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Monetary–Fiscal Policy Interactions in Korea: A QPM-Based Analysis

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ABSTRACT: This paper develops a quarterly projection model for Korea with an integrated fiscal block, enabling analysis of monetary-fiscal interactions. The model is validated through historical decompositions and forecast evaluation. Scenario analysis comparing dynamics with and without debt-stabilizing fiscal rules reveals a fundamental trade-off: rules generate short-run procyclicality but prevent permanent debt drift. Without rules, temporary nominal GDP movements cause lasting debt-to-GDP changes. For Korea, facing age-related spending pressures, a medium-term fiscal framework could safeguard sustainability.

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WORKING PAPERS

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Introduction

Korea faces evolving fiscal challenges as demographic trends and spending pressures could put pressures on long-term sustainability. The country's rapid population aging—among the fastest in the OECD—combined with moderating potential growth, has prompted discussion about the appropriate fiscal policy framework. In response, a formal fiscal rules framework to guide debt dynamics over the medium term was proposed in 2021-22 and remains under consideration. The proposed framework would target a government debt-to-GDP ratio ceiling of 60 percent alongside a fiscal deficit cap of 3 percent of GDP, representing a move toward more systematic fiscal discipline.

These fiscal developments occur alongside Korea's established inflation-targeting framework. The Bank of Korea operates with a 2 percent inflation target. Recent years have presented challenges to this framework, particularly during the COVID-19 pandemic when the government implemented substantial support programs while the Bank of Korea reduced policy rates. The subsequent inflation increase in 2021-2022—reflecting global commodity price movements, supply chain disruptions, and exchange rate changes—required monetary tightening as fiscal support was withdrawn. These developments have highlighted the relevance of understanding how monetary and fiscal policies interact: how fiscal policy affects inflation dynamics, how monetary policy influences debt sustainability, and how the two policies coordinate during different types of economic disturbances.

This paper develops a Quarterly Projection Model (QPM) for Korea with an integrated fiscal block to analyze these monetary-fiscal interactions. QPMs belong to a class of small open-economy models used in central banks' Forecasting and Policy Analysis Systems (FPAS). These models—pioneered by works such as Berg, Karam, and Laxton (2006a, 2006b)—provide a framework for monetary policy analysis in inflation-targeting regimes. QPMs are semi-structural "gap" models that focus on deviations of key macroeconomic variables (output, inflation, interest rates, exchange rates) from their long-run equilibrium values. The theoretical core is grounded in New Keynesian principles, incorporating nominal rigidities and rational expectations. At the same time, QPMs remain pragmatic and reduced-form, including empirical adjustments and country-specific features that help capture observed data patterns and institutional characteristics. In a typical QPM setup, the central bank's policy interest rate is determined by a reaction function that responds to deviations of inflation from target and the output gap, reflecting the role of monetary policy in anchoring inflation expectations. This structure makes QPMs useful for scenario analysis and medium-term projections (Laxton, Rose, and Scott, 2009).

The model builds on the standard QPM specification outlined in Mæhle et al. (2021), which provides a comprehensive overview of recent developments in semi-structural macroeconomic modeling for central banks. Among the extensions discussed in that work, fiscal blocks have received increased attention as prolonged fiscal expansions in many countries have raised questions about medium-term stability. Mæhle et al. propose a relatively simple fiscal block specification focusing on the fiscal impulse while treating stock-flow consistency and debt dynamics outside the model, noting the complexity of more detailed fiscal extensions relative to the parsimonious structure typical of QPMs. A more recent contribution by Berg et al. (2023) develops a comprehensive framework with full stock-flow consistency, fiscal rules, and detailed fiscal accounts. While that framework enables extensive analysis of monetary-fiscal interactions, its implementation demands have limited

operational applications to date. This paper develops a fiscal block that incorporates stock-flow consistency and endogenous fiscal rules while maintaining the tractability characteristic of QPM frameworks.
The model developed in this paper incorporates several features reflecting Korea's economic structure and policy challenges. Given Korea's trade openness and integration into global value chains, we model separate inflation dynamics for core, food, and energy components, recognizing that Korea's net importer status in commodities makes these components sensitive to world price movements and exchange rate fluctuations. We incorporate exchange rate dynamics through a modified uncovered interest parity condition that accounts for country risk premium and captures the currency's responsiveness to domestic and external financial conditions. Most importantly, we introduce a fiscal block featuring government debt dynamics, deficit determination, and a debt-stabilizing fiscal rule. This fiscal extension allows analysis of how the adoption of a medium-term fiscal anchor would affect macroeconomic stability and debt sustainability—questions increasingly relevant given Korea's demographic pressures.

The fiscal block models government debt accumulation through identities linking primary deficits, interest payments, and nominal GDP growth. The fiscal rule adjusts the primary deficit in response to debt deviations from target, similar to Korea's proposed 60 percent debt-to-GDP ceiling. By comparing macroeconomic dynamics with and without debt-stabilizing fiscal rules across various shock scenarios, the model allows examination of trade-offs in fiscal rule design: medium-term debt anchors versus potential short-run procyclicality when shocks affect nominal GDP.

We validate the model through two complementary exercises. Historical decompositions examine how well the model explains past economic developments. Out-of-sample forecast evaluation tests the model's predictive ability. Historical decompositions show that the model captures aspects of Korea's recent experience, with inflation reflecting persistence, exchange rate movements, and demand pressures; output gaps responding to external demand, monetary conditions, and fiscal policy; and monetary policy exhibiting systematic behavior. Forecast performance is reasonable for GDP growth and inflation at policy-relevant horizons, demonstrating the model's suitability for scenario analysis.

Scenario analysis compares model dynamics under two fiscal policy regimes. The first regime implements a debt-stabilizing fiscal rule. The second regime maintains a constant primary deficit regardless of debt developments, representing the absence of a systematic fiscal anchor. We analyze five shock scenarios: a disinflationary supply shock, an exchange rate appreciation, a demand expansion, a monetary policy adjustment, and a fiscal expansion. For the fiscal expansion, we compare temporary versus persistent scenarios. Under each scenario, we examine trade-offs between short-run stabilization and debt dynamics.

The scenario analysis reveals several patterns. Fiscal rules or even a medium-term fiscal anchor may generate short-run procyclicality when shocks affect nominal GDP: the fiscal authority adjusts in response to temporary debt changes, which can amplify shocks and affect the required monetary policy response. However, without fiscal rules, debt tends to drift following shocks as temporary movements in nominal GDP translate into lasting changes in the debt-to-GDP ratio. Korea's demographic trends will raise age-related spending over the medium term, though the pace and magnitude of any erosion of fiscal space depend on offsetting growth, revenue, and expenditure-reform measures. The fiscal expansion scenario illustrates this: temporary expansions accompanied by subsequent adjustment generate manageable debt changes, while persistent expansions without offsetting adjustment produce debt dynamics that would eventually require correction.

The paper is organized as follows. Section II describes the model structure, presenting the behavioral equations for inflation, output, monetary policy, exchange rates, and the fiscal block. Section III discusses model calibration, explaining the parametrization approach and key parameter values. Section IV presents model validation, including historical decompositions and forecast evaluation exercises. Section V presents scenario analysis, comparing dynamics with and without fiscal rules across different shock types. Section VI concludes with observations relevant to Korea's fiscal policy framework discussion.

The Model

This section describes the structure of the Korea QPM. The model combines New Keynesian micro-foundations with sufficient flexibility to fit Korea's macroeconomic data and institutional features. It is built around core behavioral equations that capture aggregate demand, inflation dynamics, exchange rate determination, and monetary policy, extended with a detailed fiscal block that reflects Korea's proposed fiscal rule framework. The model is specified in "gap" form, where observed variables are decomposed into cyclical components (gaps) and long-run equilibrium trends. Gaps represent deviations from equilibrium that can be influenced by monetary and fiscal policies in the short to medium term, while trends capture structural factors such as potential output, the neutral real interest rate, and demographic or technological change that evolve independently of cyclical policies

The Core Model

This section outlines the structure of the Korea QPM model, with further details on the fiscal block provided in the next section.

Aggregate Demand

The output gap evolves according to an IS curve augmented with a fiscal impulse term:

$$\boldsymbol{\hat{y}_t = b_1\hat{y}_{t-1} + b_2 mci_t + b_3\hat{y}^*_t + FISC\_IMP_t + \varepsilon^y_t} \tag{1}$$

where $\boldsymbol{\hat{y}_t}$ is the output gap (the percentage deviation of actual GDP from potential), $\boldsymbol{mci_t}$ is the real monetary conditions index, $\boldsymbol{\hat{y}^*_t}$ is the foreign output gap[1], $\boldsymbol{FISC\_IMP_t}$ is the fiscal impulse, and $\boldsymbol{\varepsilon^y_t}$ is an aggregate demand shock.[2] The lagged output gap $\boldsymbol{\hat{y}_{t-1}}$ captures inertia in aggregate demand due to consumption habits, investment planning lags, and adjustment costs. The coefficient $\boldsymbol{b_1}$ determines the degree of persistence in the

[1] We used a single country (US) GDP gap measure as proxy for the world demand to avoid overcomplicating the model structure.
[2] Consistent with standard QPM practice, the fiscal impulse enters the IS curve as a reduced-form representation of the short-run demand effects of discretionary fiscal policy, while debt sustainability considerations are captured separately through the fiscal rule and debt accumulation equations.

output gap; empirical estimates for Korea suggest moderate persistence consistent with a dynamic open economy.

The real monetary conditions index summarizes the channels through which monetary policy affects real economic activity:

$$\boldsymbol{mci_t = b_4 * (\hat{r}_t + CR\_PREM_t + b_6 * gb\_dev_t) + (1 - b_4)(-\hat{z}_t)} \tag{2}$$

The index comprises two main transmission channels. The interest rate channel, weighted by $\boldsymbol{b_4}$, includes three components: (i) the real interest rate gap $\boldsymbol{\hat{r}_t = r_t - \bar{r}_t}$, measuring the deviation of the real policy rate from its neutral level; (ii) the credit premium $\mathbf{CR\_PREM}_t$, capturing time-varying risk spreads in credit markets that affect borrowing costs beyond the policy rate; and (iii) the expected deviation of government debt from its medium-term target $\mathbf{gb\_dev}_t$, reflecting forward-looking concerns about fiscal sustainability that may tighten financial and lending conditions in a way that is not directly captured by policy interest rates, thereby weighing on private confidence, credit availability, and aggregate demand before fiscal adjustment occurs. The exchange rate channel, weighted by $\boldsymbol{(1 - b_4)}$, operates through the real exchange rate gap $\boldsymbol{\hat{z}_t = z_t - \bar{z}_t}$, where a negative gap (real appreciation) reduces net exports and dampens aggregate demand, while a positive gap (real depreciation) stimulates external demand. The relative weight $\boldsymbol{b_4}$ determines the balance between interest rate and exchange rate channels; for Korea, with its high degree of trade openness, the exchange rate channel plays a substantial role in monetary transmission.

The credit premium follows a first-order autoregressive process:

$$\boldsymbol{CR\_PREM_t = b_5 * CR\_PREM_{t-1} + \varepsilon_t^{CR\_PREM}} \tag{3}$$

capturing persistent fluctuations in credit conditions that arise from time-varying risk aversion, financial market stress, or changes in bank lending standards. The shock $\boldsymbol{\varepsilon_t^{\mathbf{CR\_PREM}}}$ represents unexpected changes in credit spreads, such as those observed during the global financial crisis or the COVID-19 pandemic.

