



Macroeconomic Stabilization in an Era of Deepening Economic Integration: Global Monetary Tightening, the Integrated Policy Framework, and South Korea's Structural Transition

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Abstract This study investigates the cross-border propagation of foreign interest rate shocks in an era of deepening financial globalization and evaluates stabilization policies within the IMF's Integrated Policy Framework. We find that advanced economies implement counter-cyclical monetary policy, whereas emerging markets are often forced into pro-cyclical rate hikes due to inflationary pressures. Augmenting monetary policy with foreign exchange intervention (FXI) or capital flow management (CFM) enhances stabilization, with FXI yielding superior outcomes in mitigating output and price volatility. We further recalibrate the model to reflect South Korea's transition to a net external creditor since 2014 amid deepening economic integration, a shift that appears to act as a structural stabilizer, dampening exchange rate depreciation and output contractions. However, the integrated policy mix entails a trade-off: stabilizing output while increasing consumption and trade balance volatility. These findings highlight the need to weigh output stabilization gains against the accompanying increase in consumption and external account volatility.

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I. Introduction

In the aftermath of the COVID-19 pandemic, the global economy experienced an unprecedented surge in inflation. As illustrated in Figure 1, consumer price inflation across major economies remained subdued throughout 2019 and 2020, but escalated rapidly from the second quarter of 2021. In the United States, CPI inflation rose from 1.4% in January 2021 to over 9% by June 2022. The Euro area followed a similar trajectory, peaking at 10.6% in October 2022. Small open advanced economies, such as Canada and the United Kingdom, recorded peaks

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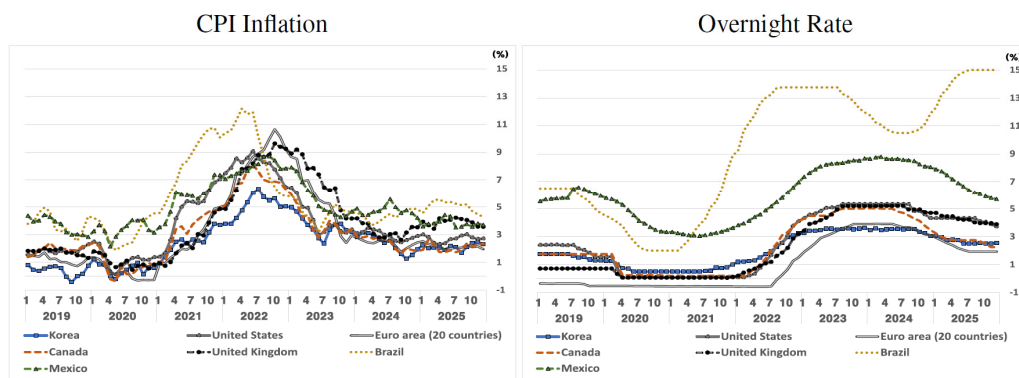
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of approximately 8% and 10%, respectively, while emerging markets experienced equally severe pressures, with Brazil reaching 12.1% and Mexico exceeding 8%. South Korea's CPI inflation also rose sharply from below 1% in early 2021 to 6.3% by July 2022. The origins of this episode were multifaceted: massive pandemic-era fiscal and monetary stimulus, persistent supply chain disruptions, pent-up consumer demand, and the Russia-Ukraine conflict, which triggered sharp increases in energy and food prices.

Figure 1. Global inflation and monetary tightening



Note. 1) CPI inflation is calculated on a year-over-year basis using the monthly national Consumer Price Index (CPI) for total expenditure.

2) The overnight rate is recorded at a monthly frequency and refers to immediate interest rates, including call money and interbank rates, expressed in percent per annum.

(Source) Author's calculations based on OECD Data (accessed February 2026).

In response, central banks worldwide embarked on one of the most aggressive monetary tightening cycles in recent history, as shown in the right panel of Figure 1. The U.S. Federal Reserve raised the federal funds rate by a cumulative 525 basis points from March 2022 to July 2023, highlighted by four consecutive 75-basis-point increases from June through November 2022 — the largest single-meeting increments since 1994. Other major central banks also raised interest rates sharply, with overnight rates rising steeply across both advanced and emerging economies throughout 2022 and 2023.

This synchronized global monetary tightening poses significant challenges for small open economies (SOEs). In an era of deepening economic integration, global monetary tightening facilitates cross-border business cycle propagation by widening interest rate differentials and triggering capital outflows. However, the severity of these external shocks differs markedly between advanced economies (AEs) and emerging market economies (EMEs). While AEs often benefit from deep FX markets and anchored inflation expectations, EMEs are more susceptible to risk-off sentiment and sharp currency depreciation, which can undermine financial stability. Consequently, policymakers in many EMEs have long utilized a broader policy mix that

complements monetary policy with foreign exchange intervention (FXI) and capital flow management (CFM) to mitigate external shocks. This multifaceted approach has recently been endorsed by the IMF and OECD, recognizing the necessity of an integrated policy toolkit to maintain macroeconomic and financial stability. Indeed, recent empirical studies confirm that emerging markets are particularly vulnerable to global risk conditions and policy uncertainty, which significantly shape capital inflows and sudden stop episodes (Veeravel and Balakrishnan, 2025; Palandökenlier and Bal, 2025), with such effects varying across investor types (Kim and Kim, 2023) and country-level information transparency (Heo, 2024).

South Korea presents a particularly compelling case within the landscape of financial globalization. Despite its classification as an emerging market in the MSCI index and its relatively shallow FX market, South Korea has maintained its status as a net external creditor since 2014, with net foreign assets reaching 43.7% of GDP by 2022 (Milesi-Ferretti, 2026). This shift to a positive net international investment position (NIIP) reflects a structural shift in Korea's economic integration and its evolving role in the global financial market. This unique combination raises important questions about how global shocks propagate through an economy at an advanced stage of globalization and how effectively the integrated policy mix can manage the resulting fluctuations.

Against this backdrop, this paper examines the cross-border business cycle propagation of a foreign interest rate hike and evaluates the efficacy of the integrated policy mix in SOEs. We compare transmission mechanisms across EMEs and AEs, deriving specific implications for South Korea. The analysis considers three policy combinations: (i) monetary policy alone, (ii) monetary policy combined with FXI, and (iii) monetary policy combined with CFM. Utilizing the IMF's Integrated Policy Framework (IPF) — a DSGE model that jointly incorporates monetary, exchange rate, and capital flow policies within a financially-frictional small open economy — we analyze multiple frictions and policy instruments simultaneously. This approach allows us to move beyond existing literature that has typically focused on single frictions or policy instruments in isolation.

The primary findings of this study are summarized as follows. A foreign interest rate hike — a hallmark of recent global monetary tightening — suppresses home export demand and triggers capital outflows through widening interest rate differentials, yet the propagation of these shocks diverges markedly across economic structures. In advanced economies (AEs), where inflation expectations are well-anchored, central banks maintain the policy space to implement counter-cyclical rate cuts to buffer the contraction in domestic activity. Conversely, emerging market economies (EMEs) face significant inflationary pressures from currency depreciation, which often necessitate pro-cyclical rate hikes to stabilize inflation expectations. Our simulations demonstrate that augmenting monetary policy with FXI or CFM enhances stabilization in EMEs, with FXI yielding superior outcomes in mitigating output and price volatility. Furthermore,

for a net external creditor economy calibrated to South Korea, the accumulation of foreign assets serves as a structural buffer that significantly constrains exchange rate depreciation and output contractions. However, the analysis reveals a critical policy trade-off: while the integrated policy mix further stabilizes output, it is also associated with an increase in the volatility of domestic consumption and the trade balance, as direct interventions amplify short-term fluctuations in international financial transactions.

The remainder of this paper is organized as follows. Section 2 reviews the related literature. Section 3 and Section 4 present the IPF model and its calibration, respectively. Section 5 discusses the counterfactual policy experiments and results, and Section 6 concludes.

II. Literature Review

Since the 1980s, capital account liberalization has integrated international financial markets, enabling cross-border financing but also exposing domestic markets to sudden surges or reversals in capital flows that can escalate into currency and financial crises. The Mundell-Fleming paradigm posits that, under a floating exchange rate, free movement of the exchange rate absorbs external disturbances and preserves macroeconomic stability — a view that long underpinned the IMF's and OECD's traditional preference for minimal restrictions on capital flows. However, since the 2008 global financial crisis, a consensus has emerged that a freely floating exchange rate alone is insufficient to absorb external shocks. In practice, particularly in emerging small open economies, monetary policy, foreign exchange intervention (FXI), and capital flow management (CFM) measures are increasingly deployed in combination to pursue macro-financial stability. Recent empirical studies in this journal corroborate that emerging markets are particularly vulnerable to global risk conditions and policy uncertainty, which significantly shape capital inflows and sudden stop episodes (Veeravel and Balakrishnan, 2025; Palandökenlier and Bal, 2025), with such effects varying across investor types (Kim and Kim, 2023) and country-level information transparency (Heo, 2024).

In the DSGE literature, the traditional approach has been to analyze frictional elements one at a time, since interactions among multiple frictions complicate the underlying mechanisms. The IMF's Integrated Policy Framework (IPF) departs from this tradition by incorporating multiple market imperfections within a single model, thereby enabling the simultaneous analysis of monetary, exchange rate, and capital flow policies. Adrian et al. (2024) develop a medium-scale New Keynesian DSGE model with two asymmetrically sized economies and five policy instruments — fiscal policy, monetary policy, FXI, macroprudential policy, and CFM — and show that FXI and CFM should be employed more actively as international trade and financial openness increase, with macroprudential and CFM policies implemented countercyclically to promote

financial stability.

