Essays on Considerations of Open Economy Central Banks

개방경제 중앙은행의 고려사항에 대한 논문

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임 웅 지

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지도 교수 김 소 영

이 논문을 경제학박사 학위논문으로 제출함
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임웅지의 경제학박사 학위논문을 인준함
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위 원 장 이 재 원 (인)

부 위 원 장 김 소 영 (인)

위 원 허 준 영 (인)

위 원 임 건 태 (인)

위 원 임 근 형 (인)

Abstract

Essays on Considerations of Open Economy Central Banks

Im, Woongji
Department of Economics
The Graduate School
Seoul National University

This dissertation consists of three essays on the issues that central banks in an open economy should consider. Chapter 1 examines the determinants of inflation for five countries, Korea, Indonesia, Malaysia, the Philippines, and Thailand, and how their influence has changed over time using a time-varying coefficient vector autoregressive model (TVC-VAR). Inflation of these countries was found to be greatly affected by commodity prices and the old-age dependency ratio, and the old-age dependency ratio became more important as time went on. In the following chapter 2, the plausibility of local currency contribution to the Chiang Mai Initiative Multilateralization arrangement is assessed. The demand for local currencies in foreign exchange reserves and the stability of local currencies is investigated. Internationalization of currency and liberalization of capital account transactions are also considered. Chapter 3 discusses how the effect of monetary policy on exchange rate changes according to the country's characteristics. A two-stage empirical analysis of VAR and regression was conducted so that various country-specific characteristics could be considered simultaneously. The degree to which the exchange rate responds to monetary policy shocks is affected by key characteristics such as the exchange rate regime, capital market openness, economic size, advanced economy, and financial development especially.

Keyword : Inflation, Time-varying coefficients VAR, demand for currency, two stage analysis, monetary policy, exchange rate

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1. Determinants of Inflation Rate

1.1. Introduction

Low growth and low inflation environments prevail in recent years, which may be of great concern to policymakers. In this chapter, we focus on the inflation rate and try to infer the main factors affecting inflation rates and the extent to which each factor contributed to the decline in the inflation rate in recent years.

Conceptually, inflation can be divided into two types, long-run, and short-run inflation. The potential determinants of the long-run inflation rate found in past studies are technological progress, demographic change, globalization, and monetary policy environments. The potential determinants of short-run inflation discussed in past studies consist of economic slack, inflation expectation, commodity prices, and the global business cycle. In this chapter, considering these various determinants of inflation comprehensively, the importance of the factors and their changes over time are examined.

In the literature, it is a general view that technological progress, especially digitalization, is deflationary. Technological progress can directly lower the price of the related products, while it can lower wages and prices by increasing the productivity of the economy. Digitalization also lowers prices by increasing competition in the market. There are previous studies such as Dew-Becker and Gordon (2005), that suggest that productivity lowers prices with a model using macro variables, and more recently, there are empirical analysis studies such as Zervas, Proserpio, and Byers (2017), Goolsbee and Klenow (2018), and Cavallo (2018) that use microdata to suggest that digitalization, such as the introduction of the Internet or the development of e-commerce, lowers prices. Reflecting on these discussions, this study includes total factor productivity as a proxy.

Another prominent factor affecting inflation in the existing

literature is a demographic shift. However, there seems to be a lack of consensus on whether population aging is inflationary or deflationary. Goodhart and Erfurth (2014) and Goodhart and Pradhan (2020) argue, as suggested by the life-cycle hypothesis, that an increase in the proportion of retirees due to aging reduces labor supply, while consumption is not reduced due to accumulated savings and it eventually leads to higher wages, which is likely to put upward pressure on the price level. Juselius and Takats (2015) presented an empirical result that, through panel regression analysis, inflation rose as the dependency ratio increased. On the other hand, many recent studies have argued that aging can be deflationary because: Anticipation of future growth slowdown due to an aging population (Shirakawa, 2012), reduced labor productivity and wage pressure due to increased retirement or entry of the elderly into low-wage jobs (Fujita and Fujiwara, 2015), and avoidance of inflation due to political influence of the elderly (Bullard et al., 2012) or a decrease in demand due to tax increases (Katagiri, Konishi, and Ueda, 2014), a decline in economic growth and real estate prices (Anderson, Botman, and Hunt, 2014). Meanwhile, a recent empirical analysis using data from developed countries showed that aging generally lowers prices (e.g., Gajewski, 2014; Fujita and Fujiwara, 2015). Therefore, in this study, the old-age dependency ratio, that is, the ratio of the elderly population to the working-age, was included in the model.

Studies are showing that globalization also has the effect of lowering prices. The mechanism is that tradable goods prices tend to decrease as more of those goods are produced in low-wage countries such as China. The empirical results in the existing literature, however, are ambiguous – many studies support this claim (Borio and Filardo, 2007; Auer, Borio, and Filardo, 2017; Ciccarelli and Mojon, 2010; Mumtaz and Surico, 2012), whereas there are also papers documenting the opposite evidence (Kamin et al., 2006; IMF, 2006; Ihrig et al., 2010.; Bianchi and Civelli, 2015) In this regard, globalization-related variable, the trade ratio to GDP, although not presented here, is tested but it turns out that the variable is

insignificant for our VAR analyses.

The monetary policy environment can also influence inflation trends. Rogoff (1985) shows that central bank independence can lower the inflation rate using dynamic inconsistency theory. Alesina and Summers (1993) is a pioneer work validating the theory by conducting empirical analysis. Several follow-up studies demonstrate that the adoption of inflation targeting lowers inflation, including Mishkin and Schmidt-Hebbel (2007). However, variables related to the monetary policy environment are excluded in this paper because the sample span for most of the target countries of this paper corresponds to the period of inflation targeting, which started in the early 2000s.

Determinants of cyclical inflation include variables related to the Phillips curve – economic slacks, and inflation expectations – and external factors – commodity prices, and the global economic cycle. Economic slacks lower inflation and inflation expectations are positively related to inflation. Commodity prices, including oil prices, account for an important part of the inflation, and the global business cycle will also affect inflation as the global economy synchronizes. The output gap and M2 are included, while inflation expectation is not included due to the data availability. All the countries considered in this paper can be regarded as small open economies, so external factors like the commodity price index and total factor productivity of the United States are also included. In addition, the global output gap is also tested as in 1.4 but it turns out not significant in the model.

On the other hand, some argue that the extent to which the factors affect the inflation rate has changed recently. There has been a debate whether the inflation-output trade-off is weakened in recent years, often referred to as the flattening Phillips curve. There is a group of studies that argues that the Phillips curve is flattened due to the anchored inflation expectation (IMF, 2013; Carney, 2017), endogenous monetary policy (Tenreyro, 2018), structural changes in the labor market (IMF, 2013; Borio, 2017), and globalization (Carney, 2017). Whereas Blanchard et al. (2015) showed that the Phillips curve was alive for 20 major countries, including the United

States, and Ciccarelli et al. (2017) for the euro area. Some studies show that the Phillips curve is still downward sloping when inflation expectations are measured differently (Coibion and Gorodnichenko, 2015) or when estimating the slope of the Phillips curve for items sensitive to business cycles (Stock and Watson, 2020). It is examined whether the relative importance of determinants has changed, and the results can be indirect evidence for this debate.

In this paper, the time-varying coefficients VAR model was used as an empirical analysis method to examine changes over time and the relative importance of inflation determinants at the same time. Existing empirical analysis studies that explore inflation determinants usually analyze the influence of inflation determinants by estimating the Phillips curve through (panel) regression analysis or by examining the effect of structural shock on inflation using VAR or VECM models. In this study, by using the TVC-VAR model, the time-dependent changes in inflation determinants were also examined. It can provide a clue to debates about the flattening of the Phillips curve or the impact of globalization on inflation. Meanwhile, Gambetti, Pappa, and Canova (2008) and Bianchi and Civelli (2015) also used the TVC-VAR model to investigate the change of influence of the factors on inflation, but they concentrated on certain factors such as technical shock and globalization while this study comprehensively examined several domestic and foreign factors together.

According to the results of the empirical analysis, the commodity price and aging have the biggest influence on the inflation of the analyzed countries. It is not surprising that commodity prices have a large impact in small open economy countries, but it is quite interesting that the impact of aging is large in emerging markets with low population aging. Most of the papers examining the effect of aging on inflation so far have focused on advanced economies with an aging population. However, this study shows that aging can also be an important factor in determining inflation, even in emerging markets. It is also an achievement to reveal that the impact of aging on price fluctuations is growing over time.

The rest of this paper is organized as follows. In Section 1.2, the empirical methodology is explained. In Section 1.3, the empirical results are presented. In Section 1.4, a robustness check follows. Section 1.5 concludes with a summary of the results.

1.2. Empirical Method

1.2.1. Data

Quarterly data from 2001Q4 to 2019Q4 for the five countries – Korea, Indonesia, Malaysia, Philippines, and Thailand – were used. The data used in the basic model is the consumer price index (CPI), the commodity price index, the old-age dependency ratio, total factor productivity (TFP), the output gap, TFP of the United States, the share of China's exports in the world export, and the broad money(M2). Data were collected from the IMF International Financial Statistics (IFS), United Nations Population Division's World Population Prospects: 2019 Revision, The Conference Board, IMF Primary Commodity Prices, WTO stats, and FRED. Meanwhile, for robustness check, the global output gap data were produced according to the method of Bianchi & Civelli (2015)[①]. For this purpose, GDP data and trade data between countries were collected from IFS and IMF Direction of Trade Statistics (DOTS).

The old-age dependency ratio, TFP, and world trade data before 2004 are provided annually, so they are interpolated to quarterly data. A cubic spline was used as the interpolate method. The quarterly old-age dependency ratio was obtained by interpolating the 65-and-over population (the numerator) and the working-age population (the denominator), respectively, and then calculating the ratio. TFP provided as log difference was made into a log level variable through cumulative summation, then made into a level

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[①] After calculating the output gap of each country, the weighted average is calculated by considering the trade ratio for each country.

variable by exponentiation, interpolated by cubic spline, and then log-differentiated. World trade data up to 2004 were interpolated as is.

To ensure stationarity, most data are converted to percentage changes by taking logarithms, being multiplied by 100, then taking the difference. The percentage difference is used for China's export share and the old-age dependency ratio.

1.2.2. Methodology

To examine how the determinants of inflation have changed over time, we employ a time-varying coefficients vector autoregressive (TVC-VAR) model developed by Primiceri (2005) and Galí and Gambetti (2015).

The reduced form VAR model is given as:

$$z_t = B_{1,t} z_{t-1} + \cdots\cdots + B_{k,t} z_{t-k} + u_t \quad t = 1, \ldots, T \qquad (1.1)$$

where z_t is an $n \times 1$ vector of residual of regression of y_t on [1 x_t]. We regress y_t on [1 x_t] to control exogenous variables before applying TVC-VAR. This set up is to avoid the curse of dimensionality by reducing the number of coefficients to be estimated. n is the number of endogenous variables, x_t is a $\mathrm{m} \times 1$ vector of exogenous variables, m is the number of exogenous variables, $B_{\mathrm{j},t}$ is a $n \times \mathrm{n}$ matrix of time-varying coefficients of endogenous variables with lag $\mathrm{j} = 1, \ldots, \mathrm{k}$ and time t, and u_t is heteroskedastic reduced form errors and the covariance matrix of u_t i.e. $E(u_t u_t^{'}) = \Omega_t$. The lag order k is set to two. The exogenous variables x_t is added to incorporate the feature of the countries analyzed in this paper as small open economies.

In short, the variables in the VAR specification are summarized as follows:

[Exogenous variables]

US total factor productivity : log difference * 100

Share of China's exports in world exports	: difference, %
[Endogenous variables]	
Commodity price index	: log difference * 100
Old age dependency ratio	: 65 and over / 15 – 64, %, apply annual data to the corresponding quarter
Total factor productivity	: YoY, %, apply annual data to the corresponding quarter
Output gap	: %, gap to GDP trend
Broad money (M2)	: log difference * 100
Consumer price index (CPI)	: log difference * 100

The exogenous variables include the total factor productivity of the United States and the share of China's exports in world exports. TFP of the US is included to control for the effects of global business cycles or global supply shock, which is likely to play a substantial role for the domestic small open economies. The share of China's exports is included to control for the Chinese effect. These two variables and the global output gap were also tried as endogenous variables for robustness check later in this chapter.

The endogenous variables consist of six variables: commodity price index, old-age dependency ratio, total factor productivity (TFP), output gap, broad money, and consumer price index (CPI). As discussed in the previous section, these variables are regarded as potential determinants of the inflation dynamics.

The order of endogenous variables is important given that the structural shocks in the model are identified by a recursive ordering (Sims, 1980). The order is shown as above. The fact that the countries of this study are small open economies makes commodity prices the most exogenous. The old-age dependency ratio follows commodity prices based on an assumption that demographic shifts tend to occur independently of the domestic business cycles. TFP and output gap are then included to capture shocks in the supply- and demand-side of the economy, respectively. These factors are ordered ahead of the nominal variables such as money and CPI because real variables are likely to react faster than nominal ones. Broad money, representing monetary shock, is placed before CPI, reflecting the preemptive monetary policy.

As mentioned, recursive VAR is used. the structural VAR is given as:

$$A_t z_t = A_t B_{1,t} z_{t-1} + \ldots + A_t B_{k,t} z_{t-k} + \Sigma_t e_t \qquad (1.2)$$

where A_t is Cholesky decomposition of the covariance matrix Ω_t and e_t is structural shocks where $A_t u_t = \Sigma_t e_t$, $E\left(e_t e_t^{'}\right) = I_n$ and $A_t \Omega_t A_t' = \Sigma_t \Sigma_t'$.

$$A_t = \begin{bmatrix} 1 & 0 & \ldots & 0 \\ \alpha_{2\,1,t} & 1 & \ldots & \ldots \\ \ldots & \ldots & \ldots & \ldots \\ \alpha_{n\,1,t} & \ldots & \alpha_{n\,n-1,t} & 1 \end{bmatrix} \quad \Sigma_t = \begin{bmatrix} \sigma_{1,t}^2 & 0 & \ldots & 0 \\ 0 & \sigma_{2,t}^2 & \ldots & \ldots \\ \ldots & \ldots & \ldots & \ldots \\ 0 & \ldots & 0 & \sigma_{n,t}^2 \end{bmatrix} \qquad (1.3)$$

The reduced form VAR (1.1) could be written as follows for state space representation:

$$z_t = Z_t' B_t + u_t, \qquad Z_t' = I_n \otimes [z_{t-1}', z_{t-2}', \cdots\cdots, z_{t-l}'] \qquad (1.4)$$

B_t is a vectorized coefficients term of endogenous variables.

B_t's state equation is expressed as follows.

$$B_t = B_{t-1} + v_t \qquad (1.5)$$

A_t and Σ_t are also time-varying and the time-varying elements of the matrices are assumed as follows:

$$\alpha_t = \alpha_{t-1} + \zeta_t \qquad (1.6)$$

$$log\sigma_t = log\sigma_{t-1} + \eta_t \qquad (1.7)$$

where α_t is a column vector of lower triangular elements of A_t and σ_t is a column vector of diagonal elements of $\Sigma_t^{\frac{1}{2}}$. The innovations in the previous equations, e_t, v_t, ζ_t, η_t, follows normal distribution and are independent each other. And it is assumed that each variance follows I_n, Q, S, $and\, W$.

The estimation also follows Primiceri (2005) and Gali and

Gambetti (2015). We set the prior distributions of the parameters using the first 36 initial samples. The Gibbs sampling procedure was used to obtain the posterior distribution of the parameters because the conditional distributions of the parameters can be derived when the other parameters are known. New values of B_t, α_t, $log\sigma_t$ were sequentially drawn using the state equations of (1.5) to (1.7) and the observation equations derived using other (drawn) parameter values and the observations z_t. The initial values for the Kalman filter are from the prior distributions.[②]

After drawing 15,000 times, we burn-in 10,000 draws, and then take every fifth one, and finally get 1,000 samples.

1.3. Empirical Results

Excluding the inflation shock itself, the most important factors that explain inflation include commodity prices and the old-age dependency. Commodity prices have been regarded as important price drivers and since the countries analyzed are small open economies, it is not surprising that commodity prices have a significant influence on inflation. However, it is interesting that population aging has a significant impact even though the level of aging is not very high, except for Korea.

Meanwhile, the influence of each factor on inflation changes over time. The negative influence of the old-age dependency ratio is on the rise, while commodity prices have varied patterns, and the response of inflation to the other factors is generally diminished or maintained. What is surprising once again is that the impact of aging increases over time, whereas other factors have a smaller or sustained impact over time. This suggests that an aging population may act as a long-term downward pressure on inflation, especially

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[②] Since the prior is used for the initial value, the prior distribution was constructed only with the initial data. For a detailed estimation algorithm, see Gali and Gambetti (2015).

considering that the population is aging rapidly.

Looking at the change patterns, the structural changes in the influence of variables by country tend to be concentrated at several points in time. In particular, it can be inferred that the global financial crisis has had a significant impact on each country's economy, as the pattern of change often changes before and after the global financial crisis in most countries.

Looking at the influence of each factor on inflation, commodity prices have a significant positive effect over the entire period in most countries, which is consistent with the general view that rising international commodity prices raise domestic prices. The direction of change in the influence of commodity prices on inflation varies from country to country, and trends tend to change even within a country.

The old-age dependency ratio has a significantly negative effect on inflation in Korea, Indonesia, and Thailand and the negative effect gradually increases. In the case of Malaysia and the Philippines, it is gradually changing to have a negative effect. This could be the basis for the argument that aging is deflationary. Meanwhile, the old-age dependency ratio shows a high contribution to long-run prices. This confirms once again that aging is a factor in long-run inflation.

Except for Thailand, it is a common phenomenon that TFP has a positive effect but gradually weakens, which is a conflict with the general view that technological progress lowers the price. This may be because TFP is not suitable as a proxy for technological progress. Another possible explanation is that if the TFP rises permanently, then the price should rise as demand may outstrip supply in the short run. According to this, it can be interpreted that the proportion of permanent TFP fluctuations was large in the past, but is gradually decreasing.

The effects of the GDP gap are generally positive but tend to decrease, suggesting a flattening of the Phillips curve. Indonesia had an insignificantly negative effect, but it got closer to 0 as time passed, and Malaysia, on the other hand, was close to 0 but showed an insignificantly negative effect as time passed.

M2 had a negative effect on prices in Korea and the Philippines, and a positive effect in Indonesia and Malaysia, so the effect on prices was not uniform, and the effect tends to converge to zero. It is not clear whether the shock identified here is a money demand shock or a money supply shock, so caution is required in interpretation.

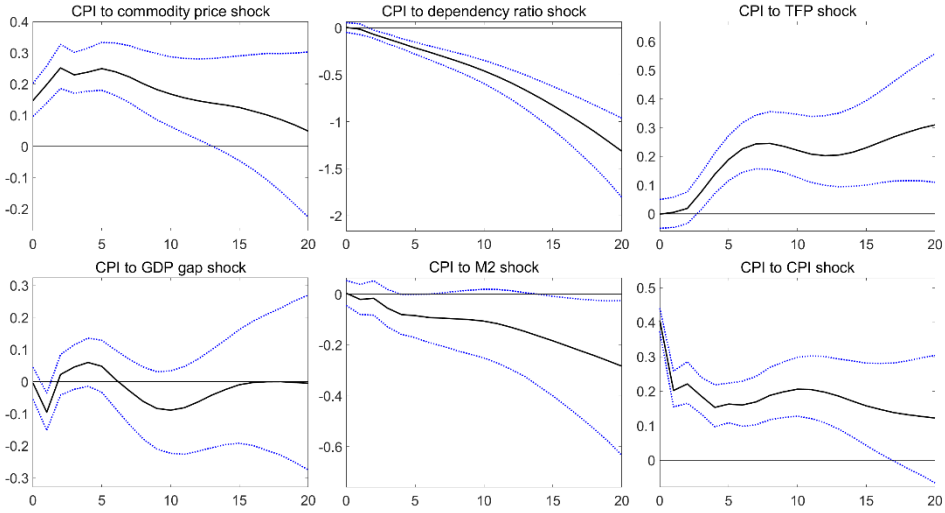
The persistence of CPI is the most important factor explaining price fluctuations, but it tends to decrease except for Malaysia.

1.3.1. Korea

Figure 1.1 and Figure 1.2 depict the (cumulative) impulse responses of CPI to the structural shocks and forecast error variance decomposition in Korea, respectively, derived by fixed coefficients VAR.

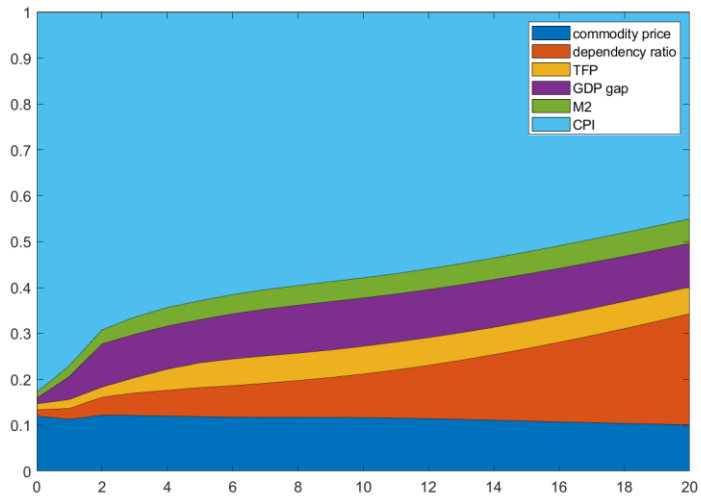
Excluding CPI's own shock, commodity price, and dependency ratio have the greatest impact on inflation but the direction of their influence on the inflation was different. Commodity price shock had a positive effect like TFP and CPI shock itself, whereas dependency ratio shock had a negative effect along with the GDP gap and the broad money. In addition, while the effects of other shocks were short-lived or limited, dependency ratio and TFP shock had a large effect in the long run.

Figure 1.1: Impulse-Responses of CPI in Korea



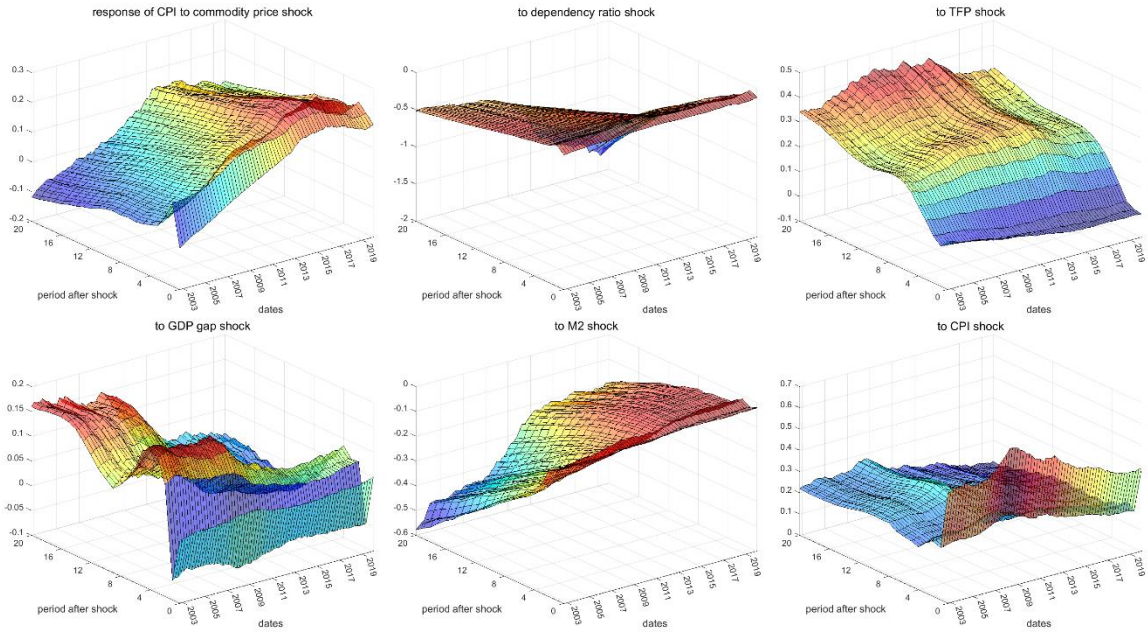
Note: In each panel, median (black line) and 68% band (blue line) estimates are reported.

Figure 1.2: forecast error variance decomposition in Korea



Below we show how these influences have changed over time. Figure 1.3 depicts how the median (cumulative) impulse response of CPI to the various structural shocks in Korea varies over time and horizons. The figure makes clear that the effects of each structural shock on the price display a substantial degree of time variability, which is more pronounced in the longer horizons.

