 (2): 211–248.

Kocherlakota, Narayana, and Christopher Phelan. 1999. Explaining the fiscal theory of the price level. *Federal Reserve Bank of Minneapolis Quarterly Review* 23 (4): 14–23.

Kocherlakota, Narayana R. 2023. Public debt bubbles in heterogeneous agent models with tail risk. *International Economic Review* 64 (2): 491–509.

Krugman, Paul. 1979. A model of balance-of-payments crises. *Journal of money, credit and banking* 11 (3): 311–325.

Kuada, John. 2019. Determinants of bank profitability in sub-saharan africa. *African Journal of Economic and Management Studies* 10 (3): 283–296.

Kuzucu, Narman, and Serpil Kuzucu. 2019. What drives non-performing loans? evidence from emerging and advanced economies during pre- and post-global financial crisis. *Emerging Markets Finance and Trade* 55 (8): 1694–1708. https://doi.org/10.1080/1540496X.2018.1547877. https://doi.org/10.1080/1540496X.2018.1547877.

Laeven, Luc, and Ross Levine. 2009. Bank governance, regulation, and risk taking. *Journal of Financial Economics* 93 (2): 259–275.

Laeven, Luc, and Fabian Valencia. 2020. Systemic banking crises database II. *IMF Economic Review* 68 (2): 307–361.

Leeper, Eric M. 1991a. Equilibria under 'active'and 'passive'monetary and fiscal policies. *Journal of monetary Economics* 27 (1): 129–147.

Leeper, Eric M. 1991b. Equilibria under 'active' and 'passive' monetary and fiscal policies. *Journal of Monetary Economics* 27 (1): 129–147.

Leeper, Eric M. 1991c. Equilibria under active and passive monetary and fiscal policies. *Journal of Monetary Economics* 27 (1): 129–147. https://doi.org/10.1016/0304-3932(91)90007-B.

Louzis, Dimitrios P., Asterios T. Vouldis, and Vasilios L. Metaxas. 2012. Macroeconomic and bank-specific determinants of non-performing loans in greece: a comparative study of mortgage, business and consumer loan portfolios. *Journal of Banking & Finance* 36 (4): 1012–1027.

Mahlangu, Thabang, and Given Chowa. 2022. The social consequences of bank asset quality: evidence from the south african credit market. *Journal of Development and Finance* 14 (3): 115–132.

Maih, Junior. 2015. Efficient perturbation methods for solving regime-switching dsge models. *Norges Bank Working Paper,* nos. 1/2015.

Mauro, Paolo, Nathan Sussman, and Yishay Yafeh. 2002. Emerging market crises: did sovereign debt restructurings disturb banking systems? *The World Bank Economic Review* 16 (3): 351–372.

McCallum, Bennett T. 2001. Indeterminacy, bubbles, and the fiscal theory of price level determination. *Journal of Monetary Economics* 47 (1): 19–30.

Mendoza, Enrique G. 2010. Sudden stops, financial crises, and leverage. *American Economic Review* 100 (5): 1941–1966.

Michael, Arthur, and Henry Atakli. 2020. The impact of non-performing loans on economic growth: evidence from ghana, nigeria, south africa, and kenya. *Journal of Development Studies* 56 (3): 421–437.

Nastansky, Andreas, and Hans Gerhard Strohe. 2015. Public debt, money and consumer prices: a vector error correction model for germany. *Econometrics. Ekonometria. Advances in Applied Data Analytics,* no. 1 (47, 9–31.

Owyang, Michael T, Valerie A Ramey, and Sarah Zubairy. 2013. Are government spending multipliers greater during periods of slack? evidence from twentieth-century historical data. *American Economic Review* 103 (3): 129–134.

Papi, Luca, Silvia Magri, and Pietro Garibaldi. 2015. Sectoral credit risk in frontier economies: the role of commodity exports. *Emerging Markets Review* 24:118–136.

Plagborg-Møller, Mikkel, and Christian K Wolf. 2021. Local projections and vars estimate the same impulse responses. *Econometrica* 89 (2): 955–980.

Reinhart, Carmen M., and Kenneth S. Rogoff. 2010. Growth in a time of debt. *American Economic Review: Papers Proceedings* 100 (2): 573–578.

Sargent, Thomas J, Neil Wallace, et al. 1981. Some unpleasant monetarist arithmetic. *Federal reserve bank of minneapolis quarterly review* 5 (3): 1–17.

Sargent, Thomas J., and Neil Wallace. 1981. Some unpleasant monetarist arithmetic. *Federal Reserve Bank of Minneapolis Quarterly Review* 5 (3): 1–17. https://doi.org/10.21034/qr.531.