Adrian et al. (2021) analyze the effects of monetary policy, FXI, and CFM within a two-country model comprising a large closed economy and a small open economy. Building on Gabaix and Maggiori (2015), they introduce a wedge in the Uncovered Interest Parity (UIP) condition through financial intermediaries' risk exposure limits, and adopt the Fisherian debt deflation mechanism from the sudden stop literature. Their findings show that financial frictions, combined with poorly anchored inflation expectations, amplify business cycle fluctuations in emerging economies, and that FXI and CFM, when coordinated with monetary policy, serve as effective stabilization tools against external shocks. Chen et al. (2023) extend this framework by estimating FXI and CFM policy rules using Bayesian methods on data from five advanced and twelve emerging small open economies. They find that the UIP risk premium is significantly larger in emerging economies — confirming shallower FX market depth — and that several emerging economies systematically deploy FXI as a policy rule to counteract exchange rate fluctuations.

This paper adopts the IPF of Chen et al. (2023) and Adrian et al. (2021) and contributes to the literature in two respects. First, while existing IPF studies focus on global financial cycle shocks (Adrian et al., 2024) or risk appetite and UIP risk premium shocks (Adrian et al., 2021; Chen et al., 2023), none directly address the propagation of a U.S. interest rate hike — the dominant external shock during the 2022-2023 global monetary tightening cycle. We fill this gap by analyzing how a foreign interest rate increase transmits to domestic macroeconomic variables in small open economies and by evaluating the stabilization effects of monetary policy, FXI, and CFM, distinguishing between emerging and advanced economies. Second, by calibrating the model to South Korea's net foreign asset-to-GDP ratio, we compare the business cycle dynamics of a net external creditor with those of a country at zero net external position, and examine whether net creditor status provides a structural buffer against U.S. interest rate hike shocks.

III. The Model

In this analysis, we employ the model of Chen et al. (2023) to posit a world economy consisting of two countries: a small open economy and a large closed economy. A small open economy is one in which there are no restrictions on the cross-border movement of goods, services, and capital, yet the economy is too small to influence world prices or international interest rates. The criteria distinguishing small and large economies are the level of GDP and the size of population or labor force. Each country is further classified as either an advanced economy or an emerging market and developing economy (EMDE). The IMF's classification criteria¹⁾ primarily include (i) per capita income levels, (ii) the degree of export diversification,²⁾ and (iii) the degree of integration into the international financial system, among other factors.

This study focuses on advanced and emerging market small open economies with external linkages centered on the United States, and analyzes the effects of U.S. interest rate hike shocks on these economies and the corresponding policy responses. Hereafter, we refer to the small open economy as the home country and the large closed economy as the foreign country. The microfoundations of the integrated policy model used in this study are described in detail in Adrian et al. (2020, 2021). Here, we employ the linearized version of the nonlinear model developed by Adrian et al. (2020, 2021), as implemented in Chen et al. (2023). We then discuss the model's mechanisms and implications.

Regarding the notation of model variables, lowercase letters denote percentage deviations from the steady-state,³⁾ while uppercase letters denote the level values of the corresponding macroeconomic variables. All variables carry a time subscript t , and variables without the subscript t denote either steady-state values of macroeconomic variables or parameters. An asterisk (*) in the superscript indicates that the variable pertains to the foreign economy.⁴⁾ A complete description of the nonlinear model is provided in the online appendix.

A. Aggregate demand

The resource constraint equation⁵⁾ of the home economy is expressed as follows:

$$y_t = c_y c_t + g_y g_t + m_y (m_t^* - m_t). \quad (1)$$

where c_y denotes the ratio of consumption (C) to output (Y) at the steady state, i.e., $c_y = \frac{C}{Y}$.

Under the assumption that exports (M^*) equal imports (M) at the steady state, net exports are zero and thus the share of public expenditure in output satisfies $g_y = 1 - c_y$. The ratio of

imports to output satisfies $m_y = \frac{M}{Y} = \frac{M^*}{Y}$. In Equation (1), y_t denotes the output gap, defined

1) IMF, "How does the WEO categorize advanced versus emerging market and developing economies?" (Last Updated: April 22, 2025).

2) Oil-exporting countries whose GDP is predominantly composed of oil production and exports, and whose export portfolio lacks other manufactured goods or information service products, are not classified as advanced economies even if their per capita GDP is high.

3) A lowercase macroeconomic variable x_t satisfies the relationship $x_t \equiv \frac{X_t - X}{X} \approx \log \frac{X_t}{X}$ with respect to the level variable X_t and the steady-state value X .

4) For example, the export variable x_t^* , which denotes the foreign demand for domestically produced goods and services, carries an asterisk in its superscript. Conversely, the import variable m_t , representing domestic demand for goods and services produced in foreign countries, does not carry an asterisk.

5) The model assumes a fixed supply of physical capital. Therefore, investment expenditure does not appear in Equation (1).

as the percentage deviation of actual output from steady-state output. Similarly, c_t , g_t , m_t^* , and m_t represent percentage deviations from the steady state for consumption (absorption), government expenditure, exports, and imports, respectively. Since an increase in the domestic interest rate raises savings and reduces consumption through the intertemporal substitution between consumption and saving, Equation (1) represents the dynamic IS curve of the New Keynesian model.

$$\lambda_{c,t} = \delta_c E_t[\lambda_{c,t+1}] + r_{b,t} \quad (2)$$

Equation (2) represents the Euler equation governing the intertemporal consumption path,⁶⁾ where $r_{b,t}$ denotes the short-term real market interest rate. The parameter δ_c is a discount factor proposed by Gabaix (2020) that captures the myopic behavior of economic agents, serving to correct the overestimation of forward guidance effects in standard New Keynesian models. The marginal utility of consumption $\lambda_{c,t}$ is determined by the persistence of consumption habits and exogenous consumption shocks as follows:

$$\lambda_{c,t} = -\frac{1}{\sigma(1-x_c)}(c_t - x_c c_{t-1} - v_{c,t}) \quad (3)$$

where σ is the coefficient of relative risk aversion and x_c is the parameter governing the degree of persistence in past consumption habits. The term $v_{c,t}$ ⁷⁾ represents a positive demand shock to current consumption following an AR(1) process. By forward iteration of Equation (2), one can verify that the marginal utility of consumption $\lambda_{c,t}$ equals the long-term real market interest rate $r_{b,t}^L$ as follows:

$$\lambda_{c,t} = \sum_{j=0}^{\infty} \delta_c^j E_t[r_{b,t+j}] \equiv r_{b,t}^L \quad (4)$$

To model foreign demand for domestically produced goods and services, following Christiano et al. (2011), we assume that the production of one unit of export goods requires not only domestic intermediate goods but also imported intermediate goods as inputs.⁸⁾ Accordingly,

6) The short-term real market interest rate $r_{b,t}$ is defined as the short-term nominal market interest rate $i_{b,t}$ minus expected consumer price inflation $E_t[\pi_{c,t+1}]$. The short-term nominal market interest rate is given by $i_{b,t} = i_t + \psi_t$, where i_t is the policy rate and ψ_t is the risk premium.

7) $v_{c,t} = \rho_c v_{c,t-1} + \sigma_c \epsilon_{c,t}$, where $\epsilon_{c,t} \sim \mathcal{N}(0,1)$

8) This assumption is necessary for the small open economy model to adequately replicate the volatility observed in country-level import and export data.

export demand m_t^* , representing foreign demand for domestic products, satisfies the following relationship:

$$m_t^* = (1 - \omega_x) m_{d,t}^* + \omega_x m_{m,t}^* \quad (5)$$

where ω_x is the share of imported intermediate goods in production for export. The demand for domestic intermediate goods $m_{d,t}^*$ ⁹⁾ and the demand for imported intermediate goods $m_{m,t}^*$ in export production are determined by aggregate demand in the foreign economy (y_t^*) and relative domestic and foreign prices as follows:

$$m_{d,t}^* = y_t^* - \eta_x \gamma_t^{x,*} + \omega_x \eta_x \gamma_t^{m,d} \quad (6)$$

$$m_{m,t}^* = y_t^* - \eta_x \gamma_t^{x,*} - (1 - \omega_x) \eta_x \gamma_t^{m,d} + v_{m,t}^* \quad (7)$$

The term $\gamma_t^{x,*}$ denotes the price of domestically produced exports relative to foreign consumer prices. A higher relative price implies reduced price competitiveness of domestic exports, leading to a decline in foreign demand. The term $\gamma_t^{m,d}$ denotes the price of imported intermediate goods relative to the price of domestic intermediate goods; a higher relative price increases demand for domestic intermediate goods and decreases demand for imported intermediate goods. The parameter η_x denotes the elasticity of export demand with respect to intermediate goods price changes, and $v_{m,t}^*$ ¹⁰⁾ represents a positive shock to export demand following an AR(1) process.

Total imports m_t are structured symmetrically to the export demand equation (5) for the foreign economy, and consist of demand for imported consumer goods $m_{c,t}$ and demand for imported intermediate goods $m_{m,t}^*$:

$$m_t = (1 - \omega_x) m_{c,t} + \omega_x m_{m,t}^* \quad (8)$$

The demand for imported consumer goods $m_{c,t}$ increases with aggregate consumption c_t and decreases with the relative price of imports to domestic consumer prices $\gamma_t^{m,c}$ ¹¹⁾ as follows:

9) In the conventional model, export production is defined using only domestic factors of production. In the present model, imported intermediate goods are also incorporated. Here, domestically produced intermediate goods $m_{d,t}^*$ can also be interpreted as domestically produced consumer goods.

