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Global Risk Factors and Their Impacts on Interest Rates and Exchange Rates: Evidence from ASEAN+4 economies*

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Abstract

The international finance trilemma represents the trade-off among exchange rate stability, monetary policy autonomy and free capital flows, resulting in varied reactions to global risk factors among Asian economies. This study explores how various monetary policy objectives shape the diverse responses of Asian interest rates and exchange rates to global risk factors. Using the Structural Vector Autoregressive Model with Exogenous Variables (SVARX), we analyze the impulse responses of short-term interest rates and exchange rates to global risk factors, including the US monetary policy changes, global economic policy and financial risks, and oil prices. The main findings are as follows: first, we found that most of the Asian monetary authorities except Japan mirror the US monetary policy changes, demonstrating that a key policy objective is to stabilize their cross-border capital flows and exchange rates. The magnitude of mirroring depends on countries' exchange rate regimes. Furthermore, although global economic policy and financial risks trigger the depreciation of most of the Asian exchange rates, their influence on Asian short-term interest rates is relatively smaller, showing the limited influence of global risk appetite on monetary policy objectives. Last, we found the opposite responses of Asian interest rates and exchange rates to oil prices, showing the diverse economic effects of oil prices on oil export and import countries.

Keywords: international financial trilemma, global risk factors, monetary policy, exchange rate, Asian economies

JEL: classification: F31, F41, E52

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1. Introduction

The concept of the international finance trilemma indicates that it is impossible for a country to simultaneously achieve three policy objectives: a fixed exchange rate, free capital movement, and monetary policy autonomy. This is owing to the inherent trade-offs that exist among these policy objectives, as discussed by Fleming (1962) and Mundell (1963). Consequently, nations are compelled to make a selection between two out of the three aforementioned policy objectives, taking into consideration their economic condition. This ultimately results in a wide range of monetary policy decisions and exchange rate arrangements. In recent decades, there has been a growing interconnectedness of the global economy due to the development in global value chains and financial markets. Asian countries, particularly those in East Asia and the ASEAN[1] region, exhibit a high level of integration with the global economy and a heavy reliance on global investment. Thus, they are particularly susceptible to global risk factors, such as the US monetary policy change. Thereby, these facts give rise to several key inquiries: What are the disparities in policy objectives among Asian countries? What is the influence of different policy objectives on the heterogeneous reactions of Asian monetary policies and exchange rates to global risk factors?

Depending on their economic situation, East Asian and ASEAN administrations have selected different monetary policy goals and implemented different exchange rate regimes. Japan selects monetary policy autonomy and free capital movements among the three policy objectives, while the majority of Asian monetary authorities, including Korea and several ASEAN nations, select exchange rate stability and free capital movement. China, on the other hand, forgoes unrestricted capital movements in favor of exchange rate stability and independent monetary policy. Furthermore, Hong Kong and Singapore have to give up their independence over monetary policy in favor of a stable exchange rate and free capital movements. Diverse monetary policy goals in Asian economies lead to unconventional reactions to international risk variables.

Regarding these, the relationship between monetary policy objectives decision and their influence on vulnerability to global risks has become a key question by scholars and policymakers, especially after the Global Financial Crisis. One reason is the high integration of Asian countries into the global economy. This deepening integration has been driven by the rise of the global supply chain, foreign direct investment, and regional trade agreements, leading to a higher vulnerability of the Asian economies to global risks. Another possible reason is the multifaceted global risks. Since Brexit and the US-China trade conflicts, global policy risk has become the major global risk source, resulting in high uncertainty on main economies' economic policies and global cooperations. Moreover, the US monetary policy changes often reverberate globally due

[1] the Association of Southeast Asian Nations

to the dominant role of the US dollar in the global economy. The US monetary tightening in 2021 increased borrowing costs and reduced capital flows to emerging markets, triggering financial market volatility and economic downturns in countries heavily reliant on external financing, thereby depreciating these countries' currencies.

Further, the COVID-19 pandemic disrupted global supply chains, halted economic activities, and strained healthcare systems worldwide. Because of its unparalleled characteristics and worldwide reach, it has become one of the biggest threats to economic stability and public health in modern history. In response to the COVID-19 shock, governments worldwide implemented large-scale monetary and fiscal measures to stabilize their economies. Nevertheless, these aggressive interventions, while necessary, have elevated global risks by increasing debt burdens and potentially fueling asset bubbles and inflationary pressures. As a result, the combination of these factors has created a new global economic landscape with complex global risk sources.

Plenty of previous literature studied how various global risk factors influence Asian monetary policies and exchange rates. Past studies underscore the pronounced influence of US monetary policy on Asian policy rates and exchange rates, with factors like financial openness and domestic monetary objectives playing a key role. Other global risks, such as global investors' risk aversion, commodity price shocks, geopolitical tensions, and pandemics, are recognized influencers on Asian monetary policy decisions. However, a notable gap persists in understanding the diverse reactions across Asian economies, the influence of global integration, and the combined influence of multifaceted global risk factors. Furthermore, the role of domestic elements like monetary autonomy and stabilizing exchange rates in Asian economies in either buffering or intensifying these spillovers has not been adequately explored, signaling a need for a deeper investigation into the intricate interplay between global risks and Asian economies.

To answer these questions, this study investigates the responses of Asian monetary policies and exchange rates to various global shocks, including the US monetary policy shock, global financial and economic policy shocks, and oil price shock. Using Structural Vector Autoregressive models with exogenous variables (SVARX), we estimate the impulse responses of monetary policy and exchange rates in ASEAN+4 economies (China, Hong Kong, Japan, and Korea) from January 2010 to June 2022. Our findings show that the Asian monetary policy responses to shocks in global risk factors heavily depend on authorities' policy objectives, and diverse monetary policy responses determine the differing exchange rate fluctuations. Compared to other global shock sources, the US monetary policy changes have significant spillover effects on Asian economies, which lead most of the Asian monetary policies instantaneously to mirror the US monetary policy changes to stabilize local economies and currencies.

The rest of the paper is organized as follows. Section 2 reviews the previous literature. Section 2 introduces the methodology to investigate the influence of multifaceted global risk

factors on the monetary policies and exchange rates in Asian economies with diverse monetary policy objectives. Section 4 reports the empirical results and discusses the influence of ASEAN+4 economies based on their diverse monetary policy objectives and exchange rate regimes. Section 5 concludes and provides policy implications.

2. Literature review

Our paper stems from two strands of the literature. First, the influence of the US monetary policy shock on the global economy, particularly in East and Southeast Asian economies, has been the subject of rigorous analysis. Early studies showed that the US monetary policy shock has significant implications for Asian financial markets (Mackowiak, 2007; Fukuda et al., 2013; Turner, 2014). Studies such as Ahmed and Zlate (2014) identified that a tighter US monetary stance generally leads to increased policy rates and exchange rate depreciations in many Asian economies. This spillover effect of the US monetary policy tightening was further explored by Bruno and Shin (2015), who noted the global bank capital flows as a major conduit for these spillovers. Chen et al. (2016) noted that these effects were particularly strong during global financial duress. Recent literature, such as Dées and Galesi (2021), revealed that the vulnerabilities of Asian markets to US monetary policy have been exacerbated by increased integration into the global financial system. Studies such as Aizenman, Chinn, and Ito (2020) emphasized that the resilience of individual Asian economies to such spillovers hinges on their macroprudential policies and regulatory frameworks. Studies such as Anaya, Hachula, and Offermanns (2017) and Ogawa, Shimizu, and Luo (2023) investigated the crucial role of capital flows in emerging market countries as the spillover channel of US monetary policy shocks. Thus, while the overarching narrative underscores the dominant influence of US monetary policy, the susceptibility of each Asian nation varies, influenced by factors like financial openness and the rigor of domestic monetary policies (Bowman, Londono, and Sapriza, 2015; Azad and Serletis, 2022).