Schmitt-Grohé, Stephanie, and Martín Uribe. 2003a. Closing small open economy models. *Journal of International Economics* 61 (1): 163–185.

Schmitt-Grohé, Stephanie, and Martín Uribe. 2003b. Closing small open economy models. *Journal of International Economics* 61 (1): 163–185.

Senbeta, Sisay R. 2017. Monetary policy in low-income countries with informal segmented financial markets. *Journal of African Economies* 26 (3): 280–305.

Sims, Christopher A. 1980. Macroeconomics and reality. *Econometrica: journal of the Econometric Society,* 1–48.

Sims, Christopher A. 1994a. A simple model for study of the determination of the price level and the interaction of monetary and fiscal policy. *Economic theory* 4:381–399.

Sims, Christopher A. 1997. Fiscal foundations of price stability in open economies. *Available at SSRN 75357.*

Sims, Christopher A. 1999. Domestic currency denominated government debt as equity in the primary surplus. In *Latin american meetings of the econometric society, cancun, mexico. august,* vol. 19.

Sims, Christopher A. 2013. Paper money. *American Economic Review* 103 (2): 563–584.

Sims, Christopher A. 1994b. A simple model for study of the determination of the price level and the interaction of monetary and fiscal policy. *Economic Theory* 4 (3): 381–399.

Smets, Frank, and Rafael Wouters. 2007a. Shocks and frictions in us business cycles: a Bayesian DSGE approach. *American Economic Review* 97 (3): 586–606.

Smets, Frank, and Rafael Wouters. 2007b. Shocks and frictions in us business cycles: a bayesian dsge approach. *American Economic Review* 97 (3): 586–606.

Tenreyro, Silvana, and Gregory Thwaites. 2016. Pushing on a string: us monetary policy is less powerful in recessions. *American Economic Journal: Macroeconomics* 8 (4): 43–74.

Woodford, Michael. 1995a. Price-level determinacy without control of a monetary aggregate. *Carnegie-Rochester Conference Series on Public Policy* 43:1–46.

Woodford, Michael. 1995b. Price-level determinacy without control of a monetary aggregate. In *Carnegie-rochester conference series on public policy,* 43:1–46. Elsevier.

Woodford, Michael. 1998. Doing without money: controlling inflation in a post-monetary world. *Review of Economic Dynamics* 1 (1): 173–219. ISSN: 1094-2025.

Woodford, Michael. 2001a. *Fiscal requirements for price stability.*

Woodford, Michael. 2001b. Fiscal requirements for price stability. *Journal of Money, Credit and Banking* 33 (3): 669–728.

A. Intertemporal problems and full equation set

This appendix sketches each agent's intertemporal optimisation problem and lists the resulting first-order conditions and equilibrium equations that close the model. We state equations in level form; the .mod implementation uses log-deviations $x = \ln X$ for variables defined on $(0, \infty)$. Forward-looking variables are time-t information expectations conditional on the period-t information set.

A.1 Household problem

The representative household chooses $\{C_t, L_t, m_t, D_t, b_t\}_{t\geq 0}$ to maximise expected lifetime utility with internal habit:

$$\max_{\{C_t,L_t,m_t\}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \Big[\frac{(C_t - hC_{t-1})^{1-\sigma} - 1}{1-\sigma} + \upsilon \ln m_t - \chi \frac{L_t^{1+\varphi}}{1+\varphi}\Big], \tag{44}$$

subject to the flow budget constraint

$$C_t + D_t + b_t + m_t \;=\; w_t L_t + \frac{R^d_{t-1}}{\pi_t} D_{t-1} + \frac{R^b_{t-1}}{\pi_t} b_{t-1} + \frac{m_{t-1}}{\pi_t} + \Pi_t - T_t.$$

Define the stochastic discount factor as $\Lambda_{t,t+1} \equiv \rho_{t+1}/\rho_t$ where ρ_t is the marginal utility of consumption. The first-order conditions are:

$$\begin{aligned}
\rho_t &= (C_t - hC_{t-1})^{-\sigma} - \beta h\, \mathbb{E}_t (C_{t+1} - hC_t)^{-\sigma}, && \text{(MU of } C\text{)} && (45)\\
\beta R_t\, \mathbb{E}_t \Lambda_{t,t+1} &= 1, && \text{(Euler / deposits)} && (46)\\
\Lambda_{t,t+1} &= \rho_{t+1}/\rho_t, && \text{(SDF)} && (47)\\
\chi L_t^{\varphi} &= \rho_t\, P_t^m (1-\alpha) Y_t / L_t, && \text{(labour supply)} && (48)\\
\upsilon &= m_t\, \rho_t\, (i_t - 1)/i_t, && \text{(money demand)} && (49)
\end{aligned}$$

where P_t^m is the real marginal cost faced by the wholesale producer and i_t the gross nominal policy rate.