Potential Output and the Natural Rate of Interest. The output gap is defined as $\boldsymbol{\hat{y}_t = y_t - \bar{y}_t}$, where $\boldsymbol{y_t}$ is log real GDP and $\boldsymbol{\bar{y}_t}$ is log potential output. Potential output evolves according to:

$$\begin{gathered}\boldsymbol{\bar{y}_t = \bar{y}_{t-1} + \frac{1}{4}\Delta\bar{y}_t} \\ \boldsymbol{\Delta\bar{y}_t = \rho^{\bar{y}}\Delta\bar{y}_{t-1} + (1 - \rho^{\bar{y}})\Delta\bar{y}^{SS} + \varepsilon_t^{\Delta\bar{y}}}\end{gathered} \tag{4}$$

where $\boldsymbol{\Delta\bar{y}_t}$ is the annualized quarter-on-quarter growth rate of potential output, which follows a persistent process around its steady-state value $\boldsymbol{\Delta\bar{y}^{SS}}$. The shock $\boldsymbol{\varepsilon_t^{\Delta\bar{y}}}$ captures changes in trend growth arising from productivity shifts, labor force developments, or capital accumulation.
The neutral real interest rate $\boldsymbol{\bar{r}_t}$, often referred to as the “natural rate” or $\boldsymbol{r^*}$, is the real interest rate consistent with output at potential and stable inflation. It evolves according to:

$$\boldsymbol{\bar{r}_t = \rho^{\bar{r}}\bar{r}_{t-1} + (1 - \rho^{\bar{r}})\bar{r}^{SS} + \varepsilon_t^{\bar{r}}} \tag{5}$$

The neutral rate is a key unobservable concept in monetary policy. It reflects structural factors such as demographics, productivity growth, and risk preferences. For Korea, estimates suggest the neutral rate has declined over the past two decades, consistent with global trends documented in the literature. The model estimates the neutral rate jointly with other unobservables through Kalman filtering.

Inflation Dynamics

Inflation is decomposed into food, energy, and core (excluding food and energy, denoted XFE) components, allowing the model to capture heterogeneous pass-through of external price shocks and domestic cost pressures. Each component follows a New Keynesian Phillips curve:

$$\pi_t^i = a_{1,i}\pi_{t-1}^i + \left(1 - a_{1,i}\right)E_t\pi_{t+1}^i + a_{2,i}rmc_t^i + \varepsilon_t^i \tag{6}$$

for $i \in \{\mathbf{F}, \mathbf{E}, \mathbf{XFE}\}$, where π_t^i is the annualized quarter-on-quarter inflation rate for component i, $E_t\pi_{t+1}^i$ is the expected inflation for the next quarter, $\mathbf{rmc}_t^i$ is the real marginal cost relevant for component i, and ε_t^i is a cost-push shock. The backward-looking term $a_{1,i}\pi_{t-1}^i$ captures inflation persistence arising from indexation, menu costs, or adaptive expectations. The forward-looking term $\left(1 - a_{1,i}\right)E_t\pi_{t+1}^i$ reflects rational expectations and forward-looking price-setting behavior. The weight $a_{1,i}$ on backward-looking inflation determines the degree of inertia; empirical estimates for Korea suggest substantial persistence, particularly in core inflation. The slope coefficient $a_{2,i}$ governs the sensitivity of inflation to real marginal costs. A higher slope implies faster pass-through of cost pressures to inflation. Cross-country evidence suggests this coefficient varies across inflation components, with food and energy inflation typically more responsive to their specific cost drivers than core inflation.

Real Marginal Costs. The real marginal costs for each inflation component capture the relevant supply-side pressures:

$$\begin{aligned} rmc_t^F &= a_{3,F}\hat{y}_t + (1 - a_{3,F})(\widehat{rp}_t^{WF} + \hat{z}_t - \widehat{rp}_t^F) \\ rmc_t^E &= a_{3,E}\hat{y}_t + (1 - a_{3,E})(\widehat{rp}_t^{RWOIL} + \hat{z}_t - \widehat{rp}_t^E) \\ rmc_t^{XFE} &= a_{3,XFE}\hat{y}_t + (1 - a_{3,XFE})(\hat{z}_t - \widehat{rp}_t^{XFE}) \end{aligned} \tag{7}$$

For food inflation, marginal costs depend on the output gap $\hat{y}_t$ (with weight $a_{3,\mathbf{F}}$), capturing domestic demand pressures, and on world food prices $\widehat{\mathbf{rp}}_t^{\mathbf{WF}}$ adjusted for the exchange rate gap $\hat{z}_t$ and relative to the domestic food price gap $\widehat{\mathbf{rp}}_t^{\mathbf{F}}$ (with weight $1 - a_{3,\mathbf{F}}$). This specification allows for both domestic and imported sources of food price inflation. Similarly, energy inflation reflects domestic demand conditions and world oil prices $\widehat{\mathbf{rp}}_t^{\mathbf{RWOIL}}$ adjusted for exchange rate movements. Core inflation depends on the output gap and the real exchange rate gap, with the latter capturing import price pressures on domestically produced goods and services. The relative weights $a_{3,i}$ determine the balance between domestic demand-pull and external cost-push factors. For Korea, with its significant dependence on imported food and energy, external factors play an important role in food and energy inflation, while core inflation is more closely tied to domestic demand conditions.

Headline CPI Aggregation. Headline CPI is constructed as a weighted average of the three components:

$$\boldsymbol{l\_cpi_t = w_f * l\_cpi_t^F + w_E * l\_cpi_t^E + \left(1 - w_f - w_E\right) * l\_cpi_t^{XFE} + shkn\_l\_cpi_t} \tag{8}$$

where $\boldsymbol{w_F}$ and $\boldsymbol{w_E}$ are the weights of food and energy in the CPI basket (calibrated to match Korea's current CPI structure), and $\mathbf{shkn\_cpi}_{\boldsymbol{t}}$ is a correction term that ensures the model-implied headline CPI matches the actual observed CPI component series historically. This term follows a random walk:

$$\boldsymbol{shkn\_cpi_t = shkn\_cpi_{t-1} + \varepsilon_t^{cpi}} \tag{9}$$

Capturing persistent measurement discrepancies or changes in the CPI basket composition over time.

Relative Price Trends. Each inflation component's relative price is defined as:

$$\boldsymbol{rp_t^i = cpi_t^i - cpi_t} \tag{10}$$

and decomposed into trend and gap:

$$\boldsymbol{rp_t^i = \bar{rp}_t^i + \widehat{rp}_t^i} \tag{11}$$

The trends in relative prices evolve according to:

$$\boldsymbol{\Delta \bar{rp}_t^i = \rho^i \Delta \bar{rp}_{t-1}^i + (1 - \rho^i)\Delta rp^{i,SS} + \varepsilon_t^{\Delta rp_i}} \tag{12}$$

for $\boldsymbol{i} \in \{\mathbf{F}, \mathbf{XFE}\}$. The energy relative price trend is determined residually to ensure that the weighted sum of relative price trends equals zero (by construction of the price index). These trends capture long-run structural changes in relative prices, such as shifts in agricultural productivity, changes in global commodity markets, or evolving consumption patterns. The gaps $\widehat{\mathbf{rp}}_{\boldsymbol{t}}^{\boldsymbol{i}}$ represent temporary deviations from these trends that arise from cyclical factors.

Exchange Rate Dynamics

The nominal exchange rate (defined as Korean won per unit of foreign currency, so an increase represents depreciation) is determined by a modified uncovered interest parity (UIP) condition:

$$\boldsymbol{l_{s_t} = l_{s_{t+1}}^{e} + \frac{i_t^* - i_t + prem_t}{4} + \varepsilon_t^{l_s}} \tag{13}$$

where $\boldsymbol{l_t}$ is the log nominal exchange rate, $\boldsymbol{l_{t+1}^e}$ represents exchange rate expectations, $\boldsymbol{i_t}$ and $\boldsymbol{i_t^*}$ are the domestic and foreign nominal interest rates (in percent per annum), $\mathbf{prem}_{\boldsymbol{t}}$ is a country risk premium, and $\boldsymbol{\varepsilon_t^s}$ is an exchange rate shock capturing deviations from UIP due to portfolio shifts, intervention, or market sentiment.

Adaptive Exchange Rate Expectations. Exchange rate expectations combine forward-looking rational expectations with backward-looking trend extrapolation:

$$\boldsymbol{l\_s^e_{t+1} = (1 - e_1)E_t\{l\_s_{t+1}\} + e_1(l\_s_{t-1} + \frac{2}{4}\Delta\overline{l\_s}_t)} \tag{14}$$

The parameter $\boldsymbol{e_1}$ controls the degree of backward-looking behavior. When $\boldsymbol{e_1 = 0}$, expectations are fully rational and model-consistent. When $\boldsymbol{e_1 > 0}$, agents partially base their expectations on recent trends, introducing inertia into exchange rate dynamics. This formulation helps the model capture the observed persistence in exchange rate movements and the gradual adjustment to shocks documented in the empirical literature.

The trend depreciation rate $\boldsymbol{\Delta\overline{l\_z}_t}$ is determined by inflation differentials and equilibrium real exchange rate movements:

$$\boldsymbol{\Delta\overline{l\_s}_t = \overline{\pi}_t - \overline{\pi}^*_t + \Delta\overline{l\_z}_t} \tag{15}$$

where $\boldsymbol{\bar{\pi}_t}$ and $\boldsymbol{\bar{\pi}^*_t}$ are domestic and foreign trend inflation rates, and $\boldsymbol{\Delta\bar{z}_t}$ is the equilibrium real exchange rate depreciation.

Equilibrium Real Exchange Rate. The real exchange rate is defined as:

$$\boldsymbol{z_t = l_t + \mathrm{cpi}^*_t - \mathrm{cpi}_t} \tag{16}$$

and decomposed into trend and gap:

$$\boldsymbol{z_t = \bar{z}_t + \hat{z}_t} \tag{17}$$

The equilibrium real exchange rate trend $\boldsymbol{\bar{z}_t}$ captures long-run factors such as productivity differentials (Balassa-Samuelson effects), terms of trade shifts, and changes in net foreign asset positions. It evolves according to:

$$\boldsymbol{\Delta\bar{z}_t = \rho^{\Delta\bar{z}}\Delta\bar{z}_{t-1} + (1 - \rho^{\Delta\bar{z}})\Delta\bar{z}^{SS} + \varepsilon^{\Delta\bar{z}}_t} \tag{18}$$

with the steady-state depreciation rate $\boldsymbol{\Delta\bar{z}^{SS}}$ calibrated to match Korea's long-run real exchange rate trend, which has exhibited periods of both appreciation (reflecting productivity catch-up) and depreciation.
The model also includes a forward-looking equilibrium UIP condition that determines the risk premium:

$$\boldsymbol{\Delta\bar{z}_{t+1} = \bar{r}_t - \bar{r}^*_t - \mathrm{prem}_t} \tag{19}$$

This condition links the equilibrium real exchange rate path to interest rate differentials and the risk premium, ensuring consistency between real and nominal exchange rate trends.