Second, aside from the US monetary policy, various global risk factors can affect Asian monetary policy and exchange rates. For instance, both global investors' risk aversion and policy uncertainty have been found to exert significant pressures on Asian exchange rates (Mueller, Tahbaz-Salehi, and Vedolin, 2017; Caldara et al., 2020; Zhou et al., 2020; Ogawa and Luo, 2022). Global commodity price shocks, especially oil price fluctuations, are another risk source for Asian currencies, especially oil importers (Kilian, 2010; Basnet and Upadhyaya, 2015; Nusair and Olson, 2019; Sun et al., 2022). Global geopolitical tensions can also induce abrupt capital flow reversals, impacting Asian financial markets (Rey, 2015). Moreover, global banking and financial linkages are conduits for transmitting global liquidity shocks to Asia (Bruno and Shin, 2015). Lastly, global

pandemics, as evidenced by the COVID-19 crisis, can dramatically influence the region's policy rates and exchange rate dynamics (Miranda-Agrippino and Rey, 2020).

While extensive research has illuminated the broad spillover effects of US monetary policy and various global risk factors on Asian policy rates and exchange rates, there remains a paucity of understanding about the heterogeneous responses across different Asian economies, the potential non-linearities in these spillovers, and the compounding or mitigating effects when multiple risk factors manifest simultaneously. Moreover, how do domestic factors in Asian economies, such as monetary autonomy, fiscal policy stances, and structural reforms, mediate or amplify these spillovers? Addressing these questions would offer a more nuanced understanding of the intricate dynamics between global risks and Asian financial markets.

3. The ASEAN+4 monetary policy objectives and exchange rate arrangements

The international financial trilemma exists in Asian countries' choices of policy objectives. Among the three policy objectives, the choices in Asian countries are significantly diverse. **Table 1** shows the exchange rate arrangements and monetary policy objectives in ten ASEAN and four East Asia economies until 2022, retrieved from the Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) by the International Monetary Fund (IMF).

<add Table 1 here>

Among these economies, Japan, Korea, Indonesia, Malaysia, the Philippines, and Thailand have implemented floating exchange rate regimes primarily with inflation targeting. These economies face the challenge of balancing the goals of maintaining stable exchange rates and preserving the ability to implement independent monetary policies despite facilitating unrestricted capital flows. Japan places a higher emphasis on maintaining autonomy in its monetary policy, whereas Korea and the ASEAN countries tend to prioritize the stability of their exchange rates.

In contrast, China and Myanmar employ a managed exchange rate system. After the implementation of significant reforms in 2005 and 2015, the renminbi's exchange rate demonstrated a notable escalation in exchange rate volatility. Despite China's efforts to enhance renminbi transactions abroad and relax regulations on foreign investments, it has experienced a decline in exchange rate stability and a reduction in its monetary policy autonomy. In contrast, it utilizes a comprehensive strategy that integrates exchange rate controls, adjustments in the money supply and benchmark interest rates, and capital movement restrictions to achieve a harmonious equilibrium between exchange rate stability and economic progress.

Furthermore, it is important to acknowledge the disparity between the nominal and actual

exchange rate regimes in nations that employ intermediate and free exchange rate systems, also known as the "*de facto vs. de jure*" problem. It is frequently observed that emerging economies often adopt exchange rate policies that deviate from their officially declared positions. According to Luo (2018), the RMB reform implemented after 2015 resulted in the US dollar's continued dominance in the RMB currency basket, which effectively maintained a reliance on the US dollar and undermined the intended shift brought about by the reform. In other regions, such as Hong Kong and Brunei, a currency board system is employed, whereby their currencies are fixed to significant reserves. This arrangement, while guaranteeing stability in exchange rates, necessitates relinquishing autonomy in monetary policy. In contrast, Singapore and Cambodia have adopted an exchange band system, which has provided them with stability in exchange rates while still allowing for a certain degree of flexibility in their monetary policy decisions.

In the past few decades, East and Southeast Asian countries, especially within the ASEAN bloc, have witnessed a significant shift in capital control policies, predominantly moving towards liberalization. This change, exemplified by Cambodia, can be traced back to the lessons learned from the Asian Financial Crisis of 1997, which highlighted the need for more open and resilient financial systems. However, the journey has not been without challenges. China has followed a distinct path, cautiously reforming its capital control measures while maintaining a degree of regulation, as seen in the Renminbi depreciation in 2015. This approach reflects China's unique policy objectives.

The Chinn-Ito Index (KAOPEN) is an index measuring a country's degree of capital account openness. **Figure 1** shows the Chin-Ito Index for ASEAN+4 economies. According to the data, most of the Asian economies have loosened capital control during from 2010 to 2021. In 2021, Japan, Korea, Hong Kong, Cambodia, and Singapore have the highest degree of capital openness. In other economies, Myanmar, Malaysia, Philippines, and Thailand have higher degree of capital openness in the latest decade. On the contrary, China and Vietnam have kept the same degree of capital openness. Indonesia is the only one whose capital openness decreased. Within East and Southeast Asian countries, the appeal of increased capital openness brings about concrete advantages, such as improved opportunities for foreign investment and faster economic integration. However, it also simultaneously increases their susceptibility to global financial crises. This phenomenon is particularly noticeable in certain areas, where there is a greater risk of being affected by fluctuations in the global market, vulnerability to speculative investments, and a heightened likelihood of being impacted by international financial crises. Therefore, these nations have an intricate task of finding a balance, considering the potential for economic expansion offered by accessible financial markets, but also considering the heightened dangers of worldwide economic instability and legislative limitations.

<add Figure 1 here>

4. Empirical analysis on the determinants of interest rate and exchange rates in asean+3 economies

4.1. Methodology

This research investigates the determinants of ASEAN+4 interest rates and exchange rates. Exchange rates fluctuate under the influence of various factors. In the long run, the exchange rate is determined by the equilibrium exchange rate based on economic fundamentals such as domestic and foreign prices, interest rate differential, government debt outstanding, and trade balance. In the short run, on the other hand, the equilibrium exchange rate is mainly determined by factors such as interest rate differentials, global risk appetite, and supply and demand conditions in the foreign exchange market.

First, due to the exchange rate determination, the Uncovered Interest Rate Parity (UIP) theory states that in the short run, spot exchange rates are determined by the expectations of future spot exchange rates and interest rate differentials between domestic and foreign currencies. It represents the following:

$$s_t = s_{t+1}^e + (i_t - i_t^*) \quad (1)$$

where, s_t is the spot exchange rate at t, s_{t+1}^e is the expected spot exchange rate at $t+1$, i_t and i_t^* are the short-term interest rates of domestic and foreign currencies, respectively. Here, if the rational expectations hypothesis holds, the expected exchange rate coincides with the realized value of the exchange rate, and the domestic currency depreciates against the foreign currency when the interest rate differential increases. Hence, based on the rational expectations hypothesis, the UIP can be rewritten as

$$s_t = a_0 + \mathrm{a}_1\, s_{t-1} - a_2(i_t - i_t^*) + u_{st} \quad (2)$$

where a is coefficient, and u_{st} is the error term. However, many empirical studies observe the divergence between spot exchange rates and interest rate differential, or the "interest rate parity puzzle." This puzzle shows that UIP may not predict future exchange rates because of capital controls, leading to a misalignment between exchange rate fluctuations and short-term interest rate differentials.