Figure 1.3: Time-varying Impulse-Responses of CPI in Korea



For full statistical analyses of the results, Figure 1.4 plots the median (solid black line) and 68% band (blue dashed lines) estimates of the impulse responses of CPI for selected horizons—at 1, 4, 8, and 12 quarters after each shock. The effect of commodity price shock on CPI was mostly positive and increased until 2015, and although it has shown a moderate downward trend since then, it still has a large effect.

The impulse responses of CPI to old-age dependency ratio shocks take significantly negative values, which provides empirical support that aging is deflationary. and the response is increasing over time. This means that the effect of aging on lowering inflation increases over time.

The effect of TFP is generally positive, but since 2014, the mid- to long-term effect has been gradually declining. The positive impact of TFP on CPI conflicts with the view that technological progress tends to lower prices. This conflict may stem from the fact that TFP is not a suitable proxy for technological progress. Another possible explanation is that if the TFP rises permanently, then the price should

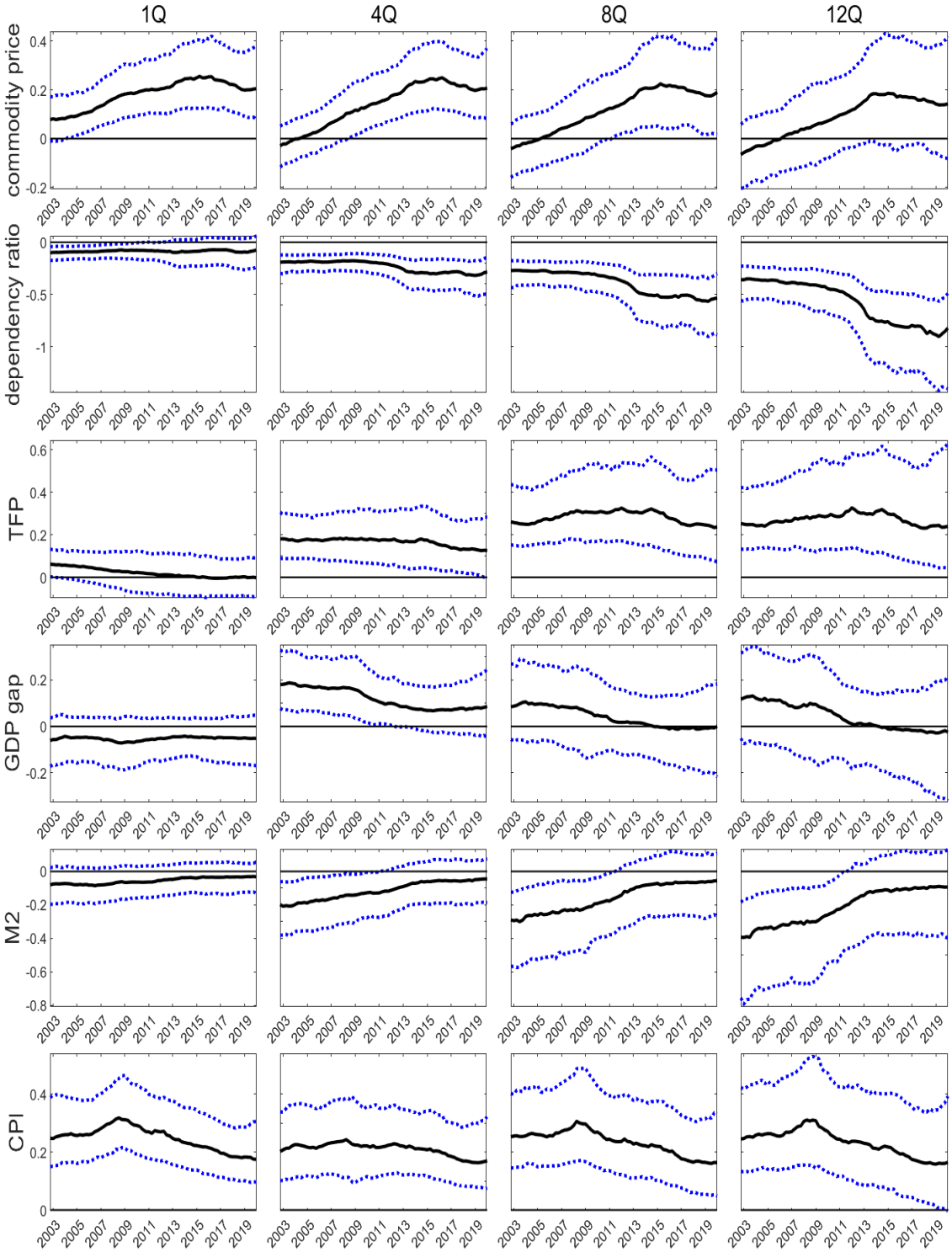
rise as demand may outstrip supply in the short run.

The output gap has a positive effect on medium-term inflation, but the effect rapidly diminishes over time, especially after the GFC. This can support the flattening Phillips curve and suggests that the GFC may have had an impact on Korea's economic structure.

Broad money displays negative impacts, which become more evident over time. Economic theory posits that an increase in money supply results in inflation. In this regard, our finding is not consistent with the theory. However, the impulse responses can make sense if the increase in broad money reflects higher money demand, instead of the higher money supply.

Lastly, the results show that the response of CPI to its own shock has a substantial degree of persistence, which is universal for the countries considered in this study. In Addition, the response increased before the GFC and then decreased.

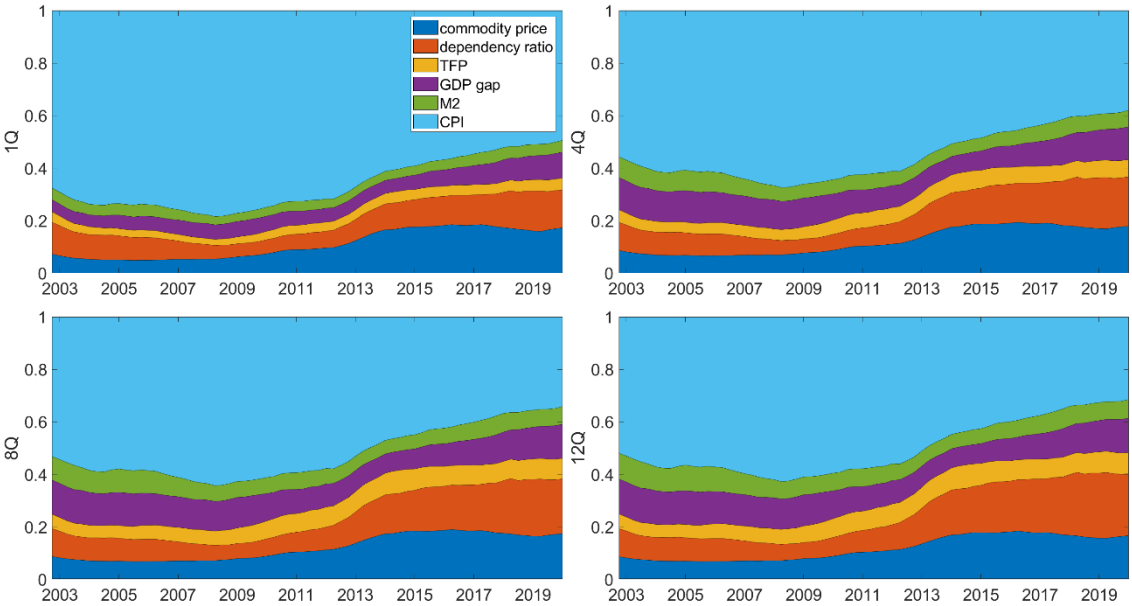
Figure 1.4: Time varying effect of structural shocks on CPI in Korea



Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported.

Figure 1.5 shows the decomposition of the forecast error variance for the selected horizons as above. It is noteworthy that the old-age dependency ratio shock accounts for a large portion of the forecast error variance, which has increased to the level of the commodity price.

Figure 1.5: Time-varying forecast error variance decomposition in Korea

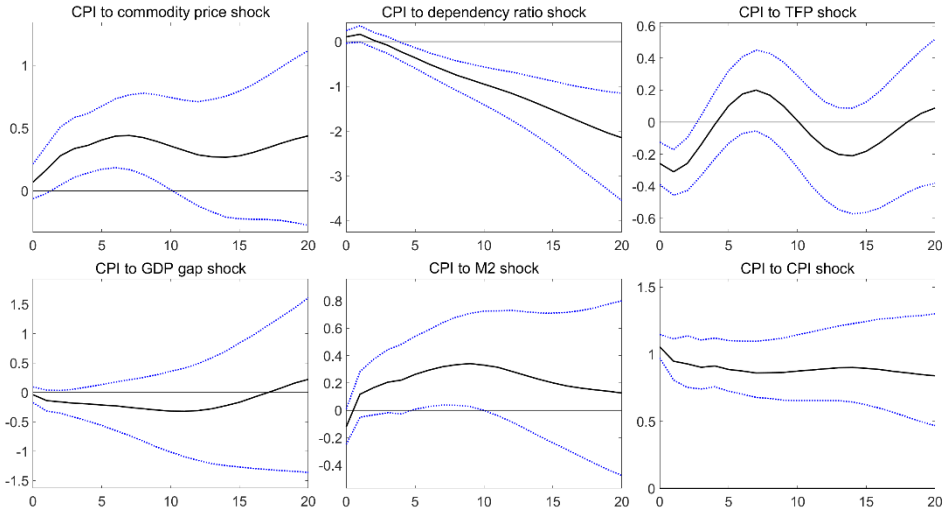


1.3.2. Indonesia

Figure 1.6 and Figure 1.7 depict the (cumulative) impulse responses of CPI to the structural shocks and forecast error variance decomposition in Indonesia, respectively, derived by fixed coefficients VAR.

As in other countries, commodity prices have a positive effect on CPI and the old-age dependency ratio has a large long-term negative effect. On the other hand, the small share of commodity prices in the forecast error variance decomposition differs from other countries.

Figure 1.6: Impulse−Responses of CPI in Indonesia



Note: In each panel, median (black line) and 68% band (blue line) estimates are reported.

Figure 1.7: forecast error variance decomposition in Indonesia

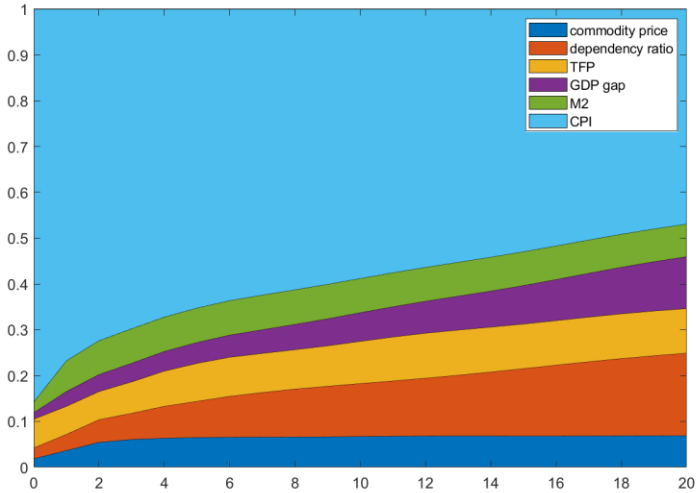


Figure 1.8 reports the median (cumulative) impulse response of CPI to the various structural shocks in Indonesia, across time and horizons.

Figure 1.8: Time-varying Impulse-Responses of CPI in Indonesia

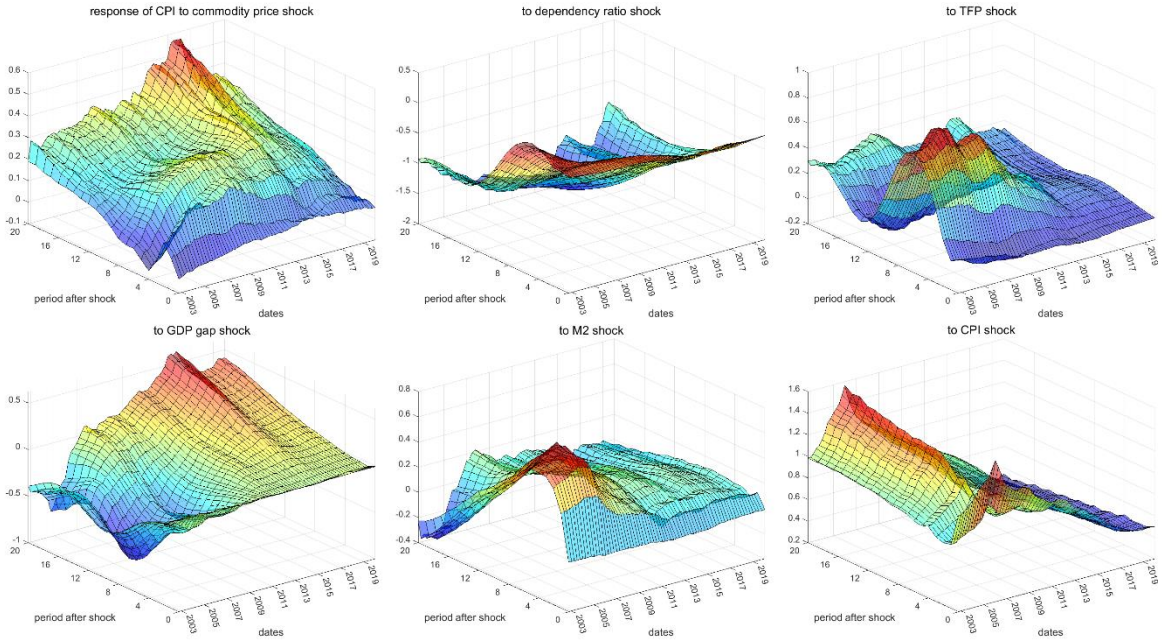
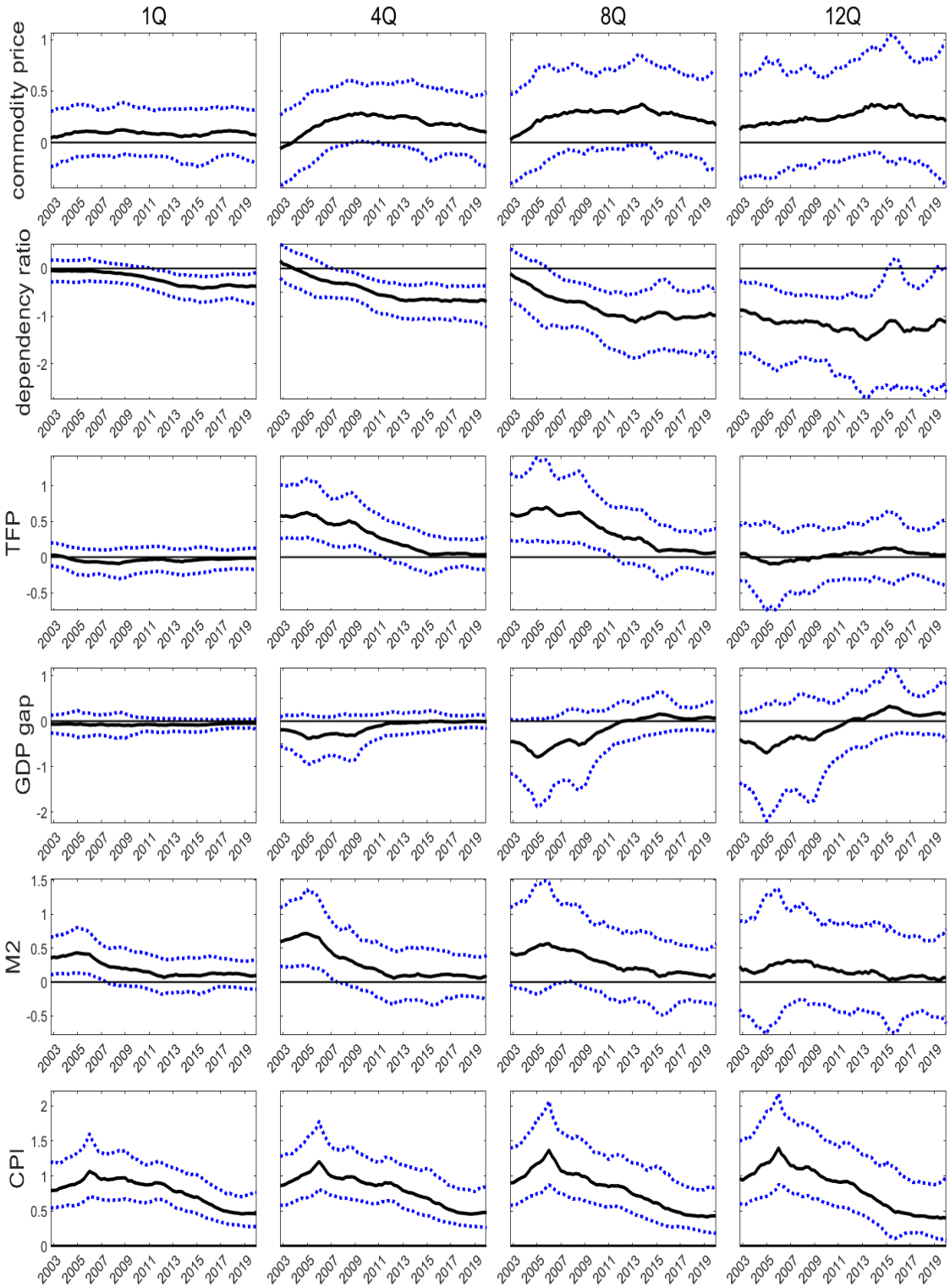


Figure 1.9 depicts the median (solid black line) and 68% band (blue dashed lines) estimates of the impulse responses of CPI for selected horizons—at 1, 4, 8, and 12 quarters after each shock.

Unlike other countries, the effect of commodity price shock is almost insignificant but still tends to be positive. On the other hand, the negative effect of the old-age dependency ratio shock is large and has been increasing, although it has moderated since 2013. Similar to countries other than Thailand, TFP has a positive effect but is decreasing. The response of CPI to the output gap shock had a generally insignificant negative effect, but it was reduced. Although the influence of M2 was positive, it is decreasing after 2005 and was not significant after 2007. The sustainability of CPI has been continuously decreasing since 2005.

The pattern of changes in the impulse response tends to change around 2005, 2008, and 2013-2015, suggesting a structural change in the economy at those times. The impact of TFP, GDP gap, M2, and CPI on prices has decreased from 2005, and the TFP and GDP gap has a small peak around 2008. In general, between 2013 and 2015, the change in the influence of a variable tends to be moderate.

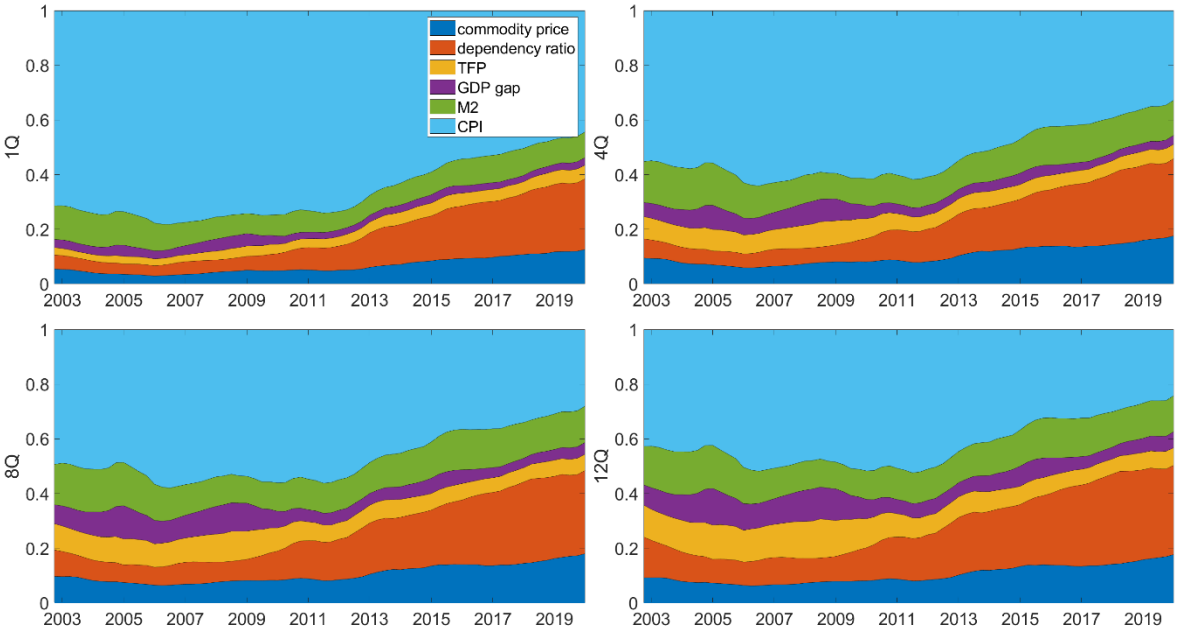
Figure 1.9 Time varying effect of structural shocks on CPI in Indonesia



Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported.

As in Figure 1.10, the influence of old age dependency on prices prevails and growing rapidly, and unlike other countries, the influence of M2 is considerable. The commodity price takes a large proportion, but its proportion is small compared to other countries.

Figure 1.10: Time-varying forecast error variance decomposition in Indonesia

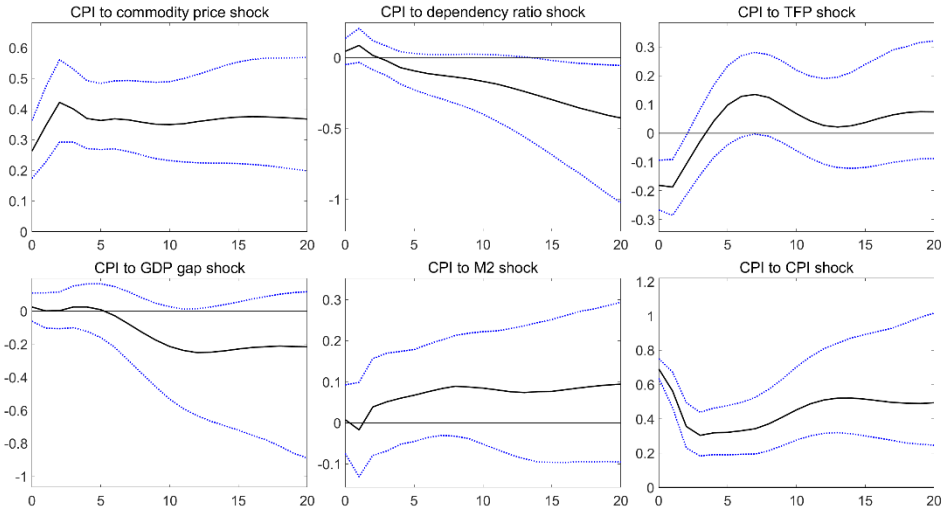


1.3.3. Malaysia

Figure 1.11 and Figure 1.12 depicts the (cumulative) impulse responses of CPI to the structural shocks and forecast error variance decomposition in Malaysia, respectively, derived by fixed coefficients VAR.

It is characteristic that the impact of commodity prices on CPI is significant regardless of the short-term and long-term, and the old-age dependency ratio has a negative long-term effect.

Figure 1.11: Impulse−Responses of CPI in Malaysia



Note: In each panel, median (black line) and 68% band (blue line) estimates are reported.