10) $v_{m,t}^* = \rho_m \cdot v_{m,t-1}^* + \sigma_m \cdot \epsilon_{m,t}^*$, where $\epsilon_{m,t}^* \sim \mathcal{N}(0,1)$

11) The relative price of imports to domestic consumer prices $\gamma_t^{m,c}$ satisfies the relationship $\gamma_t^{m,c} = \gamma_t^{m,d} - \gamma_t^{c,d} =$

$$m_{c,t} = c_t - \eta_m \gamma_t^{m,c} + v_{m,t} \tag{9}$$

We assume that the import content of government expenditure is negligible. The parameter η_m denotes the elasticity of imported consumer goods demand with respect to import price changes, and $v_{m,t}$ ¹²⁾ represents a positive shock to imported consumer goods demand following an AR(1) process.

B. Aggregate supply

The New Keynesian Phillips curve that governs the inflation dynamics of domestically produced goods is derived as follows:

$$\pi_t - \iota_p \pi_{t-1} = \beta \delta_c E_t [\pi_{t+1} - \iota_p \pi_t] + x_p m_{c,t} + v_{\pi,t} \tag{10}$$

where π_t denotes producer price inflation and ι_p represents the degree of indexation to past inflation levels in firms' price-setting decisions. The marginal cost $m_{c,t}$ increases with the production-based real wage $\zeta_{p,t}$ ¹³⁾ and decreases with the marginal product of labor mpl_t . Under a Cobb-Douglas production function, it is given by:

$$m_{c,t} = \zeta_{p,t} - mpl_t = \zeta_{p,t} + \frac{\alpha}{1-\alpha} y_t \tag{11}$$

The parameter α denotes the share of physical capital in the Cobb-Douglas production function, and the marginal product of labor satisfies $mpl_t = -\frac{\alpha}{1-\alpha} y_t$. The slope of the Phillips curve x_p is determined by $x_p = \frac{(1-\xi_p)(1-\beta\xi_p)}{\xi_p}$, where ξ_p is the parameter governing the average duration of producer price rigidity. The term $v_{\pi,t}$ ¹⁴⁾ represents a domestic cost-push shock

$(1-\omega_c)\gamma_t^{m,d}$. Here, ω_c denotes the share of imported goods in the representative consumption basket and is determined by $\omega_c = \frac{m_y(1-\omega_x)}{c_y}$, where $(1-\omega_x)$ represents the share of imported final consumer goods excluding imported intermediate goods in total imports.

12) $v_{m,t} = \rho_m v_{m,t-1} + \sigma_m \epsilon_{m,t}$, where $\epsilon_{m,t} \sim N(0,1)$

13) The production-based real wage $\zeta_{p,t}$ denotes the real wage in terms of domestic goods. In contrast, the consumption-based real wage $\zeta_{c,t}$ denotes the real wage in terms of consumer goods, where the consumption basket is composed of both domestic and imported goods.

14) $v_{\pi,t} = \rho_\pi v_{\pi,t-1} + \sigma_\pi (\epsilon_{\pi,t} - \zeta_p \epsilon_{\pi,t-1})$, where $\epsilon_{\pi,t} \sim N(0,1)$, $\zeta_p = 0$.

following an AR(1) process.

On the labor supply side, the marginal rate of substitution between leisure and consumption mrs_t , is given by:

$$mrs_t = \frac{\chi}{1-\alpha} y_t - \lambda_{c,t} \tag{12}$$

Since the log-linearized production function is $y_t = (1-\alpha)n_t^{15}$ mrs_t increases with labor supply n_t and decreases with the marginal utility of consumption $\lambda_{c,t}$. The parameter $1/\chi$ denotes the Frisch elasticity of labor supply. Following Erceg et al. (2000), the nominal wage growth rate is determined by the following wage Phillips curve:

$$\pi_{w,t} - \tilde{\pi}_{w,t-1} = \beta \delta_c E_t [\pi_{w,t+1} - \tilde{\pi}_{w,t}] + \chi_w (mrs_t - \zeta_{c,t}) + \nu_{w,t} \tag{13}$$

The nominal wage growth rate $\pi_{w,t}$ increases with the gap between the real marginal cost of labor mrs_t and the consumption-based real wage $\zeta_{c,t}$. The wage indexation term $\tilde{\pi}_{w,t}$ is determined as a weighted average of nominal wage growth $\pi_{w,t}$ and average consumer price inflation $\pi_{L,t}$:

$$\tilde{\pi}_{w,t} = \iota_w \pi_{w,t} + (1 - \iota_w) \pi_{L,t} \tag{14}$$

$$\pi_{L,t} = (1 - \nu) \pi_{L,t-1} + \frac{\nu}{m_y} \Delta s_t \tag{15}$$

In Equation (15), Δs_t denotes the growth rate of the nominal exchange rate,¹⁶ where an increase represents a depreciation of the domestic currency. Average consumer price inflation $\pi_{L,t}$ is expressed as a weighted average of its own lagged value and the contribution of nominal exchange rate changes. The slope of the wage Phillips curve is defined as $\chi_w = \frac{(1 - \xi_w)(1 - \beta \xi_w) \phi_w}{\xi_w (1 + \chi)(1 + \phi_w)}$, where the parameter ξ_w determines the duration of wage rigidity and the parameter ϕ_w represents the wage markup attributable to union wage-setting power. The term $\nu_{w,t}$ ¹⁷ represents a wage-push shock following an AR(1) process.

15) The model assumes no total factor productivity (TFP) shocks and a fixed supply of physical capital. The term n_t denotes labor input as a factor of production at time t .

16) The growth rate of nominal exchange rate Δs_t satisfies $\Delta s_t = q_{p,t} - q_{p,t-1} - \pi_t^* + \pi_t$ using the real exchange rate $q_{p,t}$.

17) $\nu_{w,t} = \rho_w \nu_{w,t-1} + \sigma_w (\epsilon_{w,t} - \varsigma_w \epsilon_{w,t-1})$, where $\epsilon_{w,t} \sim N(0,1)$, $\varsigma_w = 0$.

In the import and export sectors, the law of one price does not hold, and both import and export prices exhibit nominal rigidity. Import price inflation $\pi_{m,t}$ and export price inflation $\pi_{x,t}$ are determined by the following Phillips curves:

$$\pi_{m,t} - \iota_m \pi_{m,t-1} = \beta \delta_c E_t [\pi_{m,t+1} - \iota_m \pi_{m,t}] + \kappa_m mc_{m,t} + \nu_{\pi_{m,t}} \quad (16)$$

$$\pi_{x,t} - \iota_x \pi_{x,t-1} = \beta \delta_c E_t [\pi_{x,t+1} - \iota_x \pi_{x,t}] + \kappa_x mc_{x,t} \quad (17)$$

The parameters ι_m and ι_x represent the degree of indexation to past inflation in import and export price setting, respectively. The slopes of the import and export Phillips curves, κ_m and κ_x , satisfy $\kappa_m = \frac{(1 - \xi_m)(1 - \beta \xi_m)}{\xi_m(1 + \phi_m \epsilon_m)}$ and $\kappa_x = \frac{(1 - \xi_x)(1 - \beta \xi_x)}{\xi_x(1 + \phi_x \epsilon_x)}$, respectively. The parameters ξ_m and ξ_x determine the duration of import and export price rigidity; ϕ_m and ϕ_x govern the respective price markups; and ϵ_m and ϵ_x are the curvature parameters of the Kimball aggregator functions for import and export final goods. The term $\nu_{\pi_{m,t}}$ ¹⁸⁾ represents an import cost-push shock following an AR(1) process.

Consumer price inflation $\pi_{c,t}$, which reflects the price levels of both domestic and imported goods, is expressed using the share of imported goods in the representative consumption basket ω_c as $\pi_{c,t} = (1 - \omega_c)\pi_t + \omega_c \pi_{m,t}$. The marginal costs of imported and exported goods are given by $mc_{m,t} = q_{p,t} - \gamma_t^{m,d}$ and $mc_{x,t} = -q_{p,t} - \gamma_t^{x,*} + \omega_x \gamma_t^{m,d}$, respectively, where $q_{p,t}$ denotes the production-based real exchange rate.¹⁹⁾

The relative price of domestically produced exports to foreign consumer prices $\gamma_t^{x,*}$ and the relative price of imported goods to domestic goods prices $\gamma_t^{m,d}$ are expressed as $\gamma_t^{x,*} = \gamma_{t-1}^{x,*} + \pi_{x,t} - \pi_t^*$ and $\gamma_t^{m,d} = \gamma_{t-1}^{m,d} + \pi_{m,t} - \pi_t$, respectively. The production-based and consumption-based real wages are determined as $\zeta_{p,t} = \zeta_{p,t-1} + \pi_{w,t} - \pi_t$ and $\zeta_{c,t} = \zeta_{p,t} - \omega_c \gamma_t^{m,d}$, respectively. The nominal trade balance is given by $ntb_t = m_y(m_t^* - m_t + \gamma_t^{x,*})$, and the real trade balance is derived as $tb_t = m_y(m_t^* - m_t)$.

C. International financial market

International financial markets are incomplete and segmented, and as demonstrated by Gabaix and Maggiori (2015), moral hazard friction exists in the foreign exchange market. Specifically,

18) $\nu_{\pi_{m,t}} = \rho_{\pi_m} \nu_{\pi_{m,t-1}} + \sigma_{\pi_m} (\epsilon_{\pi_{m,t}} - \zeta_{\pi_m} \epsilon_{\pi_{m,t-1}})$, where $\epsilon_{\pi_{m,t}} \sim N(0,1)$, $\zeta_{\pi_m} = 0$.