Regarding the theory for determining short-term interest rates, the Fed's Monetary Policy Reaction Function (MPRF), or the Taylor Rule, proposed by Taylor (1993), was cited. The MPRF is a set of rules that govern how a central bank sets the level of its policy rate in response to changes in economic fundamentals. Taylor's rule formulates the Fed's monetary policy reaction function as follows:

$$i_t = \bar{r} + (\pi_t - \pi^*) + y_t \quad (3)$$

where i_t is the US monetary policy rate, $\bar{r}$ is the equilibrium real interest rate at which potential GDP is realized, π_t is the inflation rate, π^* is the target inflation rate, y_t is the GDP gap, and u_{it} is the error term. Thus, the Fed raises the policy interest rate when inflation or the GDP gap rises, reducing economic overheating. Ball (1999) extends the Taylor rule and formulated the monetary policy reaction function for an open economy as:

$$i_t = b_0 + b_1 i_{t-1} + b_2 \pi_{t-1} + b_3 y_{t-1} + b_4 s_{t-1} + u_{it} \quad (4)$$

where i_t is the policy interest rate, π_t is the inflation rate, y_t is the GDP gap, s_t is the exchange rate, b is coefficients, and u_i is the error term. When domestic currency depreciates to foreign currency, the inflation rate increases through trade or financial transactions, which causes the central bank to raise its policy rate.

Moreover, we define the determinants of output and inflation rate. The open economy IS curve function defines one nation's output as determined by lagged output, exchange rate, and domestic interest rate. The estimated formula is expressed as:

$$y_t = c_0 + c_1 y_{t-1} + c_2\, s_{t-1} + c_3 i_{t-1} + u_{yt} \quad (5)$$

where c is the coefficients, and u_y is the error term. Further, the open economy Philipps curve defines domestic inflation as relying on lagged inflation rate, output, and exchange rate fluctuations. The estimated formula is expressed as:

$$\pi_t = d_0 + d_1 \pi_{t-1} + d_2 y_{t-1} + d_3 (s_{t-1} - s_{t-2}) + u_{\pi t} \quad (6)$$

where π is the inflation rate, $s_{t-1} - s_{t-2}$ is the exchange rate fluctuation, d is the coefficients, and $u_{\pi t}$ is the error term.

Based on these, this study conducts a structural vector autoregressive (SVAR) model with exogenous variables, or the SVARX model, to investigate the determinants of ASEAN+3 interest rates and exchange rates.

We begin with the VAR specification as follows.

$$A_0 Y_t = A_1 Y_{t-1} + \cdots + A_p Y_{t-i} + \sum B_0 X_{t-j} + B u_t \quad (7)$$

where Y_t is a $n \times 1$ vector of endogenous variables. In this form, a $n \times$ n coefficient matric A_0 is used to set up restrictions on structural equations, and a $n \times$ n matric B is used to set up restrictions connected with impulse responses. X_t and B_0 is the exogenous variables and their coefficients matrix. i and j are lag lengths for endogenous and exogenous variables, which are decided by information criteria. This equation can be written in a structural form as

$$A\varepsilon_t = Bu_t$$
$$E(\varepsilon_t \varepsilon_t{}') = \Sigma_\varepsilon = A^{-1} B B'^{A^{-1}} \quad (8)$$

where u_t are shocks with unit variance and ε_t are non-unit variances.

If matric A is revertible, the above equation can be written as $\varepsilon_t = A^{-1} B u_t = S u_t$, where

$$S = A^{-1} B$$
$$\Sigma_\varepsilon = A^{-1} B B'^{A^{-1}} = SS' \quad (9)$$

. The order condition requires $k(k-1)/2$ restrictions for identification on S.

Regarding the economy sizes of sample countries, we separate sample countries into two groups: big open economies and small open economies. China and Japan, which are big open economies, have big economic sizes, and their economic shock can effectively influence global risk environments. Hence, we treat global risk as an endogenous variable. We construct a 5-variable SVAR with two exogenous variables as follows.

Model A (Large country model: Japan, China):

$$Y_t = [grisk_t, y_t, p_t, i_t, e_t]', X = [us\_i_t, oil_t]' \quad (10)$$

where $grisk_t$ is a global risk indicator, y_t is output, p_t is local prices, i_t is the short-term interest rate, e_t is exchange rate, us_i_t is the US interest rate, and oil_t is oil prices.

Endogenous variables in Y are ordered from the most exogenous to the least exogenous variables. In particular, among the endogenous variables, the global risk indicator is the most exogenous. Regarding monetary policy response function, monetary authorities decide their policy interest rate by output gap and local inflation. Finally, exchange rates are determined by the differential between short-term interest rates of local and foreign currency. Therefore, structural restrictions on S are set as a lower-triangle matrix.

Korea, Hong Kong, Indonesia, Malaysia, Philippines, Singapore, and Thailand have small economic sizes, and their economic shock hardly influences the global risk environment. Hence, we treat global risk as an exogenous variable. We construct a 4-variable SVAR with three exogenous variables as follows.

Model B (Small country model: ASEAN countries, Hong Kong, Korea):

$$Y_t = [y_t, p_t, i_t, e_t]', X = [grisk_t, us\_i_t, oil_t]' \quad (11)$$

4.2. Hypothesis

As discussed in the Trilemma of International Finance, Asian countries implement different exchange rate regimes depending on their monetary policy objectives. Based on Ogawa and Luo (2022), we hypothesize three types of determinants of exchange rates and interest rates in Asian countries according to their capital controls and exchange rate regimes (**Table 2**)

First, in the case of China with capital controls, the autonomy of monetary policy and the exchange rate stability were weakened because of the strengthening of the free international capital movement after the 2005 RMB reform (Luo, 2018). In the monetary policy response function, domestic production increase and inflation lead to an increase in policy rates, but a domestic currency depreciation may lower interest rates. In addition, higher oil prices will raise short-term interest rates, but higher global risk tends to lower short-term policy rates. Because of

financial autonomy, monetary authority does not completely follow an increase in foreign policy interest rate but determines its policy interest rate based on its monetary policy objectives.

Furthermore, countries such as Korea, Indonesia, Malaysia, the Philippines, and Thailand, which do not impose capital controls and operate under a floating exchange rate arrangement, tend to partially align their monetary policies with the US monetary policy. This is due to their policy choice to give up a certain level of monetary policy autonomy to prioritize objectives such as facilitating free capital movement and maintaining exchange rate stability. Therefore, when the US monetary policy changes, these countries can change their policy rates to stabilize their currencies by maintaining domestic and foreign interest rate differentials. On the other hand, Japan, since Abenomics, has implemented quantitative and qualitative easing (QQE) and has maintained monetary policy autonomy. As a result, the yen exchange rate moves according to changes in the interest rate differential between the yen and the US dollar. Unlike other Asian currencies, the Japanese yen appreciates as the traditional safe haven currency when global risks increase. Further, the appreciation of currencies in oil-exporter nations such as Indonesia and Malaysia is often observed in response to an increase in oil prices.

Finally, Hong Kong and Singapore have monetary policy objectives of free international capital movement and exchange rate stability, eliminating monetary policy autonomy. Therefore, while the exchange rate of the Hong Kong dollar against the US dollar is stable, the policy rate of the Hong Kong dollar has to follow that of the US policy rate completely. For Singapore, which implemented a reference currency basket to stabilize its currency, the Singapore dollar, the composition of the reference currency basket has not yet been announced. However, we hypothesize that its monetary authority will follow the changes in its reference currencies' policy rates.

<add Table 2 here>

4.3. Data

The data analyzed in this study are the exchange and short-term interest rates of the ASEAN 5+4 economies: Japan, China, Korea, Hong Kong, Indonesia, Malaysia, the Philippines, Singapore, and Thailand. The analysis period is from January 2010 to June 2022. The data used in the empirical study were obtained from Datastream, the BIS EER database, the IMF IFS database, and the EPU website. **Table 3** shows the variables used in this study. Specifically, production is the monthly industrial production index of each country, interest rate is the 3-month interbank interest rate, exchange rate is the broad-based effective exchange rate (BIS Effective Exchange Rate, broad) published by the Bank for International Settlements, prices are the monthly CPI index, and foreign interest rates are the 3-month LIBOR USD rates. The oil price is the

International Monetary Fund's Primary Commodity Prices Index (Crude Oil).