Monetary Policy Rule

The central bank follows a forward-looking Taylor rule with interest rate smoothing:

$$\boldsymbol{i_t = g_1 i_{t-1} + (1 - g_1)(i^n_t + g_2(E_t\{\pi_{t+3}\} - \pi^T_{t+3}) + g_3\hat{y}_t) + \varepsilon^i_t} \tag{20}$$

The policy rate $\boldsymbol{i_t}$ responds to three factors: (i) the neutral nominal interest rate $\boldsymbol{i_t^n}$, which is derived from the real equilibrium interest rate $\bar{\boldsymbol{r}}_t$ and a measure of inflation expectations[3]; (ii) the expected deviation of year-on-year inflation three quarters ahead from the inflation target, $\boldsymbol{E_t\{\pi_{t+3}\} - \pi_{t+3}^T}$; and (iii) the current output gap $\hat{\boldsymbol{y}}_t$. The smoothing parameter $\boldsymbol{g_1}$ captures the central bank's preference for gradualism in policy rate changes, reflecting concerns about financial market volatility and uncertainty about the economy's state. Empirical estimates for Korea suggest substantial smoothing, consistent with the Bank of Korea's observed policy behavior. The inflation response coefficient $\boldsymbol{g_2}$ determines how aggressively the central bank responds to inflation deviations. The Taylor principle requires a response to expected inflation shifts with a coefficient larger than 1 for determinacy, which corresponds to having $\boldsymbol{g_2 > 0}$in the specification used in the model, where it is reflecting the "excess" movement of the interest rates (as inflation expectations already enter the definition of the neutral nominal interest rate with a coefficient of 1). In practice, estimates for Korea suggest a response coefficient around 1.15, indicating that the real interest rate rises when inflation exceeds target. A matching value of $\boldsymbol{g_2}$ was selected to provide a good fit to Korea's observed policy dynamics, while the interest-rate smoothing parameter captures the gradual adjustment of the policy rate. The output gap coefficient $\boldsymbol{g_3}$ reflects the central bank's concern for economic stabilization beyond its inflation objective. For Korea, this coefficient is moderate, consistent with a flexible inflation targeting framework that tolerates some short-run inflation-output trade-offs.
The monetary policy shock $\boldsymbol{\varepsilon_t^i}$ represents discretionary deviations from the systematic rule due to judgment, data uncertainty, or financial stability considerations not captured in the output gap and inflation measures.

Inflation Target. The inflation target $\boldsymbol{\pi_t^T}$ is allowed to vary gradually around its steady-state level:

$$\boldsymbol{\pi_t^T = \rho^{\pi^T} * \pi_{t-1}^T + \left(1 - \rho^{\pi^T}\right)\overline{\pi}^{SS} + \varepsilon_t{}^{\pi^T}} \tag{21}$$

with $\bar{\boldsymbol{\pi}}^{SS} = \mathbf{2}$ percent (the Bank of Korea's official target). While the target is formally constant in Korea, allowing for small persistent deviations accommodates potential changes in the effective operational target or perceptions about the central bank's commitment.

The Fiscal Block

The fiscal block extends the core model to capture the government's budget constraint, debt dynamics, and fiscal policy rules. The fiscal block allows the model to analyze monetary-fiscal policy interactions, debt sustainability, and the macroeconomic implications of alternative fiscal strategies. For tractability, the fiscal block is specified in terms of the structural primary deficit and therefore abstracts from automatic stabilizers, focusing instead on discretionary fiscal policy and debt dynamics.

[3] Following the approach recently implemented in Abderrahim et al (2026) we introduce a few stabilizing elements to the definition of the neutral rate that ensure its low short-run volatility. In particular, we define inflation expectations through a combination of core inflation and a relative price trend. On top of that, we add a persistence term to the definition of the nominal neutral rate. The resulting specification becomes: $\boldsymbol{i_t^n = 0.8 * i_{t-1}^n + 0.2 * (\bar{r}_t + E_t\{\pi_{t+1}^C\} - E_t\{\Delta r\bar{p}_{t+1}^C\})}$. This specification still ensures that interest rates increase at least 1 on 1 with the increase of inflation expectations, though tends to smooth out the reaction of the neutral rates over time in case of one-off inflationary shocks.

Deficit Decomposition

The overall government deficit (as a share of GDP) is decomposed into the structural primary deficit and interest payments:

$$\boldsymbol{def_t = def\_str_t + ip\_gB_t + \varepsilon_t^{def}} \tag{22}$$

where $\mathbf{def}_t$ is the total deficit, $\mathbf{def\_str}_t$ is the structural primary deficit (net of interest payments and adjusted for the cycle), $\mathbf{ip\_gB}_t$ is interest payments on government debt, and $\boldsymbol{\varepsilon}_t^{\mathbf{def}}$ is a residual term capturing factors that affect the fiscal balance but are not explicitly modeled, including contingent liabilities, one-off fiscal operations, and measurement discrepancies. This decomposition separates discretionary fiscal policy decisions (captured in $\mathbf{def\_str}_t$) from the endogenous debt service burden ($\mathbf{ip\_gB}_t$). It allows the model to distinguish between fiscal impulses that directly affect aggregate demand and the impact of interest payments on debt accumulation and debt sustainability.

Fiscal Rule and Fiscal Impulse

The structural primary deficit adjusts in response to deviations of government debt from its medium-term target:

$$\boldsymbol{def\_str_t = \bar{def\_str}_t - \Gamma_2 \cdot gb\_dev_t + \varepsilon_t^{def\_str}} \tag{23}$$

where $\mathbf{\bar{def\_str}}_t$ is the trend structural deficit, $\mathbf{gb\_dev}_t$ measures the deviation of actual debt from its target level, and $\boldsymbol{\Gamma_2}$ is the fiscal response coefficient. The fiscal rule embodies two key features. First, the trend structural deficit $\mathbf{\bar{def\_str}}_t$ represents the desired long-run fiscal stance, taking into account structural spending needs and revenue capacity. Second, the rule builds in automatic fiscal adjustment when debt deviates from target: if debt rises above target ($\mathbf{gb\_dev}_t > \mathbf{0}$), the structural deficit falls below trend, generating primary surpluses that stabilize debt. Conversely, if debt falls below target, the rule allows for larger deficits. The parameter $\boldsymbol{\Gamma_2}$ governs the speed of fiscal adjustment. A higher $\boldsymbol{\Gamma_2}$ implies faster consolidation in response to debt deviations, which strengthens fiscal credibility but may amplify short-run output costs. For Korea, the calibration of $\boldsymbol{\Gamma_2}$ is informed by the proposed framework, which includes a 60 percent debt-to-GDP ceiling.

Debt Deviation. The deviation of debt from target is defined as:

$$\boldsymbol{gb\_dev_t = \rho^{gb\_dev}\left(gb_t - \bar{gb}_t\right) + (1 - \rho^{gb\_dev})E_t\{gb\_dev_{t+1}\}} \tag{24}$$

This formulation introduces forward-looking behavior: the effective debt gap depends on both the current deviation and expected future deviations. This captures the idea that fiscal policy responds not only to current debt levels but also to the expected debt trajectory, consistent with multi-year budget planning and debt management strategies.

Debt Target. The target debt-to-GDP ratio follows:

$$\boldsymbol{\bar{gb}_t = \rho^{\bar{gb}}\bar{gb}_{t-1} + \left(1 - \rho^{\bar{gb}}\right)\bar{gb}^{SS} + \varepsilon_t^{\bar{gb}}} \tag{25}$$

where $\mathbf{g\bar{B}}^{SS} = \mathbf{60}$ percent, reflecting Korea's proposed fiscal rule. This specification allows for gradual adjustment toward the long-run target while accommodating short-run deviations due to shocks or policy decisions.

Debt and Deficit Targets Connection. The equation below essentially defines the target deficit as "a level of deficit that is consistent with keeping the debt at its target level". This ensures consistency between the (exogenous) debt target and (essentially endogenous) deficit target.

$$\bar{gb}_t = \bar{def}\_str_t + \bar{\iota p}\_gb_t + \frac{\bar{gb}_t}{1 + \frac{\Delta \bar{ny}_t}{400}} + \varepsilon_t^{\bar{def}\_str}$$

Fiscal Impulse. The definition of fiscal impulse uses the changes in annual primary deficit-to-GDP ratio (deficit-to-GDP accumulated over the last 4 quarters) and maps these changes to GPD growth. This aims to capture the gradual transmission of fiscal expenditures through the economy and the persistent, smoothed impact of changes in expenditures on growth, as commonly observed in the data. This smoothing is further augmented by introducing inertia in the fiscal impulse dynamics:

$$FISC_{IMP_t} = c1_{fi} * FISC_{IMP_{t-1}} + c2_{fi} * FISC_{IMP_{t-2}} + c3\_fi * \left(def\_str\_ann_t - def\_str\_ann_{t-1} + \varepsilon_t^{def}\right) \quad (26)$$

where $\varepsilon_t^{\mathbf{def}}$ captures unconventional fiscal actions.

Debt Accumulation and Interest Payments

Government debt evolves according to the budget constraint:

$$gb_t = def_t + \frac{gb_{t-1}}{1 + \frac{\Delta ny_t}{400}} + \varepsilon_t^{gB} \quad (27)$$

where gb_t is the debt-to-GDP ratio, and Δny_t is the annualized nominal GDP growth rate (in percent). The denominator adjusts for the mechanical reduction in the debt-to-GDP ratio due to nominal GDP growth. The shock $\varepsilon_t^{\mathbf{gb}}$ captures stock-flow adjustments that affect debt independently of the fiscal deficit, such as valuation effects on foreign-currency debt, below-the-line operations, and off-balance-sheet liabilities.

Interest payments on government debt are determined by:

$$ip\_gb_t = \rho^{ip} \cdot ip\_gb_{t-1} + (1 - \rho^{ip}) \cdot \frac{rs\_gb_{t-1}}{400} \cdot \frac{gb_{t-1}}{1 + \frac{\Delta ny_t}{400}} + \varepsilon_t^{ip\_gB} \quad (28)$$

where $\mathbf{rs\_gb_t}$ is the effective interest rate on government debt (in percent per annum), reflecting the weighted average rate across the government's bond portfolio. The persistence parameter $\boldsymbol{\rho}^{\mathbf{ip}}$ captures the gradual pass-through of interest rate changes to debt service costs as outstanding debt is rolled over.

Sovereign Interest Rate.

The effective interest rate on government debt follows:

$$\boldsymbol{rs\_gb_t = \rho^{rs\_gb} \cdot rs\_gb_{t-1} + (1-\rho^{rs\_gb})\left(i_t + prem_t^{gb}\right) + \varepsilon_t^{rs\_gb}} \tag{29}$$

where $\boldsymbol{prem_t^{gb}}$ is the sovereign risk premium, capturing the additional spread between government borrowing costs and the policy rate that reflects sovereign risk perceptions and other factors affecting government financing conditions. The persistence parameter $\boldsymbol{\rho^{rs\_gb}}$ provides a reduced-form representation of the maturity structure of government debt by capturing the gradual pass-through of policy rates and sovereign risk premia to the effective interest rate on the outstanding debt stock as debt is refinanced. This premium responds to debt levels:

$$\boldsymbol{prem_t^{gb} = \rho^{prem\_gb} \cdot prem_{t-1}^{gb} + (1-\rho^{prem\_gb})(prem^{gBb,SS} + b_7 \cdot gb\_dev_t) + \varepsilon_t^{prem\_gb}} \tag{30}$$

The coefficient $\boldsymbol{b_7}$ governs the sensitivity of the risk premium to debt deviations. When debt rises above target, the sovereign premium increases, raising borrowing costs and strengthening the incentive for fiscal consolidation. This feedback effect is central to understanding debt sustainability and the interaction between fiscal credibility and macroeconomic stability.