Figure 1.12: forecast error variance decomposition in Malaysia

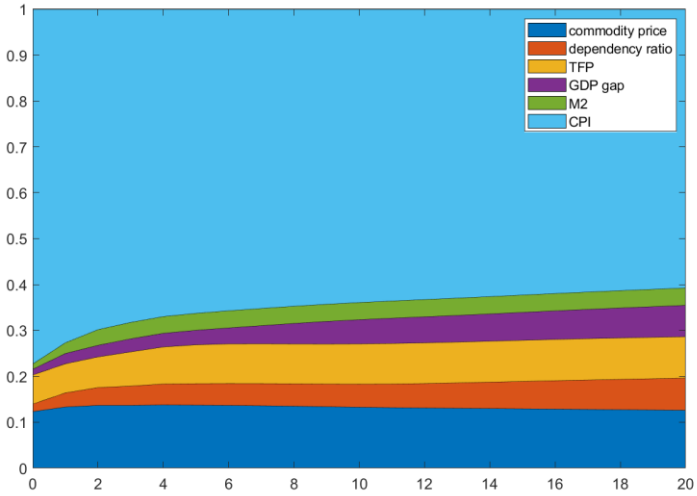
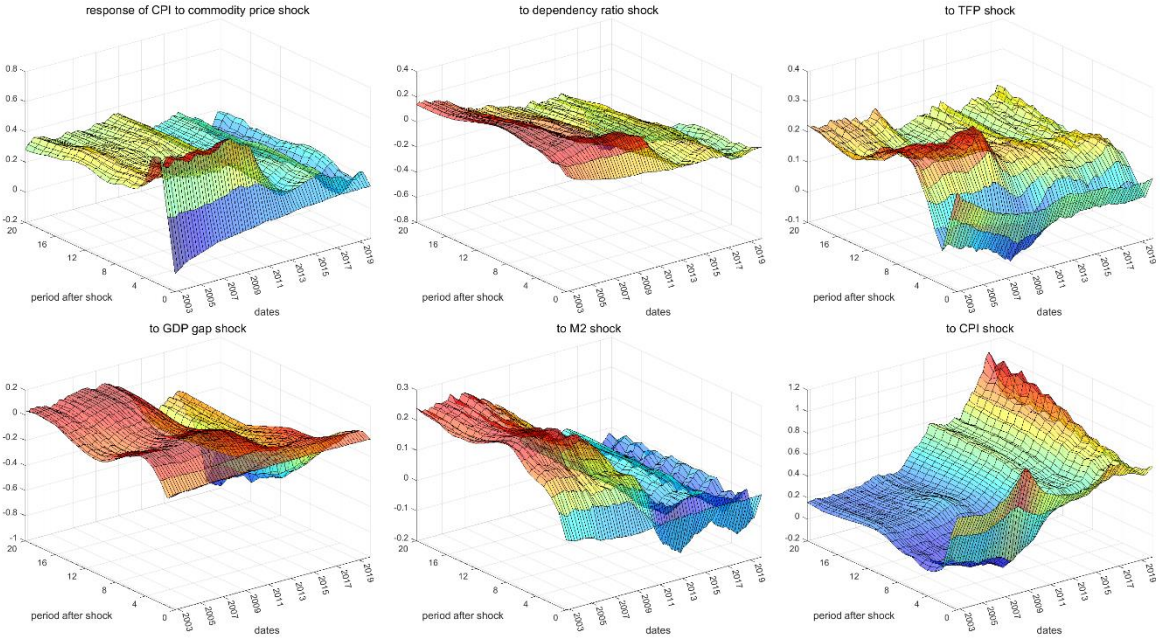


Figure 1.13 reports the median (cumulative) impulse response of CPI to the various structural shocks in Malaysia, across time and horizons.

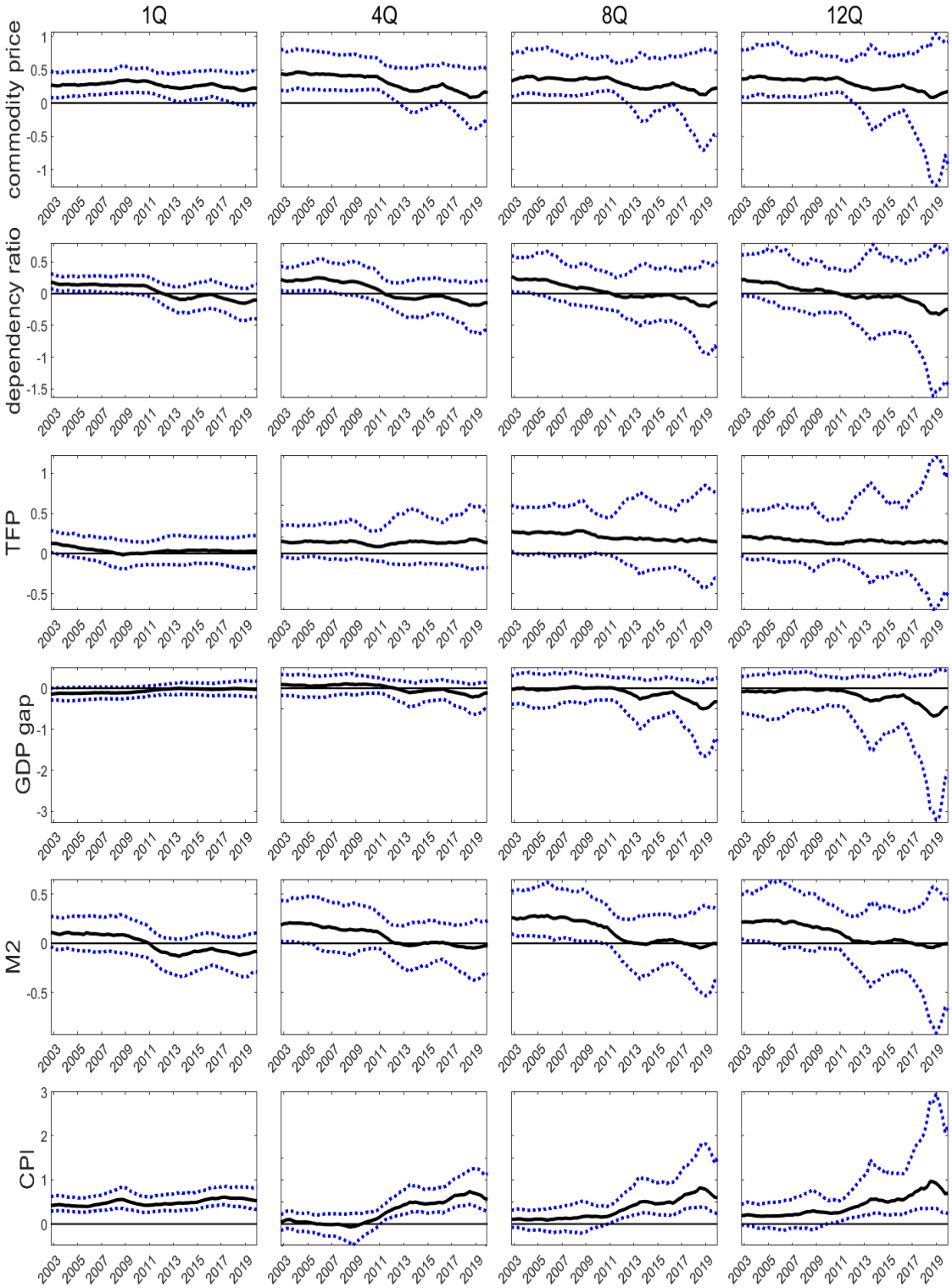
Figure 1.13: Time-varying Impulse-Responses of CPI in Malaysia



Figures 1.14 depicts the median (solid black line) and 68% band (blue dashed lines) estimates of the impulse responses of CPI for selected horizons—at 1, 4, 8, and 12 quarters after each shock.

The effect of commodity price on inflation is generally positive but diminished slightly after 2010. For the old-age dependency ratio, it had a significant positive effect in the short term before 2009, but it decreased gradually, and after 2011, although not significant, it has a negative effect. Both TFP and output gap have an insignificant effect on CPI. But TFP has a gradual positive tendency while the output gap has a negative, though insignificant, effect on long-term inflation after 2010. In the case of M2 shock, the mid- to long-term effects in the past had a significantly positive value, but after 2011, it has a value of almost zero. Meanwhile, the positive effect of CPI shock itself on mid- to long-term inflation increased until 2018, unlike other countries. In addition, some changes in the pattern of change were observed in 2008 and 2018.

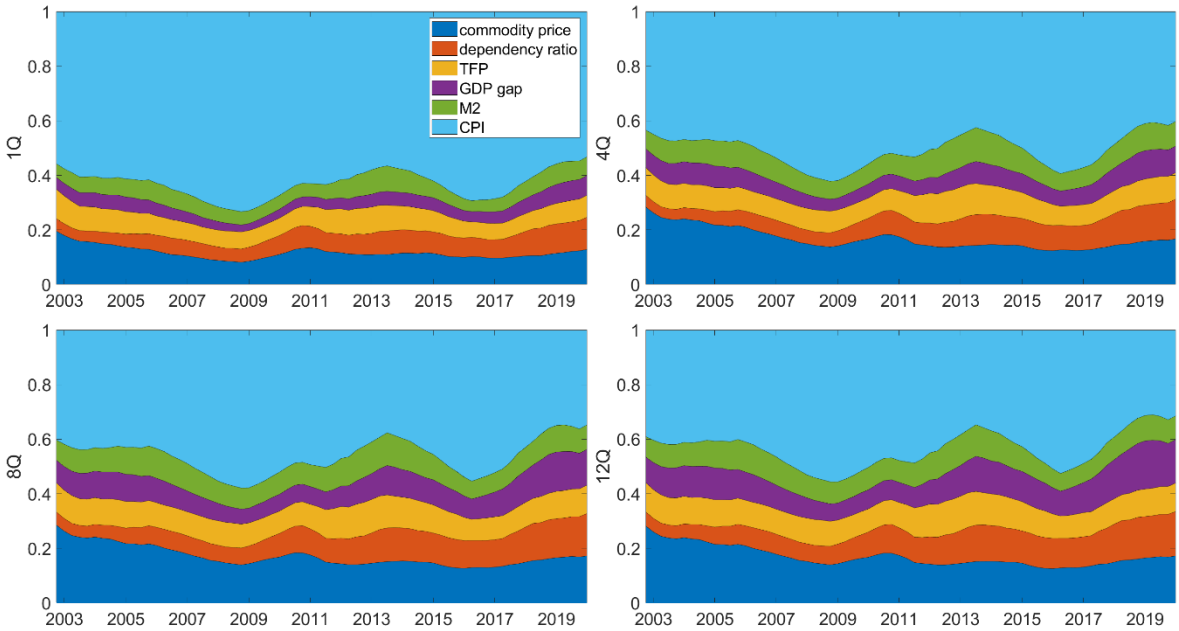
Figure 1.14: Time varying effect of structural shocks on CPI in Malaysia



Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported.

Figure 1.15 reveals that while the proportion of commodity prices is gradually decreasing, the proportion of the old-age dependency ratio tends to increase.

Figure 1.15: Time-varying forecast error variance decomposition in Malaysia

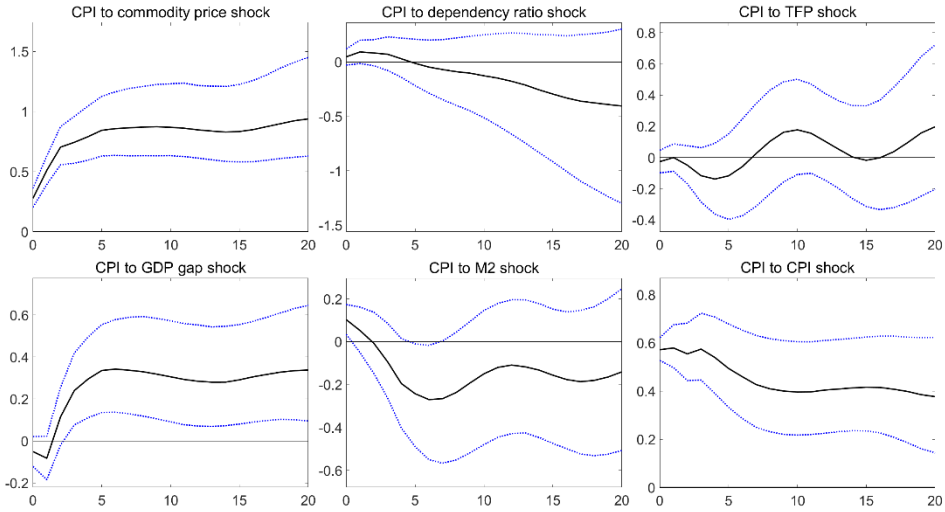


1.3.4. The Philippines

Figure 1.16 and Figure 1.17 depict the (cumulative) impulse responses of CPI to the structural shocks and forecast error variance decomposition in the Philippines, respectively, derived by fixed coefficients VAR.

It is similar to other countries in that commodity prices show a distinctly positive effect, but the difference is that the effect of the old-age dependency ratio is insignificant albeit it has a negative tendency and the GDP gap has a significant positive effect.

Figure 1.16: Impulse-Responses of CPI in The Philippines



Note: In each panel, median (black line) and 68% band (blue line) estimates are reported.

Figure 1.17: forecast error variance decomposition in The Philippines

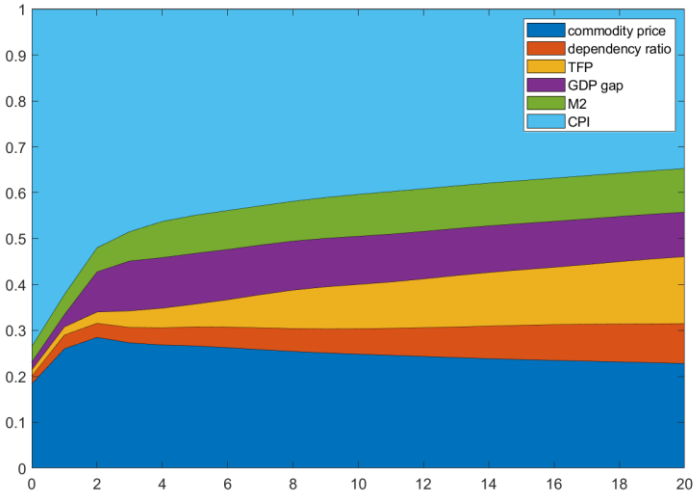
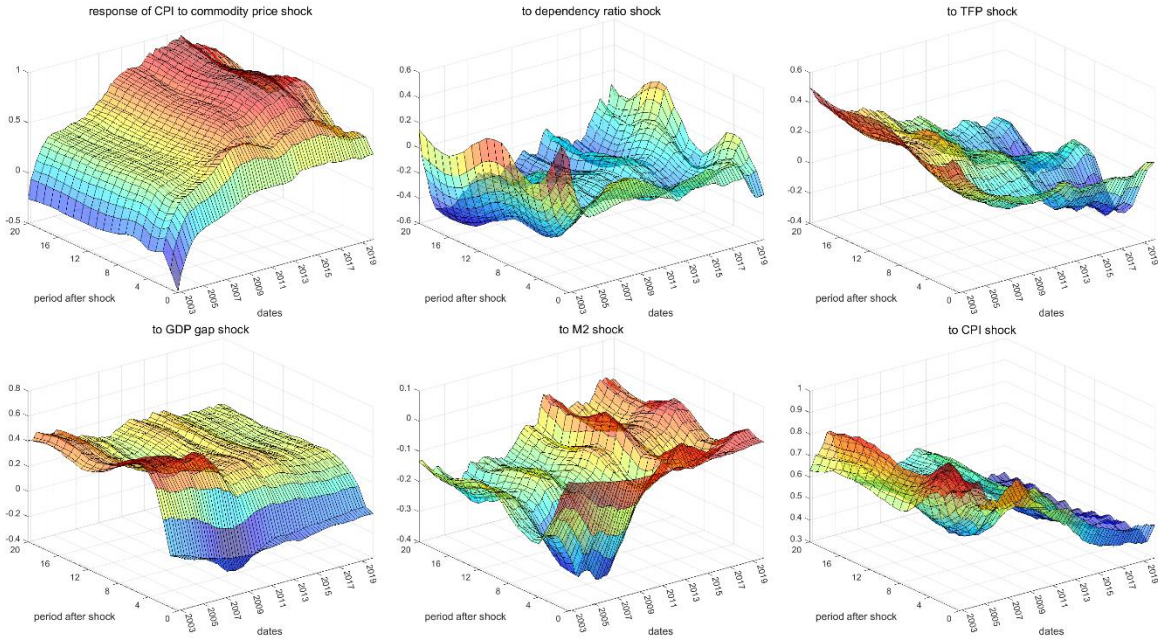


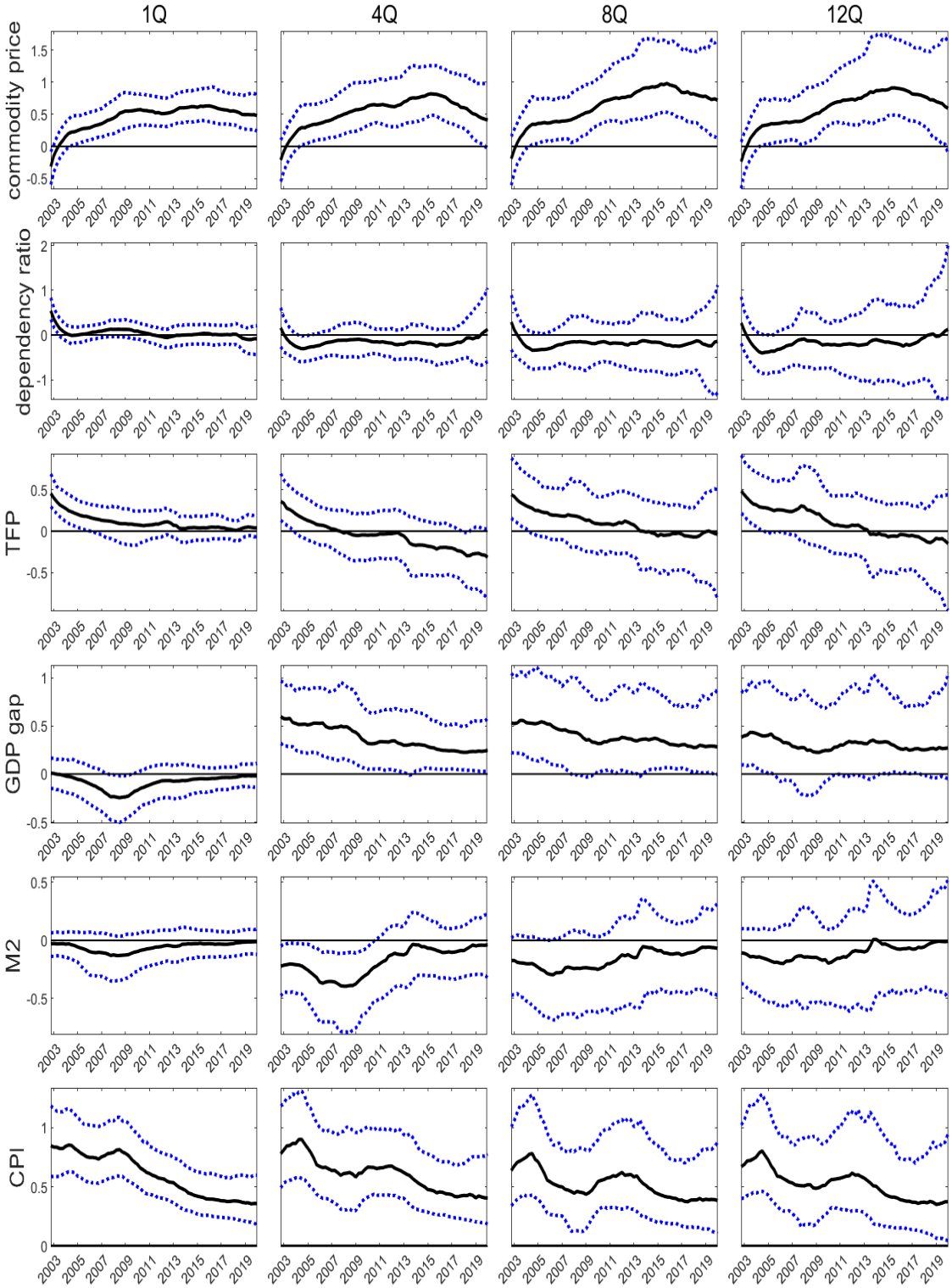
Figure 1.18 reports the median (cumulative) impulse response of CPI to the various structural shocks in the Philippines, across time and horizons.

Figure 1.18: Time-varying Impulse-Responses of CPI in the Philippines



As provided in Figure 1.19, The effect of commodity prices showed a generally positive value like the previous countries and continued to increase until 2015 and then decrease. Except for the positive effect in 2003, the impact of the dependency ratio on prices is almost insignificant. At the beginning of the analysis period, the effect of TFP shock was also significantly positive, but since then it has decreased and is close to 0 or rather turns to a negative effect. The impact of the GDP gap is generally positive except for the short-term, but the mid- to long-term effect is also gradually decreasing. Before 2010, the negative effect of M2 was particularly significant in the mid-term, but after that, the effect diminished and the significance disappeared. The persistence of CPI is large, but it is continuously shrinking.

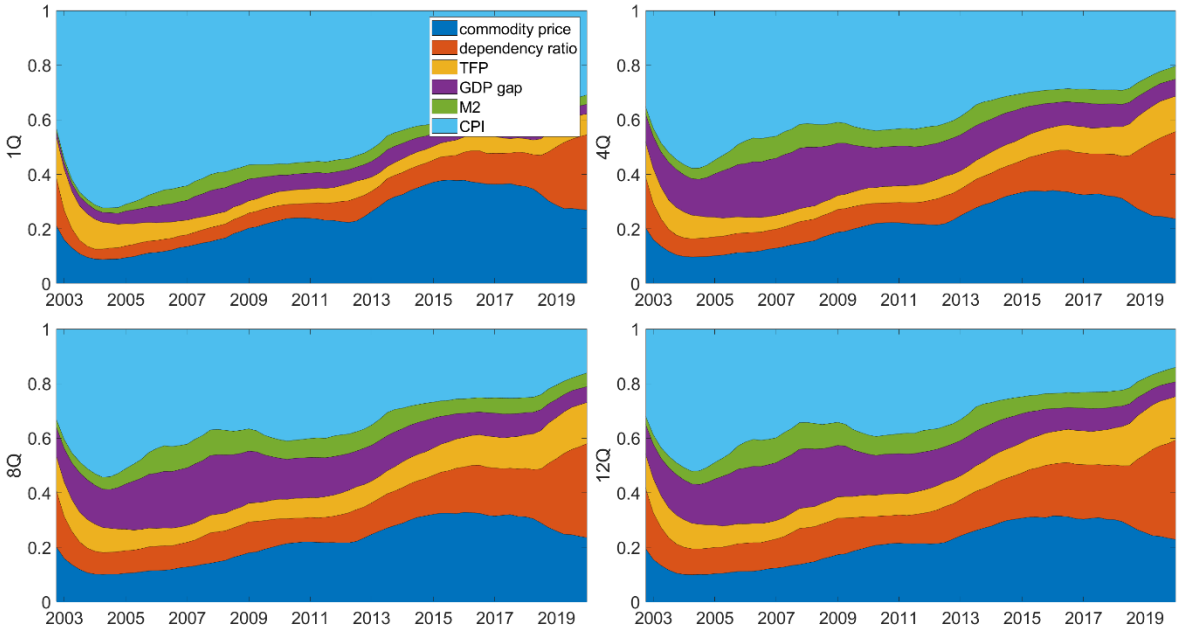
Figure 1.19: Time varying effect of structural shocks on CPI in the Philippines



Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported.

As in Figure 1.20, The positive effect of commodity prices on the price level was large and increased until 2015, but since then, the old-age dependency, although insignificant, has a greater power to explain the price change. On the other hand, the extent to which the GDP gap explains the mid- to long-term price level has gradually decreased, and the sustainability of the CPI is also continuously decreasing.

Figure 1.20: Time-varying forecast error variance decomposition in the Philippines

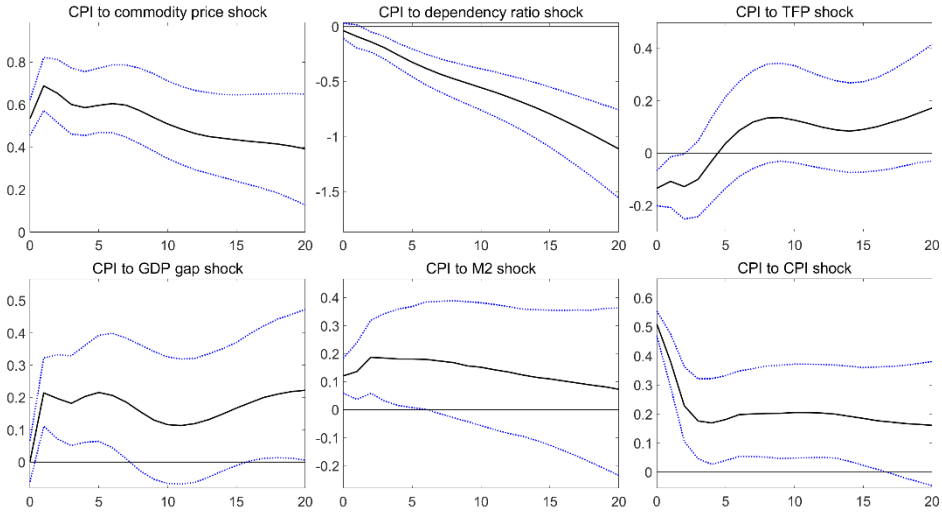


1.3.5. Thailand

Figure 1.21 and Figure 1.22 depict the (cumulative) impulse responses of CPI to the structural shocks and forecast error variance decomposition in Thailand, respectively, derived by fixed coefficients VAR.

It is similar to other countries in that commodity prices have a significant positive effect and the old-age dependency ratio has a long-term negative effect. On the other hand, the GDP gap and M2 have a positive effect, and TFP has a negative effect.

Figure 1.21: Impulse-Responses of CPI in Thailand



Note: In each panel, median (black line) and 68% band (blue line) estimates are reported.