19) The consumption-based real exchange rate $q_{c,t}$ is derived using the production-based real exchange rate and the relative price of imported goods to domestic goods as $q_{c,t} = q_{p,t} - \omega_c \gamma_t^{m,d}$.

financiers' agency friction introduces a wedge into the Uncovered Interest Parity (UIP) condition. The modified UIP condition, incorporating the effect of financial intermediaries' positions $b_{F,t}$, is given by:

$$q_{p,t} = \delta_c E_t[q_{p,t+1}] + (i_t^* - E_t[\pi_{t+1}^*]) - \left(\frac{1+r}{1+r^*}\right)(i_t - E_t[\pi_{t+1}]) \\ + \Gamma\left(\frac{1+r}{1+r^*}\right)(b_{F,t} + b_F(i_t - E_t[\pi_{t+1}])) + \tau_{F,t} \quad (18)$$

The terms r and r^* denote the domestic and foreign short-term real interest rates at the steady state, respectively. The real exchange rate $q_{p,t}$ increases (depreciates) as the foreign real interest rate rises relative to the domestic rate, as the volume of funds managed by financial intermediaries increases, and as the level of capital inflow tax $\tau_{F,t}$ rises. The agency friction wedge $\Gamma\left(\frac{1+r}{1+r^*}\right)(b_{F,t} + b_F(i_t - E_t[\pi_{t+1}]))$ in Equation (18) becomes more significant as Γ increases (i.e., as FX market depth becomes shallower), constituting the primary source of deviation from the UIP condition. Moreover, the shallower the FX market, the more financial intermediaries' positions affect the real exchange rate, implying that the effects of foreign exchange intervention (FXI) are amplified. The Gabaix (2020) discount factor δ_c attenuates the influence of expected future real exchange rates on current exchange rate dynamics, thereby increasing the relative importance of the domestic-foreign interest rate differential.

The UIP condition is complemented by the following financial market clearing condition:

$$B_t = -B_{F,t} - B_{P,t} + B_{M,t} \quad (19)$$

Net foreign assets B_t , denominated in domestic currency, are decomposed into financial intermediaries' liability positions ($-B_{F,t}$), portfolio investors' capital positions ($-B_{P,t}$), and the monetary authority's foreign exchange reserves ($B_{M,t}$). Expressing each position as a ratio to nominal GDP and linearizing the general equilibrium conditions, we obtain the following dynamic equation for b_t :

$$b_t = \frac{I^{eff}}{1+\pi} b_{t-1} + \frac{b}{1+\pi} \left\{ (1-\omega)I i_{t-1} + \omega I^* \Delta s(i_{t-1}^* + \Delta s_t) - I^{eff} \pi_t \right\} \\ - \frac{b_M(1-\omega)}{1+\pi} \left\{ \bar{H}_{t-1} - I^* \Delta s(i_{t-1}^* + \Delta s_t) \right\} - \frac{(1-\omega)(I - I^* \Delta s)}{1+\pi} (b_{M,t-1} - b_M \pi_t) \\ + \frac{(1-\omega)I}{1+\pi} (b_F + b_p) \tau_{F,t-1} + m_y (m_t^* - m_t + \gamma_t^{x,*}) \quad (20)$$

The short-term gross nominal effective interest rate at the steady state is defined as $I^{eff} = (1 - \omega)I + \omega I^* \Delta s$, where I and I^* denote the domestic and foreign short-term gross nominal interest rates at the steady state, respectively. The parameter ω represents the domestic ownership share in financial intermediaries and portfolio investment institutions, and all deposit-taking banks are assumed to be domestically owned. The linear dynamic equation for net foreign assets is composed of (i) debt service costs, (ii) foreign exchange reserve and FXI costs, (iii) capital flow management costs, and (iv) the trade balance.

Linearizing the financial position clearing condition (19) in terms of the financial intermediaries' bond position as a share of nominal GDP yields the following relationship:

$$b_{F,t} = -b_t - \left(\frac{1}{\Gamma}\right) \tilde{b}_{p,t} + b_{M,t} \tag{21}$$

The portfolio investors' capital position $\tilde{b}_{p,t}$ ²⁰⁾ follows an exogenous AR(1) process.

D. Monetary and fiscal policy

Following the standard practice in the monetary policy literature, the central bank's policy rate is assumed to follow a Taylor rule²¹⁾ of the following form:

$$i_t = \gamma_i i_{t-1} + (1 - \gamma_i) \left[(1 + \gamma_\pi) \bar{\pi}_{c,t+4} + \gamma_y y_t \right] + \gamma_{\Delta y} (y_t - y_{t-1}) + v_{i,t} \tag{22}$$

where γ_i is the interest rate smoothing parameter, and γ_π , γ_y , and $\gamma_{\Delta y}$ represent the sensitivity of the policy rate to inflation, the output gap, and the period-on-period change in output, respectively. The term $\bar{\pi}_{c,t+4}$ denotes the average expected consumer price inflation over the next four quarters and is defined as $\bar{\pi}_{c,t+4} \equiv \frac{1}{4} E_t \left[\sum_{j=1}^4 \pi_{c,t+j} \right]$. The term $v_{i,t}$ ²²⁾ represents a monetary policy shock following an AR(1) process. The short-term nominal market interest rate $i_{b,t}$ is determined as $i_{b,t} = i_t + \psi_t$, the sum of the policy rate and the risk premium, where the risk premium ψ_t ²³⁾ follows an exogenous AR(1) process.

20) $\tilde{b}_{p,t} = \rho_b \tilde{b}_{p,t-1} + \sigma_b \epsilon_{b,p,t}$, where $\epsilon_{b,p,t} \sim N(0,1)$.

21) The term y_t in Equation (22) represents the deviation of actual output from its efficient steady-state level, and thus represents the output gap. In addition, the change in output is also included in Equation (22), reflecting the assumption that not only the output gap but also the magnitude of output change relative to the previous period influences the policy rate decision.

22) $v_{i,t} = \rho_v v_{i,t-1} + \sigma_v \epsilon_{i,t}$, where $\epsilon_{i,t} \sim N(0,1)$.

23) $\psi_t = \rho_\psi \psi_{t-1} + \sigma_\psi \epsilon_{\psi,t}$, where $\epsilon_{\psi,t} \sim N(0,1)$.

In this analysis, we define the foreign exchange intervention (FXI) policy fx_t as the period-on-period change in the central bank's foreign exchange reserves. That is, the central bank's foreign exchange reserves $b_{M,t}$ at time t are given by $b_{M,t} = b_{M,t-1} + fx_t$. An increase in foreign exchange reserves raises the volume of funds intermediated by financial intermediaries, $b_{F,t}$, according to Equation (21), which in turn increases the UIP risk premium²⁴) through Equation (18), leading to a rise in the interest rate differential and/or an increase in the real exchange rate. That is, if portfolio investors are liquidating domestic funds and selling the domestic currency to repatriate foreign currency ($b_{p,t} < 0$), the monetary authority can sell its foreign exchange reserves ($fx_t < 0$) to mitigate upward pressure on the exchange rate and support the domestic currency. The monetary authority's FXI rule is assumed to be determined by an error correction term for foreign exchange reserves and the growth rate of the nominal exchange rate as follows:

$$fx_t = \rho_{fx} fx_{t-1} - (1 - \rho_{fx}) \frac{\gamma_{fx}}{1 - \gamma_{fx}} \Delta S_t - \rho_{b_M} b_{M,t-1} + \sigma_{fx} \epsilon_{fx,t} \tag{23}$$

That is, when the nominal exchange rate rises (depreciates), the monetary authority actively intervenes in the foreign exchange market by reducing its foreign exchange reserves $b_{M,t}$, which decreases the financial intermediaries' fund position $b_{F,t}$, leading to a reduction in the UIP risk premium and thereby constraining upward pressure on the exchange rate. The effectiveness of FXI increases as FX market depth becomes shallower (i.e. as Γ rises), as implied by Equation (18). The exogenous shock $\epsilon_{fx,t}$ ²⁵) represents discretionary intervention by the monetary authority in the foreign exchange market.

The capital inflow tax $\tau_{F,t}$ for capital flow management serves to constrain upward pressure on the exchange rate and is determined by $\tau_{F,t} = - \left(\frac{\gamma_\tau}{1 - \gamma_\tau} \right) \Delta S_t + \rho_{\tau_F} \tau_{F,t-1} + \sigma_{\tau_F} \epsilon_{\tau_F,t}$, where the parameter γ_τ reflects the sensitivity of the capital inflow tax to exchange rate growth. In the IS curve of Equation (1), government expenditure g_t ²⁶) follows an exogenous AR(1) process, and government expenditure at the steady state is financed through labor income taxation.

24) An increase in the UIP risk premium $\Gamma \left(\frac{1+r}{1+r^*} \right) (b_{F,t} + b_F(i_t - E_t[\pi_{t+1}]))$ exerts upward pressure on the domestic foreign interest rate differential and the real exchange rate.

25) $\epsilon_{fx,t} \sim N(0,1)$

26) $g_t = \rho_g g_{t-1} + \sigma_g \epsilon_{g,t}$, where $\epsilon_{g,t} \sim N(0,1)$.