Nominal GDP Approximation

The fiscal block requires a measure of nominal GDP growth to compute debt-to-GDP dynamics. Nominal GDP growth is approximated as:

$$\boldsymbol{\Delta ny_t = \Delta y_t + \pi_t + discr_t^{\Delta ny}} \tag{31}$$

where $\boldsymbol{\Delta y_t}$ is real GDP growth, $\boldsymbol{\pi_t}$ is headline inflation, and $\mathbf{discr}_t^{\Delta\mathbf{ny}}$ is a discrepancy term that captures differences between GDP deflator inflation (used in national accounts) and CPI inflation (modeled explicitly). This term follows an AR(1) process:

$$\boldsymbol{discr_t^{\Delta ny} = \rho^{discr} \cdot discr_{t-1}^{\Delta ny} + (1-\rho^{discr}) \cdot discr^{\Delta ny,SS} + \varepsilon_t^{discr}} \tag{32}$$

Similarly, trend nominal GDP growth is:

$$\boldsymbol{\Delta n\bar{y}_t = \Delta \bar{y}_t + \pi_t^T + discr_t^{\Delta ny}} \tag{33}$$

These approximations allow the model to maintain internal consistency between real and nominal variables while recognizing that GDP deflator and CPI inflation can diverge due to different coverage and weighting.

Calibration

The Korea QPM model is calibrated rather than estimated, following the standard approach across other QPM frameworks (Abradu-Otoo et al., 2024). Steady state values reflect Korea-specific factors – including the inflation target and the proposed fiscal rule's debt-to-GDP ceiling – and expert judgement. Model parameters and relative standard deviations of shocks were calibrated with reference to similar economies in the region, impulse response analysis, and data filtration results to ensure the model produces plausible dynamics and fits the Korean data well. Table 1 lists the parameter values of the key behavioral equations.

Table 1. Calibration Parameters of Key Behavioral Equations

Parameter		Value	Parameter		Value
IS curve			Energy Phillips curve		
Persistence	b_1	0.5	Persistence	$a_{1,E}$	0.25
Monetary conditions index	b_2	-0.2	Real marginal costs	$a_{2,E}$	0.05
External demand	b_3	0.2	Relative weight of local to international factors	$a_{3,E}$	0
Weight of real interest rate gap in monetary conditions index	b_4	0.7			
Credit premium persistence	b_5	0.7	Exchange rate		
			Persistence	e_1	0.2
Core Phillips curve					
Persistence	$a_{1,XFE}$	0.5	Monetary policy rule		
Real marginal costs	$a_{2,XFE}$	0.25	Persistence	g_1	0.8
Relative weight of local to international factors	$a_{3,XFE}$	0.85	Inflation deviation reaction	g_2	0.15
			Weight of output gap	g_3	0.15
Food Phillips curve					
Persistence	$a_{1,F}$	0.25	Fiscal block		
Real marginal costs	$a_{2,F}$	0.1	Debt deviation reaction	Γ_2	0.15
Relative weight of local to international factors	$a_{3,F}$	0.25	Weight of current debt deviation from target	ρ^{gb_dev}	0.5

Model Validation

This section assesses whether the calibrated framework accurately reflects Korean macroeconomic dynamics and can support reliable policy analysis. We employ two complementary validation approaches: historical interpretation through equation-based decompositions and forecast accuracy evaluation of the key behavioral equations through pseudo out-of-sample exercises. Historical decompositions reveal whether the model's interpretation of past economic developments aligns with institutional knowledge and conventional narratives. Forecast evaluation tests whether the model can anticipate future developments based on limited information. Together, these exercises demonstrate that the model captures key features of Korea's economy and provides a credible foundation for scenario analysis.

Historical Data Interpretation

Historical decompositions reveal the drivers the model uses to explain Korea's macroeconomic fluctuations. These decompositions attribute observed outcomes to contributions from various components in the model's behavioral equations—such as monetary conditions, external demand, and fiscal impulses in the IS curve, or inflation persistence, exchange rate movements, and demand pressures in the Phillips curve. This approach provides economic intuition directly connected to the model's structure, making results readily interpretable and verifiable against conventional economic narratives[4].

As is common with semi-structural models, we use equation-based decompositions rather than shock decompositions. Equation-based decompositions identify broad drivers (monetary conditions, foreign demand) that can be connected to observable economic developments and policy actions. Shock decompositions, which attribute outcomes to specific structural shocks, can yield unreliable results when models contain non-linearities—as in the fiscal block—and depend substantially on the decomposition algorithm employed. The equation-based approach maintains economic clarity while avoiding these technical complications.

The decompositions address several requirements central to model validation. The filtered gap variables should correspond to established understanding of Korea's historical economic dynamics. Residual errors should be small, indicating good model specification, or attributable to known one-off factors beyond the model's scope—such as pandemic-related disruptions or region-specific shocks. The model's interpretation of historical episodes should align with institutional knowledge and narrative accounts from policymakers and analysts. Meeting these criteria provides confidence that the model embodies sensible economic mechanisms.

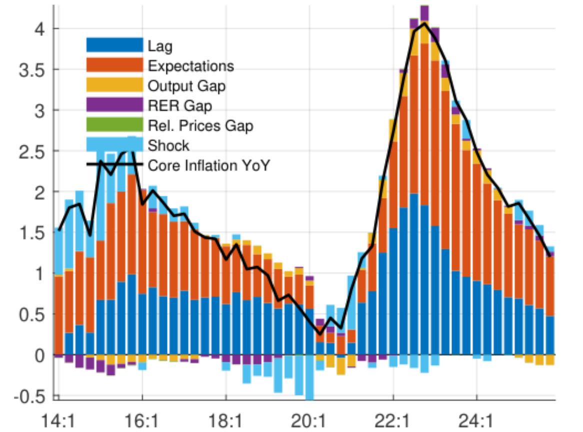
Inflation Dynamics

Core inflation in Korea has been driven primarily by three factors: inflation persistence, exchange rate movements, and domestic demand pressures. The calibrated Phillips curve allocates these influences in proportions consistent with both econometric evidence and economic intuition. Inflation persistence—captured through the backward-looking component of the Phillips curve—accounts for a substantial share of core inflation variation. The calibrated parameter of 0.5 implies that roughly half of current inflation reflects past inflation, with the remainder determined by forward-looking expectations and current cost pressures. This persistence generates considerable inertia: once inflation begins rising or falling, sustained policy action is required to reverse the trend. The decomposition shows the persistent component (which incorporates backward-looking inflation expectations) dominating during stable periods, consistent with anchored but adaptive expectations.

[4] The equation-based decompositions used in this section provide an operationally useful interpretation of historical developments. It should be noted that, although they look more intuitive and provide a less technical way of summarizing macroeconomic developments compared to conventional shock decompositions, some caution is needed while using them to infer about causal relationships.

Figure 1 illustrates these contributions over 2014-2024. The decomposition shows inflation expectations dominating during stable periods, with exchange rate and output gap effects becoming more pronounced during the pandemic and recovery. The post-COVID inflation surge appears to be driven primarily by exchange rate depreciation and strong domestic demand, as reflected in significant positive contributions from both the real exchange rate gap and the output gap during 2021-2022. Residual shocks remain modest throughout most of the sample, suggesting the model captures the main inflation drivers. This observation aligns with extensive literature documenting inflation persistence and the expectations channel as critical features of inflation dynamics.

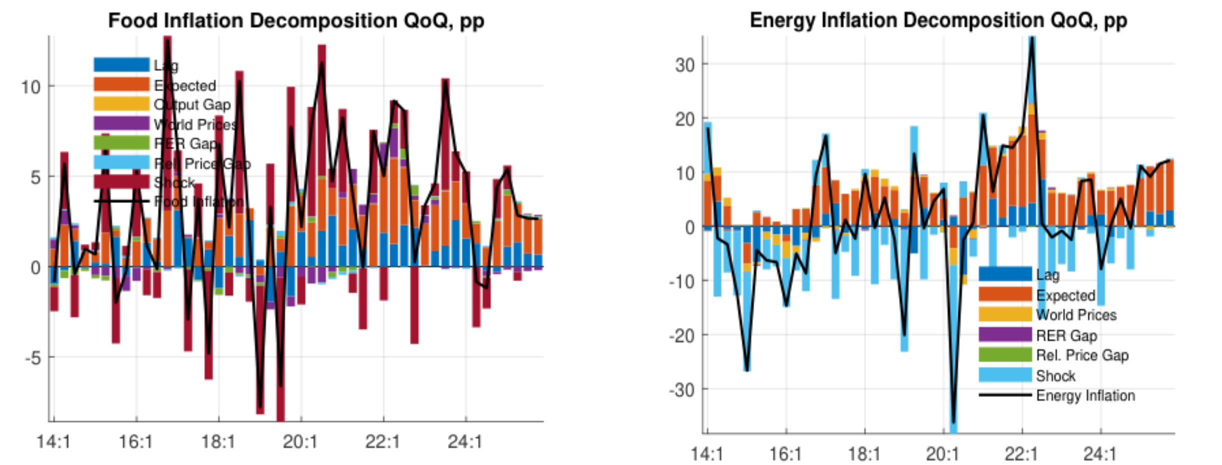
Figure 1. Core Inflation Decomposition (YoY)



Food and energy inflation exhibit greater volatility than core inflation and are dominated by external factors. The separate Phillips curves for these components—a key feature of the model's inflation block—allow them to respond primarily to their specific drivers rather than being mechanically tied to core inflation dynamics. Food and energy inflation dynamics are driven largely by fluctuations in global commodity prices. Korea's status as a net importer of both food and energy, combined with deep integration into global supply chains, makes these components highly sensitive to world market developments. World commodity prices and exchange rate movements together account for approximately 75 percent of food inflation variation and 100 percent of energy inflation variation, with domestic demand playing a secondary role. The post-COVID period saw particularly large commodity price shocks. World food prices surged due to supply chain disruptions, adverse weather, and geopolitical tensions, pushing Korean food inflation to around 7 percent year-on-year in mid-2022. World oil prices rose sharply from pandemic lows, driving energy inflation above 20 percent year-on-year in early 2022.

Figure 2 shows the decompositions for food and energy inflation. World commodity prices (adjusted for exchange rates) account for the majority of variation in both components. Domestic demand contributions are visible but secondary. Residual shocks are larger than for core inflation, reflecting these components' inherent volatility and sensitivity to factors beyond the model's scope—such as weather shocks, trade disruptions, or geopolitical events. The decompositions validate the model's treatment of food and energy as separate components with distinct drivers.