<Add Table 3 here>

For global risk indicators, we use two types of global risks. One global risk measurement is global economic policy uncertainty by Davis (2016), a monthly index of national policy-related economic uncertainty by Baker, Bloom, and Davis (2016). The other global risk measurement is global financial risk. The CBOE Volatility Index (VIX), the implied volatility of the S&P 500 index for the next 30 days, is widely used to indicate global investors' risk appetite. Further, the OFR Financial Stress Index (FSI) is constructed from 33 financial market variables to show the market-based snapshot of stress in global financial markets.

Figure 2 shows the dynamics of the ASEAN+4 economies' short-term interest rates as well as the differences between those rates and the US dollar from 2010 to 2022. The short-term interest rates in the left panel show different paths for each economy, which correspond to distinct monetary policies and economic conditions. Notably, most of the Asian economies have observed an overall decline as 2020 draws near in reaction to the COVID-19 pandemic. The interest rate differential with the US dollar in the right panel shows how the ASEAN+4 interest rates differ from US interest rates during the same period. Some nations kept the interest rate differential constant, whereas others showed noticeable swings. This difference highlights the relationship between US and ASEAN+4 monetary policy behaviors, as well as the equilibrium each economy aimed to achieve between its own domestic economic requirements and external financial environment.

<add Figure 2 here>

Figure 3 displays the ASEAN+4 nominal effective exchange rate dynamics during the analysis period. First, there is a discernible variance in the exchange rate movements among these Asian currencies over the period. Notably, the Chinese renminbi exchange rate exhibits a steady upward trend, particularly post-2015, underscoring its relative strength and possible implications of its economic policies and global trade dynamics. In contrast, currencies like the Thai baht and the Malaysia ringgit have seen a more tumultuous path, with marked declines in certain intervals, potentially reflecting domestic economic challenges or shifts in global export demand. Meanwhile, economies like Japan and Korea maintained a relatively stable exchange rate with modest fluctuations. The displayed trajectories underscore the diverse economic landscapes and policy directions among these Asian nations, highlighting the region's multifaceted nature of exchange rate determinants.

<add Figure 3 here>

Figure 4 shows the dynamics of significant global risk factors that influence the monetary policies and exchange rates within the ASEAN+4 economies. Before 2015, the short-term interest rate in the United States, which serves as an indicator of global monetary policy patterns, remained significantly low. The low US interest rate can be attributed to the lingering effects of the global financial crisis. In 2015, as the economy began to recover, the Federal Reserve implemented gradual increases in interest rates. Nevertheless, a surge in global economic apprehensions and trade conflicts prompted decreased US monetary policy rates. The Federal Reserve responded to the unprecedented COVID-19 crisis in 2020 by reducing interest rates to near zero to provide economic support. During this period, policy approaches oscillated between expansionary measures and prudent tightening. The VIX, the CBOE volatility index, indicates global investor risk aversion. It generally exhibited moderate volatility but experienced significant increases during prominent market uncertainties, such as the Eurozone debt crisis and the ongoing pandemic. The Financial Stress Index (FSI) by the Office of Financial Research experienced fluctuations, indicating increased levels of financial strain during significant events and demonstrating occasional periods of stability. The GEPU Index exhibited elevated levels during notable geopolitical events, signifying increases in global policy uncertainty. Simultaneously, there were notable fluctuations in oil prices, characterized by increases driven by geopolitical factors and supply constraints and decreases reflecting declines in global demand, particularly during the pandemic.

<add Figure 4 here>

Since the hypothesis that each variable has a unit root cannot be rejected by the ADF unit root test, each variable in the SVARX model is differenced and used in the empirical study.

5. Empirical results

This section presents the empirical findings of impulse responses in SVARX models for the ASEAN 5 + 4 economies. The objective is to examine the impact of global indicators on Asian monetary policies and exchange rates. In the case of country-specific models, we employ the Akaike information criterion (AIC) to determine the optimal lag lengths of endogenous and exogenous variables in SVARX models. We estimated country-specific models separately utilizing VIX, GEPU, and FSI as global risk indicators. **Table 4** presents the results indicating

that, across all country-specific model specifications, the optimal lag lengths of endogenous variables consistently range between one and two. Furthermore, the optimal lag lengths of exogenous variables consistently remain at one. Next, we estimate the accumulated impulse responses of Asian short-term interest rates and exchange rates in response to exogenous shocks originating from global risk factors, specifically the US interest rate, global policy risk, global financial risk, and oil prices.

<Add Table 4 here>

5.1. US monetary policy shock

The accumulated impulse responses of Asian monetary policy rates, represented by short-term interbank interest rates, and exchange rates, represented by BIS nominal effective exchange rates, to a one percentage shock in the US monetary policy rate, represented by the 3-month LIBOR USD rate, are presented in the panels of **Table 5**.

<add Table 5 here>

Asian monetary policy responses:

Numerous Asian economies, including China, Korea, and the Philippines, exhibited favorable adaptations in response to the US monetary policy shock, with notable responses observed in Hong Kong and the Philippines. In contrast, Japan displayed a slight downward trajectory. China and Singapore responded with increasing intensity over time, reaching a peak and waning after twelve months. Japan consistently maintained a negative trajectory throughout the period, while Korea and Hong Kong exhibited a sustained and robust positive trend. The results suggest that several Asian economies align their policies with changes in US policy, possibly to ensure economic stability or maintain competitive exchange rates. The distinctive behavior observed in Japan can be attributed to its distinctive monetary policy.

Asian currencies' responses:

Some currencies, like the Korean won and the Indonesian rupiah, depreciated after the shock, while others, like the Japanese yen and the Chinese renminbi, appreciated. The renminbi experienced a significant appreciation over the first twelve months post-shock, whereas the initial momentum of the yen wavered. The Indonesian rupiah underwent a substantial devaluation while the initial decline of the Malaysian ringgit stabilized. These results reveal surprising patterns, the most notable of which is the renminbi's unexpected appreciation against the usual expectation of Asian currency devaluation after a US interest rate hike. These results could indicate the effect of exchange rate management on the renminbi. The significant depreciation of the rupiah could be

attributed to increased sensitivity towards the US monetary policy shock. On the other hand, the evolving response of the yen indicates that the impact of US monetary changes may be temporary.

5.2. Global financial shocks

Panels in **Table 6** show the accumulated impulse responses of Asian monetary policy rates (short-term interbank interest rates) and exchange rates (BIS nominal effective exchange rates) to one percentage shock in global financial risk (CBOE VIX).

<add Table 6 here>

Asian monetary policy responses:

Following a shock in global financial risk, there was a notable decrease in China's interest rate. Japan and Singapore exhibited favorable responses, although Japan's response gained particular attention approximately one month later. Over time, Hong Kong, Indonesia, Malaysia, and the Philippines tended to decrease interest rates, while Korea maintained a stable rate. Thailand's rates decreased slightly post-shock. China's significant decline in its rate may indicate a proactive implementation of monetary easing measures in response to global economic pressures. Japan's delayed yet positive response suggests a temporal discrepancy in its adjustment to the financial market. Indonesia, Malaysia, and the Philippines' responses highlight their susceptibility to international financial risks, and Korea's unwavering position raises the possibility of capital controls. In essence, Asian economies display varied methods of managing global financial shock.

Asian currencies' responses:

Following the shock, the value of the Chinese renminbi significantly increased over time. The value of the Japanese yen experienced a significant increase during economic disruption, followed by a subsequent decrease. The value of the Korean won experienced a marginal decline one month after the shock. The Hong Kong dollar, Indonesian rupiah, and Thai baht all saw modest fluctuations in value following the shock, but currencies like the Malaysia ringgit, the Philippine peso, and the Singapore dollar saw significant depreciation. Though its fading response suggests this role may be temporary, the yen's initial rise highlights its role as a safe-haven currency during global financial challenges. The continuous renminbi appreciation may indicate resilience or strategic management, while some currencies' persistent depreciation indicates susceptibility to global financial shocks.