A.2 Armington aggregator and import demand

Consumption is a CES aggregate of home and foreign goods:

$$\begin{aligned}
1 &= \omega_c\, p_t^{H\,1-\gamma_c} + (1-\omega_c)\, p_t^{F\,1-\gamma_c}, && \text{(CPI identity)} && (50)\\
c_t^H &= \omega_c\, p_t^{H\,-\gamma_c}\, C_t, && \text{(home demand)} && (51)\\
c_t^F &= (1-\omega_c)\, p_t^{F\,-\gamma_c}\, C_t, && \text{(foreign demand)} && (52)\\
\pi_t^H &= p_t^H / p_{t-1}^H \cdot \pi_t, && \text{(home inflation)} && (53)\\
\pi_t^F &= p_t^F / p_{t-1}^F \cdot \pi_t, && \text{(foreign inflation)} && (54)\\
c_t^{H*} &= c_{ss}^{H*}\, (s_t/s_{ss})^{\gamma_{exp}}, && \text{(export demand)} && (55)
\end{aligned}$$

A.3 Goods producers

Wholesale producers operate the technology $Y_t^m = a_t(\xi_t U_t K_{t-1})^\alpha L_t^{1-\alpha}$ with utilisation U_t and capital-quality shock ξ_t. Maximising profits taking factor prices as given yields

$$P_t^m \alpha Y_t^m / U_t = \delta'(U_t)\, \xi_t K_{t-1}, \qquad \text{(utilisation FOC)} \qquad (56)$$

$$\delta_t = \delta_c + \frac{b_u}{1+\zeta} U_t^{1+\zeta}, \qquad \text{(depreciation)} \qquad (57)$$

$$w_t = P_t^m (1-\alpha)\, Y_t / L_t, \qquad \text{(wage)} \qquad (58)$$

$$R_t^k = \frac{P_t^m \alpha Y_t^m / K_{t-1} + \xi_t (Q_t - \delta_t)}{Q_{t-1}}. \qquad \text{(return on capital)} \qquad (59)$$

A.4 Capital producers and Tobin's Q

Capital producers transform investment I_t into next-period capital subject to convex adjustment costs $\Phi(I_t, I_{t-1})$. The optimality condition pinning down Tobin's Q is

$$Q_t = 1 + \tfrac{\eta_i}{2} (\tilde{I}_t/\tilde{I}_{t-1} - 1)^2 + \eta_i (\tilde{I}_t/\tilde{I}_{t-1} - 1)\tilde{I}_t/\tilde{I}_{t-1} - \beta \mathbb{E}_t \Lambda_{t,t+1} \eta_i (\tilde{I}_{t+1}/\tilde{I}_t - 1)(\tilde{I}_{t+1}/\tilde{I}_t)^2, \qquad (60)$$

where $\tilde{I}_t = I_t + I_{ss}$. Net investment and capital accumulation:

$$I_t^n = I_t - \delta_t \xi_t K_{t-1}, \qquad \text{(net investment)} \qquad (61)$$

$$K_t = \xi_t K_{t-1} + I_t^n. \qquad \text{(capital law of motion)} \qquad (62)$$

A.5 Calvo retailers

A continuum of retailers indexes domestic prices with probability $(1-\gamma)$ of resetting per period. Define the auxiliary recursive sums

$$F_t = Y_t P_t^m + \beta\gamma\, \mathbb{E}_t \Lambda_{t,t+1}\, \pi_{t+1}^{H\ \epsilon}\, \pi_t^{H\, -\epsilon\gamma_P}\, F_{t+1}, \qquad (63)$$

$$\mathcal{Z}_t = Y_t + \beta\gamma\, \mathbb{E}_t \Lambda_{t,t+1}\, \pi_{t+1}^{H\ \epsilon-1}\, \pi_t^{H\, \gamma_P(1-\epsilon)}\, \mathcal{Z}_{t+1}, \qquad (64)$$

$$\pi_t^* = \frac{\epsilon}{\epsilon-1} \frac{F_t}{\mathcal{Z}_t} \pi_t^H. \qquad \text{(reset price)} \qquad (65)$$