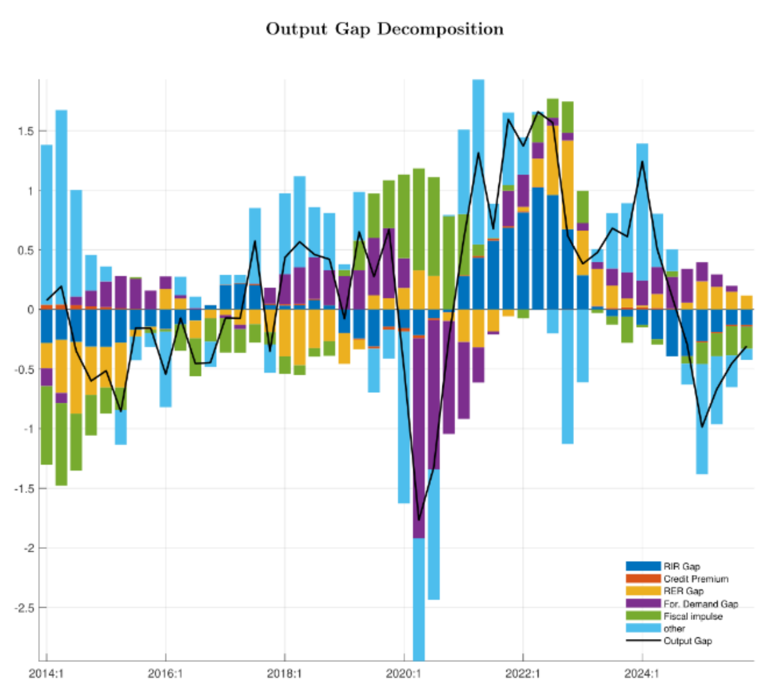
Figure 2. Food and Energy Inflation Decompositions



Output Gap Dynamics

The output gap decomposition reveals the relative importance of domestic versus external factors in Korea's business cycle. External demand consistently plays a prominent role, reflecting Korea's export orientation and integration into global value chains. The COVID-19 pandemic induced a sharp output gap contraction to approximately -1.8 percent in 2020Q2. The decomposition shows this decline was driven primarily by collapsing external demand (large negative purple bars representing foreign demand gap). Fiscal policy (green bars) provided substantial offsetting support during 2020-2021, with positive fiscal impulse contributions visible throughout this period as the government implemented aggressive pandemic response measures.

Figure 3. Output Gap Decomposition



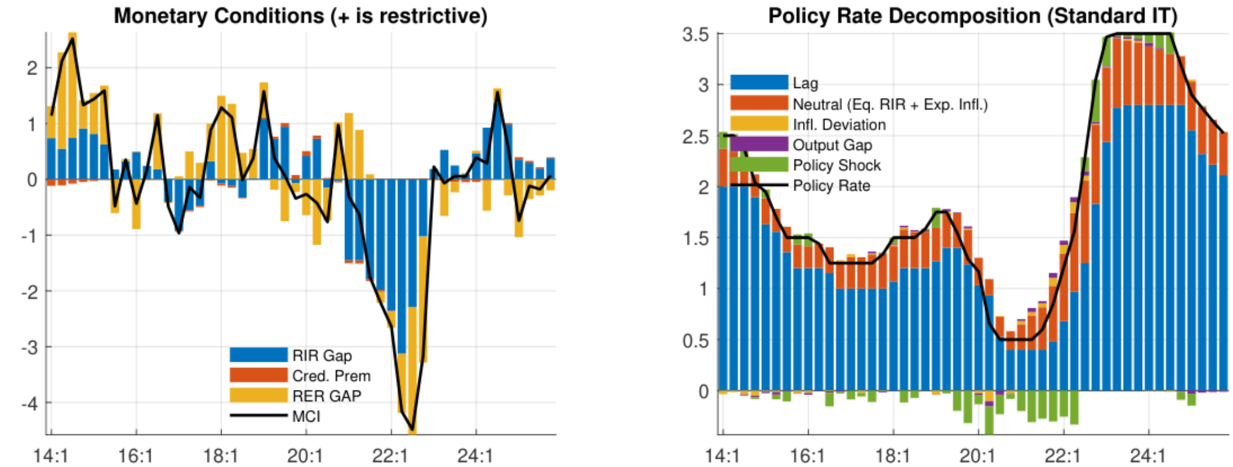
The post-pandemic recovery in 2021-2022 saw the output gap turn strongly positive by approximately 1.2 percent on average. This recovery was supported by multiple factors: accommodative monetary conditions (positive dark blue RIR gap contributions), recovering external demand (purple bars turning positive), and continued fiscal support (positive green bars). By 2023-2024, policy normalization began restraining demand. The RIR gap contributions diminished and fiscal impulse turned neutral to slightly negative (green bars near zero), while external demand remained supportive. Figure 3 illustrates these contributions. The decomposition aligns well with Korea's recent economic performance: an external demand-driven contraction in 2020, strong policy-supported recovery in 2021-2022, and gradual normalization in 2023-2024.

Monetary Policy Stance

The decomposition of monetary policy reveals important insights about the stance and transmission of monetary policy during recent episodes. The left panel shows the monetary conditions index, which combines interest rate and exchange rate effects, where positive values indicate restrictive conditions. The right panel decomposes the policy rate into contributions from the Taylor rule components: the lagged rate (smoothing), the neutral rate adjusted for expected inflation, inflation deviations from target, the output gap, and policy shocks reflecting deviations from systematic behavior. In 2020, the Bank of Korea cut policy rates by 75 basis points cumulatively in response to the pandemic shock. However, the monetary conditions index shows that despite these cuts, the policy stance remained restrictive in the first half of 2020 as the RIR gap (blue bars) stayed positive. Real interest rates initially increased as inflation expectations fell faster than nominal rates, keeping monetary conditions tight in the short run. This was reversed by the end of the year, as inflation expectations fully adjusted. The policy rate decomposition (right panel) shows that actual rates remained slightly below what the Taylor rule prescribed during 2021-2022, visible as negative green policy shock bars. The model interprets this persistent accommodation as deliberate support for economic recovery, with the central bank prioritizing output stabilization over strict adherence to the systematic rule.

Exchange rate movements played a significant role in monetary conditions during the post-pandemic period. The MCI decomposition (left panel) shows large negative contributions from the RER gap (yellow bars) during 2021-2022, indicating that won depreciation substantially loosened monetary conditions. This exchange rate effect helped maintain an accommodative overall stance even as the Bank of Korea began raising rates in 2022. The policy rate increased by 275 basis points cumulatively during 2022-2023, visible in the right panel as the black line rising sharply. However, the MCI shows more gradual tightening than interest rates alone would suggest, as exchange rate depreciation (negative yellow bars) partially offset the restrictive impact of higher policy rates. By 2023-2024, monetary conditions normalized as both interest rates stabilized and exchange rate effects diminished. The decomposition demonstrates that for a small open economy like Korea, the exchange rate channel represents an important component of the monetary transmission mechanism, sometimes reinforcing and sometimes offsetting interest rate policy.

Figure 4. Monetary Conditions Index & Policy Rate Decomposition



Evaluation of Forecast Accuracy

Forecast evaluation tests whether the model can project economic developments based on limited information. While historical fit demonstrates that the model can replicate known outcomes when all information is available, forecasting exercises assess whether the model can anticipate future developments. This is a more stringent test of its practical usefulness and a critical requirement for scenario analysis. In our assessment of forecast accuracy, we focus on conditional evaluation of the forecasts generated by the model's core behavioral equations.

Methodology

We evaluate forecast performance through pseudo out-of-sample forecasting, a widely used cross-validation technique. This approach involves sequentially withholding portions of historical data, generating forecasts, comparing them to actual outcomes, and calculating forecast errors. It offers a practical alternative to a fully recursive out-of-sample forecast evaluation.[5] The key difference of the exercise that we report is the recursive forecasts on trends and external variables derived from the full-sample filter outcome. This approach isolates the behavioral equations' forecasting performance from the inherent difficulty of forecasting supply-side trends and external developments. For semi-structural models, which typically model trends as parsimonious autoregressive processes without deep structural content, this conditioning provides an undiluted assessment of the core model mechanics. The rationale stems from how the model would be used in practice: in operational forecasting, assumptions about trend variables—potential output growth, the neutral interest rate, equilibrium exchange rates—would be informed by additional analysis and data beyond simple mechanical extrapolation. Similarly, external sector assumptions (U.S. economic conditions, commodity prices) would typically incorporate information from specialized forecasts or market expectations rather than relying solely on model-based projections.

[5] The forecast accuracy evaluation based on recursively estimated trends, judgmental and external assumptions available at each forecast origin would of course provide an even more rigorous assessment. However, it can be carried out only after the model is used to generate conditional forecasts over a sufficiently long period of time, accumulating a database of these real-time forecasts. While such database is not available yet, conditioning on full-sample values provides a meaningful alternative.

Starting from 2015Q1, we generate six-quarter-ahead forecasts conditioning on actual data for: external variables (U.S. GDP, inflation, and interest rates), commodity prices (world oil and food prices), fiscal variables (government debt and deficit), and trends that are estimated using the full set of historical data up to the end of 2025 (potential output, neutral interest rate, equilibrium exchange rate, relative price trends). After generating each forecast, we add one quarter of actual data and repeat, creating a sequence of six-quarter-ahead forecasts through 2024Q4. This yields a substantial sample of forecast errors across different economic conditions—stable periods, the pandemic shock, and the recovery—allowing comprehensive performance assessment. Forecast accuracy is measured using Root Mean Squared Error (RMSE):

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(\hat{y}_i - y_i)^2} \tag{34}$$

where $\boldsymbol{y_i}$ is the actual value and $\boldsymbol{\hat{y}_i}$ is the forecast. To facilitate comparison across variables with different units and scales, we report relative RMSE, which compares the model's RMSE to that of a naive random walk forecast:

$$\hat{y}_t^{naive} = y_{t-1}$$

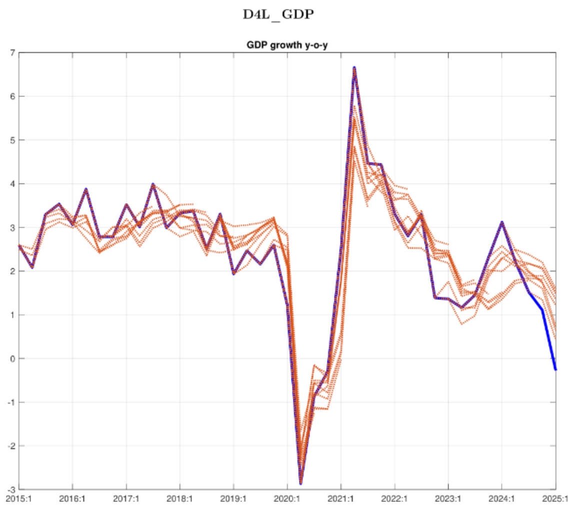
$$RMSE_{naive} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(\hat{y}_i^{naive} - y_i\right)^2} \tag{35}$$

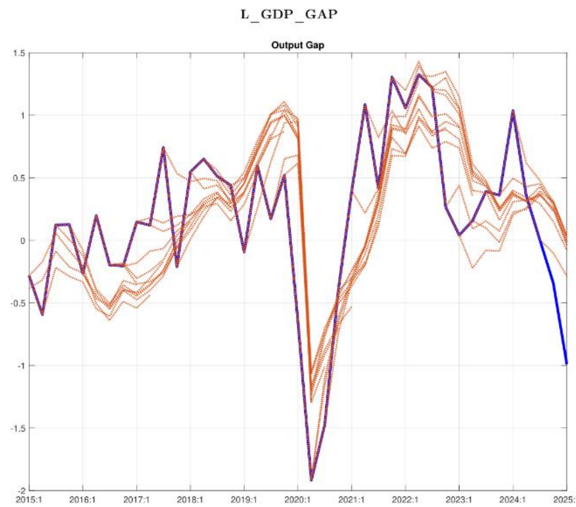
If the relative RMSE $\left(\frac{RMSE}{RMSE_{naive}}\right)$ is less than one, the model outperforms the naïve benchmark, providing an improvement in the forecast accuracy. A value greater than one suggests the opposite. The random walk serves as a natural benchmark because it is difficult to outperform at short horizons for many macroeconomic variables, particularly inflation. Alternative forecast error metrics exist—such as Mean Absolute Error (MAE) and Mean Absolute Percentage Error (MAPE)—but empirical experience and literature generally find these yield qualitatively similar conclusions. RMSE relative to a random walk remains the most prevalent metric for reporting forecast quality in the QPM literature.