Figure 1.22: forecast error variance decomposition in Thailand

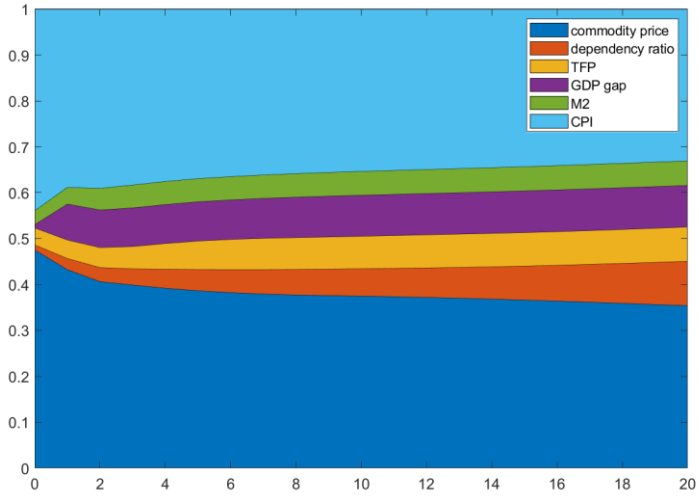


Figure 1.23 reports the median (cumulative) impulse response of CPI to the various structural shocks in Thailand, across time and horizons.

Figure 1.23: Time-varying Impulse-Responses of CPI in Thailand

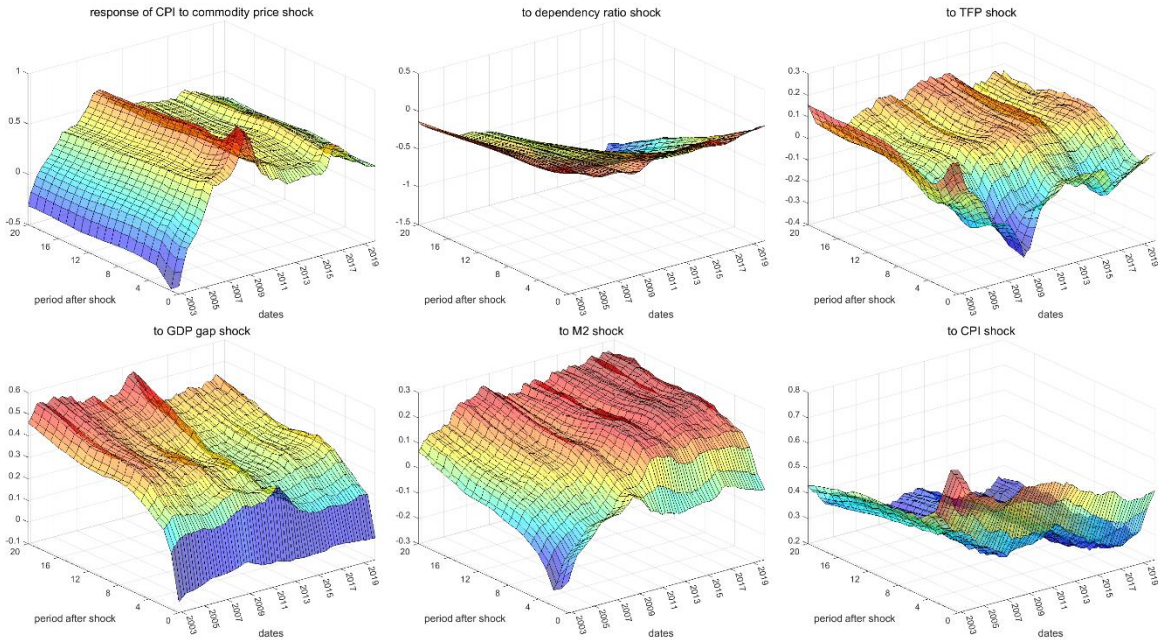
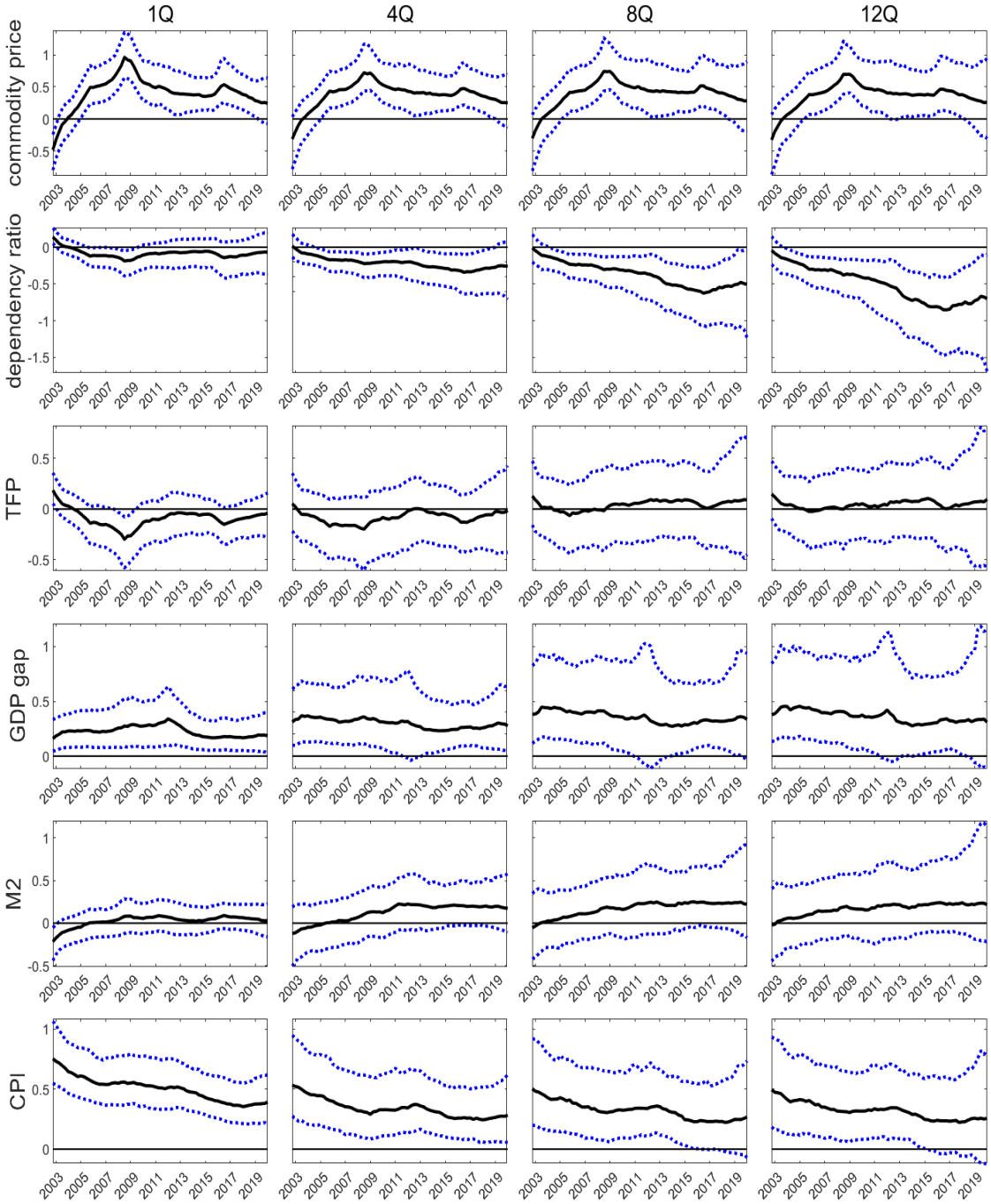


Figure 1.24 reports the impulse responses of CPI to variable shocks in the model. The effect of commodity price increased until 2008 and then turned downward, but generally had a significantly positive effect, with a small peak in 2015-2016. The effect of the old-age dependency ratio lowering the mid- to long-term price level has slightly reversed since 2016 but has generally grown and become the second important factor in explaining the price level. Although TFP was found to have a significantly negative effect on short-term inflation in 2008 and 2016, it was found to have no significant effect on mid- to long-term inflation. The effect of the GDP gap has a significantly positive effect on prices and has been slightly decreasing since 2012, so its importance as an explanatory factor for prices has decreased compared to the past. Since the mid-2000s The effect of M2 showed a generally insignificant positive value, and the positive effect increased with time, unlike other countries. The persistence of the CPI is large but has diminished over time like other countries except for a slight rise in 2008-2012.

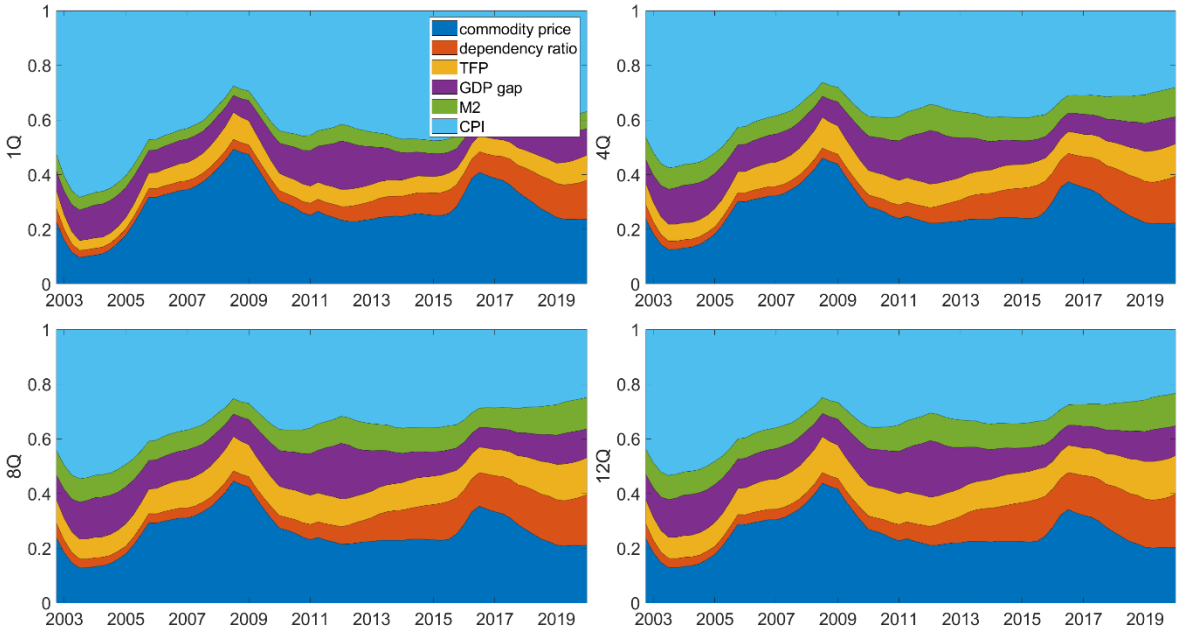
Figure 1.24: Time varying effect of structural shocks on CPI in Thailand



Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported.

Figure 1.25 depicts the impact of commodity prices on inflation is significant and volatile. The proportions of other factors were similar, but the proportion of the GDP gap decreased while the proportion of old-age dependency increased.

Figure 1.25: Time-varying forecast error variance decomposition in Thailand



1.4. Robustness Check

In this section, the robustness of the results is examined by extending the model in various directions. The commodity price was replaced with the oil price. It was also investigated whether robustness is maintained by including external variables such as global output gap, US TFP, and share of China's exports in world exports.

Figures 1.26-30 show the impulse responses of the CPI for the selected period when commodity prices are replaced by oil prices. For comparison, impulse responses of the basic model using commodity prices are indicated by a red line. There was no substantial difference between the two settings. Every variable of

every country analyzed has a similar impulse response regardless of whether oil price or commodity price is contained as an endogenous variable. This seems to be because oil price accounts for a large portion of commodity prices and drives change.

[Base Model]

exogenous variables: US TFP, share of China's exports in world exports

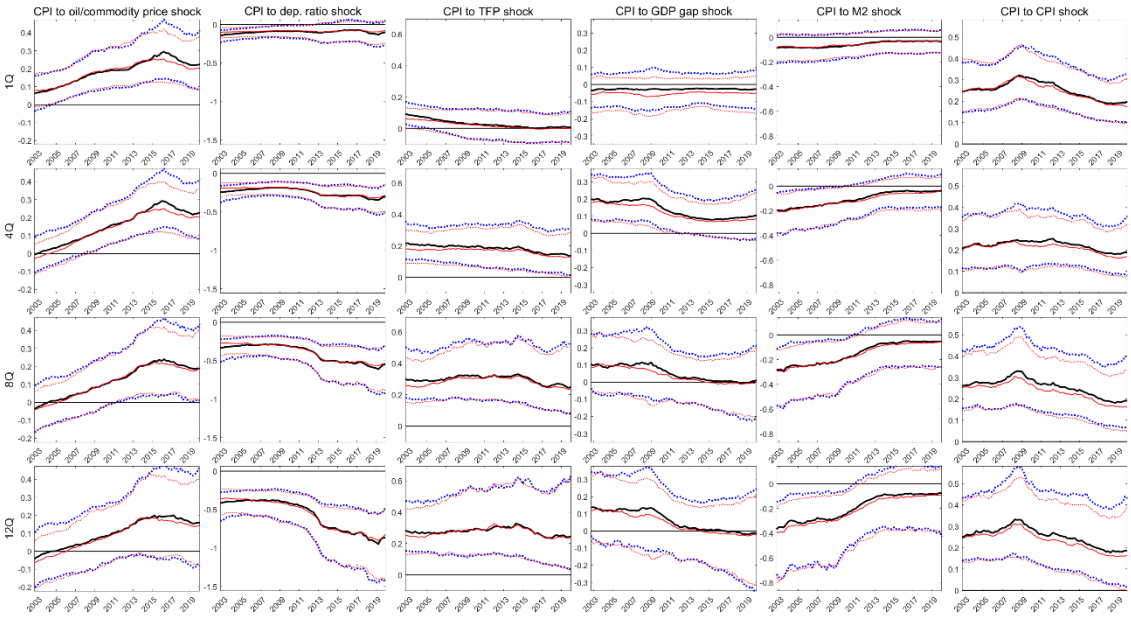
endogenous variables: ***commodity price***, old−age dependency ratio, TFP, GDP gap, M2, CPI

[Alternative Model]

exogenous variables: US TFP, share of China's exports in world exports

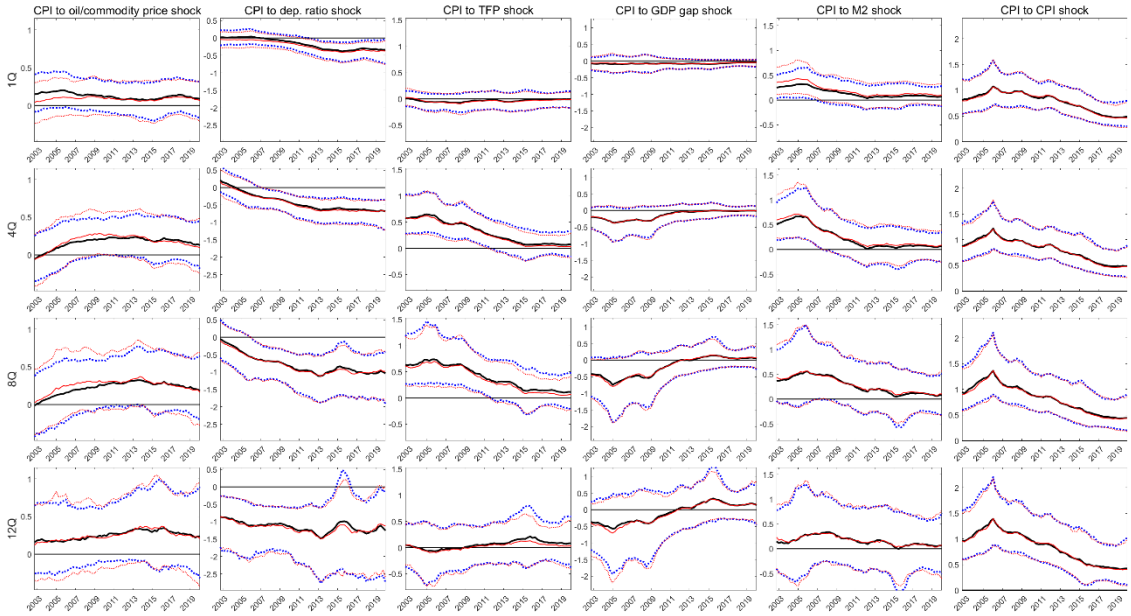
endogenous variables: ***oil price***, old−age dependency ratio, TFP, GDP gap, M2, CPI

Figure 1.26: Time varying effect of structural shocks on CPI in Korea (Oil Price vs. Commodity Price)



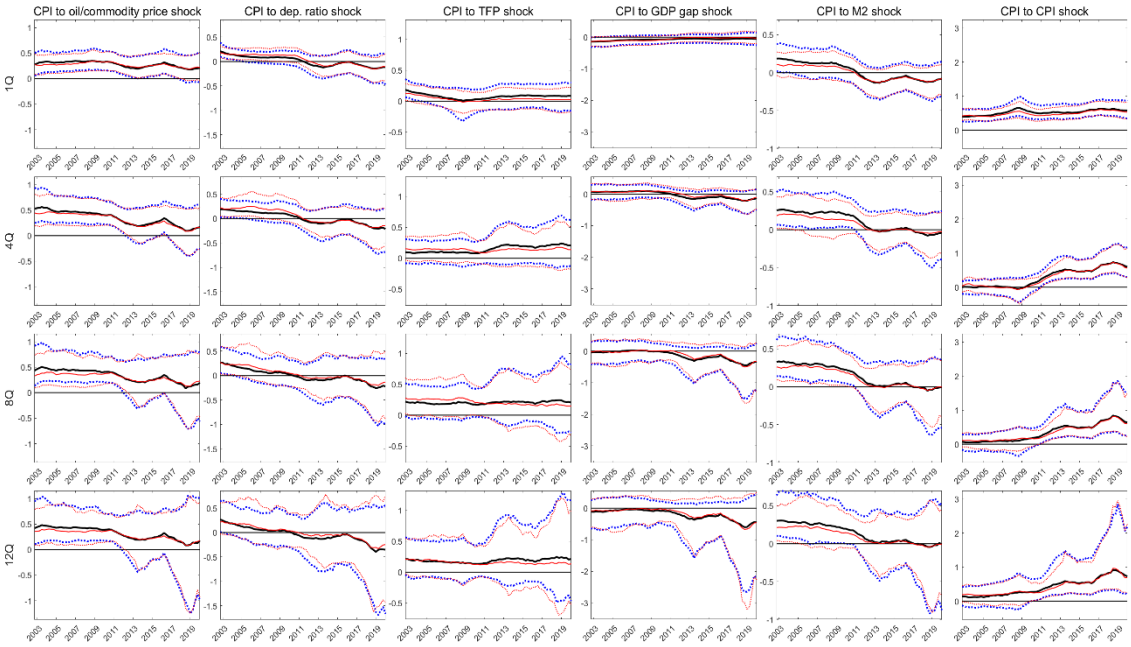
Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

Figure 1.27: Time varying effect of structural shocks on CPI in Indonesia
(Oil Price vs. Commodity Price)



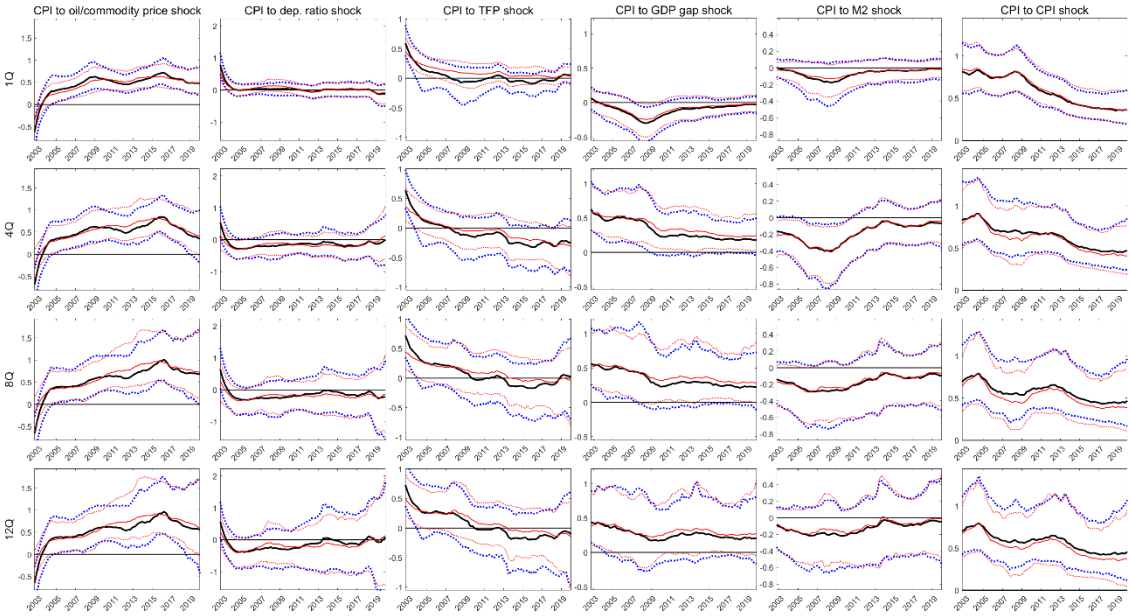
Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

Figure 1.28: Time varying effect of structural shocks on CPI in Malaysia
(Oil Price vs. Commodity Price)



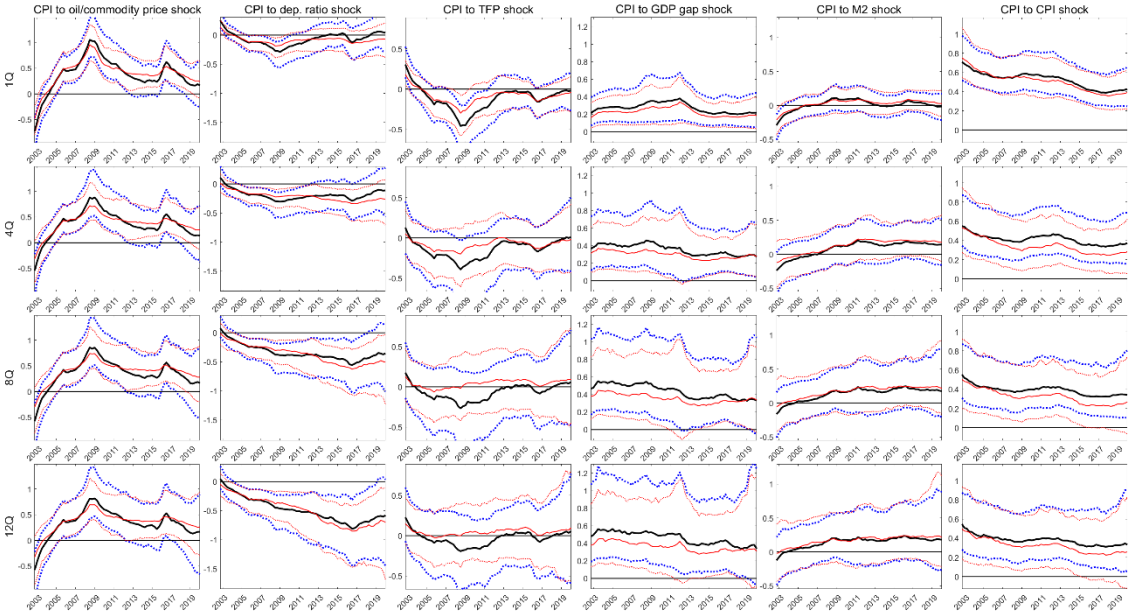
Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

Figure 1.29: Time varying effect of structural shocks on CPI in The Philippines
(Oil Price vs. Commodity Price)



Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

Figure 1.30: Time varying effect of structural shocks on CPI in Thailand
(Oil Price vs. Commodity Price)



Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

Figures 1.31−35 depict the (cumulative) impulse responses of CPI to the structural shocks in case the global output gap was included in the model as an endogenous variable. For comparison, impulse responses of the basic model are indicated by a red line. Looking at the first column, except for Indonesia, the impact on CPI of the global output gap was almost insignificant over the entire period, and the impulse responses of CPI to other variables were meaningfully different from the basic model and the band tends to be wider. In other words, the inclusion of the global output gap seems to lower the explanatory power of the model. Therefore, the global output gap was excluded from the base model.

This is contrary to the existing research that the global demand shock represented by the global output gap has a positive effect on inflation or the study that the effect of global variables on inflation increases over time. It is beyond the scope of this paper to examine the cause, but it may be partially because of the influence of other variables. For example, if the rise in commodity prices is largely due to an increase in global demand, the impact of the global demand shock on inflation may be masked by the impact of commodity prices.