The home price index and dispersion follow:

$$\pi_t^{H\, 1-\epsilon} = \gamma\, \pi_{t-1}^{H\ \gamma_P(1-\epsilon)} + (1-\gamma)\, \pi_t^{*\, 1-\epsilon}, \qquad (66)$$

$$D_t = \gamma\, D_{t-1}\, \pi_{t-1}^{H\ -\gamma_P \epsilon}\, \pi_t^{H\, \epsilon} + (1-\gamma)\left(\frac{1-\gamma\, \pi_{t-1}^{H\ \gamma_P(1-\gamma)}\, \pi_t^{H\, \gamma-1}}{1-\gamma}\right)^{-\epsilon/(1-\gamma)}, \qquad (67)$$

$$X_t = 1/P_t^m. \qquad \text{(markup)} \qquad (68)$$

Imported goods follow an analogous Calvo–Taylor rule with FX pass-through and a direct monetisation-pressure term $\psi_{m\pi}\mu_t$:

$$\pi_t^F = \pi_{t-1}^{F\ \gamma_F \gamma_{PF}} (e_t^n)^{1-\gamma_F} \exp(\psi_{m\pi}\mu_t). \qquad (69)$$

A.6 Banker problem and the bank-profitability fragility wedge

A banker exits with probability $1-\theta$ each period. While operating, the banker takes domestic deposits, foreign loans, and equity to fund firm-equity claims. Let ν_t be the marginal value of bank assets, η_t the marginal value of net worth. The banker's recursive optimisation yields:

$$\nu_t = (1-\theta)\beta\, \mathbb{E}_t \Lambda_{t,t+1} (R_{t+1}^k - R_t) + \beta\, \mathbb{E}_t \Lambda_{t,t+1} \theta\, x_{t+1}^{bank}\, \nu_{t+1}, \qquad (70)$$

$$\eta_t = (1-\theta) + \beta\, \mathbb{E}_t \Lambda_{t,t+1} \theta\, z_{t+1}^{bank}\, \eta_{t+1}. \qquad (71)$$

The incentive-compatibility constraint binds with equality, delivering endogenous leverage and balance-sheet identities:

$$\phi_t = \eta_t/(\lambda - \nu_t), \tag{72}$$

$$Q_t K_t = \phi_t N_t, \qquad \text{(bank assets)} \tag{73}$$

$$b_t^* = \gamma_{open}(Q_t K_t - N_t), \qquad \text{(foreign debt of banks)} \tag{74}$$

$$N_t = N_t^e + N_t^n, \tag{75}$$

$$N_t^e = \theta\, z_t^{bank} N_{t-1} \exp(e_{Ne,t}), \qquad \text{(continuing bankers)} \tag{76}$$

$$N_t^n = \omega\, Q_t\, \xi_t K_{t-1}. \qquad \text{(new bankers)} \tag{77}$$

The two key intertemporal laws-of-motion for bank profitability and net-worth growth—the locus of the *bank-profitability fragility wedge*—are stated in pre-wedge × multiplicative-wedge form to match the main-text presentation:

$$\tilde{z}_t^{bank} = (R_t^k - R_{t-1})\,\phi_{t-1} + (R_{t-1} - R_t^* e_t^n)\,\frac{b_{t-1}^*}{N_{t-1}} + R_{t-1}, \tag{78}$$

$$z_t^{bank} = \tilde{z}_t^{bank} \exp\left[-\psi_{z\mu}\,\hat{\mu}_t - \psi_{zs}\,\hat{e}_t^n\right], \tag{79}$$

$$\hat{\mu}_t = \ln(\mu_t/\mu_{ss}), \qquad \hat{e}_t^n = \ln(e_t^n/e_{ss}^n), \tag{80}$$

$$x_t^{bank} = (\phi_t/\phi_{t-1})\, z_t^{bank}. \tag{81}$$

Equation (79) is the multiplicative reduced-form fragility wedge: $\psi_{z\mu}$ is the elasticity of bank profitability to money-growth deviations from the steady state, and ψ_{zs} the elasticity to nominal-depreciation deviations. Both are estimated.

The bank-fragility metrics that serve as observables and HD targets are:

$$\text{ROE}_t = z_t^{bank} - 1, \tag{82}$$

$$\text{ROA}_t = (z_t^{bank} - 1)/\phi_t, \tag{83}$$

$$\text{CAR}_t = 1/\phi_t, \tag{84}$$

$$\text{Zscore}_t = (\text{ROA}_t + \text{CAR}_t)/\sigma_{ROA}^{data}. \tag{85}$$

A.7 Open-economy block: foreign borrowing rate and country risk premium

The foreign borrowing rate facing domestic banks reflects an external gross rate R_t^{n*} marked up by an endogenous country risk premium Ψ_t^{rp} that responds to debt, inflation, exchange-rate depreciation, and money growth:

$$R_t^* = \Psi_t^{rp}(1 + r_t^{n*}), \qquad \text{(foreign borrowing rate)} \tag{86}$$

$$\Psi_t^{rp} = \exp\left[\psi_1(b_t^* - b_{ss}^*)\right] \pi_t^{\psi_\pi} (e_t^n)^{\psi_e} \mu_t^{\psi_\mu} \exp(\psi_t^{shock}). \qquad \text{(risk premium)} \tag{87}$$