E. The foreign economy

The home economy trades with the foreign economy through exports and imports, but the home economy is assumed to be sufficiently small that its activity has a negligible impact on foreign domestic demand. Accordingly, the model for the foreign economy is a simplified closed-economy version of Equations (1) through (23). The resource constraint of the foreign economy is obtained by setting the net export terms to zero in Equation (1):

$$y_t^* = (1 - g_y^*)c_t^* + g_y^*g_t^* \quad (24)$$

Government expenditure in the foreign economy $g_t^{*27)}$ follows an exogenous AR(1) process. The Euler equation and the marginal utility of consumption are defined symmetrically to their domestic counterparts in Equations (2) and (3) as follows:

$$\lambda_{c,t}^* = \delta_c^* E_t[\lambda_{c,t+1}^*] + r_t^* \quad (25)$$

$$\lambda_{c,t}^* = -\frac{1}{\sigma^*(1 - \chi_c^*)} (c_t^* - \chi_c^*c_{t-1}^* - v_{c,t}^*) \quad (26)$$

where the foreign real interest rate r_t^* is defined as the foreign nominal interest rate i_t^{*} minus expected foreign inflation $E_t[\pi_{t+1}^*]$. The term $v_{c,t}^{*28)}$ represents a positive demand shock to current consumption following an AR(1) process. The aggregate supply side of the foreign economy is characterized by two Phillips curves — one for producer prices and one for wages:

$$\pi_t^* - \iota_p \pi_{t-1}^* = \beta^* \delta_c^* E_t[\pi_{t+1}^* - \iota_p \pi_t^*] + \chi_p^* \left(\zeta_t^* + \frac{\alpha^*}{1 - \alpha^*} y_t^* \right) + v_{\pi,t}^* \quad (27)$$

$$\pi_{w,t}^* - \iota_w \pi_{w,t-1}^* = \beta^* \delta_c^* E_t[\pi_{w,t+1}^* - \iota_w \pi_{w,t}^*] + \chi_w^* \left(\frac{\chi^*}{1 - \alpha^*} y_t^* - \lambda_{c,t}^* - \zeta_t^* \right) + v_{w,t}^* \quad (28)$$

where the real wage satisfies $\zeta_t^* = \zeta_{t-1}^* + \pi_{w,t}^* - \pi_t^*$. The terms $v_{\pi,t}^{*29)}$ and $v_{w,t}^{*30)}$ represent cost-push and wage-push shocks following AR(1) processes, respectively. The foreign monetary authority determines its policy rate according to the following Taylor rule:

27) $g_t^* = \rho_g^* g_{t-1}^* + \sigma_g^* \epsilon_{g,t}^*$, where $\epsilon_{g,t}^* \sim N(0,1)$.

28) $v_{c,t}^* = \rho_c^* v_{c,t-1}^* + \sigma_c^* \epsilon_{c,t}^*$, where $\epsilon_{c,t}^* \sim N(0,1)$.

29) $v_{\pi,t}^* = \rho_\pi^* v_{\pi,t-1}^* + \sigma_\pi^* (\epsilon_{\pi,t}^* - \zeta_p^* \epsilon_{\pi,t-1}^*)$, where $\epsilon_{\pi,t}^* \sim N(0,1)$, $\zeta_p^* = 0$.

30) $v_{w,t}^* = \rho_w^* v_{w,t-1}^* + \sigma_w^* (\epsilon_{w,t}^* - \zeta_w^* \epsilon_{w,t-1}^*)$, where $\epsilon_{w,t}^* \sim N(0,1)$, $\zeta_w^* = 0$.

$$i_t^* = \gamma_i^* i_{t-1}^* + (1 - \gamma_i^*) [(1 + \gamma_\pi^*) \pi_t^* + \gamma_y^* y_t^*] + \gamma_{\Delta y}^* (y_t^* - y_{t-1}^*) + v_{i,t}^* \quad (29)$$

The term $v_{i,t}^*$ ³¹⁾ represents a foreign monetary policy shock following an AR(1) process.

IV. Model Calibration

In this study, we calibrate the model to analyze the propagation of external shocks to small open economies and to evaluate the macroeconomic stabilization effects of monetary policy, foreign exchange intervention (FXI), and capital flow management (CFM) measures. The external shock is specified as a foreign interest rate hike. The foreign economy is benchmarked to the United States, while the home economy is divided into two groups — an emerging market and an advanced small open economy — with stabilization policy effects assessed for each group separately.

Table 1. Calibration of Parameters Used in the Emerging and Advanced Economy

Parameter	Description	EME	AvE	Foreign (U.S.)
β	Household subjective discount factor	0.9943	0.9975	0.9987
σ	Coefficient of relative risk aversion	1	1	1
χ	Inverse of Frisch labor supply elasticity	2	2	2
π	SS producer price inflation (annualized, %)	3.375	2.1	2
r	SS short-term real interest rate (annualized, %)	2.291	1.0	0.5
i	SS short-term nominal interest rate (annualized, %)	5.666	3.1	2.5
g_y	SS government expenditure-to-GDP ratio	0.122	0.224	0.216
α	Share of physical capital in production function	0.3	0.3	0.3
ϕ_w	Wage markup in the labor market	1/3	1/3	1/3
ϕ_m, ϕ_x	Price markup in import/export markets	1	1/2	-
ϵ_m, ϵ_x	Kimball aggregator curvature in import/export markets	50	50	-
η_m	Elasticity of imports w.r.t. price changes	0.8	0.8	-
η_x	Elasticity of exports w.r.t. price changes	0.8	0.8	-
ω_x	Share of imported intermediates in export production	0.203	0.190	-
m_y	Import-to-output ratio	0.331	0.311	-
ω	Domestic ownership share in financial institutions	0.8	0.8	-
b	SS net foreign assets-to-annual GDP ratio	-0.253	0	-
b_M	Foreign exchange reserves-to-GDP ratio	0.758	0.320	-

31) $v_{i,t}^* = \rho_i v_{i,t-1}^* + \sigma_i \epsilon_{i,t}^*$, where $\epsilon_{i,t}^* \sim N(0,1)$.

Table 1. Continued

Parameter	Description	EME	AvE	Foreign (U.S.)
Γ	FX market depth measure	0.031	0.020	-
$\hat{\delta}_c$	Gabaix (2020) discount factor	0.974	0.970	0.980
χ_c	Consumption habit persistence parameter	0.370	0.230	0.197
ξ_m	Calvo parameter for import prices	0.774	0.852	-
ξ_x	Calvo parameter for export prices	0.850	0.888	-
ξ_p	Calvo parameter for domestic goods prices	0.921	0.836	0.948
ξ_w	Calvo parameter for wages	0.721	0.790	0.806
ι_m	Indexation parameter for import prices	0.735	0.728	-
ι_x	Indexation parameter for export prices	0.660	0.786	-
ι_p	Indexation parameter for domestic goods prices	0.483	0.544	0.740
ι_w	Indexation parameter for wages	0.568	0.364	0.095
ν	Sensitivity of wage changes to the exchange rate	0.046	0.006	-
γ_π	Sensitivity of interest rate to inflation	0.616	1.106	0.488
γ_y	Sensitivity of interest rate to the output gap	0.091	0.098	0.190
$\gamma_{\Delta y}$	Sensitivity of interest rate to output growth	0	0	0.050
γ_i	Interest rate smoothing parameter	0.824	0.846	0.918
ρ_{fx}	Persistence parameter of FXI rule	0.452	0.254	-
$\rho_{\Delta M}$	Error correction parameter of FXI rule	0.015	0.040	-
γ_{fx}	Sensitivity of FXI rule to exchange rate changes	0.449	0.132	-
γ_τ	Sensitivity of capital inflow tax to exchange rate	0	0	-
$\rho_{\tau F}$	Persistence parameter of capital inflow tax	0.9	0.9	-
σ_i	Size of policy rate shock	0.167	0.078	0.111
σ_{fx}	Size of FXI shock	6.001	2.010	-
ρ_c	Persistence of consumption demand shock	0.910	0.944	0.892
ρ_g	Persistence of government expenditure shock	0.854	0.918	0.967
ρ_m^*	Persistence of export demand shock	0.862	0.932	-
ρ_m	Persistence of import demand shock	0.801	0.806	-
ρ_{π_m}	Persistence of import price markup shock	0	0	-
ρ_π	Persistence of domestic production price markup shock	0	0	0
ρ_w	Persistence of wage markup shock	0	0	0
ρ_y	Persistence of market interest rate risk premium shock	0.755	0.834	-
ρ_p	Persistence of FX market risk premium shock	0.910	0.906	-
ρ_i	Persistence of policy rate shock	0	0	0
σ_c	Size of consumption demand shock	3.546	2.498	2.320

Table 1. Continued

Parameter	Description	EME	AvE	Foreign (U.S.)
σ_g	Size of government expenditure shock	3.314	1.032	0.764
σ_m^*	Size of export demand shock	30.029	17.064	-
σ_m	Size of import demand shock	4.945	3.224	-
σ_{π_m}	Size of import price markup shock	0.515	0.550	-
σ_π	Size of domestic production price markup shock	0.504	0.416	0.211
σ_w	Size of wage markup shock	1.864	0.712	1.012
σ_ψ	Size of market interest rate risk premium shock	1.320	0.482	-
σ_{b_p}	Size of FX market risk premium shock	0.824	0.786	-

Note. 1) 'SS' stands for the steady state.

2) '-' indicates not applicable.

(Source) Author's compilation, adjusted based on Chen et al. (2023).

Table 1 presents the parameter values for the emerging market, advanced, and foreign (U.S.) economies. The calibration is based on the Bayesian estimation results of Chen et al. (2023), who estimate country-specific parameters for 12 emerging market small open economies (Brazil, Chile, Colombia, Indonesia, Kazakhstan, Mexico, Malaysia, Peru, the Philippines, Thailand, Türkiye, and South Africa) and five advanced small open economies (Australia, Canada, Norway, New Zealand, and Sweden). The values in Table 1 represent the group averages of these country-specific estimates, with a quarterly time unit. Parameters reported to three or more decimal places are Bayesian estimates from Chen et al. (2023), while those reported to two or fewer decimal places are standard values in the literature.