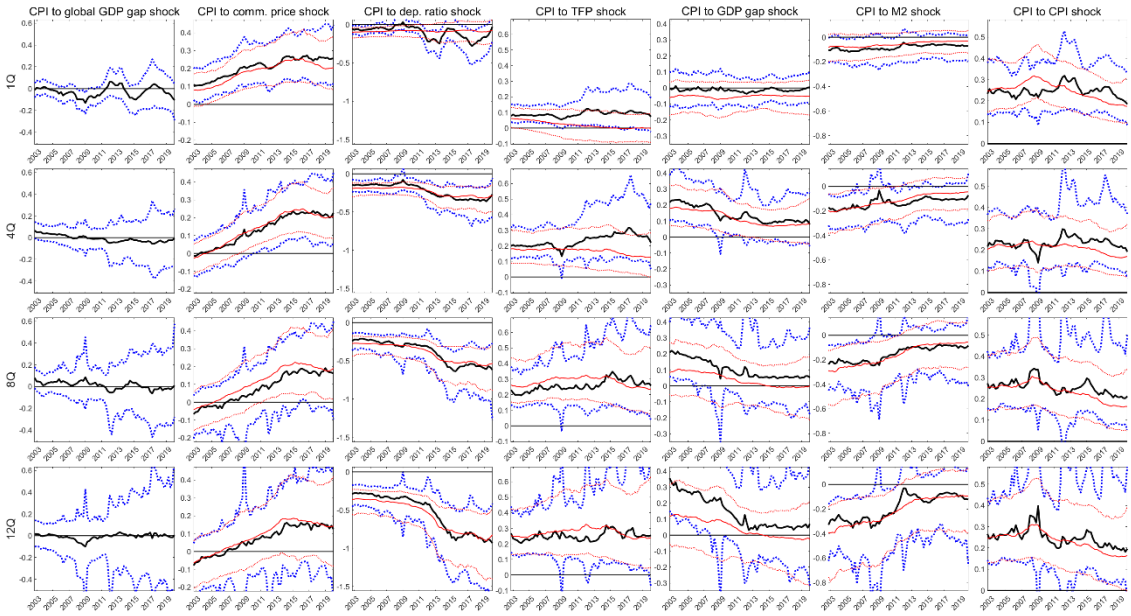
[Base Model]

exogenous variables:	US TFP, share of China's exports in world exports
endogenous variables:	commodity price, old−age dependency ratio, TFP, GDP gap, M2, CPI

[Alternative Model]

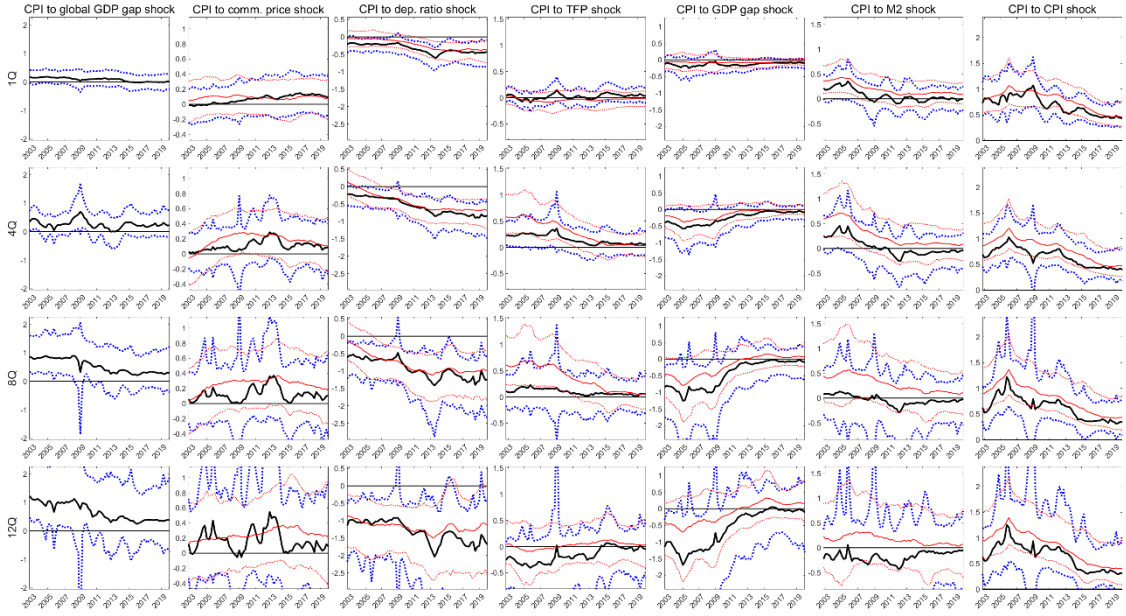
exogenous variables:	US TFP, share of China's exports in world exports
endogenous variables:	***the global output gap,*** commodity price, old−age dependency ratio, TFP, GDP gap, M2, CPI

Figure 1.31: Time varying effect of structural shocks on CPI in Korea (with / without Global Output Gap)



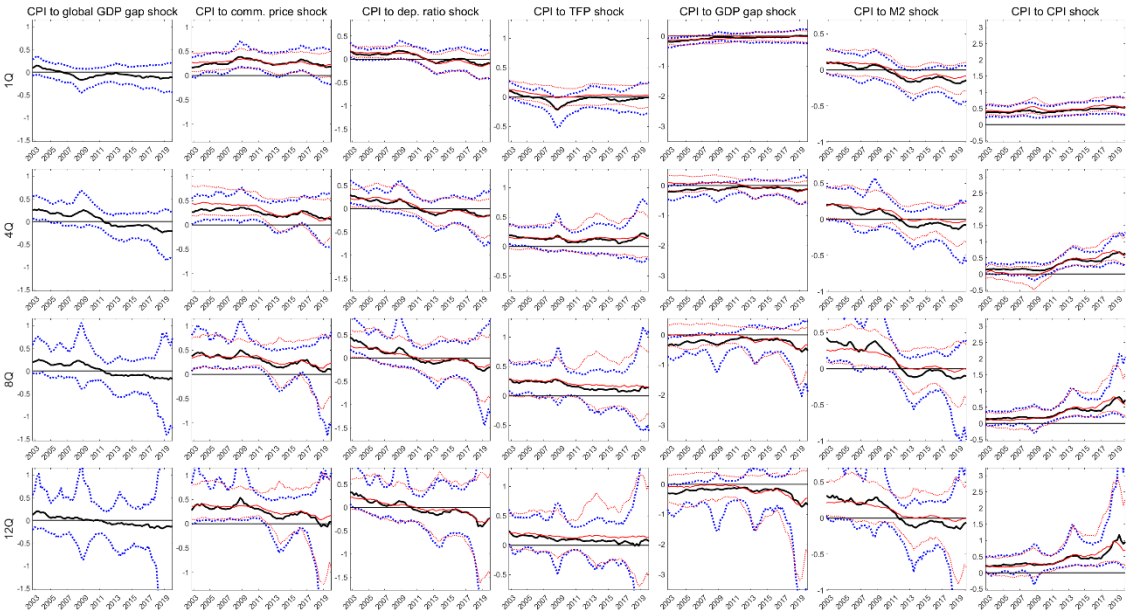
Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

Figure 1.32: Time varying effect of structural shocks on CPI in Indonesia (with / without Global Output Gap)



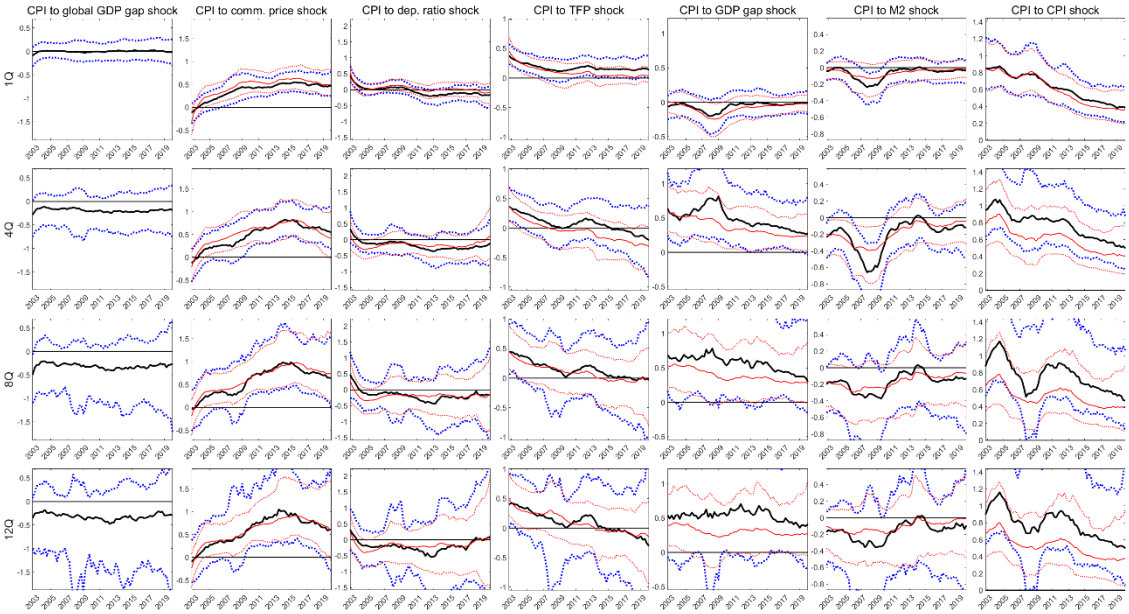
Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

Figure 1.33: Time varying effect of structural shocks on CPI in Malaysia
(with / without Global Output Gap)



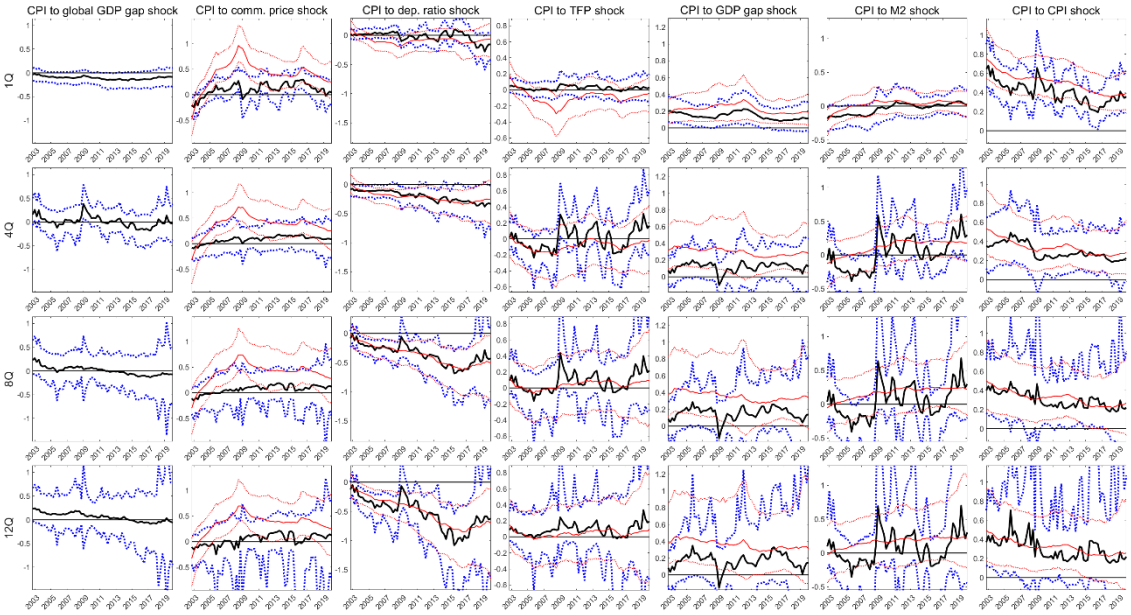
Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

Figure 1.34: Time varying effect of structural shocks on CPI in The Philippines
(with / without Global Output Gap)



Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

Figure 1.35: Time varying effect of structural shocks on CPI in Thailand (with / without Global Output Gap)



Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

Figures 1.36−40 depict the (cumulative) impulse responses of CPI to the structural shocks in case US TFP was included in the model as an endogenous variable. For comparison, impulse responses of the basic model are indicated by red lines. The impact of the US TFP shock on CPI was significantly negative over some time except for Malaysia. It is noteworthy that, unlike the TFP of individual countries, US TFP, as a proxy for world productivity or technological progress, has been shown to lower inflation in general. Meanwhile, the impulse responses of CPI to other variables show a similar tendency except for Thailand. Accordingly, US TFP is included in the base model as an exogenous variable.

[Base Model]

exogenous variables: ***US TFP,*** share of China's exports in world exports

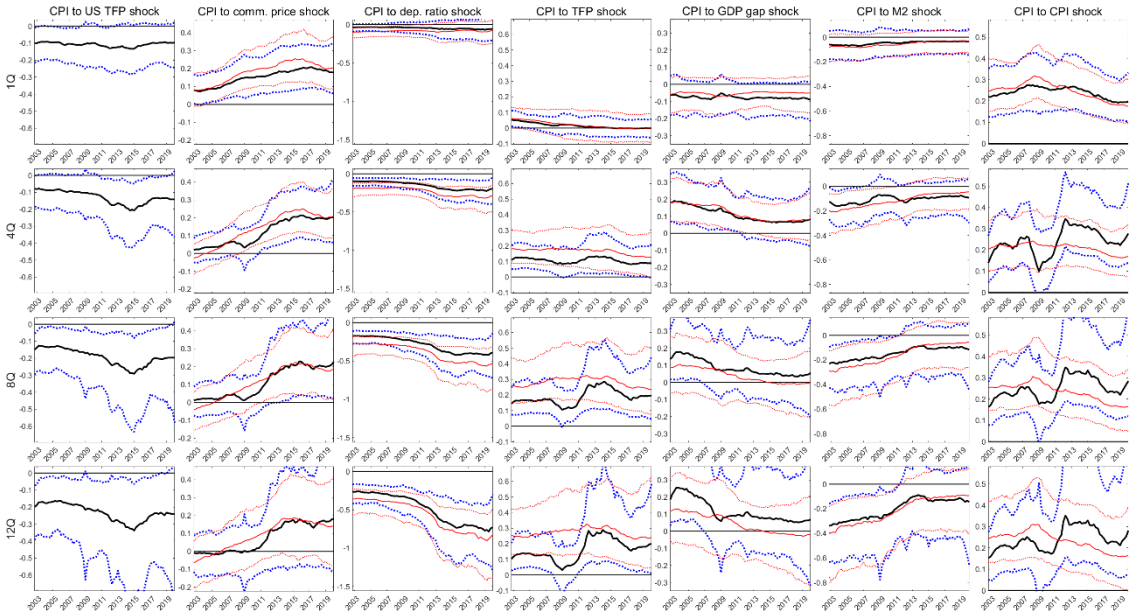
endogenous variables: commodity price, old−age dependency ratio, TFP, GDP gap, M2, CPI

[Alternative Model]

exogenous variables: share of China's exports in world exports

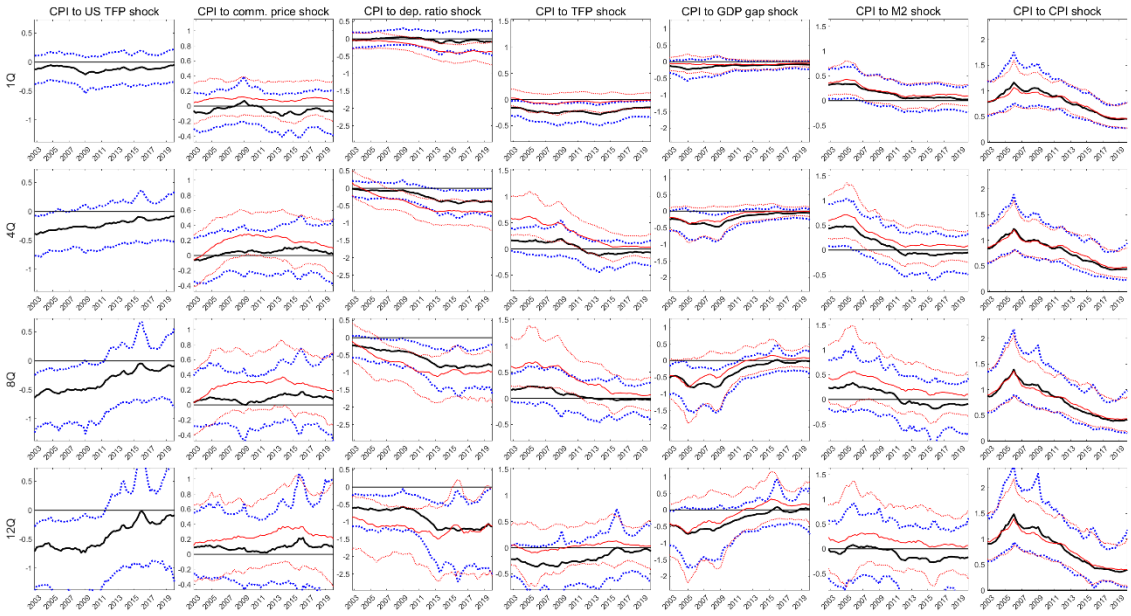
endogenous variables: ***US TFP,*** commodity price, old−age dependency ratio, TFP, GDP gap, M2, CPI

Figure 1.36: Time varying effect of structural shocks on CPI in Korea
(US TFP as Endogenous or Exogenous Variable)



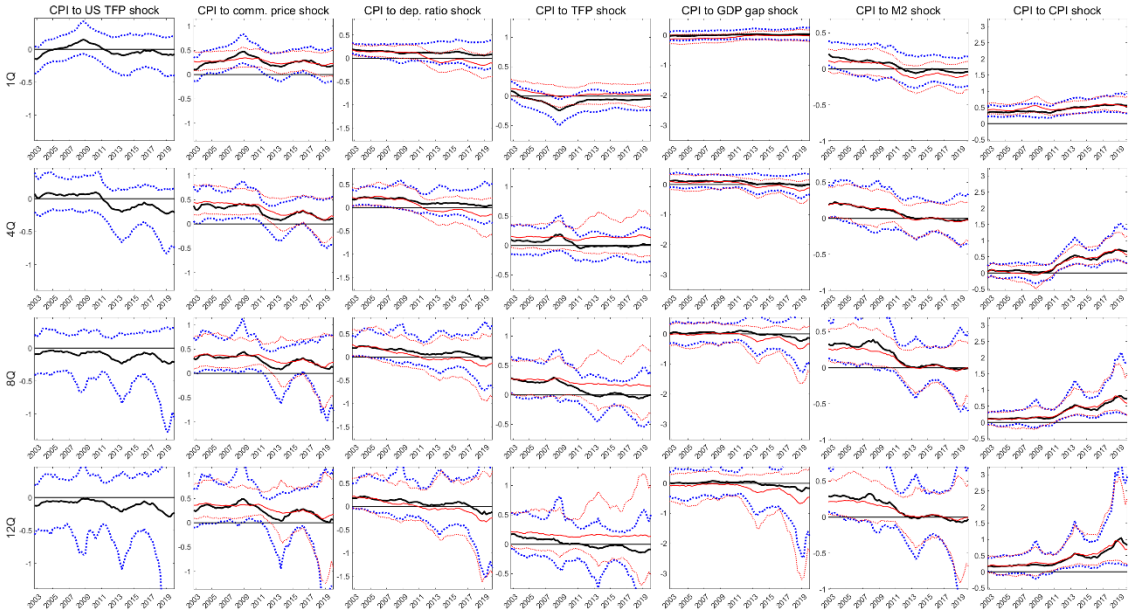
Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

Figure 1.37: Time varying effect of structural shocks on CPI in Indonesia
(US TFP as Endogenous or Exogenous Variable)



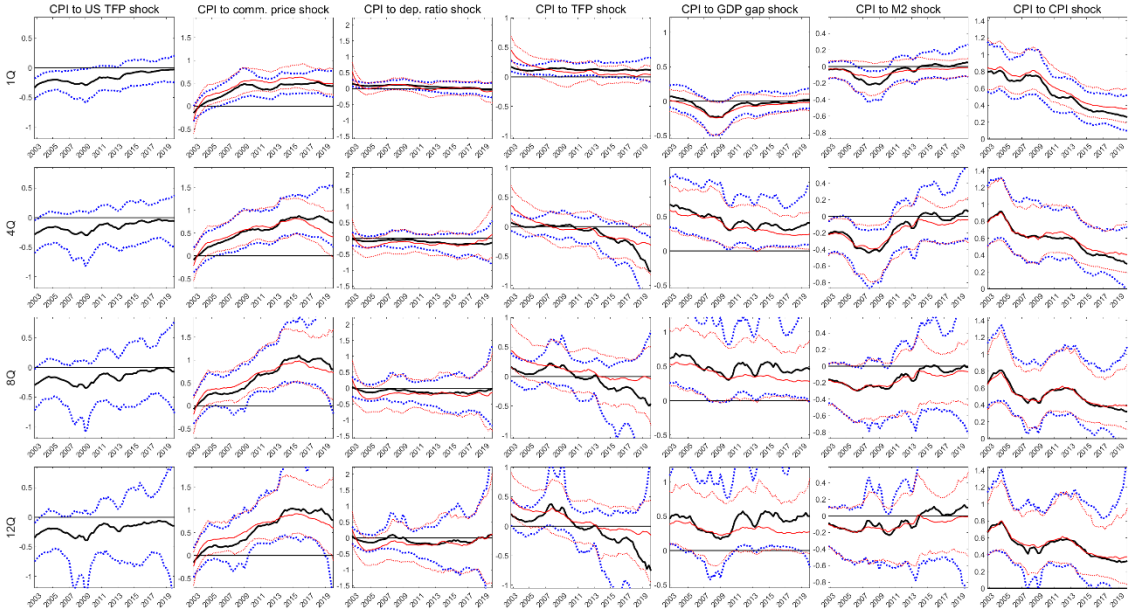
Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

Figure 1.38: Time varying effect of structural shocks on CPI in Malaysia
(US TFP as Endogenous or Exogenous Variable)



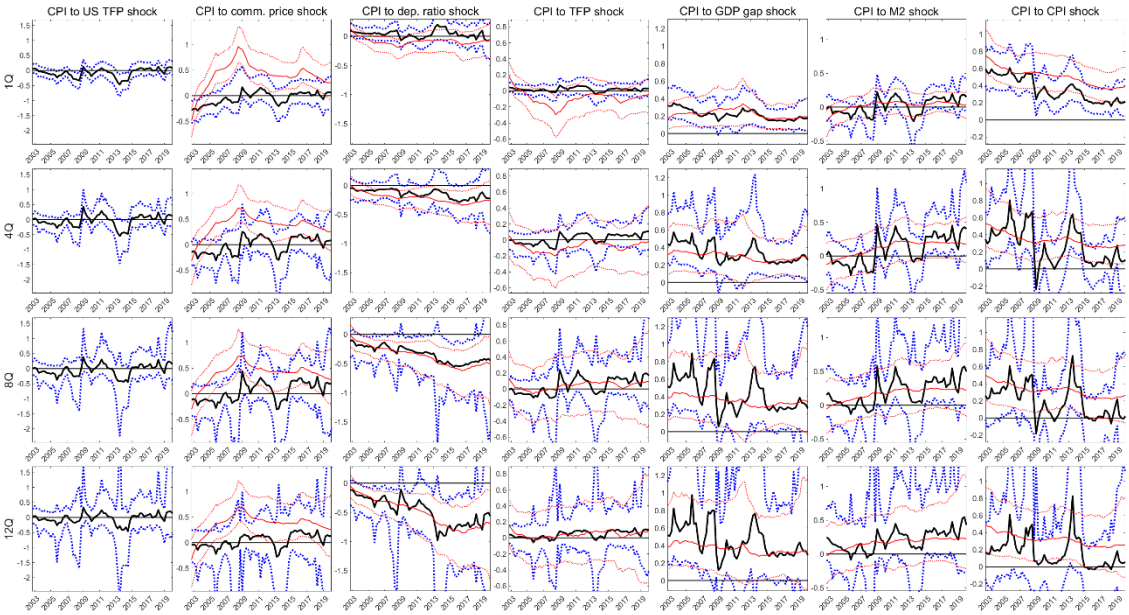
Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

Figure 1.39: Time varying effect of structural shocks on CPI in The Philippines
(US TFP as Endogenous or Exogenous Variable)



Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

Figure 1.40: Time varying effect of structural shocks on CPI in Thailand
(US TFP as Endogenous or Exogenous Variable)



Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

Figure 1.41−45 depict the (cumulative) impulse responses of CPI when the share of China's exports in world exports was included in the model as an endogenous variable. Impulse responses of the basic model are also shown as red lines to compare. The share of China's export was included as a variable to reflect the so−called Chinese effect of low−priced Chinese products lowering global inflation, and similarly to the existing perception, it was found to have a negative effect on CPI in countries other than Malaysia.