GDP Growth and Output Gap

The model demonstrates strong forecasting performance for GDP growth and the output gap. Actual series (solid lines) closely track predicted paths (dotted lines) over most of the sample. The model successfully anticipated the pandemic-induced contraction in 2020, the sharp recovery in 2021, and the subsequent moderation in 2022-2024. Forecast errors are smallest during stable periods and largest during the initial pandemic shock, when exceptional uncertainty affected all forecasting frameworks. Quantitatively, the model significantly outperforms the random walk benchmark across all forecast horizons for GDP. This strong performance reflects the importance of external drivers and fiscal variables, which are conditioned on actual data and therefore do not contribute to forecast error. The model's structural links from these drivers to output—through the foreign output gap and fiscal impulse terms in the IS curve—provide substantial predictive content beyond simple extrapolation.

Figure 5. Real GDP Growth and Output Gap





YoY GDP growth

	t+1	t+2	t+3	t+4	t+5	t+6
Mean	0.01	0.00	−0.00	−0.01	−0.02	−0.01
Median	−0.04	−0.16	−0.10	0.00	0.07	0.00
Std	0.53	0.59	0.60	0.74	0.77	0.79
SE	0.27	0.33	0.35	0.54	0.57	0.61
RMSEvsRW	0.39	0.31	0.25	0.28	0.30	0.31

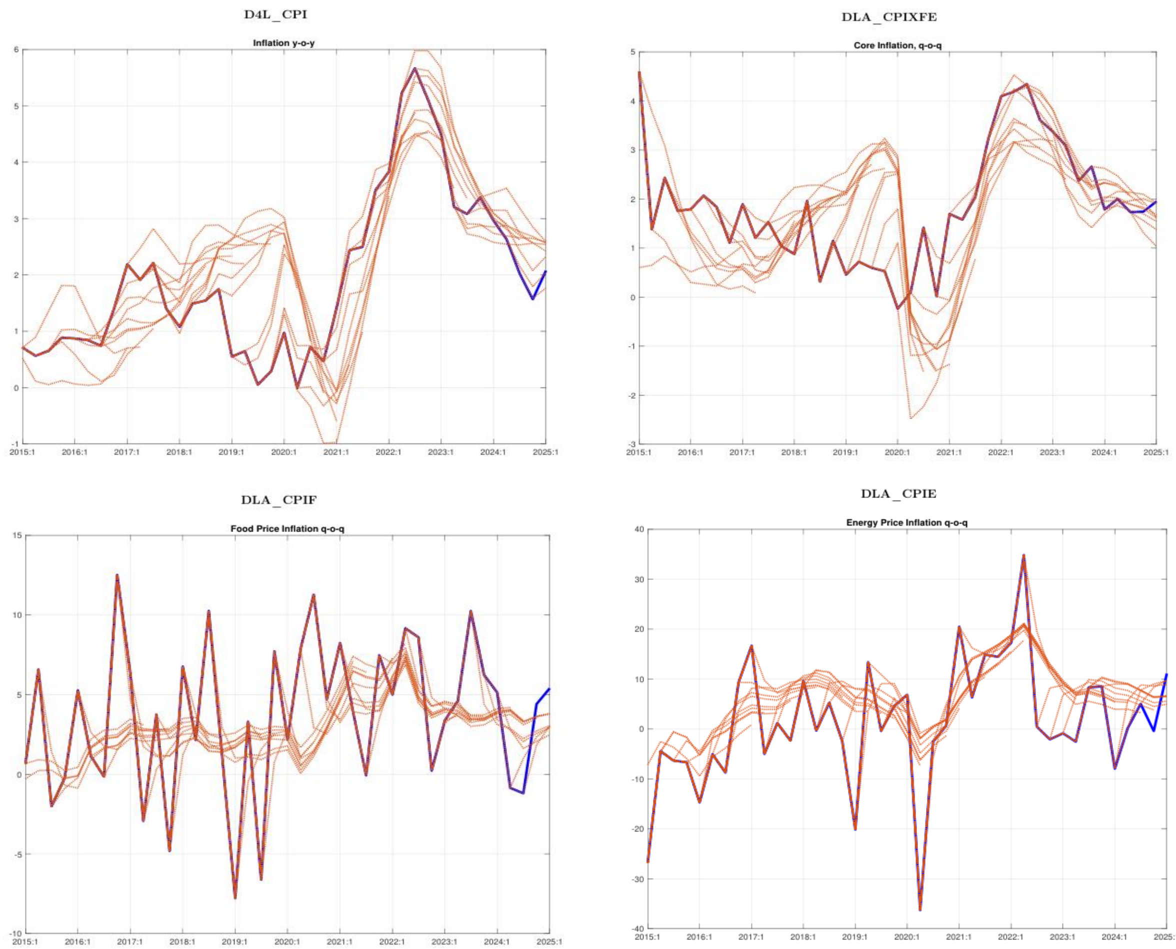
Output Gap

	t+1	t+2	t+3	t+4	t+5	t+6
Mean	0.01	0.00	−0.00	−0.01	−0.02	−0.01
Median	−0.04	−0.16	−0.10	−0.09	−0.04	−0.04
Std	0.53	0.59	0.60	0.59	0.56	0.53
SE	0.27	0.33	0.35	0.33	0.31	0.27
RMSEvsRW	0.90	0.73	0.61	0.55	0.54	0.48

Inflation

Inflation forecasting performance varies across components and horizons, consistent with extensive literature documenting that random walk forecasts are difficult to outperform at short horizons. The forecasts generally align well with actual dynamics, with some exceptions during the pre-pandemic period when unforeseen negative shocks to food and energy prices shifted relative prices and induced disinflationary pressures in core inflation. Core inflation forecasts perform well across all horizons, consistent with core inflation's central role in the model and its closer connection to modeled drivers such as the output gap and exchange rate. Food and energy inflation forecasts are less accurate, reflecting these components' high volatility and sensitivity to commodity price shocks that remain difficult to predict even when conditioning on actual commodity price trends. However, modeling these components separately serves an important practical purpose: it allows assumptions about agricultural conditions, energy market developments, or planned policy changes to be incorporated without mechanically affecting core inflation projections.

Figure 6. Inflation



YoY Inflation

	t+1	t+2	t+3	t+4	t+5	t+6
Mean	0.18	0.25	0.30	0.25	0.19	0.13
Median	0.16	0.09	0.17	0.00	0.06	0.00
Std	0.59	0.87	1.11	1.17	1.19	1.15
SE	0.37	0.80	1.28	1.40	1.41	1.31
RMSEvsRW	0.99	0.97	0.92	0.80	0.72	0.60

QoQ Core Inflation

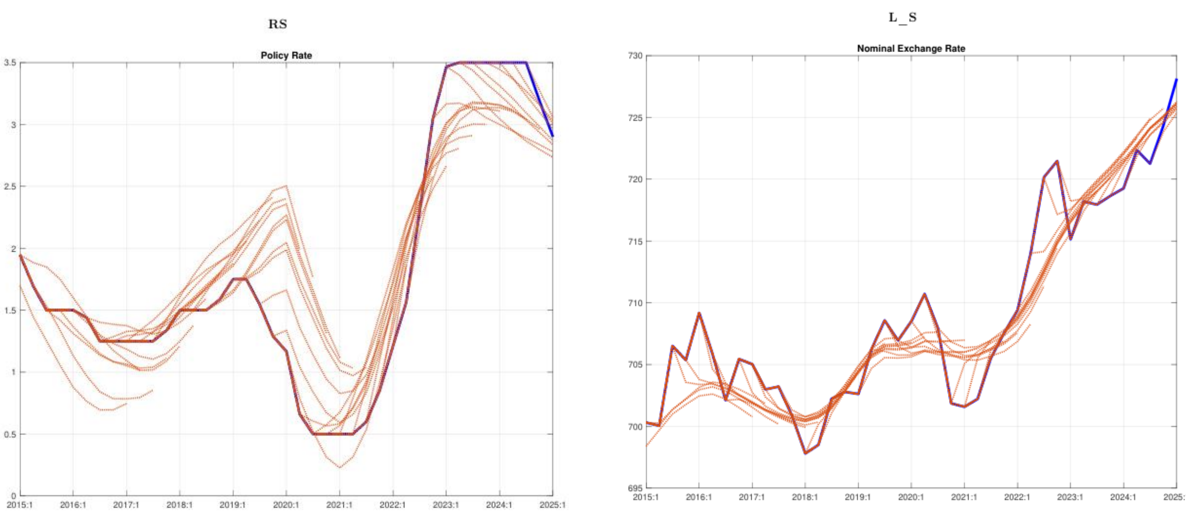
	t+1	t+2	t+3	t+4	t+5	t+6
Mean	−0.04	−0.09	−0.11	−0.13	−0.13	−0.12
Median	−0.04	−0.31	−0.15	−0.19	−0.28	−0.31
Std	1.09	1.21	1.28	1.28	1.24	1.20
SE	1.16	1.43	1.61	1.60	1.53	1.42
RMSEvsRW	1.22	1.44	1.17	0.97	0.85	0.73

Quantitative measures confirm these patterns. The model consistently delivers forecast accuracy improvements over longer horizons. This aligns well with extensive literature on inflation forecasting, which often finds that random walk forecasts are among the best-performing models for short-term inflation prediction—a result attributed to inflation persistence and the difficulty of forecasting near-term price changes (see, for example, Stock and Watson, 1999). The model's stronger performance at medium horizons (three to six quarters) reflects its structural content becoming more valuable as cyclical factors and policy responses accumulate over time.

Interest Rates and Exchange Rates

Interest rate and exchange rate forecasts align reasonably well with actual data. For interest rates, the random walk outperforms the model at shorter horizons, indicating that actual Bank of Korea decisions deviated from the model's Taylor rule prescription. Much of this deviation occurred during 2020-2022, when the central bank prioritized economic support over strict adherence to systematic rules. However, over longer horizons—particularly those relevant for monetary policy—the model's forecasts show notable improvement in accuracy. This pattern suggests the central bank exercises considerable short-run discretion in response to data uncertainty and financial stability concerns while maintaining medium-term orientation toward systematic responses to inflation and output gaps. Exchange rate forecasts moderately outperform the random walk, consistent with the modified uncovered interest parity condition providing some structure for medium-term movements while short-term fluctuations remain largely unpredictable.