5.3. Oil price shock

Panels in **Table 7** report the accumulated impulse responses of Asian monetary policy rates

(as proxied by short-term interbank interest rates) and exchange rates (as proxied by BIS nominal effective exchange rates) to one percentage shock in oil price risk (as proxied by IMF Oil Price Index).

<add Table 7 here>

Asian monetary policy responses:

China's rates exhibit a consistent positive correlation with the upward movement of oil prices. In the meantime, post-shock rates in Hong Kong, Japan, and Korea first declined, though, over time, Japan and Korea's responses became less pronounced. In reaction to oil shocks, Malaysia and Hong Kong exhibit a steady decline, while Indonesia exhibits a positive shift that eventually fades. On the other hand, post-shock rates are constantly rising in the Philippines, Singapore, and Thailand. These results indicate that oil importers like Japan and Korea may initially cut rates to deal with the economic difficulties brought on by rising oil prices. On the contrary, oil exporters such as Indonesia encounter intricacies because increasing oil prices do not consistently result in immediate fiscal benefits. ASEAN may have implemented a similar strategy to that of the Philippines, Singapore, and Thailand in response to the volatility of oil prices.

Asian currencies' responses:

After the shock, the currencies of oil exporters like Indonesia and Malaysia appreciated while those of China, Japan, and Hong Kong depreciated in response to rising oil prices, confirming our main theory. The currencies of Korea, the Philippines, and Singapore also fluctuate; the Philippine Peso depreciates while the Singapore Dollar and Korean Won appreciate. Though this gradually decreases, Thailand's Baht initially appreciates. The initial trends mostly hold as we move away from the shock, but responses level off. In conclusion, as oil prices rise, major oil importers like China and Japan see a depreciation in their currencies, while oil exporters like Malaysia and Indonesia witness an appreciation.

5.4. Global policy shocks

Panels in **Table 8** report the accumulated impulse responses of Asian monetary policy rates (as proxied by short-term interbank interest rates) and exchange rates (as proxied by BIS nominal effective exchange rates) to one percentage shock in global policy risk (as proxied by Global Economic Policy Uncertainty Index).

<add Table 8 here>

Asian monetary policy responses:

While Korea, Indonesia, Hong Kong, and the Philippines had a variety of significant reactions, Japan began with a significant positive response, suggesting a possible interest rate hike. Japan continued to take a positive stance, while China's initial negative response was not significant initially but became more so over time. Notably, nations like Singapore, Malaysia, and Thailand have continuously alluded to interest rate reductions. The findings indicate that Japan, given its developed economy, is inclined to implement more stringent monetary measures in response to the prevailing global policy uncertainties. However, China's strong negative trend—which is not statistically significant—indicates that domestic economic factors may have a greater impact than global risk factors. Smaller economies such as Indonesia, Malaysia, and the Philippines are sensitive to global policy uncertainty shock due to global investors' risk aversion. Remarkably, a lot of Asian economies seem to be inclined toward cutting rates, suggesting a higher degree of regional susceptibility to changes in international policy.

Asian currencies' responses:

The Japanese yen experienced a substantial appreciation, thereby reinforcing its established status as a safe-haven currency. The HK dollar, Singapore dollar, and Thai baht all experienced modest appreciation. In contrast, the Chinese renminbi, Korean won, and Malaysian ringgit all experienced depreciation. After the shock, other currency trends continued, but the yen's appreciation decreased but remained statistically significant. The response of the yen serves to underscore its distinctive position within the Asian region. Given China's significant global influence, the renminbi's unexpected depreciation is noteworthy. Depreciation of currencies such as the Korean won is consistent with the assumption. However, strengthening certain currencies, such as the Singapore dollar, highlights how crucial exchange rate regimes are in facing global policy uncertainties.

5.5. Global Financial Stability Shocks

Table 9 displays the reactions of Asian monetary policy and exchange rates to a one percent shock in global policy risk, represented by the OFR Financial Stress Index.

<add Table 9 here>

Asian monetary policy responses:

Following the shock, Japan's monetary rate increased little but significantly—a pattern that persisted throughout time. On the other hand, many Asian economies, such as Singapore, Malaysia, the Philippines, Thailand, and China, cut interest rates. While Indonesia's rates first declined, they increased post-shock, and Hong Kong's rates dramatically and continuously surged.

Japan's steady rate hikes show resilience to external shocks. The fluctuating rates in Indonesia may indicate a shift in the country's approach to dealing with global financial instability. The general downward trend of rates in many Asian economies indicates their attempt to insulate their economies against external shocks.

Asian currencies' responses:

The Japanese yen notably appreciated after the shock, a statistically significant pattern at the 99% confidence level. On the other hand, the value of several Asian currencies depreciated, such as the Malaysian ringgit and the Korean won. On the other hand, the Hong Kong dollar and Chinese yuan significantly appreciated post-shock. The yen's notable increase in value supports its status as a refuge currency in times of financial instability. Remarkably, currency rate control or the dollar peg may have contributed to the appreciation of the renminbi and Hong Kong dollar, even if many of their competitors saw declines. The decline of Asian currencies, except the yen, highlights the region's vulnerability to global shocks and the complexity of their exchange rate regimes.

6. Concluding remarks and policy implications

The international finance trilemma continues to be a crucial factor for Asian economies as this trilemma complex the monetary policy responses to multifaceted global shocks. From the perspective of the trilemma, this study sheds light on the intricate monetary policy responses and exchange rate fluctuations to multifaceted global shocks. We used the SVARX models to investigate the monetary policy responses and exchange rate fluctuations in the ASEAN+4 economies from January 2010 to June 2022. Our initial findings indicate that the majority of Asian monetary authorities, except Japan, are following the changes in US monetary policy, with the primary goal of stabilizing their exchange rates and cross-border capital flows. The magnitude of mirroring depends on countries' exchange rate regimes. Second, although financial risk and global economic policy drive the depreciation in most of the Asian currencies, their impact on Asian short-term interest rates is comparatively modest, indicating the limited influence of global risk appetite on monetary policies. Finally, we found the opposite responses of monetary policies and exchange rates between oil exporters and importers, demonstrating the various economic implications of economic structures.

Based on the empirical findings, there are some crucial policy implications. First, monetary authorities should carefully monitor the multifaceted global risk source and their joint influence on domestic money markets and exchange rates because of their significant effects, triggering economic instability. Second, among the global risk sources, US monetary policy shock is still the largest external shock source, triggering diverse policy responses and regional financial

instability. Hence, considering the increasing interdependence of Asian economies and the developments in global value chains and financial integrations, there is a pressing need for enhanced regional monetary coordination. Such coordination could be synchronized policy responses, shared information systems, and joint interventions when faced with major external shocks. By harmonizing monetary policies and strategies regionally, Asian economies could mitigate the spillover effects of shocks from major economies like the US. Furthermore, a well-coordinated regional approach could bolster confidence among investors and markets, fostering a more stable and resilient economic environment facing global uncertainties.