[Base Model]

exogenous variables: US TFP, ***share of China's exports in world exports***

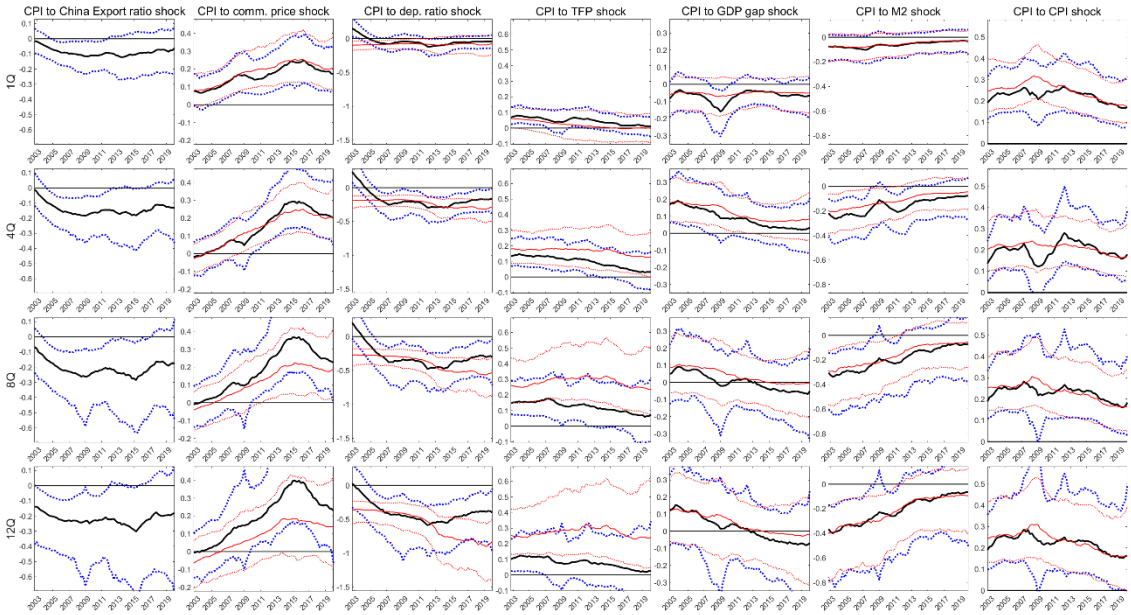
endogenous variables: commodity price, old−age dependency ratio, TFP, GDP gap, M2, CPI

[Alternative Model]

exogenous variables: US TFP

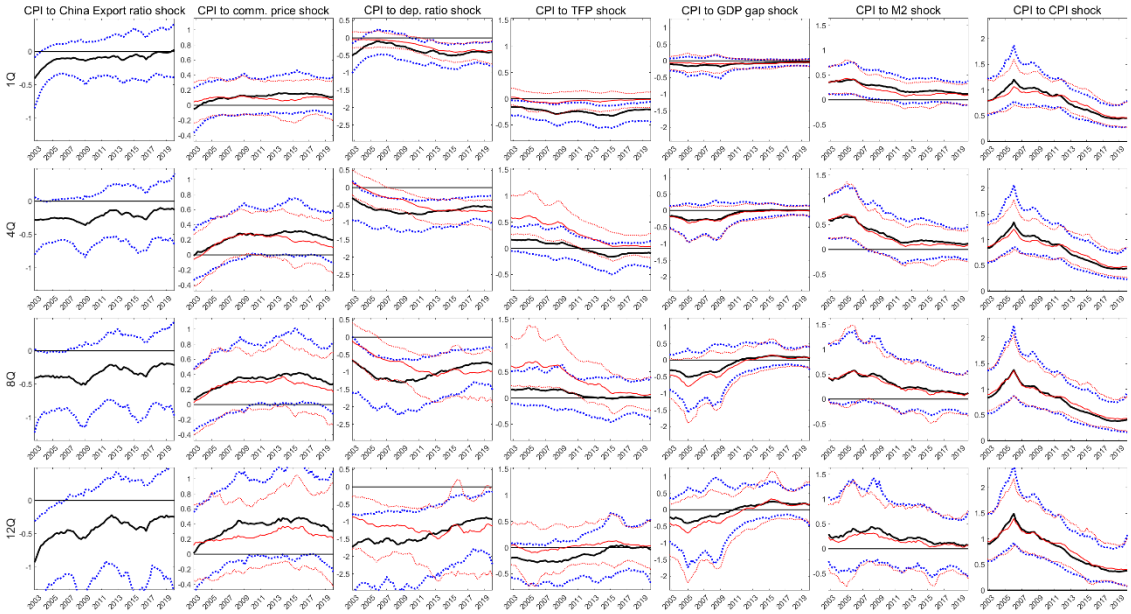
endogenous variables: ***share of China's exports in world exports***, commodity price, old−age dependency ratio, TFP, GDP gap, M2, CPI

Figure 1.41: Time varying effect of structural shocks on CPI in Korea
(China Export Share as Endogenous or Exogenous Variable)



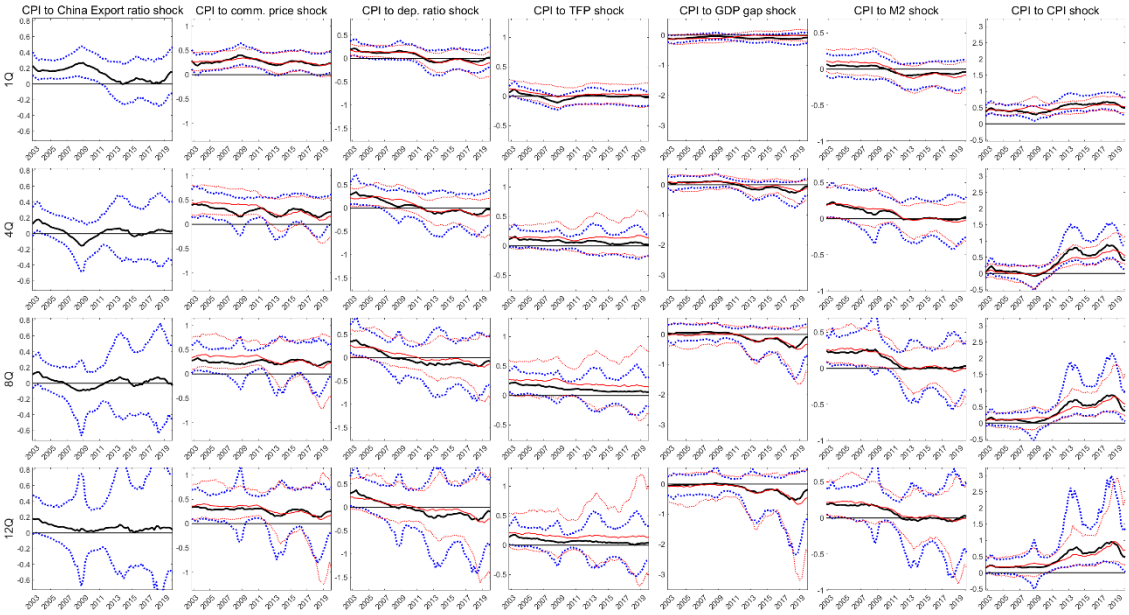
Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

Figure 1.42: Time varying effect of structural shocks on CPI in Indonesia
(China Export Share as Endogenous or Exogenous Variable)



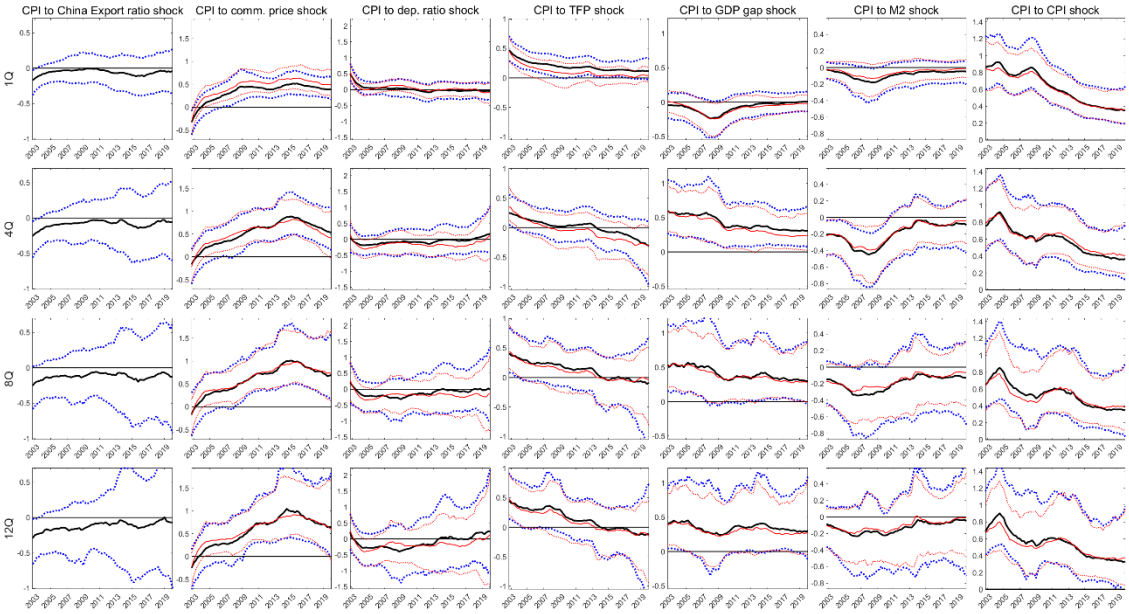
Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

Figure 1.43: Time varying effect of structural shocks on CPI in Malaysia
(China Export Share as Endogenous or Exogenous Variable)



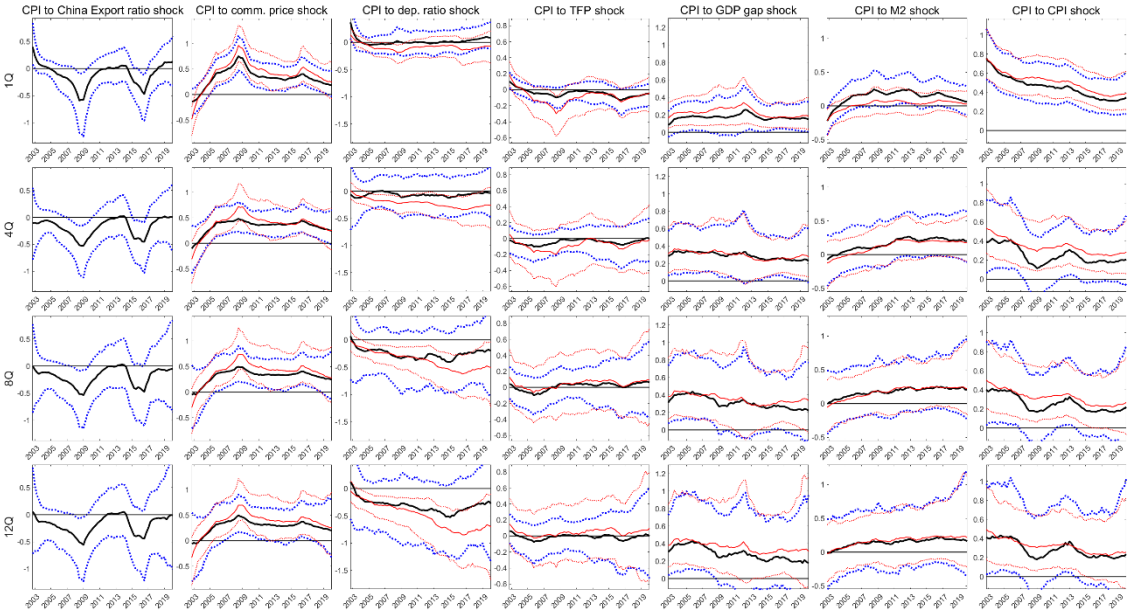
Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

Figure 1.44: Time varying effect of structural shocks on CPI in The Philippines
(China Export Share as Endogenous or Exogenous Variable)



Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

Figure 1.45: Time varying effect of structural shocks on CPI in Thailand
(China Export Share as Endogenous or Exogenous Variable)



Note: In each panel, median (black line) and 68% band (blue dash) estimates are reported. Red lines for median and 68% band of impulse responses of the basic model

1.5. Conclusion

The empirical results of the five countries have several things in common. First of all, the most important factors that explain inflation are inflation itself, commodity prices, and the old-age dependency ratio. Considering the characteristics of a small open economy, it seems natural that commodity prices have a large influence on inflation. However, it is interesting that the aging of the population has a large impact even though the level of aging is not very high except in Korea. Moreover, the negative impact of the old-age dependency ratio appears to have increased over time. The influence of commodity prices increases or decreases depending on the country, so there is no certain pattern, and the influence of other factors is generally decreasing or maintained. If this trend continues, coupled with the rapid aging of the population, it could act as a long-term downward pressure on inflation.

In particular, the importance of the output gap in accounting for the inflation dynamics turns out to be limited for the countries considered in this study, which may be originated from the flattened Phillips curve in recent years. This, along with the downward pressure on inflation mentioned earlier, is worrisome in that it means that demand-stimulating policies such as monetary policy will lose the ability to adjust prices.

In many cases, the effects of shocks to CPI vary over time. One of the most notable patterns is that the determinants of inflation seem to change around the GFC. This suggests that the GFC may be an important episode incurring a structural break of the economies.

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Appendix

[Data sources]

Variable	Source
CPI	International Financial Statistics
The commodity price index	IMF Primary Commodity Prices
The old−age dependency ratio	United Nations Population Division's World Population Prospects: 2019 Revision. Interpolated
TFP	The Conference Board. Interpolated
Output gap	International Financial Statistics. Calculated
US TFP	Federal Reserve Bank of San Francisco
The share of China's exports in world export	WTO stats. Interpolated for Chinese data before 2004. Calculated
The broad money(M2)	International Financial Statistics
The global output gap	International Financial Statistics and IMF Direction of Trade Statistics. Calculated

2. Plausibility of Local Currency Contribution to the CMIM

2.1. Introduction

Chiang Mai Initiative Multilateralization (CMIM) is a multilateral currency swap arrangement between Association of Southeast Asian Nations (ASEAN), the People's Republic of China (including Hong Kong), Japan, and South Korea. (ASEAN+3) with the purpose of addressing balance of payment and/or short-term liquidity difficulties in the region and supplementing existing international financial arrangements.③

In May 2000, the Chiang Mai Initiative (CMI) was launched by the ASEAN+3 countries as a bilateral currency swap arrangement, and CMIM was Established in 28 December 2009 and came into effect on 24 March 2010 with a total size of U.S. dollars 120 billion drawing from a foreign exchange reserves pool. Since then, various amendments were added to the CMIM for improvements. For example, the total size was doubled in 2014, and an overarching legal basis for conditionality was introduced in order for the CMIM to support members in addressing their risks and vulnerabilities through policy recommendations as well as financial support.

An interesting issue to be considered for CMIM is local currency contribution to the CMIM arrangements. That is, currently, U.S. dollars is used in the CMIM but local currencies such as the Japanese yen, RMB, and the Korean won may be further considered at least partially. This study assesses the plausibility of local currency contribution to the CMIM arrangements.

Using local currencies in the arrangement is efficient and reduces costs if receiving members need local currencies to settle trade or finance matters when faced with balance of payments and/or short-

③ See Appendix for a more detailed explanation.

term liquidity difficulties. Using local currencies directly is more efficient and less costly than exchanging local currencies for U.S. dollars. Providing members can decrease the burden of drawing on foreign exchange reserves. In addition, there are various externalities, such as promoting trade and financial integration in the region and weakening the over-dependence on the U.S. dollar. However, the arrangement can generate costs if receiving members do not need local currencies when they are faced with balance of payments and/or short-term liquidity difficulties. In such cases, it is inefficient and costly as receiving members have to exchange local currencies for U.S. dollars. Also, exchanging local currencies for U.S. dollars may result in the instability of local currencies and increase the possibility of contagion. Detailed discussion about benefits and costs of local currency contribution to CMIM arrangements is provided in 2.2.

Next, we investigate whether receiving members need local currencies in CMIM. To address the issue, first, we consider whether the demand for local currencies in foreign exchange reserves is sufficient. The demand for local currencies in foreign exchange reserves for ASEAN+3 is inferred by combining the demand for foreign exchange reserves and information on local currency usage in the region. We estimated the demand for foreign exchange reserves with various measures according to past studies④. They are three months of imports, 100 percent of short-term debt, 20 percent of M2 and the IMF rule. The demand for local currencies in foreign exchange reserves is calculated by multiplying measures for demand for foreign exchange reserves by relevant local currency composition ratio. Information on local currency usage in the region such as currency composition data for short-term debt, foreign liabilities, and other portfolio liabilities and invoicing currency data for exports are used to calculate local currency composition ratio. We find

④ See Appendix for a more detailed explanation.

substantial demand for local currencies in foreign exchange reserves. The size of the demand is large enough compared to the size of the maximum withdrawal from CMIM. This result may support the idea of introducing local currency contribution to CMIM arrangements.

The net demand for local currencies in CMIM arrangements is also inferred by subtracting estimated actual foreign exchange reserves in the sense that demand for local currencies can be fully met with own foreign exchange reserves and members don't need another facilities to cover the demand for local currencies if so. We find that net demand for local currency in CMIM tends to be positive, which may suggest local currency contribution to CMIM arrangements acceptable, even after considering the current level of local currencies in actual foreign exchange reserves. We discuss this issue in detail in 2.3.

Stability of local currencies is further examined using the exchange market pressure index because the costs of local currency contribution to CMIM arrangements can depend on stability of local currencies. We find several currencies of members quite stable. Currencies of China, Japan, Korea, and Vietnam are as stable as popular non-U.S. international currencies even using conservative measures. In recent years, the currencies of China, Japan and Korea have been as stable as those of the U.K., Canada and the E.U., and even more stable than those of Australia and Switzerland while the currencies of Myanmar, Vietnam and Hong Kong have also been as stable as those of Australia and Switzerland.

In addition, the internationalization of a currency and the liberalization of capital account transactions are considered because those are important in implementing local currency contributions to CMIM arrangements. In the term of level of internationalization, the Japanese yen is first and RMB, the Singapore dollar, Hong Kong dollar and Korean won follows in order. The degree of capital controls in these economies is low except for RMB. These issues are covered in 2.4. Conclusion with summaries is provided in 2.5.

2.2. Benefits and Costs of local currency contribution to CMIM arrangements

2.2.1. Benefits

First, there can be concrete demand for local currencies. If local currencies are used in settling trade and finance matters, then ASEAN+3 members may need local currencies to address balance of payments and/or short-term liquidity difficulties. When members need local currencies, they can obtain local currencies by exchanging U.S. dollars (provided by CMIM arrangements). However, using local currencies directly is more efficient and less costly than exchanging local currencies for U.S. dollars. In addition, the value of U.S. dollars against local currencies fluctuates over time, such that local currency contribution to the CMIM arrangements is worthwhile at times when local currencies are needed.

Second, providing members can decrease the burden of drawing on foreign exchange reserves because they can provide their currencies. This factor is likely to be important during crisis periods when receiving members experience crisis and providing members are subject to contagion risks. Drawing on foreign exchange reserves can increase the contagion risks of providing members, such that providing members may be reluctant to draw on foreign exchange reserves and CMIM arrangements may not work well when receiving members experience crisis. However, members are likely to provide their currencies without much hesitation if local currencies can be provided. More fundamentally, each member under CMIM arrangements may need to prepare foreign exchange reserves for potential drawing from other members, which involves costs (usual costs of holding foreign exchange reserves), but a country is not subject to such a cost if its currency can be used. Similarly, local currency contribution may help increase the size of CMIM when ASEAN+3 wants to increase the size of CMIM because providing members are likely to feel less burden by using their currencies in CMIM arrangements.

Third, there are various positive externalities associated with introducing local currency contribution to CMIM arrangements. Introducing local currency contribution to CMIM may promote trade and financial integration in the region. It could also promote local currency use in the region and reduce the region's over-dependence on the U.S. dollar. This would be regarded as a positive signal for local currency use in the market.

2.2.2. Costs

Introducing local currency contribution to CMIM can generate costs if receiving members do not need local currency when they are faced with balance of payments and/or short-term liquidity difficulties. Providing currencies such as the U.S. dollar, instead of local currencies, is clearly a better option for receiving members if local currency is not needed because they have to exchange local currencies for U.S. dollars, which is inefficient and costly. This is costly in two aspects. First, receiving members need to pay the transaction costs of exchanging currencies. Second, given the size of local currencies arranged in CMIM, receiving members may exchange local currencies for a lesser amount of U.S. dollars if local currencies depreciate against the U.S. dollar. Generally, the instability of local currency value (against currencies needed) is likely an incurred cost given that the amount of currencies needed (that can be obtained with local currencies) is uncertain. In fact, local currencies' value can be unstable, especially during times when receiving members experience currency crisis, which can be contagious in the region.

In addition, as receiving members exchange local currencies for U.S. dollars (or currencies needed), local currencies are likely to depreciate against the U.S. dollar, which may result in the instability of local currencies and increase the possibility of contagion to members issuing the local currencies. This potential problem can occur for providing members. If this problem happens, then the second benefit of not drawing on foreign exchange reserves may disappear because this situation is similar to the case in which

providing members draw on foreign exchange reserves and then purchase the same amount of foreign exchange reserves with local currencies. If each member decides not to prepare extra foreign exchange reserves, given that its currency can be used despite not being needed by receiving members (that is, they will exchange the local currency for currencies needed), then the currency of the providing member will be subject to extra depreciation pressure, which can increase the possibility of a contagion risk.

If the size of the CMIM arrangements is defined in terms of U.S. dollars, then the stability of local currencies may not matter much for receiving members even when local currencies are used in CMIM because the receiving members can exchange local currencies with the same amount of U.S. dollars. However, ASEAN+3 may not pursue this arrangement because it arrangement is similar to using U.S. dollars (one difference may be that the transaction costs of exchanging local currencies for U.S. dollars fall into receiving members instead of providing members if arranged in such a way). In addition, if providing members do not prepare extra U.S. dollars for CMIM, then, as indicated before, this situation can lead to the depreciation of local currencies and increase the chance of contagion to local currencies.

Note that costs are generated when receiving members do not need local currencies during the time of balance of payments and/or short-term liquidity difficulties. Also note that first and second benefits are likely to disappear if local currencies are not needed during the time of balance of payments and/or short-term liquidity difficulties. That is, when receiving countries do not need local currencies, all types of costs are generated potentially, but first and second benefits are likely to disappear. Additionally, when the stability of the value of local currencies is low, the exchanging cost is likely high. More seriously, local currencies are likely to experience a currency crisis or abrupt changes in the value of currency when local currencies are subject to high foreign exchange market pressure (that is, under high speculative attacks). Therefore, to discuss the plausibility of local currency contribution to CMIM, this

study will address the following questions.

Do the members of ASEAN+3 need local currencies when they face balance of payments and/or short-term liquidity difficulties?

Are the values of local currencies stable? Are local currencies subject to low exchange market pressure?

2.3. Demand for Local Currencies in Foreign Exchange Reserves and CMIM

In this chapter, we discuss whether members of ASEAN+3 need local currencies when they are faced with balance of payments and/or short-term liquidity difficulties. Foreign exchange reserves and CMIM play a similar role, so demand for local currencies in foreign exchange reserves for ASEAN+3 is discussed by combining the demand for foreign exchange reserves and information on local currency usage in the region. Finally, net demand for local currencies in CMIM arrangements is inferred by subtracting estimated actual foreign exchange reserves from demand for local currencies in foreign exchange reserves.

2.3.1. Demand for Foreign Exchange Reserves

To infer roughly the size of foreign exchange demand for ASEAN+3 members, we calculate various alternative measures for each ASEAN+3 members. First, we consider three traditional measures, namely, three months of imports, 100 percent of short-term debt, and 20 percent of M2. In addition, we consider a rule suggested by IMF (2011), which comprises the sum of 30 percent of short-term debt, 15 percent of other portfolio liabilities (long-term debt and equities), 5 percent of M2, and 5 percent of exports for flexible exchange rate regime; and the sum of 30 percent of short-term debt, 20 percent of other portfolio liabilities (long-term debt and equities), 10 percent of M2 and 10 percent of exports for other exchange rate regimes. The IMF rule is a more comprehensive

measure given that it considers various additional factors.

Table 2.1 reports the size of four measures of foreign exchange demand for each ASEAN+3 country, together with the actual size of foreign exchange reserves. In certain cases, the sizes of foreign exchange reserve demand are fairly different across measures in each member. Among the four measures, 20 percent of M2 measure shows the largest number in Brunei, Indonesia, Myanmar, the Philippines, Thailand, Vietnam, China and Korea. However, the IMF rule measure has the highest numbers in Cambodia and Lao P.D.R. and 100 percent of short-term debt measure has the highest number in Malaysia, Singapore, Hong Kong and Japan.

We can compare the number based on each of four measures with the actual holdings of foreign exchange reserves (which is reported in the last column of Table 2.1). For easy comparison, Figure 2.1 reports the ratio of actual foreign exchange reserves to demand for foreign exchange reserves based on each of four measures. When the ratio is larger than 1, actual foreign exchange reserves are larger than the demand for foreign exchange reserves calculated on the basis of each measure. In Cambodia, Indonesia, the Philippines and Thailand, the actual foreign exchange reserves exceed the demand for foreign exchange reserves based on all four measures. In Myanmar, China, and Korea, the actual foreign exchange reserves exceed the demand based on three measures. For all members, the actual foreign exchange reserves exceed the demand based on at least one measure.