The nominal exchange rate is linked to domestic and foreign rates through the benchmark UIP condition with the country risk premium, together with the nominal-depreciation identity and a slow-moving real-exchange-rate equation:

$$i_t = (1 + r_t^{n*})\,\Psi_t^{rp}\,\mathbb{E}_t e_{t+1}^n, \qquad \text{(UIP with risk premium)} \tag{88}$$

$$e_t^n = E_t/E_{t-1}, \qquad \text{(gross nominal depreciation)} \tag{89}$$

$$s_t = (s_{t-1}\, e_t^n/\pi_t)^{1-\kappa_s}\, s_{ss}^{\kappa_s}. \qquad \text{(real exchange rate)} \tag{90}$$

An increase in the country risk premium therefore raises the external borrowing rate faced by banks and, other things equal, generates depreciation pressure through the UIP block.

A.8 Government and seigniorage

The consolidated fiscal-monetary authority faces the budget identity

$$G_t - T_t \;=\; m_t(\mu_t - 1) \;\equiv\; \text{seign}_t, \tag{91}$$

with exogenous spending $G_t = G_{ss}\exp(g_t)$ and lump-sum taxes $T_t = G_{ss}$ fixed at the deterministic steady state, so that the fiscal residual is endogenously monetised. Monetary policy follows the Taylor rule

$$i_t = i_{t-1}^{\rho_i}\left[(1/\beta)\,\pi_t^{\kappa_\pi}\,(X_t/X_{ss})^{\kappa_y}\right]^{1-\rho_i}\exp(e_{i,t}), \tag{92}$$

augmented through the country risk premium (87) where the parameters $\psi_\pi, \psi_e, \psi_\mu$ operate. The Fisher relation $i_t = R_t\,\pi_{t+1}$ closes the link between nominal and real rates.

A.9 Market clearing

Goods, capital, and bond markets clear:

$$\frac{Y_t^m}{D_t} = c_t^H + c_t^{H*} + I_t + G_t + \tfrac{\eta_i}{2}\,(\tilde{I}_t/\tilde{I}_{t-1} - 1)^2\,\tilde{I}_t, \tag{93}$$

$$nx_t = p_t^H c_t^{H*} - p_t^F c_t^F. \qquad \text{(net exports)} \tag{94}$$

$$Y_t = p_t^H Y_t^m / D_t. \qquad \text{(GDP identity)} \tag{95}$$

A.10 Welfare

The recursive welfare definition that is reported in the IRF and HD plots:

$$W_t = \ln(C_t - hC_{t-1}) - \chi\,\frac{L_t^{1+\varphi}}{1+\varphi} + \upsilon\,\ln m_t + \beta\,\mathbb{E}_t W_{t+1}. \tag{96}$$

A.11 Exogenous shock processes

All structural shocks are AR(1) in their natural state space:

$$a_t = \rho_a\,a_{t-1} + e_{a,t}, \qquad \text{(TFP)} \tag{97}$$

$$\xi_t = \rho_\xi\,\xi_{t-1} + e_{\xi,t}, \qquad \text{(capital quality)} \tag{98}$$

$$g_t = \rho_g\,g_{t-1} + e_{g,t}, \qquad \text{(govt / seigniorage)} \tag{99}$$

$$\psi_t^{shock} = \rho_\psi\,\psi_{t-1}^{shock} + e_{\psi,t}, \qquad \text{(country risk premium)} \tag{100}$$

$$r_t^{n*} - r_{ss}^{n*} = \rho_{R^*}(r_{t-1}^{n*} - r_{ss}^{n*}) + e_{R^*,t}, \qquad \text{(foreign rate)} \tag{101}$$

plus i.i.d. innovations $e_{i,t}$ (monetary policy) and $e_{Ne,t}$ (bank capital). Innovations are assumed mutually orthogonal and Gaussian: $e_{j,t} \sim \mathcal{N}(0, \sigma_j^2)$.