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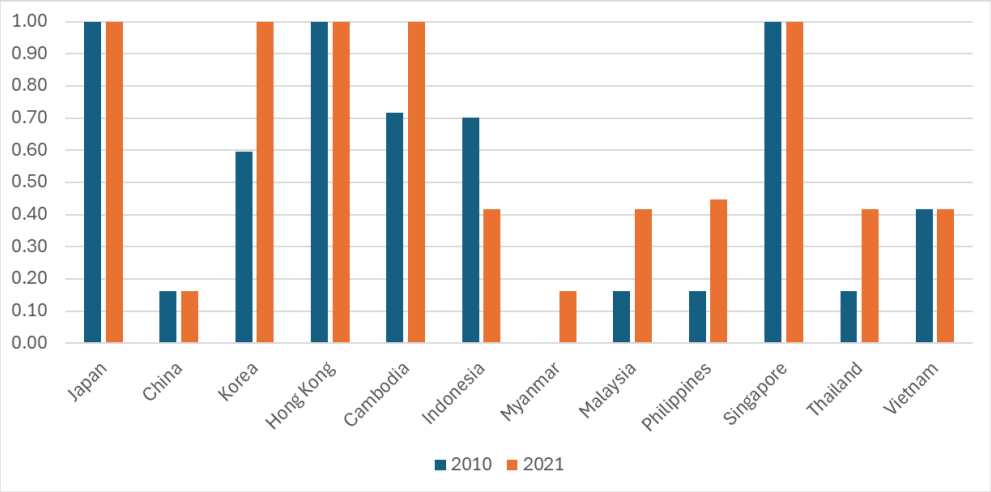
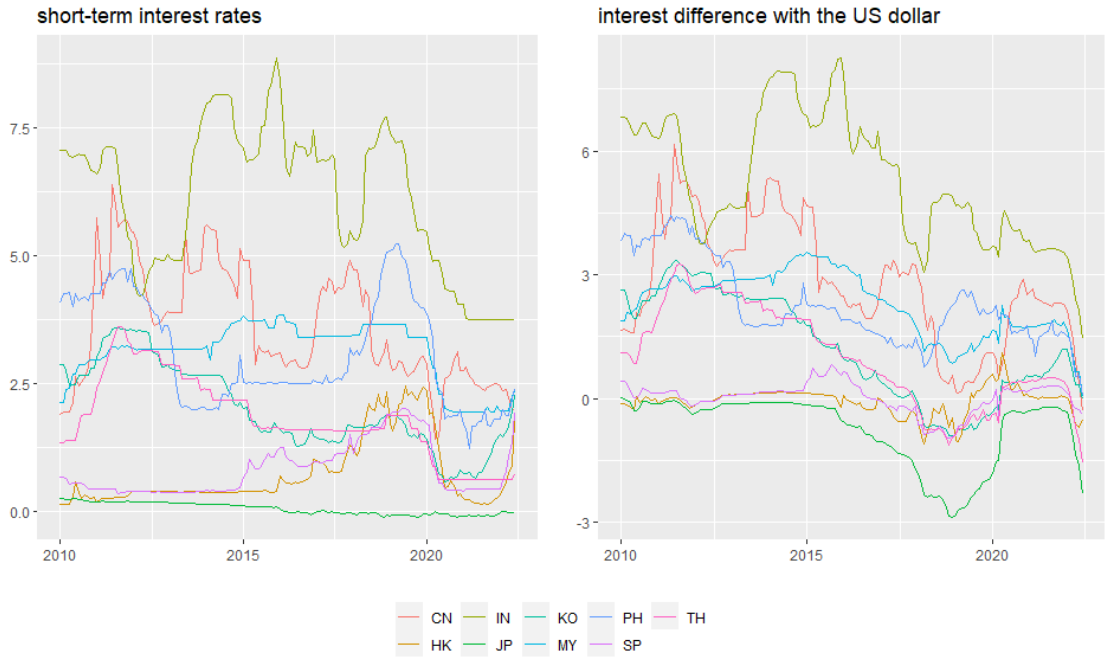
Figure 1. Capital account openness in ASEAN+5 economies



Source: Chinn-Ito Index website

Note: The figure shows the ASEAN+4 economies' Chinn-Ito Index, which measures a country's degree of capital account openness. See Chinn and Ito (2006).

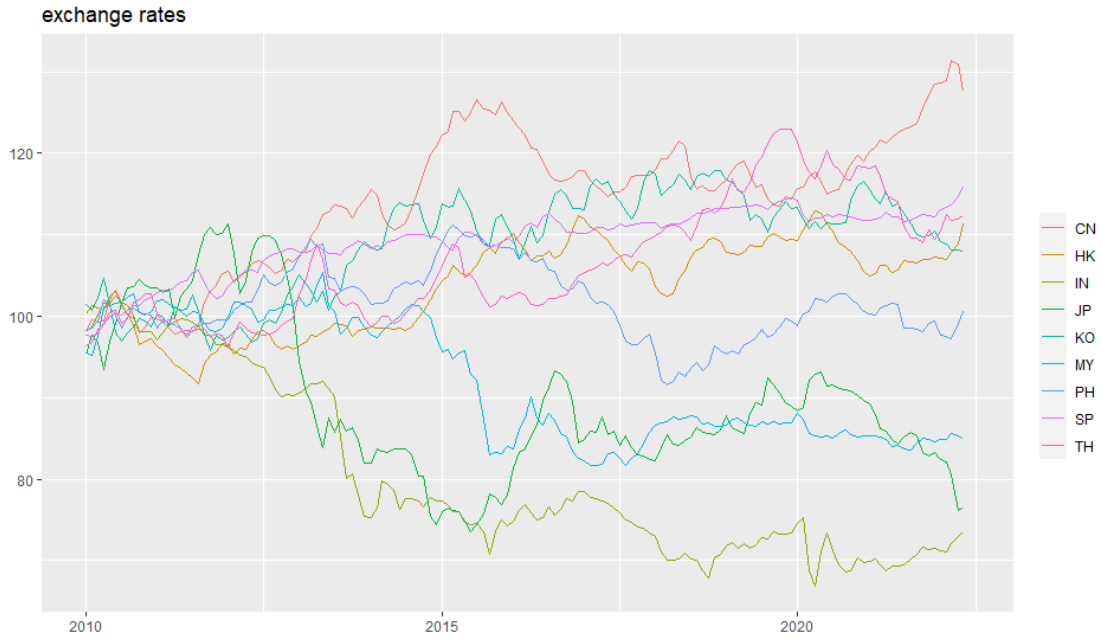
Figure 2. Dynamics of ASEAN+4 short-term interest rates and their interest rate differential with the US dollar (2010M1 - 2022M6)



Source: Datastream; Authors' calculation

Note: The figure shows the monthly movements of short-term interest rates for ASEAN+4 economies, China (CN), Japan (JP), Korea (KO), Hong Kong (HK), Indonesia (IN), Philippines (PH), Thailand (TH), Malaysia (MY), and Singapore (SP), alongside their corresponding rate differentials with the US dollar, during the period from January 2010 to June 2022. The left facet captures domestic 3-month short-term interest rates, while the right facet highlights the relative differentials with the LIBOR 3-month US dollar rates.

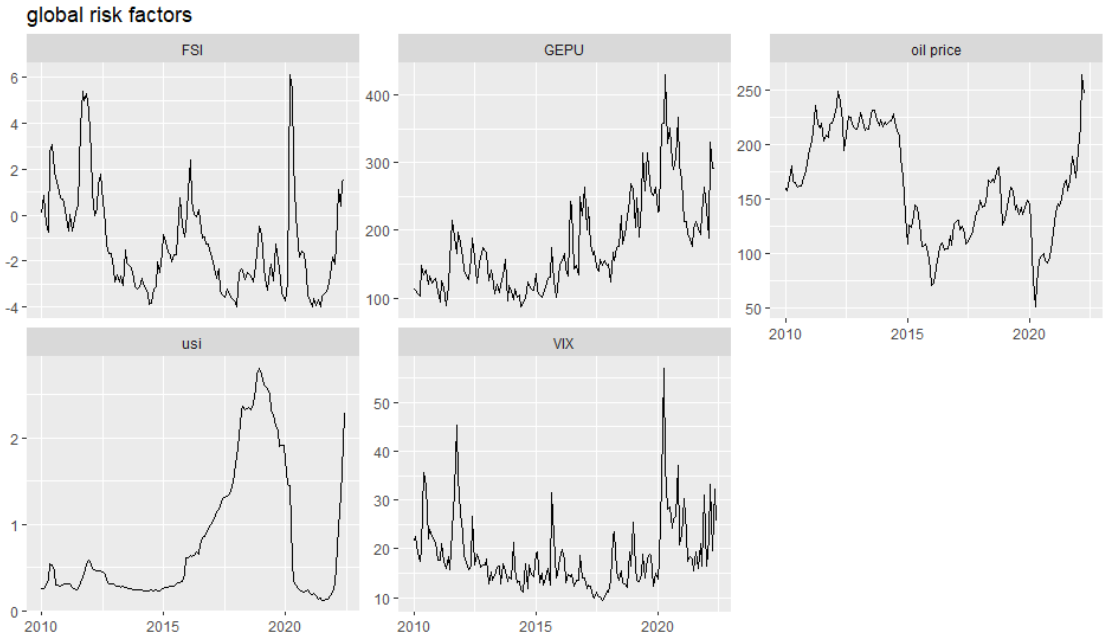
Figure 3. Dynamics of ASEAN+4 Exchange Rates (2010M1 - 2022M6)



Source: Bank of International Settlement

Note: The figure shows the monthly movements of the BIS broad nominal effective exchange rates for ASEAN+4 economies, China (CN), Japan (JP), Korea (KO), Hong Kong (HK), Indonesia (IN), Philippines (PH), Thailand (TH), Malaysia (MY), and Singapore (SP), during the period from January 2010 to June 2022.