Figure 7. Interest Rate and Exchange Rate



Policy Rate

	t+1	t+2	t+3	t+4	t+5	t+6
Mean	0.06	0.08	0.09	0.09	0.09	0.10
Median	0.06	0.08	0.10	0.01	0.00	0.00
Std	0.27	0.35	0.41	0.46	0.50	0.52
SE	0.08	0.12	0.17	0.21	0.25	0.27
RMSEvsRW	1.14	0.76	0.64	0.56	0.50	0.46

Nom. Exch. Rate, 100*log

	t+1	t+2	t+3	t+4	t+5	t+6
Mean	−0.63	−0.67	−0.54	−0.47	−0.31	−0.25
Median	−0.35	0.00	−0.19	0.00	0.00	0.00
Std	2.88	2.97	2.87	2.84	2.69	2.69
SE	8.48	9.04	8.33	8.06	7.15	7.09
RMSEvsRW	0.96	0.67	0.54	0.45	0.38	0.35

Summary Assessment

The validation exercises demonstrate that the model captures important features of Korean macroeconomic dynamics and can support reliable policy analysis. GDP growth forecasts substantially outperform naive benchmarks, demonstrating the value of the model's structural links from external conditions and policy to domestic output. Inflation forecasts perform reasonably well, particularly for core inflation at medium horizons where the model's behavioral content matters most. Interest rate forecasts improve at policy-relevant horizons, suggesting the Taylor rule captures medium-term policy orientation despite short-run discretion. Exchange rates show moderate predictability consistent with modified uncovered interest parity providing some structure for trend movements. Recognized limitations—particularly short-term inflation and interest rate forecast

errors—indicate areas where additional information and analysis should complement model-based projections. These limitations do not undermine the model's value for scenario analysis and medium-term policy discussions but rather highlight that mechanical forecasts should be combined with institutional knowledge, market information, and careful assessment of current conditions**Simulations and Scenario Analysis**
This section examines how fiscal rules affect macroeconomic dynamics by comparing model responses under two fiscal policy regimes. The first regime implements a debt-stabilizing fiscal rule, where the fiscal authority adjusts the primary deficit in response to deviations of debt from its target. This specification resembles Korea's proposed fiscal framework, which targets a 60 percent debt-to-GDP ratio with a 3 percent deficit ceiling. The second regime maintains a constant primary deficit regardless of debt developments, representing the absence of a systematic fiscal anchor. The comparison illustrates how the presence or absence of fiscal rules influences the economy's response to various shocks and the resulting implications for debt sustainability and macroeconomic stability.

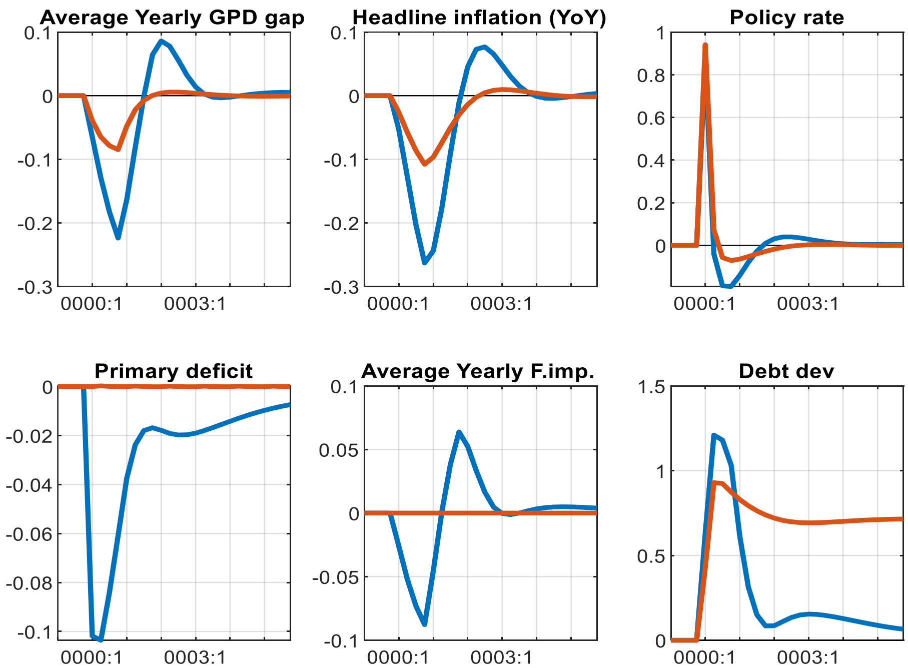
We analyze five shock scenarios: a monetary policy tightening, a fiscal expansion, a disinflationary supply shock, an exchange rate appreciation, and a demand expansion. These scenarios span different types of disturbances—affecting prices, external conditions, real activity, and policy instruments—allowing a comprehensive assessment of fiscal rule implications across various circumstances. In each case, blue lines show dynamics with the debt-stabilizing rule, while orange lines show dynamics without systematic fiscal response. The simulations demonstrate how fiscal rules interact with monetary policy and shape the adjustment process following economic disturbances. For Korea, understanding these interactions is particularly relevant amid rising age-related spending pressures and demographic headwinds to potential growth.

Monetary Policy Shock

A monetary policy shock—modeled as a temporary 100 basis point increase in the policy rate above the Taylor rule prescription—illustrates how fiscal rules affect monetary transmission and the division of stabilization responsibilities between authorities. The rate increase contracts demand, reducing both output and inflation. Lower nominal GDP mechanically raises the debt-to-GDP ratio. With a debt-stabilizing rule, fiscal policy must tighten to return debt to target. This consolidation amplifies the contractionary impulse: the output gap declines further, inflation falls more, and the eventual monetary easing required to restore equilibrium must be larger and more prolonged. The fiscal response reveals the rule's procyclical tendency. The fiscal authority responds mechanically to the debt increase even though the rate increase represents a temporary deviation from systematic policy that will be reversed. This response amplifies the macroeconomic costs, generating greater output loss and deeper disinflation than would occur with monetary policy adjustment alone. The monetary shock scenario highlights a limitation of simple fiscal rules: they cannot distinguish between permanent changes requiring fiscal adjustment and temporary fluctuations better left unaddressed.

Without a fiscal rule, monetary policy can reverse the temporary deviation without fiscal amplification. Fiscal policy does not respond to temporary debt fluctuations, allowing monetary policy alone to manage the stabilization process. Adjustment is faster and less volatile, but debt rises permanently due to the temporary nominal GDP decline. The trade-off is clear: fiscal rules prevent permanent debt drift but may amplify temporary macroeconomic volatility when monetary policy deviates from systematic behavior. The simulation suggests that fiscal rule design—particularly the speed of adjustment to debt deviations—affects the magnitude of this amplification.

Figure 8. Monetary Policy Shock (1pp shock to the Taylor rule equation)



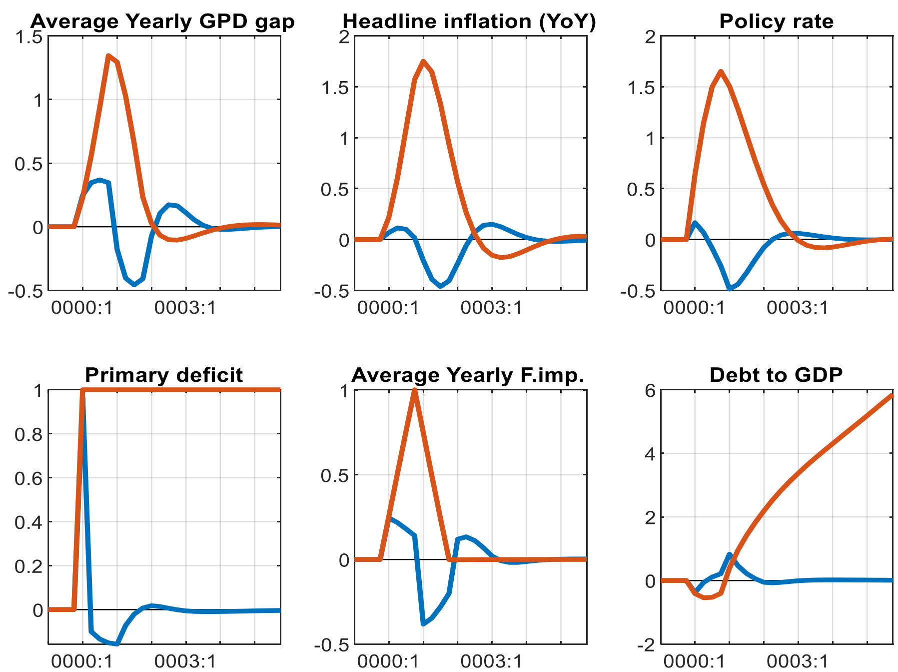
Blue line: model with a fiscal rule; Orange line: model without a fiscal rule.

Fiscal Shock: Transitory versus Persistent Expansion

A fiscal expansion shock—modeled as an exogenous 1 percentage point increase in the primary deficit—illustrates most directly the consequences of abandoning fiscal discipline. We compare two scenarios: a temporary expansion where the fiscal rule eventually reasserts itself, and a persistent expansion where the higher deficit continues indefinitely. In the temporary expansion scenario (blue line), the deficit increase stimulates demand, raising the output gap and generating inflationary pressure. Monetary policy tightens to offset these pressures. The fiscal impulse gradually fades as the debt-stabilizing rule requires consolidation to return debt to target. The temporary stimulus generates a brief boom followed by necessary restraint, with debt ultimately returning to target. The charts show that while the blue line exhibits short-run volatility in output, inflation, and interest rates, all variables stabilize and debt returns to its baseline level within the forecast horizon.

In the persistent expansion scenario (orange line), the higher deficit continues without correction. Initial effects mirror the temporary case: demand expands, inflation rises, monetary policy tightens. But without fiscal consolidation, debt grows continuously. As the debt-to-GDP ratio rises without bound, interest payments consume increasing shares of revenue, requiring further borrowing, ultimately leading to with debt rising faster than GDP indefinitely. The persistent scenario is not an equilibrium—eventually markets would demand higher risk premia, forcing fiscal adjustment—but it illustrates the fundamental point: without an effective medium-term fiscal anchor, expansionary impulses may generate risks to debt sustainability. Figure 9 shows the stark contrast. Temporary expansions, generate manageable debt increases followed by stabilization. Persistent expansions in the absence of rules or anchors lead to sustained increases in debt. When evaluating these simulation results, however, caution is warranted as the model specification abstracts from potential supply-side impacts of productive public spending - such as investments in R&D, infrastructure, and demographic transition - which can enhance potential output growth and expand the GDP denominator over the medium to long term. Given these structural limitations of the model, the policy simulation results should be interpreted with appropriate nuance rather than taken as prescriptive.