The subjective discount factor β is set such that the steady-state real interest rate³²⁾ equals 2.29% per annum for the emerging market economy and 1% for the advanced economy. Steady-state inflation is calibrated to 3.37% and 2.1% per annum, respectively. For the foreign sector, we assume an annual U.S. inflation rate of 2% and a real interest rate of 0.5%, implying a household discount factor of 0.9987.

The following parameter values are common across all economies. The intertemporal elasticity of substitution σ is set to unity, implying a log utility specification over consumption. The capital share α in the Cobb-Douglas production function is set at 0.3, and the Frisch elasticity of labor supply is calibrated to $1/\chi = 0.5$. The wage markup is set at $\phi_w = 1/3$, and the price markups in the import and export retail sectors are assigned as $\phi_m = \phi_x = 1$ for the emerging market economy and $1/2$ for the advanced economy. The Kimball curvature parameters, which

32) The real interest rate is computed as $r = \frac{1}{\beta} - 1$, and the annualized rate is obtained by multiplying by four.

determine the slope of the aggregate supply curves for traded goods, are set at $\epsilon_m = \epsilon_x = 50$, and the import and export price elasticities are both calibrated to $\eta_m = \eta_x = 0.8$. The domestic ownership share in financial institutions is $\omega = 0.8$, which determines the effective domestic interest rate³³⁾ and, consequently, the return on foreign investment in net foreign assets. The steady-state ratio of net foreign assets to annual GDP is calibrated to -25.3% for the emerging market economy, indicating net external debt of 25.3% of annual GDP, while external assets and liabilities are assumed to be equal for the advanced economy.

The remaining parameters represent the group averages of Bayesian estimates from Chen et al. (2023). The FX market depth parameter Γ captures the sensitivity of domestic currency-denominated bond prices to changes in market sentiment. As FX market depth becomes shallower (i.e., as Γ increases), financial intermediaries demand a larger premium³⁴⁾ on domestic currency-denominated bonds, widening the wedge in the Uncovered Interest Parity (UIP) condition. Accordingly, Γ is assigned a value of 0.031 for the emerging market economy and 0.020 for the advanced economy. The Gabaix (2020) discount factor δ_c , which captures myopic behavior relative to rational expectations, is set at 0.974 and 0.970 for the emerging market and advanced economies, respectively, with little difference between the two. The consumption habit parameter χ_c is set at 0.370 for the emerging market economy and 0.230 for the advanced economy, indicating greater consumption persistence in the former.

The Calvo parameter for import prices ξ_m implies an average price adjustment interval of approximately 4.4 quarters³⁵⁾ in the emerging market economy and 6.7 quarters in the advanced economy. The corresponding Calvo parameter for export prices ξ_x implies adjustment intervals of approximately 6.7 and 8.9 quarters, respectively. The Calvo parameter ξ_p is calibrated so that domestic goods prices are more rigid in emerging markets (adjusting every 12.6 quarters) than in advanced economies (6.1 quarters), consistent with the estimation results of Chen et al. (2023). This implies that, despite higher headline inflation, individual firms in emerging markets re-optimize prices less frequently. The Calvo parameter for wage rigidity ξ_w implies adjustment intervals of approximately 3.6 quarters in the emerging market economy and 4.8 quarters in the advanced economy. Regarding indexation to past prices, the export price and domestic goods price indexation parameters (ι_x, ι_p) are stronger in the advanced economy, while the import price and wage indexation parameters (ι_m, ι_w) are larger in the emerging market economy.

33) The effective nominal interest rate is defined as $\tilde{I} = (1 - \omega)I + \omega I^*$, representing the weighted sum of the domestic nominal interest rate and the nominal return on foreign investment.

34) This premium reflects balance sheet frictions, encompassing collateral constraints, funding liquidity constraints, margin requirements, leverage constraints, and capital adequacy ratio constraints.

35) The Calvo parameter ξ represents the probability that a firm does not adjust its price in any given period, so the average duration until adjustment is $\frac{1}{1 - \xi}$.

Turning to monetary policy parameters, the sensitivity of the policy rate to inflation is $\gamma_\pi = 0.616$ for the emerging market economy versus $\gamma_\pi = 1.106$ for the advanced economy, indicating a stronger inflation response in the latter. The sensitivity to the output gap γ_y and the interest rate smoothing parameter γ_i show no significant differences between the two economy groups. For the FXI rule, both the persistence (ρ_{fx}) and the sensitivity to exchange rate changes (γ_{fx}) are larger in the emerging market economy (0.452 and 0.449, respectively) than in the advanced economy (0.254 and 0.132), indicating more persistent and responsive intervention in emerging markets. The interest rate policy shock is set at $\sigma_i = 0.167$ for the emerging market economy and $\sigma_i = 0.078$ for the advanced economy, while the FXI shock is $\sigma_{fx} = 6.001$ for the emerging market economy and approximately one-third of that level, $\sigma_{fx} = 2.010$, for the advanced economy.

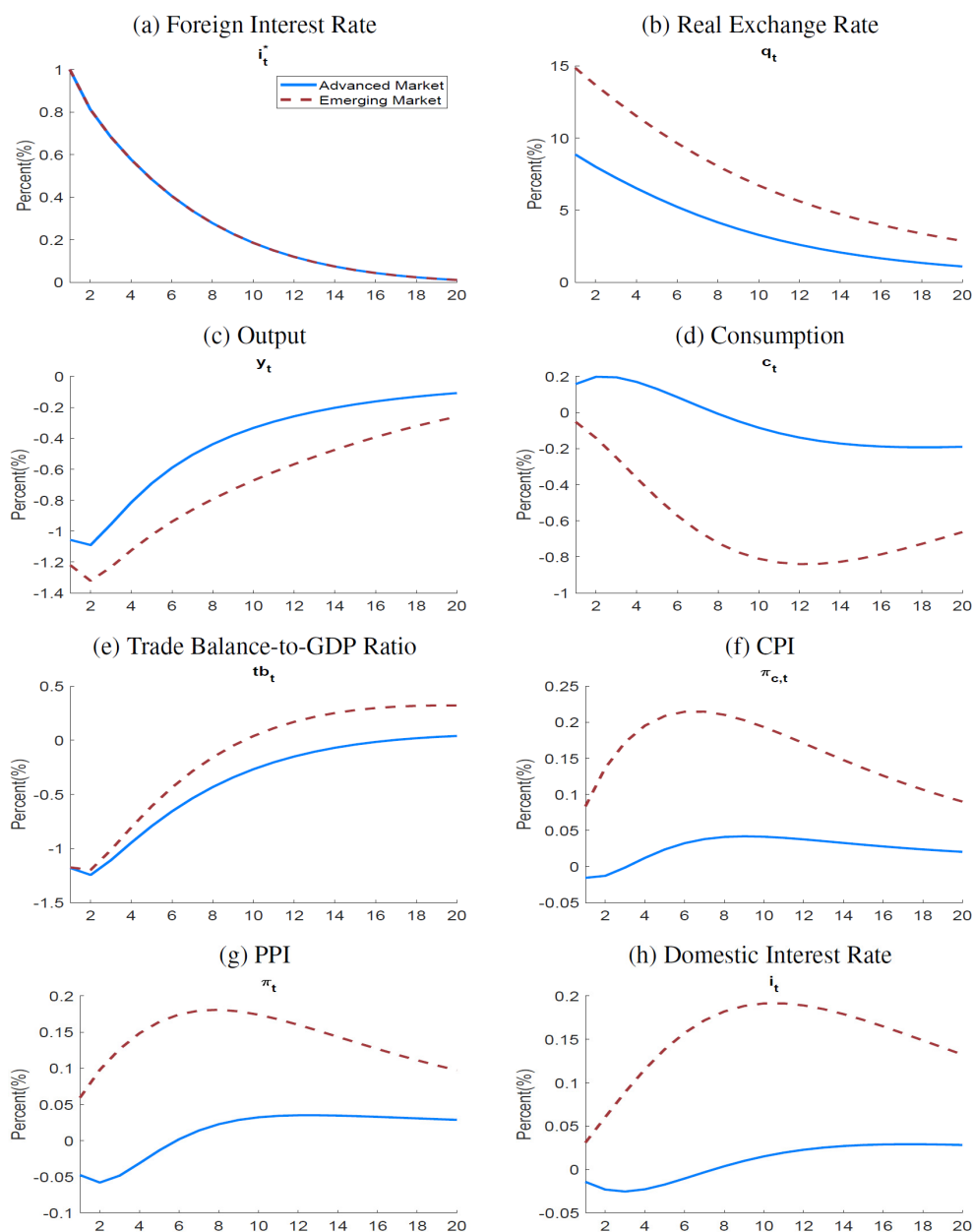
The remaining parameters govern the AR(1) exogenous shock processes. Aggregate demand shocks include consumption demand, government expenditure, export demand, import demand, and risk premium shocks, while aggregate supply shocks include import price markup, domestic goods price markup, and wage markup shocks. Across all shock processes, the shock sizes are larger in the emerging market economy, whereas the persistence parameters are generally smaller.