Table 2.1: Measures for Foreign Exchange Reserve Demand
(USD millions, 2017)

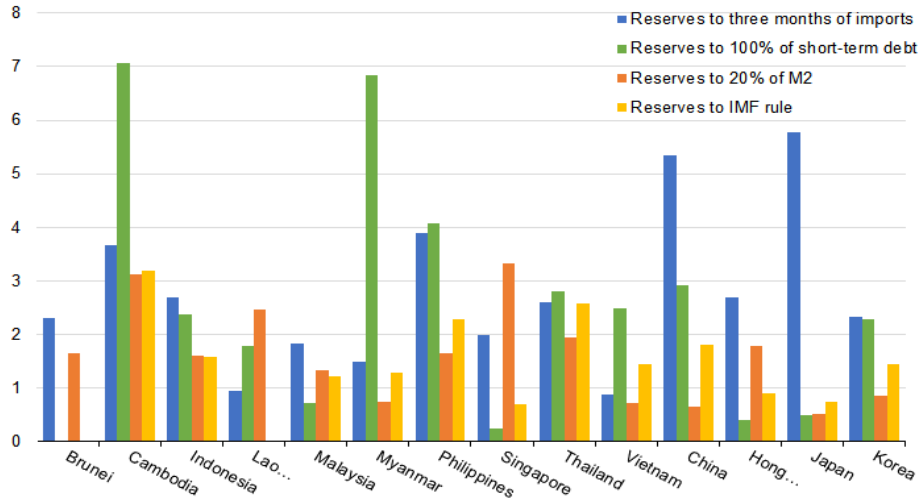
	Three months of imports	100% of short-term debt	20% of M2	IMF rule	Actual FX Reserves
Brunei	1,506	..	2,103	..	3,488
Cambodia	*3,317*	*1,727*	3,911	4,066	12,200
Indonesia	48,375	54,756	80,999	73,592	130,203
Lao P.D.R.	*1,340*	*710*	516	1,344	1,270
Malaysia	56,249	143,337	*77,365*	123,088	102,446
Myanmar	3,495	*762*	7,018	5,715	5,214
Philippines	20,951	19,963	49,551	33,179	81,565
Singapore	140,367	1,085,132	84,011	477,552	279,902
Thailand	77,689	71,904	*103,640*	76,020	202,562
Vietnam	56,811	19,959	69,497	65,786	49,497
China	605,728	1,109,306	4,958,823	3,197,649	3,235,350

Hong Kong	160,453	1,048,002	*241,641*	601,363	431,442
Japan	218,823	2,584,425	*2,399,228*	1,704,287	1,264,141
Korea	166,220	170,445	447,682	272,642	389,248

Note: The IMF rule is 30 percent of short-term debt plus 15 percent of other portfolio liability (calculated as equity and portfolio funds share plus long-term debt securities as of 2017 June) plus 5 percent of M2 plus 5 percent of exports for flexible exchange rate regime countries. Multipliers for other exchange rate regime countries are 30 percent, 20 percent, 10 percent, and 10 percent, respectively. Short-term debt is calculated on remaining maturity basis, but the figures for Cambodia, Lao P.D.R., Myanmar, Singapore, Hong Kong and Japan are based on original maturity, but some numbers (shown in italics) are calculated based on 2016 data, and others (underlined) are calculated based on 2010 data.

Source: IMF IFS/CPIS/WEO/ARA; WDI

Figure 2.1: Ratio of Actual Foreign Exchange Reserves to Demand for Foreign Exchange Reserves



2.3.2. Demand for Local Currencies in Foreign Exchange Reserves

In this section, we discuss the demand for local currencies in foreign exchange reserves.

First, we present the types of information needed to infer the demand for local currencies in foreign exchange reserves, in addition to information on the total reserve demand for foreign exchange reserves discussed in the previous section.

The demand for local currencies in foreign exchange reserves is likely to depend on local currency use in trade settlements in the sense the demand for foreign exchange reserves is related to trade statistics, such as imports, exports and current account as discussed in previous section. Foreign exchange reserves are needed to cover a certain period of imports. If local currency use in import settlements is large, then demand for local currency in foreign

exchange reserves is large as well given that a large amount of local currencies would be needed to pay for imports.

Export earnings reflect the potential loss of foreign exchange provisions that can arise from a drop in external demand or terms of trade shock. If local currency use in export settlements is large, then the potential loss of local currency provisions is large; thus, the demand for local currency in foreign exchange reserves may be high.⑤

The demand for local currency in foreign exchange reserves is large if a large amount of local currency is needed to finance a current account deficit with similar reason.⑥ Additionally, the current account includes net investment income in addition to trade in goods and services; thus, local currency use in net investment income flow must be considered.

In sum, information on local currency use in trade settlements is important to determine the demand for local currencies in foreign exchange reserves. High local currency use in imports implies high demand for local currencies in foreign exchange reserves. High local currency usage in exports may be positively related to high demand for local currencies in foreign exchange reserves.

Second, local currency use in cross-border assets and liabilities is an important determinant of demand for local currencies in foreign exchange reserves. External liabilities, such as short-, medium-,

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⑤ Export earnings may be regarded as a resource that can provide foreign exchange reserves to a country. When a member has high local currency use for exports, the member can receive more local currencies. Therefore, high local currency use in exports may not necessarily imply that the member needs more demand for local currency in foreign exchange reserves. Rather, high local currency use in exports may imply that the member has less demand for local currency in foreign exchange reserves given the size of exports. That is, exports provide local currencies instead of international reserve currencies; thus, the member may need to accumulate more international reserve currencies in foreign exchange reserves. However, export earnings included in the IMF rule is the measure to reflect the potential loss of foreign exchange provisions, and thus, local currency use in export settlements is treated as positively related with demand for local currency in foreign exchange reserves.

⑥ If the composition of local currency is different for credit and debit transactions, high local currency use in debit transactions implies high local currency demand in foreign exchange reserves, but high local currency usage in credit transactions does not necessarily imply high local currency demand in foreign exchange reserves.

and long-term debt, equities and FDI, are indicators for demand for foreign exchange reserves as foreign investors are likely to sell these assets during a crisis. Therefore, when the local currency composition of external liabilities is large, demand for local currencies in foreign exchange reserves is large. Given that short-term debts are riskier and are likely sold more quickly than other external liabilities, the local currency composition of short-term debts is likely to be more important than that of other external liabilities.

Capital flight of domestic residents is another consideration. Domestic residents can sell liquid domestic assets and purchase foreign assets during crisis periods. If the current local currency composition of foreign assets can represent the composition of foreign assets that domestic residents would like to purchase during crisis, then the high local currency composition of foreign assets may suggest high demand for local currency in foreign exchange reserves.⑦

In sum, the local currency composition of foreign assets and liabilities is important to infer demand for local currencies in foreign exchange reserves. A high local currency composition of foreign liabilities and assets implies a high demand for local currencies in foreign exchange reserves.

We determine the demand for local currencies in foreign exchange reserves by inferring how much local currencies is likely needed in the demand for foreign exchange reserves based on various measures, as calculated in the previous section. This means we calculate the likely portion of local currency demand out of total

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⑦ However, foreign assets can be regarded as a resource for international reserve currencies during the crisis time. That is, domestic residents may sell foreign assets to obtain international reserve currencies in need during crisis. In that case, the high local currency composition of foreign liabilities may not necessarily suggest high demand for local currency in foreign exchange reserves. The high local currency composition of foreign liabilities given the size of foreign liabilities means that local currencies can be more easily obtained by selling foreign liabilities, but international reserve currencies can be obtained with more difficulties. Therefore, the high local currency composition of foreign liabilities may imply low demand for local currency in foreign exchange reserves.

demand for foreign exchange reserves calculated in the previous section and multiply the portion by the total demand for foreign exchange reserves to obtain demand for local currencies in foreign exchange reserves. The likely portion of local currency demand in total demand for foreign exchange reserves based on each measure is calculated thus.

We use the following information on local currency shares. For the three-month import measure, we use the local currency proportion data in import settlements. For the 100 percent short-term debt measure, we use the local currency composition data for foreign liabilities because obtaining the data is difficult on currency composition for short-term debt only. For the 20 percent of M2 measure, we use the local currency composition data for foreign assets. For the IMF rule components, such as imports and short-term debts, the same data are used as explained above. For other portfolio liabilities in the IMF rule, we use the local currency composition data for foreign liabilities. For exports in the IMF rule, we use the local currency proportion data in export settlements.

Relevant data on local currency shares are collected in the following way. For export and import local currency share data, we first use the survey data prepared by ASEAN+3 Macroeconomic Research Office (AMRO). However, for Indonesia and Thailand, relevant data are collected from the web page of each central bank where separate data for import and export shares are available. For the local currency composition of short-term debts and foreign liabilities, we first use the survey data. For the local currency composition of foreign asset data, we first use the survey data. Thereafter, we use CPIS data (Coordinated Portfolio Investment Survey from IMF) for Malaysia because the relevant data are unavailable from the survey. We use CPIS data for Thailand and the Philippines given that the survey data do not provide separate information for foreign assets and liabilities unlike CPIS data. When the relevant data are unavailable, the proportion in foreign exchange market turnover data is used to approximate the share of each currency.

Table 2.2 reports the demand for all local currencies in foreign exchange reserves in each ASEAN+3 member. The size in U.S. dollars and the size as a fraction of the maximum amount of withdrawal from CMIM are reported. The maximum amount of withdrawal from CMIM is also reported for each country. We compare the demand for local currencies in foreign exchange reserves with the maximum amount of withdrawal from CMIM to infer whether local currency demand is enough for CMIM arrangements. For instance, if the demand for local currencies in foreign exchange reserves is smaller than the size of potential CMIM withdrawal, then introducing local currency contribution to CMIM arrangements may not be desirable as demand for local currencies might not be enough. However, if the former is larger than the latter, then we may further consider local currency contribution to CMIM arrangements because of enough demand that can be compared with the size of potential CMIM withdrawal. In the last row ("Total") of Table 2.2, the aggregates of all ASEAN+3 members are reported. For the 100 percent of short-term debt measure and the IMF rule, we report an additional number in brackets for the aggregate of all ASEAN+3 members. That number shows the aggregate, excluding Hong Kong and Singapore. Hong Kong and Singapore are huge offshore financial centers, which means that their demand for foreign exchange might be exaggerated when assessed on the basis of the size of financial assets and liabilities. To avoid such potential problems, we report the additional aggregate number, excluding Hong Kong and Singapore, for two measures that are based on the size of financial assets and liabilities.

Table 2.2: Demand for Local Currencies in Foreign Exchange Reserves (USD millions, 2017)

	Three months of imports		100% of short-term debt		20% of M2		IMF rule		Maximum withdrawal (CMIM)
Brunei	240	80%	..	..	335	112%	..	..	300
Cambodia	528	44%	275	23%	623	52%	648	54%	1,199
Indonesia	3,212	15%	4,008	18%	607	3%	3,583	16%	21,896
Lao P.D.R.	213	71%	113	38%	82	27%	214	71%	300
Malaysia	3,844	18%	22,574	103%	4,936	23%	13,951	64%	21,896
Myanmar	557	93%	121	20%	1,118	186%	910	152%	600
Philippines	859	4%	739	3%	606	3%	944	4%	21,896

Singapore	21,090	96%	163,041	745%	12,623	58%	71,752	328%	21,896
Thailand	5,671	26%	8,125	37%	15,053	69%	8,591	39%	21,896
Vietnam	9,049	91%	581	6%	2,022	20%	4,773	48%	9,917
China	12,115	50%	154,569	632%	690,955	2,826%	419,156	1,714%	24,452
Hong Kong	24,168	398%	71,264	1,172%	16,432	270%	46,170	759%	6,079
Japan	3,064	12%	0	0%	23,992	92%	6,668	26%	26,111
Korea	13,131	41%	3,409	11%	53,274	165%	16,048	50%	32,255
Total	97,741	46%	428,819	204%	822,658	390%	593,408	282%	210,694
			(194,514)	(106%)			(475,486)	(260%)	(182,719)

Note: Figures are derived by multiplying demand for foreign exchange reserves by relevant local currency composition ratio. Demand for own currency is not counted. Invoicing currency data for import, currency composition data for short-term debt, currency composition data for foreign liabilities, currency composition data for other portfolio liabilities, and invoicing currency data for exports are used to calculate relevant local currency composition ratios for imports, short-term debts, M2, other portfolio liabilities (in the IMF rule) and exports (in the IMF rule) respectively. Currency invoicing and composition data are collected from survey and IMF CPIS. Foreign exchange reserves in local currency are estimated by applying the compositions of the RMB and yen in world international reserves (IMF COFER, 2017).

When the total aggregate number for all ASEAN+3 members (shown in the last row of Table 2.2) suggests the demand for local currencies is far larger than the maximum amount of withdrawal from CMIM based on all measures, except for the first measure. Based on the first, second, third, and fourth measures, the demand for local currencies stands at 46 percent, 204 percent, 390 percent and 282 percent of the maximum withdrawal from CMIM respectively. The aggregate numbers for the two measures, excluding Hong Kong and Singapore, are still larger than 100 percent, at 106 percent and 260 percent respectively. As the first measure tends to be out of date, this result suggests that the demand for local currencies in foreign exchange reserves is far larger than the size of the maximum withdrawal in CMIM, which may provide a rationale for considering local currency contribution to CMIM arrangements.

The demand for local currencies in foreign exchange reserves tends to be lower for most individual members than for the aggregate results, as aggregate results include huge local currency demand in China. Still, seven members record demand larger than the maximum withdrawal from CMIM based on at least one measure. They are Brunei, Malaysia, Myanmar, Singapore, China, Hong Kong and Korea. In addition, only two members have a demand that is smaller than 50 percent of the maximum withdrawal from CMIM based on all measures – Indonesia and the Philippines. The ratios of demand for local currencies in foreign exchange reserves to actual foreign

exchange reserves for Indonesia and the Philippines range from 3 percent to 18 percent and from 3 percent to 4 percent respectively, based on four measures. Overall, the results affirm substantial demand for local currencies in foreign exchange reserves compared with the size of the maximum withdrawal from CMIM for most ASEAN+3 members.

In Table 2.3, we calculate the demand for the Japanese yen in foreign exchange reserves. We see that more than half the demand for local currencies is in Japanese yen. The number for the sum of all ASEAN+3 members shows that the demand for the yen is far larger than the maximum withdrawal from Japan in CMIM based on three measures. In all members, except for Indonesia and the Philippines, demand for the yen is larger than 95 percent of the maximum withdrawal from Japan in the CMIM, based on at least one measure.

Table 2.3: Demand for the Yen in Foreign Exchange Reserves
(USD millions, 2017)

	Three months of imports		100% of short-term debt		20% of M2		IMF rule		Maximum withdrawal from Japan (CMIM)
Brunei	163	170%	..	..	227	237%	..	..	96
Cambodia	359	93%	187	49%	423	110%	440	114%	384
Indonesia	1,823	25%	3,669	50%	40	1%	3,044	42%	7,283
Lao P.D.R.	145	151%	77	80%	56	58%	145	151%	96
Malaysia	1,354	19%	15,496	213%	570	8%	7,704	106%	7,283
Myanmar	378	197%	82	43%	759	395%	618	322%	192
Philippines	670	9%	659	9%	520	7%	810	11%	7,283
Singapore	15,175	208%	117,312	1,611%	9,082	125%	51,627	709%	7,283
Thailand	4,739	65%	3,092	42%	10,539	145%	4,765	65%	7,283
Vietnam	6,142	192%	487	15%	1,696	53%	3,444	108%	3,200
China	12,115	111%	119,925	1,096%	536,091	4,898%	326,202	2,981%	10,944
Hong Kong	17,346	860%	71,264	3535%	16,432	815%	43,454	2,155%	2,016
Japan	..	..	..	..	..	..	..	..	..
Korea	11,303	92%	1,704	14%	12,087	98%	4,586	37%	12,288
Total	71,712	109%	333,954	509%	588,523	897%	446,839	681%	65,632
			(145,378)	(258%)			(351,757)	(624%)	(56,333)

Table 2.4 reports the demand for the RMB in foreign exchange reserves. Demand for the RMB is smaller than that of the yen, but still substantial based on the aggregate numbers, showing 9 percent to 78 percent of the maximum size of withdrawal from China. Demand for the RMB in each country is non-negligible. Except for Indonesia,

the Philippines and Thailand, demand for RMB is larger than 20 percent of the maximum withdrawal from China in CMIM, based on at least one measure.

Table 2.4: Demand for RMB in Foreign Exchange Reserves
(USD millions, 2017)

	Three months of imports		100% of short-term debt		20% of M2		IMF rule		Maximum withdrawal from China (CMIM)
Brunei	30	35%	..	..	42	49%	..	..	86
Cambodia	66	19%	34	10%	78	23%	81	24%	342
Indonesia	307	5%	110	2%	567	9%	262	4%	6,487
Lao P.D.R.	27	31%	14	16%	10	12%	27	31%	86
Malaysia	521	8%	2,858	44%	502	8%	1,717	26%	6,487
Myanmar	70	41%	15	9%	140	82%	114	67%	171
Philippines	63	1%	20	0%	34	1%	41	1%	6,487
Singapore	2,799	43%	21,636	334%	1,675	26%	9,522	147%	6,487
Thailand	544	8%	0	0%	0	0%	37	1%	6,487
Vietnam	1,133	40%	0	0%	0	0%	438	15%	2,850
China	..	..	..	..	..	..	..	..	..
Hong Kong	3,199	178%	0	0%	0	0%	1,274	71%	1,796
Japan	1,969	18%	0	0%	2,399	22%	1,270	12%	10,944
Korea	1,662	15%	1,704	16%	41,187	376%	11,462	105%	10,944
Total	12,389	21%	26,392 (4,756)	44% (9%)	46,634	78%	26,244 (15,449)	44% (30%)	59,651 (51,368)

Table 2.5 reports the demand for other currencies in foreign exchange reserves (excluding the yen and RMB). The demand for other currencies is substantial too. The aggregate demand is larger than the maximum size of withdrawals from other members in the CMIM based on two measures. The numbers based on the four measures are 16 percent, 80 percent (59 percent), 220 percent, and 141 percent (144 percent). Except for Korea, Indonesia and the Philippines, the demand for local currency is larger than 20 percent of the maximum withdrawal from China in CMIM based on at least two measures.

Table 2.5: Demand for Other Local Currencies in Foreign Exchange Reserves
(USD millions, 2017)

	Three months of imports		100% of short-term debt		20% of M2		IMF rule		Maximum withdrawal from others
Brunei	47	40%	..	..	66	55%	..	..	118
Cambodia	104	22%	54	11%	122	26%	127	27%	473
Indonesia	1,082	13%	230	3%	0	0%	277	3%	8,126

Lao P.D.R.	42	35%	22	19%	16	14%	42	35%	118
Malaysia	1,969	24%	4,220	52%	3,863	48%	4,530	56%	8,126
Myanmar	109	46%	24	10%	219	93%	178	75%	237
Philippines	126	2%	60	1%	52	1%	93	1%	8,126
Singapore	3,116	38%	24,093	296%	1,865	23%	10,603	130%	8,126
Thailand	388	5%	5,033	62%	4,514	56%	3,789	47%	8,126
Vietnam	1,774	46%	94	2%	327	8%	892	23%	3,867
China	0	0%	34,643	256%	154,863	1146%	92,954	688%	13,508
Hong Kong	3,622	160%	0	0%	0	0%	1,442	64%	2,268
Japan	1,094	7%	0	0%	21,593	142%	5,398	36%	15,167
Korea	166	2%	0	0%	0	0%	0	0%	9,023
Total	13,640	16%	68,473 (44,381)	80% (59%)	187,501	220%	120,325 (108,280)	141% (144%)	85,412 (75,017)

Table 2.6 reports the aggregate ASEAN+3 demand for each local currency in foreign exchange reserves. Except for the Indonesian rupiah, Philippines peso and RMB, aggregate demand for the currency of each member in foreign exchange reserves is larger than 100 percent of the maximum withdrawal from each member based on at least one measure. For those three members, the numbers are larger than 30 percent based on at least one measure.

Table 2.6: Aggregate Demand for Each Local Currency in Foreign Exchange Reserves
(USD millions, 2017)

	Three months of imports		100% of short-term debt		20% of M2		IMF rule		Maximum withdrawal from relevant country (CMIM)
Indonesian rupiah	404	5%	2,331 (1,250)	28% (17%)	5,320	64%	3,717 (3,178)	44% (44%)	8,373 (7,270)
Malaysian ringgit	792	9%	3,978 (2,041)	48% (28%)	9,304	111%	6,460 (5,493)	77% (76%)	8,373 (7,270)
Philippine peso	261	3%	1,626 (872)	19% (12%)	3,709	44%	2,585 (2,209)	31% (30%)	8,373 (7,270)
Singapore dollar	4,851	58%	12,110 (12,110)	145% (149%)	47,639	569%	30,446 (29,870)	364% (367%)	8,373 (8,134)
Thai baht	2,205	26%	4,254 (2,301)	51% (32%)	9,443	113%	6,801 (5,826)	81% (80%)	8,373 (7,270)
Chinese yuan	12,389	21%	26,392 (4,756)	44% (9%)	46,634	78%	26,244 (15,449)	44% (30%)	59,651 (51,368)
Hong Kong dollar	1,992	24%	21,213 (11,822)	256% (158%)	67,827	817%	37,585 (33,453)	453% (446%)	8,302 (7,505)
Japanese yen	71,712	109%	333,954 (145,378)	509% (258%)	588,523	897%	446,839 (351,757)	681% (624%)	65,632 (56,333)
Korean won	3,046	9%	19,423 (10,445)	59% (37%)	44,202	135%	30,818 (26,338)	94% (94%)	32,816 (28,166)
Other ASEAN currency	89	4%	3,539 (3,539)	146% (166%)	56	2%	1,912 (1,912)	79% (90%)	2,430 (2,130)
Total	97,741	46%	428,819 (194,514)	204% (106%)	822,658	390%	593,408 (475,486)	282% (260%)	210,694 (182,719)

In sum, there is substantial demand for local currencies in foreign exchange reserves. The size of the demand is large in comparison

with the size of the maximum withdrawal from CMIM. This result can support the idea of introducing local currency contribution to CMIM arrangements.

2.4. Net Demand for Local Currencies in CMIM

In this section, net demand for local currencies in CMIM arrangements is inferred by subtracting estimated actual foreign exchange reserves from demand for local currencies in foreign exchange reserves calculated in 2.2.2. This net demand can represent the demand for local currencies in CMIM arrangements after excluding the demand that is satisfied by the actual holding of local currency foreign exchange reserves.

However, the exact information on actual local currency holdings in foreign exchange reserves is difficult to obtain. To roughly infer the size of local currencies in foreign exchange reserves, we simply multiply the actual reserve holdings by the local currency ratio in the world international reserves. For local currencies, we only consider Chinese yuan and Japanese yen in which the numbers are provided. However, this is a very rough method, and the correct numbers can be different from the numbers calculated here; thus, we opt to use these numbers as rough reference points only, without drawing a strong conclusion based on these numbers.

Note that each member can decrease the size of actual local currency holdings when local currency contribution to CMIM arrangements is introduced if the net demand is small or negative. Therefore, a small or negative net demand is not necessarily a big hurdle for introducing local currency contribution to CMIM arrangements if enough demand for local currency in foreign exchange reserves exists, as shown in the previous section.

Table 2.7 reports the net demand for local currencies in CMIM arrangements based on four measures. The last column of Table 2.7 presents estimated numbers for actual local currency holdings. We see that the estimated size of the actual foreign exchange reserves in local currencies tends to be smaller than the maximum withdrawal

from CMIM in all members, except for China. The net demand for local currencies in CMIM is still more than 100 percent of maximum withdrawal of CMIM based on the third and fourth measures for the aggregate of ASEAN+3, which may suggest enough demand for local currency use in CMIM arrangements, even after considering the existing local currency foreign exchange reserves. In all members, except for Cambodia, Indonesia and the Philippines, net demand is positive based on at least one measure.