Figure 9. Fiscal Shock (1pp shock to the primary deficit equation)

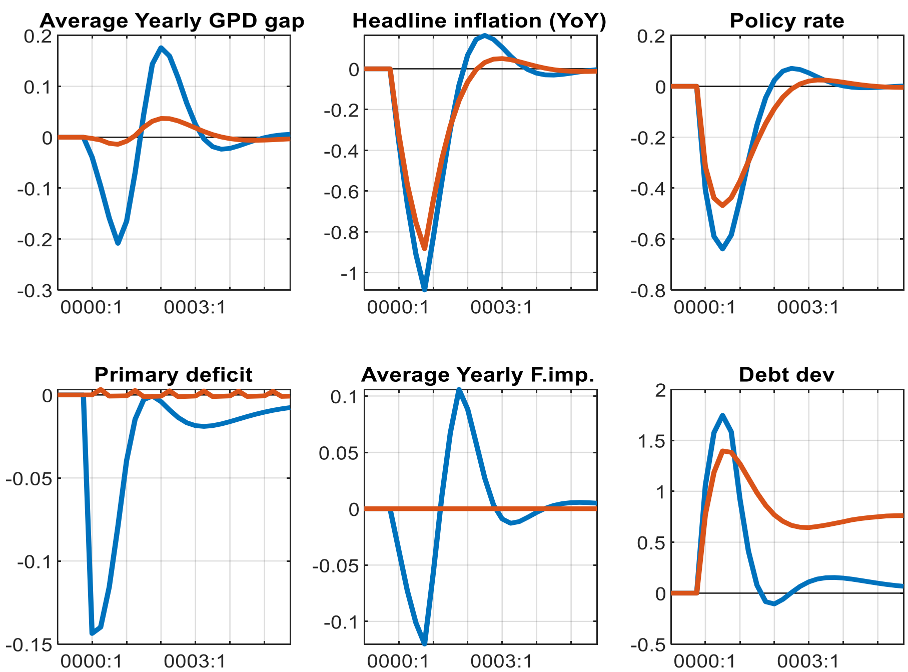


Supply Shock

A disinflationary shock—modeled as a negative cost-push disturbance—illustrates the tension between debt stabilization and cyclical flexibility. The shock reduces inflation and nominal GDP, mechanically raising the debt-to-GDP ratio even as real debt remains unchanged. With a debt-stabilizing rule, fiscal policy must tighten to return debt to target. The fiscal contraction reinforces the initial disinflationary impulse: the output gap declines further, adding to downward pressure on prices. Monetary policy must ease more aggressively to offset both the original shock and the procyclical fiscal response, cutting rates deeper and for longer. The economy experiences greater short-run volatility in both inflation and output. However, this volatility delivers medium-term stability. As monetary easing succeeds in returning inflation to target and closing the output gap, nominal GDP recovers to its trend path. With debt now below target—due to earlier fiscal consolidation—the rule prescribes fiscal expansion. Deficits rise, providing demand stimulus that supports the recovery. The debt-to-GDP ratio returns to target as both numerator and denominator stabilize.

Without a fiscal rule, adjustment appears smoother in the short run. Fiscal policy does not respond to the temporary debt increase, avoiding procyclical consolidation. Monetary policy alone manages stabilization, cutting rates to offset the disinflationary shock. Output and inflation gaps close faster with less volatility. But the price level remains permanently lower than baseline, as the disinflation is never fully reversed. Nominal GDP settles at a lower level, while the nominal deficit remains unchanged. The debt-to-GDP ratio rises permanently, as lower nominal GDP raises the ratio. This permanent debt increase reflects the absence of a fiscal anchor: without a rule forcing adjustment, one-time shocks to the price level translate into permanent debt shifts. Figure 10 illustrates these dynamics. The trade-off is clear: fiscal rules generate short-run volatility but ensure debt returns to target. Without rules, stabilization is smoother but debt remains permanently higher.

Figure 10. Supply Shock (negative 1pp shock to the core inflation)



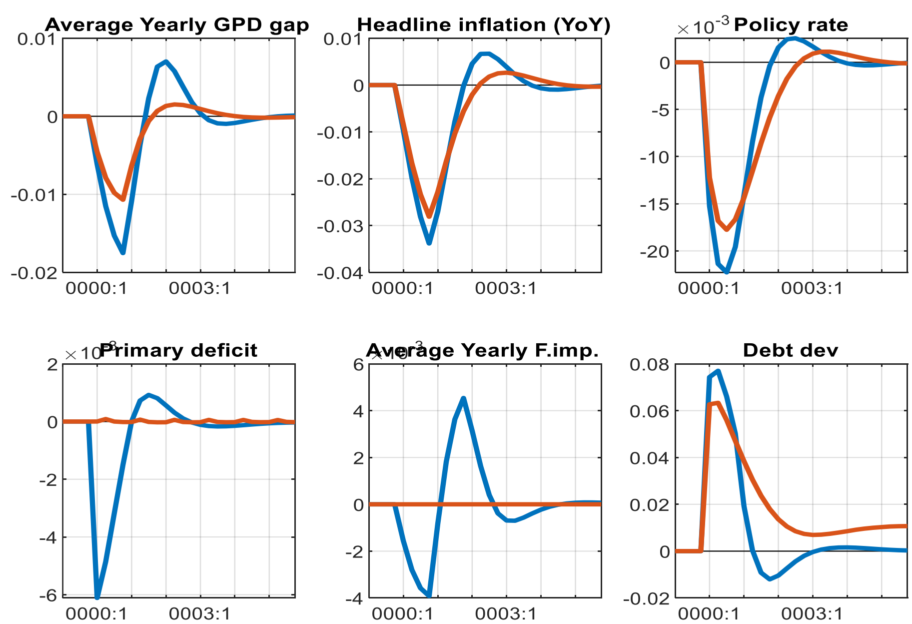
Blue line: model with a fiscal rule; Orange line: model without a fiscal rule.

Exchange Rate Shock

An exchange rate appreciation shock—modeled as an exogenous strengthening of the won—produces similar dynamics through slightly different channels. Appreciation reduces import prices, generating disinflationary pressure. It also weakens external demand for Korean exports, contracting the output gap. Both effects reduce nominal GDP growth, raising the debt-to-GDP ratio. With a debt-stabilizing rule, fiscal policy tightens to offset the debt increase. This consolidation amplifies the demand contraction from lost export competitiveness, forcing more aggressive monetary easing. The economy experiences greater short-run volatility but debt returns to target as nominal GDP eventually recovers. The magnitude of fiscal adjustment required depends on debt composition: if a substantial share of government debt is foreign-currency denominated, appreciation automatically reduces the won value of that debt, partially offsetting the nominal GDP effect. For Korea, where most government debt is won-denominated, this automatic stabilizer is limited.

Without a fiscal rule, the debt-to-GDP ratio rises persistently as lower nominal GDP raises the ratio without triggering fiscal adjustment. The exchange rate scenario highlights how fiscal rules interact with external shocks in Korea's economy. Given Korea's export orientation and integration into global value chains, exchange rate movements significantly affect both inflation and output. Without fiscal anchors, external shocks generate permanent debt effects as nominal GDP shifts translate directly into lasting changes in the debt-to-GDP ratio. With rules, temporary volatility in output and inflation ensures medium-term debt stability. For Korea's highly open economy, where exchange rate fluctuations are frequent and often driven by global financial conditions beyond domestic control, the permanent debt drift from repeated external shocks poses particular risks in the absence of systematic fiscal discipline.

Figure 11. Exchange Rate Shock (negative 1pp shock to the UIP equation)

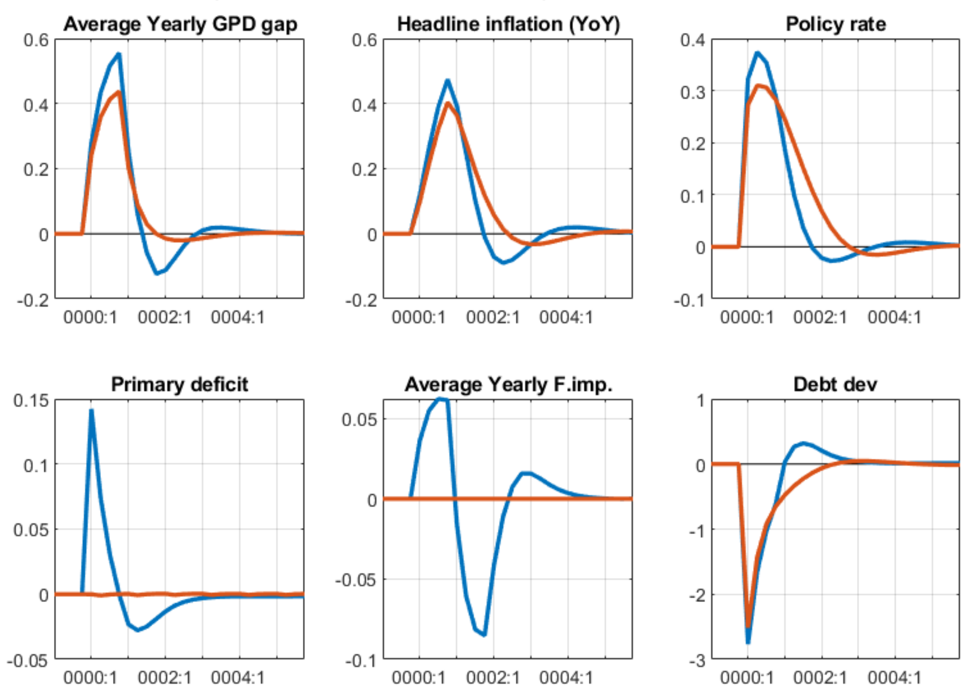


Demand Shock

A positive demand shock—modeled as an exogenous increase in the output gap—illustrates fiscal rule implications for real shocks. Unlike nominal shocks, demand disturbances affect real GDP directly, generating both output and inflation movements. With a debt-stabilizing rule, fiscal policy's procyclical response is less pronounced than in nominal shock cases. The demand expansion raises both real and nominal GDP, reducing the debt-to-GDP ratio. The fiscal rule prescribes expansion to return debt to target, reinforcing the initial demand impulse. Output rises further above potential, and inflation increases more than without fiscal response. Monetary policy tightens more aggressively to offset the combined demand pressures from the original shock and accommodative fiscal policy. The amplification is temporary. As monetary tightening closes the output gap, nominal GDP growth moderates. Debt gradually returns to target as deficits adjust. The economy converges to steady state with both output and debt at target levels.

Without a fiscal rule, the initial demand impact is smaller. Fiscal policy does not respond to temporary debt declines, providing no additional stimulus. Monetary policy alone manages stabilization, raising rates to close the output gap and return inflation to target. For real shocks, the trade-off differs from nominal shock cases. Fiscal rules still generate volatility, but the medium-term outcome ensures debt returns to target. The key question is whether the short-run amplification outweighs the value of maintaining the debt anchor. For demand shocks, the costs appear more modest than for supply shocks, as fiscal and monetary policies work in the same direction rather than conflicting. For Korea, where domestic demand shocks are often amplified by credit cycles and household balance sheet effects, the fiscal rule's ability to stabilize debt outweighs the modest additional volatility it generates during expansion phases.

Figure 12. Demand Shock (1pp shock to the IS curve)



Blue line: model with a fiscal rule; Orange line: model without a fiscal rule.

Conclusion

This paper develops a quarterly projection model for Korea with an integrated fiscal block to analyze monetary-fiscal policy interactions. The model includes government debt dynamics and fiscal policy rules that adjust deficits in response to debt deviations from target. Validation exercises show the model captures Korea's macroeconomic dynamics reasonably well. Scenario analysis comparing dynamics with and without debt-stabilizing fiscal rules reveals a fundamental trade-off. Fiscal rules generate short-run procyclicality when shocks affect nominal GDP, requiring more aggressive monetary responses and creating temporary volatility. However, without fiscal rules, debt drifts permanently as temporary nominal GDP movements translate into lasting debt-to-GDP changes. For Korea, there is near-term fiscal space but structural fiscal pressures from population aging and rising age-related spending are likely to intensify in the coming years. The analysis illustrates a trade-off: a medium-term anchor can limit debt drift from repeated shocks, but — as the simulations show — it can also introduce short-run procyclicality and constrain the flexibility needed to accommodate structural spending. The appropriate framework is therefore a policy choice for the authorities, weighing these costs and benefits against the discipline already provided by Korea's existing medium-term budget framework

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