A.12 Measurement equations

The model is solved in log-deviation form within Dynare; Y_t, G_t and similar level-named variables in this appendix denote logs of their respective levels. The eight observables connect the data to the model in percentage-point units, each carrying an i.i.d. Gaussian measurement error $\varepsilon_t^j \sim \mathcal{N}(0, \sigma^2_{ME,j})$:

$$\text{obs\_y}_t = 100\,(Y_t - Y_{t-1}) + \varepsilon_t^y, \tag{102}$$
$$\text{obs\_pi}_t = 100\,\ln \pi_t + \varepsilon_t^\pi, \tag{103}$$
$$\text{obs\_i}_t = 100\,\ln(i_t/i_{ss}) + \varepsilon_t^i, \tag{104}$$
$$\text{obs\_e}_t = 100\,\ln e_t^n + \varepsilon_t^e, \tag{105}$$
$$\text{obs\_g}_t = 100\big[\ln(G_t/Y_t) - \ln(G_{ss}/Y_{ss})\big] + \varepsilon_t^g, \tag{106}$$
$$\text{obs\_seign}_t = 100\,\text{seign}_t/Y_t + \varepsilon_t^{seign}, \tag{107}$$
$$\text{obs\_car}_t = 100\,(\text{CAR}_t - 1/\phi^{mom}) + \varepsilon_t^{car}, \tag{108}$$
$$\text{obs\_roa}_t = 100\big[\text{ROA}_t - (z^{mom} - 1)/\phi^{mom}\big] + \varepsilon_t^{roa}, \tag{109}$$

where $\phi^{mom} = 5.74$ and $z^{mom} = 1.060$ are the Ghana 2014Q2–2024Q2 sample-average bank leverage and gross profitability, respectively.

A.13 System summary

The full system consists of: 5 household FOCs (45–49), 6 Armington/import equations (50–55), 4 producer FOCs (56–59), 3 capital-producer equations (60–62), 8 Calvo retailer/import-pricing equations (63–69), 9 banker equations including the bank-profitability fragility wedge (70–81) plus the four fragility metrics (82–85), 4 open-economy / foreign-borrowing equations (86–90), 2 government equations (91–92), 3 market-clearing identities (93–95), 1 welfare recursion (96), 7 exogenous shock processes (97–101), and 8 measurement equations (102–109). The system is solved at first-order around the deterministic steady state. Steady-state expressions are derived analytically and are reported in the accompanying `gc_extended_steadystate.m` file.

B. Prior distributions

This appendix gives the full prior distributions used in the Bayesian estimation. Priors fall into four blocks: monetary policy and open-economy feedback parameters; shock persistences; structural-shock standard deviations, and measurement-error standard deviations. Beta priors are used for parameters restricted to $[0, 1]$ (smoothing, persistences); Gamma priors for parameters restricted to be positive (slopes, elasticities); and Inverse-Gamma priors with two degrees of freedom for all standard deviations. All choices follow the standard EMDE-DSGE conventions of Adolfson, Laséen, et al. 2007 and Justiniano, Primiceri, and Tambalotti 2010 and are deliberately wide enough to let the data dominate the posterior.

Table 7. Priors — monetary-policy rule and open-economy feedback

Parameter	Shape	Mean	Std	Economic role
ρ_i	Beta	0.80	0.10	Policy-rate smoothing in the Taylor rule
κ_π	Gamma	1.50	0.25	Inflation-response coefficient (Taylor rule)
ψ_π	Gamma	0.40	0.15	Inflation feedback into country-risk premium
ψ_e	Gamma	0.20	0.10	Self-reinforcing FX feedback in risk premium
ψ_μ	Gamma	0.30	0.10	Money-growth surcharge in risk premium
$\psi_{m\pi}$	Gamma	0.08	0.05	Direct money-growth pass-through into import prices
κ_s	Beta	0.10	0.05	Speed of mean reversion of the real exchange rate to s_{ss}

Table 8. Priors — shock persistences

Parameter	Shape	Mean	Std	Shock
ρ_a	Beta	0.85	0.10	Total factor productivity
ρ_ξ	Beta	0.60	0.15	Capital-quality shock
ρ_g	Beta	0.60	0.15	Fiscal/government-spending shock
ρ_ψ	Beta	0.80	0.10	Country risk-premium shock
ρ_{r^*}	Beta	0.80	0.10	Foreign interest-rate shock

Table 9. Priors — structural-shock standard deviations

Parameter	Prior	Prior mean	Shock interpretation
σ_a	Inv. Gamma$(0.010, 2)$	0.010	TFP innovation
σ_ξ	Inv. Gamma$(0.030, 2)$	0.030	Capital-quality innovation
σ_g	Inv. Gamma$(0.020, 2)$	0.020	Fiscal/government-spending innovation
σ_{N_e}	Inv. Gamma$(0.020, 2)$	0.020	Bank-equity innovation
σ_i	Inv. Gamma$(0.005, 2)$	0.005	Monetary-policy innovation
σ_ψ	Inv. Gamma$(0.005, 2)$	0.005	Country-risk premium innovation
σ_{r^*}	Inv. Gamma$(0.003, 2)$	0.003	Foreign-rate innovation

Table 10. Priors — measurement-error standard deviations (percentage points)