V. Counterfactual Analysis

This section examines business cycle fluctuations in response to foreign interest rate shocks for emerging market and advanced small open economies, and evaluates the macroeconomic stabilization effects of monetary policy, foreign exchange intervention (FXI), and capital flow management (CFM) measures. We then apply South Korea's net foreign asset-to-GDP ratio to the advanced small open economy model to assess how the magnitude of business cycle fluctuations changes for a net external creditor and to reassess the effectiveness of stabilization policies.

A. Foreign interest rate shock

Figure 2 illustrates the time paths of key macroeconomic variables for an advanced small open economy (blue solid line) and an emerging market small open economy (red dashed line) in response to a 1 percentage point increase in the foreign nominal interest rate from the steady state (Figure 2(a)). The rise in the foreign interest rate slows down the foreign economy, reducing foreign output, consumption, and CPI. All panels report percentage deviations from the steady state, with the interest rate and inflation expressed in quarterly rather than annualized terms.

Figure 2. Impulse responses of macro-variables in EME and AvE to a 1% global rate hike

Note. 1) The horizontal axis represents time in quarters, and the vertical axis represents the percentage deviation of each macroeconomic variable from its steady-state value.

2) The blue solid line denotes the advanced small open economy (AvE), and the red dashed line denotes the emerging market small open economy (EME).

(Source) Author's compilation.

As the foreign interest rate rises, the domestic-foreign interest rate differential widens, triggering

capital outflows and exchange rate depreciation ($q_t \uparrow$, Figure 2(b)). The depreciation of the domestic currency raises import prices, leading to inflationary pressures, while the slowdown in the foreign economy reduces export demand, producing adverse spillover effects. The resulting downturn differs markedly across economy types: the exchange rate rises by 14.8% from the steady state in the emerging market economy but only 8.8% in the advanced economy, reflecting the shallower FX market depth characteristic of emerging markets.

The foreign slowdown reduces demand for exports, while exchange rate depreciation raises import prices, causing imports to decline as well. Because the decline in exports is relatively larger,³⁶⁾ the trade balance deteriorates ($tb_t \downarrow$, Figure 2(e)). In both emerging and advanced economies, the trade balance-to-GDP ratio falls by 1.18% on impact; however, in the emerging market economy, where the elevated exchange rate persists longer, the subsequent reversal to surplus occurs more rapidly owing to the eventual export-promoting effect.

The exchange rate depreciation also raises the cost of imported intermediate goods, increasing domestic production costs and reducing output ($y_t \downarrow$, Figure 2(c)). Output declines by 1.22% in the emerging market economy versus 1.06% in the advanced economy, and the pace of recovery is also slower in the former. Meanwhile, higher prices for both imported consumer goods and intermediate inputs generate consumer and producer price inflation ($\pi_{c,t} \uparrow$, $\pi_t \uparrow$, Figure 2(f), (g)). In the emerging market economy, consumer prices rise by nearly 0.2 percentage points after four quarters before gradually subsiding, whereas in the advanced economy the increase remains below 0.05 percentage points, showing little significant change.

The divergence between emerging and advanced economies extends to policy rate behavior. In advanced economies, well-anchored inflation expectations, deep FX markets, and strong fundamentals limit upward pressure on prices and capital outflows, so the domestic interest rate actually declines in response to reduced output from sluggish export demand. In the emerging market economy, by contrast, the need to contain inflation pushes the policy rate up by nearly 0.2 percentage points with a lag.

B. Stabilization policy responses to the foreign interest rate shock

This section examines the stabilization effects when FXI or CFM policies are implemented alongside monetary policy, which adjusts the policy rate in response to inflation and the output gap. FXI policy refers to the mechanism whereby the authority sells foreign currency from its reserves and purchases domestic currency in response to exchange rate depreciation, or

36) When the foreign interest rate rises, the foreign economy slows and foreign-produced goods prices fall. Although exchange rate depreciation lowers the foreign-currency price of domestic exports, foreign goods prices decline by even more, so the relative price of domestic exports rises in foreign markets. Hence, the export-promoting effect of depreciation is offset, and exports decline.

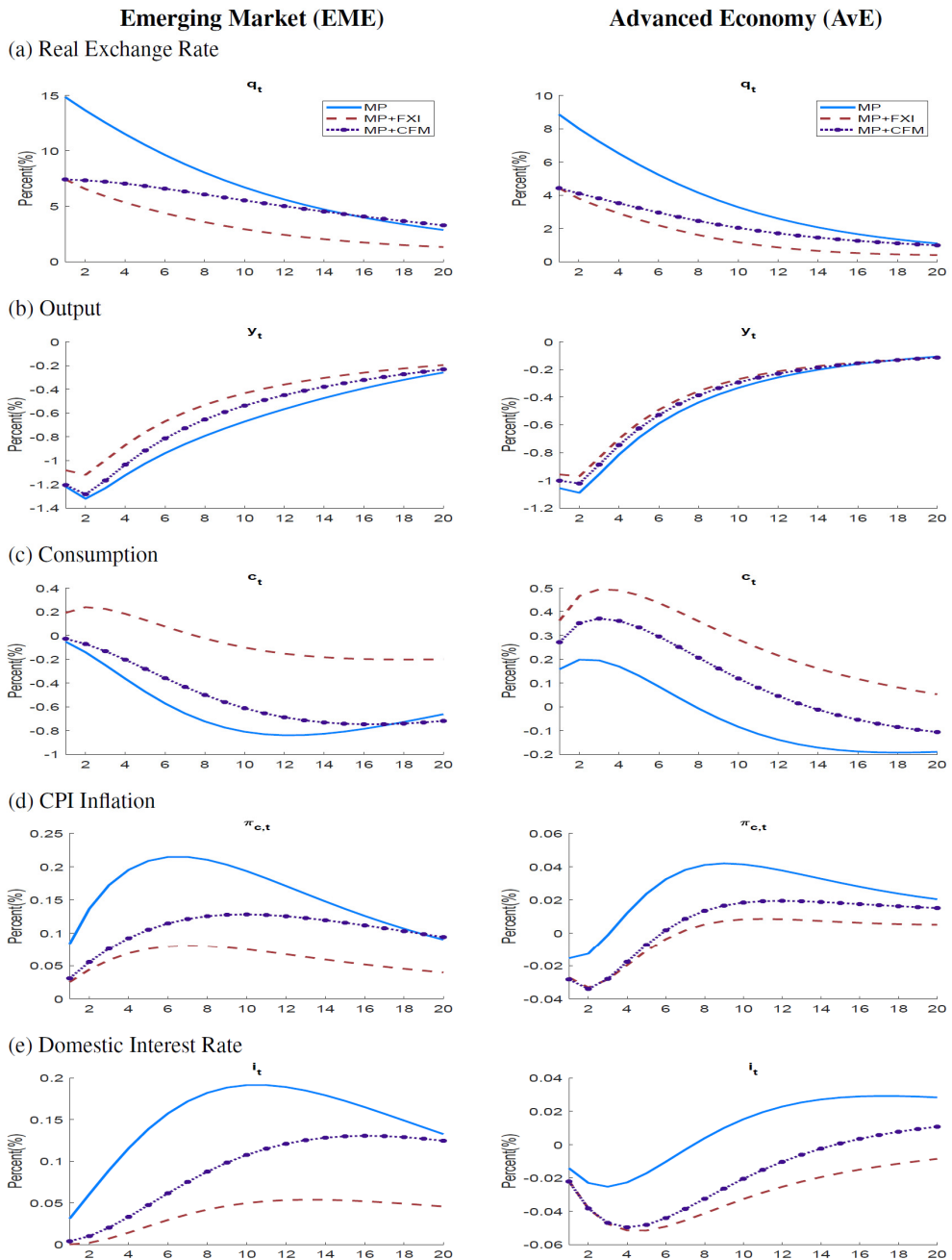
conversely, purchases foreign currency and sells domestic currency in response to appreciation. In the policy experiment of this analysis, CFM policy is defined as the monetary authority imposing a tax on capital outflows or providing a subsidy on capital inflows.

Figure 3 illustrates the stabilization effects in the emerging market and advanced economies. The analytical scenario is as follows. The foreign interest rate rises by 1 percentage point, reducing foreign demand and causing the exchange rate to depreciate. The intensity of FXI and CFM policies is then adjusted so that the increase in the real exchange rate is reduced to half of the level that would prevail under monetary policy alone. The blue solid line indicates the case with monetary policy only, the red dashed line the case with monetary policy combined with FXI, and the purple circle-dashed line the case with monetary policy combined with CFM.

In the left five subfigures of Figure 3, which depict business cycle fluctuations in the emerging market economy, the real exchange rate rises by 15% on impact under monetary policy alone. The figure shows the episode in which FXI or CFM is combined with monetary policy to limit this increase to 7.5%. While the initial exchange rate response is identical under both policy frameworks, FXI achieves more persistent stabilization over a longer horizon. On impact, output declines by -1.22% under monetary policy alone, but by -1.08% with FXI and -1.21% with CFM, indicating that FXI also delivers a larger output stabilization effect. Consumer price inflation peaks at 0.21% after five quarters under monetary policy alone, but the increase is limited to 0.13% with CFM and 0.08% with FXI. Notably, under FXI, consumption increases by 0.2% on impact and turns negative only after eight quarters, whereas under monetary policy alone or combined with CFM, consumption declines immediately following the shock.

A similar pattern is observed for the advanced economy in the right five subfigures of Figure 3. When monetary policy and FXI are used in combination, inflation is contained more quickly and the decline in output is smaller than under alternative policy combinations. Unlike in the emerging market economy, inflation in the advanced economy is relatively stable, so monetary policy responds more strongly to the output decline by lowering the policy rate, which in turn boosts consumption. The magnitude of the consumption increase is also larger under FXI.