Figure 4. Fluctuations in global risk factors (2010M1 - 2022M6)



Source: Datastream

Note: This figure presents the crucial global risk factors that affect ASEAN+4 monetary policies and their exchange rates from 2010 to 2022: VIX, the CBOE volatility index; FSI, the OFR Financial Stress Index; GEPU, the Global Economic Policy Uncertainty index; oil price, the IMF oil price index; and usi, the short-term interest rate of the US dollar.

Table 1. Asian exchange rate regimes and monetary policy framework

Country	Exchange rate regime		Monetary aggregate target	Inflation-targeting framework	Other objectives
	Exchange rate arrangement	Exchange rate anchor			
China	Crawling-like arrangement	–	yes	–	–
Japan	Free floating	–	–	2%	–
Korea	Floating	–	–	2%	–
Hong Kong	Currency board	US dollar	–	–	–
Brunei	Currency board	Singapore dollar	–	–	–
Cambodia	Stabilized arrangement	US dollar	–	–	–
Indonesia	Floating	–	–	3%±1%	–
Laos	Crawl-like arrangement	–	–	–	A mixed regime of monetary targeting and an exchange rate anchor.
Malaysia	Floating	–	–	–	Maintain price stability and developments in the economy.
Myanmar	Other managed arrangement	–	yes	–	–
Philippines	Floating	–	–	3%±1%	–
Singapore	Stabilized arrangement	Composite	–	–	–
Thailand	Floating	–	–	1–3%	–
Vietnam	Crawling-like arrangement	composite	–	–	–

Source: IMF (2023), Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)

Table 2. Hypotheses on impulse response from the SVARX model.

(A) Economies adopting capital controls: China

Shock / Response	$\boldsymbol{grisk}\uparrow$	$\boldsymbol{y}\uparrow$	$\boldsymbol{p}\uparrow$	$\boldsymbol{i}\uparrow$	$\boldsymbol{e}\uparrow$	$\boldsymbol{us\_i}\uparrow$	$\boldsymbol{oil}\uparrow$
i	↓	↑	↑		↓	↑ or 0 or ↓	↑
e	↓	↑	↓	$i - us\_i$		$i - us\_i$	↓

(B) Economies adopting floating exchange rate and capital openness: Japan, Korea, Indonesia, Malaysia, Philippines, and Thailand

Shock / Response	$\boldsymbol{grisk}\uparrow$	$\boldsymbol{y}\uparrow$	$\boldsymbol{p}\uparrow$	$\boldsymbol{i}\uparrow$	$\boldsymbol{e}\uparrow$	$\boldsymbol{us\_i}\uparrow$	$\boldsymbol{oil}\uparrow$
i	Japan: ↑ Others: ↓	↑	↑		↓	↑ or 0	↑
e	Japan: ↑ Others: ↓	↑	↓	$i - us\_i$		$i - us\_i$	Exporters: ↑ Importers: ↓

(C) Economies adopting dollar peg or reference currency basket and capital openness: Hong Kong and Singapore

Shock / Response	$\boldsymbol{grisk}\uparrow$	$\boldsymbol{y}\uparrow$	$\boldsymbol{p}\uparrow$	$\boldsymbol{i}\uparrow$	$\boldsymbol{e}\uparrow$	$\boldsymbol{us\_i}\uparrow$	$\boldsymbol{oil}\uparrow$
i	Mirroring anchor currency's interest rate						
e	Fixed to anchor currency						

Note: "↑" and "↓" show the hypothesized responses of local interest rates and exchange rates to domestic and global shock factors. "0" shows no responses. $i - us\_i$ shows dependency on interest rate differential.

Table 3. Variable descriptions

Variables	Descriptions	Source
VIX	CBOE Volatility Index	Datastream
GEPU	Global Economic Policy Uncertainty Index	policy uncertainty website
FSI	Financial Stress Index	Office of Financial Research website
y	Industrial production index, seasonal adjustment	IMF IFS
p	Consumer price index, seasonal adjustment	IMF IFS
i	3-month interbank interest rate, percentage	Datastream
us_i	3-month LIBOR USD interest rate, percentage	Datastream
e	BIS Effective Exchange Rate, broad	BIS
oil	Oil price index	IMF Primary Commodity Prices Index

Note: This table reports the monthly data employed in empirical analysis and their descriptions.

Table 4. Optimal lag length of country-specific SVARX models

Global risk indicator	Lag operator	CN	JP	KR	HK	MY	PH	SP	TH
VIX	*i*	2	2	2	2	2	2	2	2
	j	1	1	1	1	1	1	1	1
GEPU	*i*	2	2	2	2	2	2	2	2
	j	1	1	1	1	1	1	1	1
FSI	*i*	2	2	2	2	2	2	2	2
	j	1	1	1	1	1	1	1	1

Note: this table reports the optimal lag lengths in SVARX models selected by the Akaike information criterion (AIC) when using VIX, GEPU, and FSI as global risk indicators, respectively. *i* and *j* represent the selected lag lengths of endogenous and exogenous variables in SVARX models.

Table 5. Impulse responses to US interest rate shock

(a) Interest rates

Period	China	Japan	Korea	Hong Kong	Indonesia	Malaysia	Philippines	Singapore	Thailand
0	0.3733***	-0.0020*	0.1849***	0.4793***	0.1984***	0.0662***	0.4631***	0.3304***	0.0029***
1	0.5680***	-0.0040*	0.2449***	0.5524***	0.4305***	0.0920***	0.5033***	0.3141***	0.0330***
3	0.3568***	-0.0038	0.2832***	0.5741***	0.5053***	0.1258***	0.6307***	0.3836***	0.0528***
6	0.3523***	-0.0038	0.2889***	0.5789***	0.5327***	0.1424***	0.6783***	0.4069***	0.0577***
12	0.3396***	-0.0038	0.2892***	0.5814***	0.5366***	0.1466***	0.6823***	0.4073***	0.0582***

(b) Exchange rates

Period	China	Japan	Korea	Hong Kong	Indonesia	Malaysia	Philippines	Singapore	Thailand
0	1.5363***	0.5175***	-0.7778***	0.4227***	-1.7782***	-0.1586***	-1.0405***	0.1751***	0.1302***
1	2.0505***	0.8290**	-0.6208***	0.6879***	-2.3719***	-0.2912***	-1.2451***	0.2778***	0.0866***
3	2.0908***	0.7923	-0.5965***	0.7620***	-2.4038***	-0.0436**	-1.3752***	0.3105***	0.0551***
6	2.1752***	0.7923	-0.5877***	0.7209***	-2.3416***	0.0046	-1.2387***	0.3253***	0.0673***
12	2.1854***	0.7923	-0.5870***	0.6693***	-2.3602***	0.0126	-1.2301***	0.3278***	0.0705***

Note: Panels in this table show the accumulated impulses response to a 1% US interest rate shock at the shock period, after 1, 3, and 12 periods. ***99%, **95%, *90% Significance level.