Parameter	Prior	Prior mean	Observable
σ_y^{me}	Inv. Gamma$(0.50, 2)$	0.50	Real GDP growth
σ_π^{me}	Inv. Gamma$(0.50, 2)$	0.50	CPI inflation
σ_i^{me}	Inv. Gamma$(0.25, 2)$	0.25	Policy rate
σ_e^{me}	Inv. Gamma$(1.00, 2)$	1.00	Nominal depreciation of the cedi
σ_g^{me}	Inv. Gamma$(1.00, 2)$	1.00	Government-spending share
σ_{seign}^{me}	Inv. Gamma$(0.50, 2)$	0.50	Monetary-base seigniorage proxy
σ_{car}^{me}	Inv. Gamma$(0.50, 2)$	0.50	Bank capital adequacy ratio
σ_{roa}^{me}	Inv. Gamma$(0.25, 2)$	0.25	Bank return on assets

Comments on prior choice. The Beta prior on ρ_i is centred at 0.80, in line with the high observed inertia of the Bank of Ghana's policy rate. The Gamma Prior on κ_π has a mean of 1.50 to embed the Taylor principle while leaving a substantial mass below it, so that the posterior can settle on a weaker inflation response if the data demand. The open-economy feedback parameters $(\psi_\pi, \psi_e, \psi_\mu, \psi_{m\pi})$ are loosely centred but with wide standard deviations because the empirical Evidence on FX risk-premium loadings in EMDEs is heterogeneous. The Inverse-Gamma scale parameters on the structural shocks are chosen to match the order of magnitude of the corresponding observable, ensuring that the priors are non-informative in log-likelihood units. The Measurement-error priors are deliberately moderate so that fitting power is not absorbed by noise: tighter priors on σ_i^{me} and σ_{roa}^{me} reflect the high quality of the underlying series, while looser priors on σ_e^{me} and σ_g^{me} recognise known volatility in Ghana's quarterly FX and fiscal data.

Sampling and diagnostics. The posterior is simulated with the Random-Walk Metropolis-Hastings sampler, two parallel chains of 20,000 draws each, jump-scale 0.45, and the first half of each chain is discarded as burn-in. The acceptance rate is in the conventional 23–35% range, the Brooks-Gelman univariate and multivariate diagnostics are in `check_plots/`, and trace plots together with the Prior vs. posterior densities are reproduced in Appendix C.

C. Full Posterior Summary

The complete posterior summary for all 27 estimated parameters, including the prior shape, prior mean, prior standard deviation, posterior mean, posterior median, posterior standard deviation, and the 5th and 95th posterior quantiles, is provided in the supplementary file `prior_posterior_summary.csv` accompanying this manuscript. Figure 10 reproduces the full set of prior-versus-posterior density comparisons.