Figure 3. Policy stabilization effects in EME and AvE following a 1%p foreign nominal interest rate shock



Note. 1) The horizontal axis represents time in quarters, and the vertical axis represents the percentage deviation of each macroeconomic variable from its steady-state value. 2) Blue solid: monetary policy only; red dashed: monetary policy + FXI; purple circle-dashed: monetary policy + CFM.

(Source) Author's compilation.

Table 2. Model Simulations of Business Cycle Volatility in EMEs and AEs

Macro Variable	Emerging Market Economy			Advanced Economy		
	MP	MP+FXI	MP+CFM	MP	MP+FXI	MP+CFM
Nominal interest rate	0.78	0.25	0.61	0.16	0.17	0.17
Real exchange rate	37.19	17.65	26.57	20.14	9.14	11.53
Output	3.53	2.72	3.19	2.46	2.17	2.28
Consumption	3.50	1.28	3.55	1.03	1.65	1.27
Trade balance	2.67	2.93	3.07	2.63	3.17	2.90
CPI inflation	0.76	0.31	0.55	0.15	0.09	0.12
PPI inflation	0.69	0.27	0.51	0.19	0.15	0.18

Note. 1) Values indicate the long-run standard deviation (%) of macroeconomic variables obtained through IPF model simulations.

2) The foreign interest rate shock is calibrated so that a one-standard-deviation shock raises the foreign interest rate by 1 percentage point on impact.

3) MP denotes monetary policy, FXI denotes foreign exchange intervention, and CFM denotes capital flow management; '+' indicates that the policies are implemented in combination.

(Source) Author's compilation.

Table 2 presents the stabilization effects of various policy combinations — Monetary Policy (MP) alone, MP combined with Foreign Exchange Intervention (MP+FXI), and MP combined with Capital Flow Management (MP+CFM) — categorized by economy type. As in the preceding analysis, the simulation applies a one-standard-deviation foreign interest rate shock (a 1 percentage point increase on impact). Both FXI and CFM are calibrated to mitigate the resulting exchange rate depreciation by 50% relative to the MP-only baseline.

The results show that augmenting MP with either FXI or CFM enhances stabilization, particularly in the emerging market economy. When using only monetary policy, output volatility in the emerging market is 3.53%; however, this figure decreases to 3.19% with CFM and 2.72% with FXI. Similarly, CPI inflation volatility drops from 0.76% under MP alone to 0.55% with CFM and 0.31% with FXI, demonstrating the superior smoothing effect of FXI on price levels.

A notable divergence between emerging and advanced economies appears in consumption volatility. In the emerging market, where business cycles are more volatile, FXI significantly reduces consumption volatility from 3.50% to 1.28%, whereas CFM slightly increases it to 3.55%. Conversely, for the advanced economy, both auxiliary policies exacerbate consumption fluctuations: volatility rises from a baseline of 1.03% to 1.27% under CFM and 1.65% under FXI.

In summary, while FXI and CFM effectively dampen business cycle fluctuations triggered by foreign interest rate shocks — especially regarding output and inflation in the emerging market economy — the trade-offs differ by economic development. In the advanced economy, characterized by anchored inflation expectations, the combined use of FXI or CFM stabilizes output but widens the amplitude of consumption fluctuations.

C. Scenario analysis: The net external creditor case (South Korea)

In this section, we recalibrate the model to reflect the structural characteristics of the South Korean economy as a net external creditor and reassess the effects of monetary policy, FXI, and CFM. South Korea's Net International Investment Position (NIIP) turned positive in the third quarter of 2014 and has trended upward since, reaching 43.7% of GDP as of 2022. A positive NIIP generally improves financial market stability and bolsters the creditworthiness of the external sector.

While maintaining the baseline Advanced Economy (AE) calibration, we adjust the ratio of net foreign assets to GDP (b) from the equilibrium level 0% to 43.7% based on the South Korean case. Furthermore, considering the consensus that South Korea's FX market is shallower than those of major advanced economies and its continued classification as an emerging market in the MSCI index, the FX market depth parameter (I) is set to the emerging market value of 0.031.

Table 3 compares macroeconomic fluctuations between a standard AE (NFA Equilibrium) and a Net External Creditor (South Korea). Comparing the monetary-policy-only (MP) cases across both structures reveals that the transition to a net external creditor status provides a significant structural buffering effect. Specifically, real exchange rate volatility drops from 20.14% to 10.43%, while output volatility declines from 2.46% to 2.09%. As the exchange rate stabilizes, CPI inflation volatility also eases from 0.15% to 0.06%, suggesting that a creditor position inherently dampens the pass-through effects of external shocks.

Table 3. Model Simulations of Business Cycle Volatility in AEs with Balanced vs. Positive NFA

Macro Variable	AE (NFA Equilibrium)			AE (Net External Creditor)		
	MP	MP+FXI	MP+CFM	MP	MP+FXI	MP+CFM
Nominal interest rate	0.16	0.17	0.17	0.18	0.28	0.26
Real exchange rate	20.14	9.14	11.53	10.43	6.53	6.72
Output	2.46	2.17	2.28	2.09	1.93	1.97
Consumption	1.03	1.65	1.27	3.18	3.90	3.90
Trade balance	2.63	3.17	2.90	4.33	4.74	4.78
CPI inflation	0.15	0.09	0.12	0.06	0.09	0.08
PPI inflation	0.19	0.15	0.18	0.10	0.10	0.09

Note. 1) Values indicate the long-run standard deviation (%) of macroeconomic variables obtained through IPF model simulations.

2) The foreign interest rate shock is calibrated so that a one-standard-deviation shock raises the foreign interest rate by 1 percentage point on impact.

3) MP denotes monetary policy, FXI denotes foreign exchange intervention, and CFM denotes capital flow management; '+' indicates that the policies are implemented in combination.

(Source) Author's compilation.

A notable divergence in the creditor scenario is the amplification of volatility in consumption and the trade balance. Under the MP-only framework, consumption volatility increases more than threefold, from 1.03% in the baseline AE to 3.18% in the creditor case. Similarly, trade balance volatility rises from 2.63% to 4.33%. This indicates that while creditor status stabilizes price levels and output, it shifts the burden of adjustment to domestic demand and external accounts when the economy is hit by foreign interest rate shocks.

In a net external creditor environment, augmenting monetary policy with FXI or CFM marginally suppresses output volatility (to 1.93% and 1.97%) but offers limited improvements in inflation stability. A critical side effect of these policy combinations is the heightened volatility of consumption and the trade balance, with FXI driving consumption volatility to 3.90%. This implies that for creditor economies with advanced features, suppressing exchange rate adjustments shifts the burden of volatility toward domestic consumption. Consequently, while the policy mix stabilizes output, it generates a pronounced trade-off by destabilizing consumption and the trade balance.

VI. Concluding Remarks

This study investigated the cross-border propagation of foreign interest rate shocks within the IMF's Integrated Policy Framework (IPF) and evaluated the relative efficacy of various stabilization policies amid deepening globalization and economic integration. Our analysis identifies three primary transmission channels through which a foreign rate hike impacts a small open economy: first, a demand channel, where a slowdown in the foreign economy suppresses domestic export demand; second, a monetary channel, where widening interest rate differentials trigger capital outflows and domestic currency depreciation; and third, a risk-premium channel, where declining net exports and capital flight heighten the country-specific risk premium, accelerating currency depreciation. These transmission channels are consistent with earlier work emphasizing how capital reversals and credit contractions amplify recessionary pressures in emerging market economies (Basu and Nag, 2010).

A fundamental finding of this research is the asymmetric impact of these shocks across EMEs and AEs. EMEs, characterized by shallower foreign exchange market depth, experience higher exchange rate volatility, sharper output contractions, and more persistent inflationary pressures. Furthermore, a critical divergence emerges in the conduct of monetary policy: while AEs maintain the policy space to adopt counter-cyclical measures, EMEs are frequently compelled to adopt a pro-cyclical tightening stance to anchor inflation expectations, thereby exacerbating the domestic downturn.

The simulation results suggest that augmenting monetary policy with FXI or CFM consistently

enhances macroeconomic stability compared to a standalone monetary framework. However, the stabilization performance and associated trade-offs of the integrated policy mix are contingent upon an economy's developmental stage. In EMEs, FXI effectively dampens volatility across output and consumption. Conversely, in AEs — where inflation expectations are well-anchored — these auxiliary instruments introduce a pronounced trade-off: while they stabilize output, they are associated with an increase in the cyclical amplitude of domestic consumption and the trade balance. This trade-off resonates with earlier findings that stabilization instruments in open economies inevitably entail tensions across competing policy objectives (Nag, 2008).

Applying this framework to South Korea reveals that its transition to a net external creditor status — a significant structural shift in its financial globalization — functions as a structural stabilizer. This creditor status inherently dampens the volatility of exchange rates, output, and inflation. However, the results indicate a trade-off: while the integrated policy mix contributes to output stabilization, it is also associated with an increase in the volatility of domestic consumption and the trade balance. For economies that have reached advanced stages of financial globalization, such as South Korea, policymakers must therefore consider the benefits of output stabilization alongside the associated increases in the volatility of consumption and external accounts.

To build upon these findings, future research should move toward estimating the model using actual South Korean economic data through a Bayesian approach. This would allow for a more realistic fit by capturing Korea's unique structural characteristics and historical reaction functions. By using real-world data, subsequent studies can provide more practical, data-driven policy implications. Ultimately, this empirical step will be essential for determining the right balance for the integrated policy mix — helping to stabilize the economy while managing the difficult trade-offs inherent in a globalized financial environment.

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