Table 6. Impulse responses to VIX shock

(a) Interest rates

Period	China	Japan	Korea	Hong Kong	Indonesia	Malaysia	Philippines	Singapore	Thailand
0	-0.02869*	0.00064	0.00006	-0.00047	-0.00055	-0.00061	-0.00077	0.00022	-0.00004
1	-0.04199*	0.00274**	-0.00005	-0.00052*	-0.00087**	-0.00063*	-0.00072**	0.00019	-0.00011**
3	-0.01267	0.00240**	-0.00009	-0.00052*	-0.00103*	-0.00093*	-0.00089*	0.00020	-0.00021**
6	-0.03770*	0.00240**	-0.00009	-0.00052*	-0.00109*	-0.00106*	-0.00096*	0.00021	-0.00024**
12	-0.04020*	0.00240**	-0.00010	-0.00052*	-0.00109*	-0.00109*	-0.00096*	0.00021	-0.00024**

(b) Exchange rates

Period	China	Japan	Korea	Hong Kong	Indonesia	Malaysia	Philippines	Singapore	Thailand
0	0.0903***	0.3163**	-0.0108	0.0006	-0.0002	-0.0058***	-0.0031***	-0.0029***	-0.0009
1	0.1580***	0.1506	-0.0115*	0.0007**	-0.0003	-0.0070***	-0.0035***	-0.0040***	-0.0003
3	0.2961***	0.2095**	-0.0119*	0.0008**	0.0000	-0.0085***	-0.0037***	-0.0036***	-0.0000
6	0.3040***	0.2119**	-0.0119*	0.0008**	0.0000	-0.0094***	-0.0039***	-0.0036***	-0.0001
12	0.3103***	0.2120**	-0.0119*	0.0008**	0.0000	-0.0096***	-0.0039***	-0.0036***	-0.0001

Note: Panels in this table show the accumulated impulse response to a 1% VIX shock at the shock period, after 1, 3, and 12 periods. ***99%, **95%, *90% Significance level.

Table 7. Impulse responses to oil price shock

(a) Interest rates

Period	China	Japan	Korea	Hong Kong	Indonesia	Malaysia	Philippines	Singapore	Thailand
0	0.0026***	-0.0001***	-0.0001***	-0.0024***	0.0013***	-0.0014***	0.0004***	0.0008***	0.0001***
1	0.0026***	-0.0001	0	-0.0031***	0.0004	-0.0009**	0.0004***	0.0007***	0.0009***
3	0.0029***	-0.0001	0.0002	-0.0035***	0	-0.0006**	0.0004***	0.0009***	0.0016***
6	0.0041***	-0.0001	0.0002	-0.0036***	0.0002	-0.0005**	0.0004***	0.0010***	0.0017***
12	0.0043***	-0.0001	0.0002	-0.0037***	0.0002	-0.0005**	0.0004***	0.0010***	0.0018***

(b) Exchange rates

Period	China	Japan	Korea	Hong Kong	Indonesia	Malaysia	Philippines	Singapore	Thailand
0	-0.0110***	-0.0582***	0.0065***	-0.0173***	0.0443***	0.0267***	-0.0108***	0.0042***	0.0072***
1	-0.0161***	-0.0701***	0.0072***	-0.0222***	0.0549***	0.0294***	-0.0124***	0.0060***	0.0038
3	-0.0229**	-0.0772**	0.0074*	-0.0234*	0.0474***	0.0309**	-0.0116**	0.0058***	0.0024
6	-0.0241*	-0.0778*	0.0074*	-0.0219*	0.0483***	0.0316**	-0.0109**	0.0059***	0.0028
12	-0.0245*	-0.0778*	0.0074*	-0.0202*	0.0482***	0.0316**	-0.0110**	0.0059***	0.0029

Note: Panels in this table show the accumulated impulse response to a 1% oil price shock at the shock period, after 1, 3, and 12 periods. ***99%, **95%, *90% Significance level.

Table 8. Impulse responses to GEPU shock

(a) Interest rates

Period	China	Japan	Korea	Hong Kong	Indonesia	Malaysia	Philippines	Singapore	Thailand
0	-0.0023	0.0003***	-0.0001	0.0004	0.0008	-0.0004	-0.0015	-0.0005	0.0001
1	-0.046	0.0004**	-0.0001*	0.0004**	0.0011**	-0.0004**	-0.0015**	-0.0003**	0.0002**
3	-0.0088	0.0005***	-0.0001*	0.0004**	0.0012**	-0.0006**	-0.0015**	-0.0005**	0.0002**
6	-0.0157	0.0005***	-0.0001*	0.0004**	0.0013**	-0.0007**	-0.0015**	-0.0005**	0.0002**
12	-0.0147	0.0005***	-0.0001*	0.0004**	0.0013**	-0.0007**	-0.0015**	-0.0005**	0.0002**

(b) Exchange rates

Period	China	Japan	Korea	Hong Kong	Indonesia	Malaysia	Philippines	Singapore	Thailand
0	-0.0723**	0.3127***	-0.0079	0.0014	-0.0006	-0.0072	-0.0009	0.0018	0.0014
1	-0.1061*	0.1974**	-0.0092*	0.0023**	-0.0006	-0.0089*	-0.0006	0.0031**	0.0027**
3	-0.05	0.2171	-0.0094	0.0027	-0.0019	-0.0101	-0.0004	0.0022	0.0032*
6	-0.061	0.2187	-0.0094	0.0029	-0.0013	-0.0109	-0.0004	0.0022	0.0033*
12	-0.0602	0.2187	-0.0094	0.0031	-0.0015	-0.0111	-0.0004	0.0022	0.0033*

Note: Panels in this table show the accumulated impulse response to a 1% GEPU shock at the shock period, after 1, 3, and 12 periods. ***99%, **95%, *90% Significance level.

Table 9. Impulse responses to financial stability shock

(a) Interest rates

Period	China	Japan	Korea	Hong Kong	Indonesia	Malaysia	Philippines	Singapore	Thailand
0	-0.0098	0.0009***	-0.0019	0.0180***	-0.0029	-0.0257***	-0.0181***	-0.0403***	-0.0084***
1	-0.0468	0.0032***	-0.0042	0.0244***	0.0062	-0.0264***	-0.0157***	-0.0347***	-0.0112***
3	-0.0666	0.0033***	-0.0049	0.0285***	0.0244***	-0.0412***	-0.0170***	-0.0457***	-0.0121***
6	-0.0667	0.0033***	-0.005	0.0303***	0.0221***	-0.0493***	-0.0175***	-0.0491***	-0.0122***
12	-0.0692	0.0033***	-0.005	0.0317***	0.0229***	-0.0514***	-0.0174***	-0.0492***	-0.0122***

(b) Exchange rates

Period	China	Japan	Korea	Hong Kong	Indonesia	Malaysia	Philippines	Singapore	Thailand
0	0.1646*	0.7251***	-0.5445*	0.1775***	-0.5441*	-0.3341*	-0.2650*	-0.0912*	-0.0730*
1	0.3435***	0.7092***	-0.6074**	0.2295***	-0.6458**	-0.4098**	-0.3168***	-0.1017***	-0.1119***
3	0.3103***	0.7115***	-0.6213**	0.2528***	-0.4792**	-0.5145**	-0.3242**	-0.1128**	-0.1333**
6	0.3310***	0.7121***	-0.6218**	0.2476***	-0.5330**	-0.5804**	-0.3294**	-0.1165**	-0.1364**
12	0.3380***	0.7122***	-0.6218**	0.2382***	-0.5214**	-0.6004**	-0.3293**	-0.1173**	-0.1365**

Note: Panels in this table show the accumulated impulse responses to a 1% VIX shock at the shock period, after 1, 3, and 12 periods. ***99%, **95%, *90% Significance level.