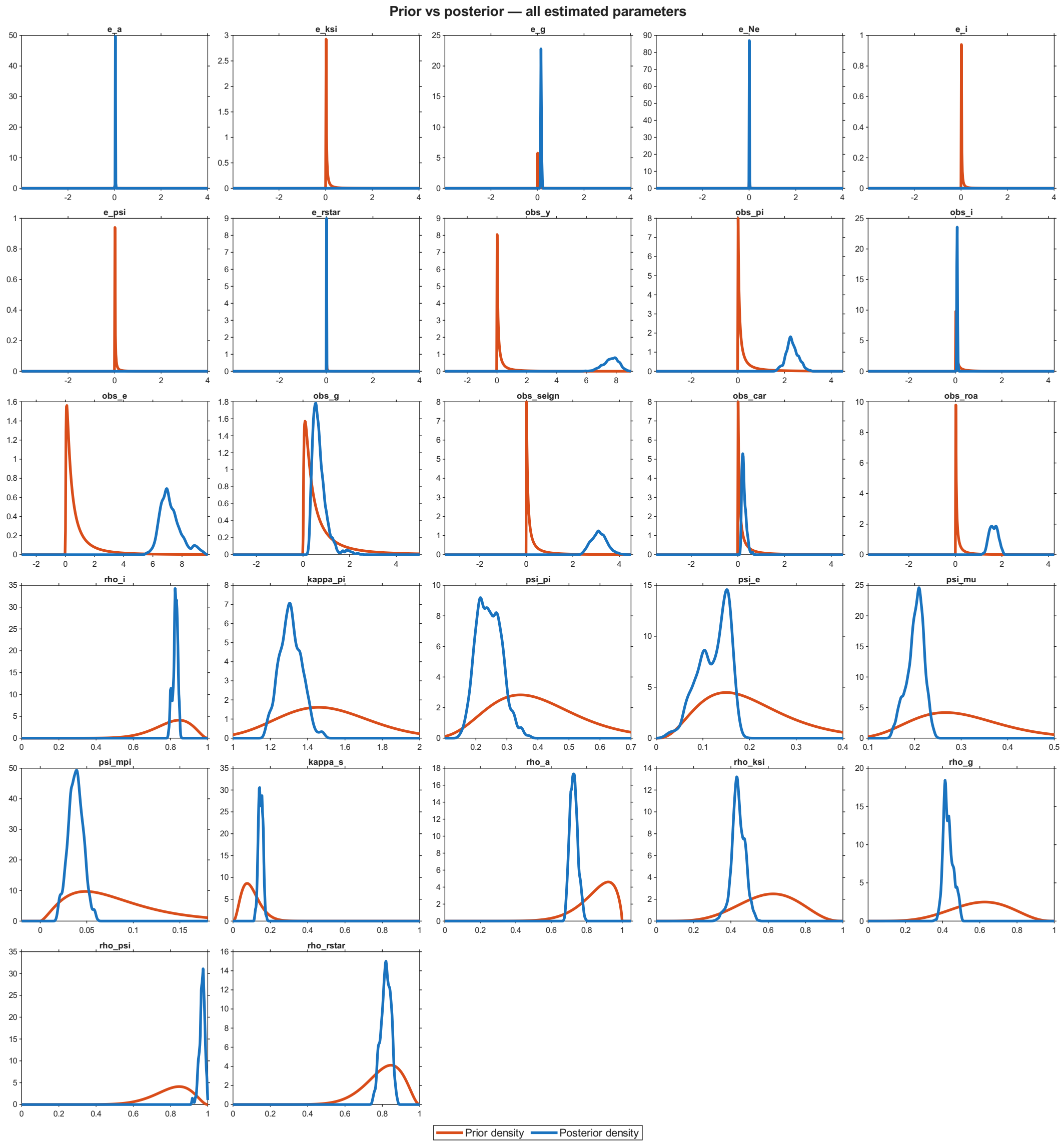


Figure 10. Prior (dashed) and posterior (solid) marginal densities for all 27 estimated parameters. Posterior tightening, relative to the prior, indicates parameters that are well identified by the data; the risk-premium loadings ($\psi_\pi, \psi_e, \psi_\mu, \psi_{m\pi}$) and the bank-fragility elasticities ($\psi_{z\mu}, \psi_{zs}$) exhibit the largest concentration relative to their priors.

D. Additional historical-decomposition figures

Figure 11 provides historical decompositions for the eight observable series. Figures for the eleven non-observable bank variables are in Section 6.

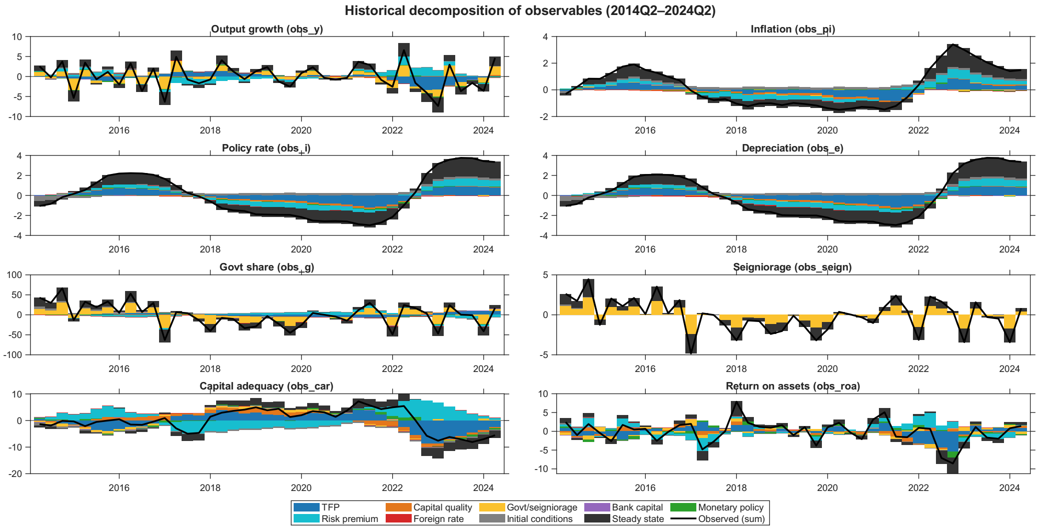


Figure 11. Historical decomposition of the eight observables, 2014Q2–2024Q2. The figure shows that the main macro-financial episodes are attributed within the model to combinations of fiscal/seigniorage and external-risk shocks rather than to isolated monetary-policy disturbances.