Table 2.7: Net Demand for Local Currencies in CMIM
(USD million, 2017)

	Three months of imports		100% of short-term debt		20% of M2		IMF rule		Maximum withdrawal (CMIM)	FX reserves in LCY
Brunei	27	9%	..	..	122	41%	..	..	300	213
Cambodia	−218	−18%	−471	−39%	−123	−10%	−98	−8%	1,199	746
Indonesia	−4,750	−22%	−3,954	−18%	−7,355	−34%	−4,380	−20%	21,896	7,962
Lao P.D.R.	136	45%	35	12%	4	1%	136	45%	300	78
Malaysia	−2,421	−11%	16,309	74%	−1,329	−6%	7,686	35%	21,896	6,265
Myanmar	238	40%	−198	−33%	799	133%	591	99%	600	319
Philippines	−4,129	−19%	−4,249	−19%	−4,382	−20%	−4,044	−18%	21,896	4,988
Singapore	3,973	18%	145,924	666%	−4,494	−21%	54,635	250%	21,896	17,117
Thailand	−6,716	−31%	−4,262	−19%	2,666	12%	−3,796	−17%	21,896	12,387
Vietnam	6,022	61%	−2,446	−25%	−1,005	−10%	1,746	18%	9,917	3,027
China	−148,106	−606%	−5,652	−23%	530,734	2,170%	258,935	1,059%	24,452	160,221
Hong Kong	−2,216	−36%	44,880	738%	−9,952	−164%	19,786	325%	6,079	26,384
Japan	−13,202	−51%	−16,265	−62%	7,727	30%	−9,597	−37%	26,111	16,265
Korea	−10,672	−33%	−20,395	−63%	29,470	91%	−7,756	−24%	32,255	23,804
Total	−182,035	−86%	149,043 (−41,761)	71% (−23%)	542,882	258%	313,632 (239,211)	149% (131%)	210,694 (182,719)	279,776 (236,275)

Note: The figures are derived by subtracting estimated actual foreign exchange reserves from demand for local currencies in foreign exchange reserves. Demand for own currency is not counted. Invoicing currency data for import, currency composition data for short-term debt, currency composition data for foreign liabilities, currency composition data for other portfolio liabilities, invoicing currency data for exports are used to calculate relevant local currency composition ratios for imports, short-term debts, M2, other portfolio liabilities (in the IMF rule) and exports (in the IMF rule). Currency invoicing and composition data are collected from survey and IMF CPIS. Foreign exchange reserves in local currency are estimated by applying the compositions of RMB and yen in world international reserves (IMF COFER, 2017).

Table 2.8 reports the net demand for yen in CMIM arrangements. For the aggregate of ASEAN+3, net demand is 142 percent (−108 percent), 530 percent and 314 percent (259 percent) of maximum withdrawal from Japan in CMIM arrangements based on the last three measures. For eight members, the net demand is larger than 80 percent of the maximum withdrawal from Japan in CMIM. The results generally confirm the substantial demand of many members for the yen.

Table 2.8: Net Demand for Japanese Yen in Foreign Exchange Reserves (USD millions, 2017)

	Three months of imports		100% of short-term debt		20% of M2		IMF rule		Maximum withdrawal from Japan (CMIM)	FX reserves in yen
Brunei	−8	−8%	..	..	56	59%	..	..	96	171
Cambodia	−238	−62%	−410	−107%	−174	−45%	−157	−41%	384	597
Indonesia	−4,546	−62%	−2,700	−37%	−6,329	−87%	−3,325	−46%	7,283	6,369
Lao P.D.R.	83	86%	15	15%	−6	−6%	83	87%	96	62
Malaysia	−3,657	−50%	10,485	144%	−4,441	−61%	2,693	37%	7,283	5,011
Myanmar	123	64%	−173	−90%	504	262%	363	189%	192	2,55
Philippines	−3,320	−46%	−3,331	−46%	−3,470	−48%	−3,180	−44%	7,283	3,990
Singapore	1,483	20%	103,620	1,423%	−4,610	−63%	37,935	521%	7,283	13,692
Thailand	−5,170	−71%	−6,817	−94%	630	9%	−5,144	−71%	7,283	9.909
Vietnam	3,721	116%	−1,934	−60%	−725	−23%	1,023	32%	3,200	2,421
China	−148,106	−1,353%	−40,296	−368%	375,870	3,434%	165,981	1,517%	10,944	160,221
Hong Kong	−3,758	−186%	50,160	2,488%	−4,672	−232%	22,350	1,109%	2,016	21,104
Japan	..	..	..	..	..	..	..	..	...	..
Korea	−7,737	−63%	−17,336	−141%	−6,953	−57%	−14,454	−118%	12,288	19,040
Total	−169,129	−258%	93,113 (−60,667)	142% (−108%)	347,682	530%	205,998 (145,712)	314% (259%)	65,632 (56,333)	240,841 (206,045)

Table 2.9 reports the net demand for RMB in CMIM arrangements. For the aggregate of ASEAN+3, the net demand is positive based on 20 percent of M2 measure, although negative based on the other three measures. For members such as Lao P.D.R., Malaysia, Myanmar, Singapore, Vietnam and Korea, the net demand is positive based on at least one measure, although negative numbers are found in many cases.

Table 2.9: Net Demand for RMB in Foreign Exchange Reserves (USD millions, 2017)

	Three months of imports		100% of short-term debt		20% of M2		IMF rule		Maximum Withdrawal From China (CMIM)	FX Reserves in RMB
Brunei	−13	−15%	..	..	−1	−1%	..	..	86	43
Cambodia	−83	−24%	−115	−33%	−71	−21%	−68	−20%	342	149
Indonesia	−1,286	−20%	−1,483	−23%	−1,026	−16%	−1,331	−21%	6,487	1,593
Lao P.D.R.	11	12%	−2	−2%	−6	−7%	11	13%	86	16
Malaysia	−733	−11%	1,604	25%	−752	−12%	463	7%	6,487	1,254
Myanmar	6	3%	−49	−29%	76	44%	50	29%	171	64
Philippines	−935	−14%	−978	−15%	−964	−15%	−957	−15%	6,487	998
Singapore	−626	−10%	18,211	281%	−1,750	−27%	6,097	94%	6,487	3,425

Thailand	−1,935	−30%	−2,479	−38%	−2,479	−38%	−2,442	−38%	6,487	2,479
Vietnam	527	18%	−606	−21%	−606	−21%	−168	−6%	2,850	606
China	..	..	..	..	..	..	..	..	..	..
Hong Kong	−2,081	−116%	−5,280	−294%	−5,280	−294%	−4,006	−223%	1,796	5,280
Japan	−14,296	−131%	−16,265	−149%	−13,866	−127%	−14,995	−137%	10,944	16,265
Korea	−3,101	−28%	−3,059	−28%	36,424	333%	6,699	61%	10,944	4,763
Total	−24,546	−41%	−10,543 (−23,474)	−18% (−46%)	9,699	16%	−10,691 (−12,781)	−18% (−25%)	59,651 (51,368)	36,935 (28,230)

In sum, the net demand for local currency in CMIM, after subtracting estimated actual foreign exchange reserves, tends to be positive. This result suggests there is room for introducing local currency contribution to CMIM arrangements, even after considering the current level of local currencies in actual foreign exchange reserves. However, this result should be interpreted with caution because the data used in this analysis, especially the estimates for actual foreign exchange reserves, is not perfect.

2.5. Stability of Local Currencies

If certain parts of arranged local currencies are not needed by receiving the members when they experience balance of payments and/or short−term liquidity difficulties, then this situation will be inefficient and there will be costs involved. The receiving member will subsequently need to exchange local currencies for the currencies needed, such as USD. In such a case, when local currencies are unstable, the cost is likely to be large.

First, we calculate the measure of volatility in the value or exchange rate of local currencies. If the value of local currencies is unstable, then receiving members would incur higher costs in exchanging local currencies for the currencies needed. However, this measure has one drawback. The volatility of the exchange rate is likely to depend on the exchange rate regime. For instance, if one member adopts a fixed exchange rate regime, then the volatility of the exchange rate is likely to be small, except during crisis. Nonetheless, this situation does not necessarily imply that the currency is stable. The country with a fixed exchange rate regime potentially has a greater chance of experiencing a currency crisis and

the exchange rate volatility can be very high during such a crisis. Therefore, we consider the next measure.

Second, we calculate the exchange market pressure index. The measure captures total pressure on an exchange rate. Instead of simply considering exchange rate movements, the measure also considers the degree of foreign exchange managements. In that way, the measure tries to capture the size of the fundamental source of exchange rate instability that each member faces. For instance, suppose, in a flexible exchange rate regime, the sales of domestic currency under an economic event leads to exchange rate depreciation. However, the sales of domestic currency do not lead to exchange rate depreciation in a fixed exchange rate regime in most cases. Instead, foreign exchange intervention is needed to prevent an exchange rate depreciation. Therefore, by considering exchange rate changes and the degree of foreign exchange market intervention, one may capture the total pressure on exchange rate or the size of the fundamental source of exchange rate instability that each country faces.

In addition, the exchange market pressure index has been widely used in past studies to measure the severity of speculative attacks and to define a currency crisis. If local currencies tend to be subject to large speculative attacks, then the currencies are more likely to experience a currency crisis and lose value, which also leads to high costs for receiving and providing members (as their chance of crisis increases).

Note that we mostly compare the stability of currencies of ASEAN+3 members with well-known international currencies, such as the Euro, U.K. pound, Canadian dollar and Swiss franc, instead of U.S. dollars. First, to define the value of currency, a base currency is needed, and thus, we use the U.S. dollar as the base currency. Second, U.S. dollars are likely more stable than other currencies in the world. Therefore, the results should be interpreted with caution.

Stability for the Value of Local Currencies

We first calculate the standard deviation of the growth rate of the value of local currencies. Ideally, we must consider the value of local

currencies against the currencies needed for each country. However, we do not know the exact currency composition needed for each country. Therefore, we first consider the exchange rate of local currencies against the U.S. dollar as it is the representative international reserve currency. In addition, we construct an effective exchange rate against the actual currency composition of foreign exchange reserves in the world, as reported in Currency Composition of Official Foreign Exchange (COFER) from IMF. In the first quarter of 2018, for allocated reserves, U.S. dollars, euros, RMB, yen, pound sterling, Australian dollars, Canadian dollars and Swiss francs take up 62.48 percent, 20.39 percent, 1.39 percent, 4.81 percent, 4.68 percent, 1.70 percent, 1.86 percent and 0.17 percent respectively. Other currencies make up 2.5 percent, but we do not know the exact currency composition in that category; thus, we normalize the weights of each currency to sum up to 100 percent after excluding other currencies.

We calculate the standard deviation of the growth rate of these exchange rates for each ASEAN+3 member's currency. We also calculate the standard deviation for six world reserve currencies outside the region (U.S. dollars, euros, pound sterling, Australian dollars, Canadian dollars and Swiss francs) for comparison. By using monthly data, we calculate the standard deviation from 2000 to 2017. We also consider various sub-periods, such as after 2010 to check more recent trends. In addition, we consider 2007-2009 to check the stability during the global crisis period. To check the stability during the recent U.S. tapering, we consider 2013 to 2017 (including taper tantrum during 2013) and 2015 to 2017 (the periods of U.S. interest rate increase).

The results are reported in Table 2.10. As expected, they depend on the exchange rate regime. The volatility of the exchange rate tends to be very high for the free floating exchange rate regime. The floating exchange rate regime is adopted in countries/regions with most well-known international reserve currencies, such as the U.S., the U.K., Japan, Canada, Switzerland and the E.U. The exchange rate volatility of those countries, except for the U.S., is fairly high. For

the entire sample period, the standard deviation of exchange rate growth ranges from 2 to 2.4 percent for the exchange rate against the U.S. and from 1.7 percent to 2.2 percent for the effective exchange rate. For the period after 2010, they range from 1.8 to 2.4 percent and from 1.6 percent to 2.2 percent for the exchange rate against the U.S. and for the effective exchange rate, respectively. The value is low for the U.S. given that the exchange rate is mostly calculated against the value of own currency. For the exchange rate against the U.S. dollar, the volatility of the exchange rate is not clearly larger than these numbers for any members. However, this situation does not necessarily mean that the currencies of these members are as stable as the more well-known international reserve currencies. These members tend to have taken more rigid exchange rate regime, which may explain low volatility. For other three sub-periods, the results are similar. For all ASEAN+3 members, exchange rate volatility is not clearly larger than that of well-known international reserve currencies. Again, this result can be mostly explained by the differences in exchange rate regime.

Table 2.10: Standard Deviation of Exchange Rate Growth

(1) Exchange Rate Against the U.S. Dollar

	From 2000	From 2010	2007~ 2009	2013~ 2017	2015~ 2017		From 2000	From 2010	2007~ 2009	2013~ 2017	2015~ 2017
Thailand	1.4%	1.3%	1.4%	1.3%	1.2%	U.K.	2.3%	2.1%	3.2%	2.1%	2.3%
Myanmar	1.5%	1.7%	1.3%	1.9%	2.1%	Switzerland	2.4%	2.4%	2.6%	1.7%	1.8%
Malaysia	1.5%	2.0%	1.6%	2.2%	2.5%	Canada	2.0%	1.8%	3.2%	1.9%	2.3%
Cambodia	0.6%	0.6%	0.6%	0.5%	0.5%	Euro	2.4%	2.2%	2.9%	1.9%	2.1%
Vietnam	0.9%	0.8%	0.9%	0.2%	0.3%	Australia	3.0%	2.4%	4.9%	2.3%	2.2%
Brunei	1.2%	1.2%	1.6%	1.1%	1.3%	U.S.	0.0%	0.0%	0.0%	0.0%	0.0%
Philippines	1.5%	1.1%	2.1%	1.0%	1.0%						
Laos	1.6%	0.5%	0.7%	0.5%	0.4%						
Indonesia	3.0%	1.7%	4.1%	2.0%	1.6%						
Singapore	1.2%	1.2%	1.5%	1.1%	1.3%						
China	0.5%	0.6%	0.5%	0.8%	0.9%						
Japan	2.4%	2.3%	2.8%	2.5%	2.2%						
Korea	2.4%	1.9%	4.1%	1.8%	1.9%						
Hong Kong	0.1%	0.1%	0.2%	0.1%	0.1%						

(2) Effective Exchange Rate (Against World International Reserves)

	From 2000	From 2010	2007~ 2009	2013~ 2017	2015~ 2017		From 2000	From 2010	2007~ 2009	2013~ 2017	2015~ 2017
Thailand	1.2%	1.2%	1.1%	1.3%	1.2%	U.K.	1.9%	1.8%	2.7%	1.9%	2.1%
Myanmar	1.1%	1.5%	0.5%	1.8%	2.1%	Switzerland	1.9%	2.0%	1.9%	1.4%	1.5%
Malaysia	1.4%	1.8%	1.1%	2.1%	2.3%	Canada	1.7%	1.6%	2.7%	1.6%	2.0%
Cambodia	0.9%	0.9%	1.0%	0.8%	0.9%	Euro	1.7%	1.6%	2.1%	1.4%	1.6%

Vietnam	1.1%	1.1%	1.1%	0.6%	0.6%	Australia	2.6%	2.1%	4.2%	2.1%	2.0%
Brunei	0.9%	0.9%	1.0%	0.9%	1.0%	U.S.	0.7%	0.6%	0.8%	0.5%	0.6%
Philippines	1.5%	1.1%	1.9%	1.1%	1.0%						
Laos	1.6%	0.7%	0.9%	0.7%	0.6%						
Indonesia	2.9%	1.7%	3.6%	2.0%	1.6%						
Singapore	0.9%	0.9%	0.8%	0.9%	1.0%						
China	0.7%	0.7%	0.8%	0.8%	0.9%						
Japan	2.2%	2.2%	2.7%	2.3%	2.0%						
Korea	2.2%	1.7%	3.6%	1.7%	1.9%						
Hong Kong	0.7%	0.6%	0.8%	0.5%	0.6%						

2.5.1. Exchange Market Pressure Index for Local Currencies

We also calculate the exchange market pressure index. In past studies, the index is widely used to identify currency crisis periods by capturing total pressure on an exchange rate. This measure can represent the size of the fundamental sources of exchange rate instability that can be applied to different exchange rate regimes, as discussed earlier. If local currencies are subject to more pressure or huge speculative attacks, then the currencies are more likely to experience currency crisis and lose their value. This situation implies that receiving members need to pay high costs when they exchange local currencies for the currencies needed. In addition, providing members are more likely to experience a crisis as they have more pressure in the foreign exchange market, and using local currencies may imply more chances of a crisis in providing members.

Various measures are suggested in past studies. Here, we use the four alternative measures of exchange market pressure. First, we use the simplest form, as follows:

$$EMP1 = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{IR_t - IR_{t-1}}{IR_{t-1}}$$

Where e_t is the exchange rate against the U.S. dollar and IR_t is exchange rate reserves (in U.S. dollars). This index sums the rate of exchange rate depreciation and the rate of reserve loss. The index captures total pressure on exchange rate from (net) sales of domestic currency. The sales of domestic currency would lead to an exchange rate depreciation if no foreign exchange intervention is done. If the central bank intervenes in the foreign exchange market

to stabilize the exchange rate, then international reserves would suffer losses resulting from intervention. This simple index has been widely used in past studies, such as Aizenman and Binici (2016) and Aizenman, Lee, and Sushko (2012).

Second, in addition to foreign exchange market intervention, the monetary authority may increase the interest rate to stabilize the exchange rate. That is, an increase in the interest rate would fend off depreciation pressure on the exchange rate. Therefore, changes in the interest rate are added to the previous index.

$$EMP2 = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{IR_t - IR_{t-1}}{IR_{t-1}} + (i_t - i_{t-1})$$

Where i_t is domestic short-term interest rates. Sachs, Tornell, and Velasco (1996), Kaminsky, Lizondo, and Reinhart (1998) and Kaminsky and Reinhart (1999) added the short-term interest rate in the exchange rate market index.

The above indices are not formally derived from theoretical models. Thus, we also consider several indices derived from theoretical models. The third index is similar to the first one in having two components – exchange rate and foreign exchange reserves. However, the international reserve changes are normalized by monetary base. Girton and Roper (1977) contended that such normalization is consistent with the theoretical model, such as the monetary model of exchange rate.

$$EMP3 = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{IR_t - IR_{t-1}}{M_{t-1}/e_{t-1}}$$

where M_t is the monetary base (in domestic currency). Note that IR is expressed in U.S. dollars, but M is expressed in domestic currency; thus, M is divided by e to be expressed in U.S. dollars.

The fourth index is similar to the second one, in having three components – exchange rate, foreign exchange reserves and interest rate. However, the difference lies in two aspects. First, as in the third

measure, foreign exchange reserve changes are normalized by a monetary base. Second, the interest rate changes are entered with a negative sign. Klaasen and Jager (2011) validated that the index can be derived from the monetary model. The index is also used in Aizenman and Binici (2016).

$$EMP4 = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{IR_t - IR_{t-1}}{M_{t-1}/e_{t-1}} - (i_t - i_{t-1})$$

We calculate the average of absolute value of the index for each country for various sub-periods to show the stability of each currency during the considered periods. We use the average of absolute value because non-zero value of the index implies the existence of pressure on exchange rate, and the size of (the absolute value of) the index shows the size of pressure on exchange rate. We calculate the standard deviation of the index, and report the results in the Appendix 3. The main implications of the results are not much different. As for the standard deviation of the exchange rate growth rate, we calculate the average of absolute value of the index for the currency of each ASEAN+3 member and six world reserve currencies outside the region, for 2000 to 2017, 2010 to 2017, 2007 to 2009, 2013 to 2017, and 2015 to 2017, by using monthly data.

The numbers for the U.S. indicate the role of the second component only because the first component (growth rate of the exchange rate) is zero. In addition, evaluating the size of the second component may not be meaningful for the U.S. Therefore, comparing the results for the U.S. with the results for other countries/regions is difficult. We first compare the results for the currencies of ASEAN+3 members with those for the euro, which is the second largest international reserve currency, making up more than 20 percent of world reserves. The average of absolute value of the exchange market index for euro is 2.9 percent and 2.2 percent for 2000 to 2017 and 2010 to 2017 respectively. Interestingly, several currencies show an even lower number for both periods, namely currencies of the Philippines, Singapore, China, Japan, Korea and

Hong Kong. In addition, the currencies of Thailand, Malaysia and Cambodia show similar numbers. For countries/regions with well-known international reserve currencies (U.K., Switzerland, Canada, the Euro area and Japan), the average of absolute value of exchange market index ranges from 2.4 percent to 4.3 percent and from 2.1 percent to 4.6 percent for 2000 to 2017 and 2010 to 2017 respectively. Most ASEAN+3 members have an average value that is not greater than those numbers. Only three members have numbers larger than those ranges – Myanmar for the period from 2000, and Brunei and Laos for both periods. For 2007 to 2009, 2013 to 2017 and 2015 to 2017, the results are similar in that the numbers for most ASEAN+3 members are not greater than those numbers.

Table 2.11: Average of Absolute Value of Exchange Market Index

(1) $EMP1 = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{IR_t - IR_{t-1}}{IR_{t-1}}$

	From 2000	From 2010	2007~ 2009	2013~ 2017	2015~ 2017		From 2000	From 2010	2007~ 2009	2013~ 2017	2015~ 2017
Thailand	2.5%	2.3%	3.3%	2.2%	2.4%	U.K.	3.5%	2.7%	6.0%	2.7%	2.9%
Myanmar	5.4%	3.9%	6.3%	4.5%	3.6%	Switzerland	4.3%	4.6%	5.2%	2.4%	2.6%
Malaysia	2.7%	2.6%	3.6%	2.8%	2.9%	Canada	2.4%	2.1%	3.7%	1.9%	2.1%
Cambodia	2.4%	2.2%	3.3%	2.4%	2.1%	Euro	2.9%	2.2%	4.5%	2.0%	2.3%
Vietnam	3.8%	4.1%	4.3%	3.4%	3.1%	Australia	7.7%	7.7%	9.7%	8.4%	9.4%
Brunei	4.6%	5.8%	4.8%	5.0%	5.6%	U.S.	2.0%	1.3%	4.0%	1.2%	1.2%
Philippines	2.6%	2.0%	3.4%	1.5%	1.4%						
Laos	5.3%	6.9%	3.7%	7.2%	6.2%						
Indonesia	3.8%	3.2%	4.7%	2.8%	2.8%						
Singapore	2.1%	2.1%	2.7%	1.7%	1.9%						
China	2.1%	1.4%	2.8%	1.3%	1.5%						
Japan	2.5%	2.1%	2.9%	2.1%	1.9%						
Korea	2.6%	2.1%	4.1%	1.9%	1.9%						
Hong Kong	1.2%	1.0%	2.4%	1.0%	1.1%						

(2) $EMP2 = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{IR_t - IR_{t-1}}{IR_{t-1}} + (i_t - i_{t-1})$

	From 2000	From 2010	2007~ 2009	2013~ 2017	2015~ 2017		From 2000	From 2010	2007~ 2009	2013~ 2017	2015~ 2017
Thailand	2.5%	2.3%	3.4%	2.2%	2.4%	U.K.	3.5%	2.7%	6.0%	2.7%	2.9%
Myanmar	5.4%	3.9%	6.3%	4.5%	3.6%	Switzerland	4.3%	4.6%	5.2%	2.5%	2.7%
Malaysia	2.7%	2.6%	3.6%	2.8%	2.9%	Canada	2.4%	2.1%	3.7%	1.9%	2.1%
Cambodia	2.4%	2.3%	3.4%	2.5%	2.1%	Euro	2.8%	2.2%	4.5%	2.0%	2.3%
Vietnam	3.9%	4.3%	4.7%	3.6%	3.4%	Australia	7.7%	7.7%	9.6%	8.4%	9.4%
Brunei	4.9%	5.8%	4.8%	5.0%	5.6%	U.S.	2.0%	1.3%	4.1%	1.2%	1.2%
Philippines	2.7%	2.0%	3.5%	1.5%	1.4%						
Laos	5.2%	6.8%	3.7%	7.2%	6.1%						
Indonesia	3.9%	3.2%	4.8%	2.9%	2.8%						
Singapore	2.1%	2.1%	2.8%	1.7%	1.8%						
China	2.1%	1.5%	2.8%	1.5%	1.5%						
Japan	2.5%	2.1%	2.9%	2.1%	1.9%						
Korea	2.6%	2.1%	4.1%	1.9%	1.9%						
Hong Kong	1.3%	1.0%	2.5%	1.0%	1.2%						

(3) $EMP3 = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{IR_t - IR_{t-1}}{M_{t-1}/e_{t-1}}$

	From 2000	From 2010	2007~ 2009	2013~ 2017	2015~ 2017		From 2000	From 2010	2007~ 2009	2013~ 2017	2015~ 2017
Thailand	6.8%	7.1%	10.4%	5.8%	6.5%	U.K.	1.7%	1.6%	2.2%	1.5%	1.6%
Myanmar	1.5%	2.3%	1.0%	2.8%	2.1%	Switzerland	2.7%	3.2%	2.5%	2.4%	2.7%
Malaysia	8.8%	6.6%	14.7%	5.3%	5.0%	Canada	1.5%	1.4%	2.3%	1.5%	1.9%
Cambodia	3.3%	3.0%	4.8%	3.3%	3.0%	Euro	1.9%	1.7%	2.3%	1.4%	1.6%
Vietnam	2.5%	2.3%	3.9%	1.9%	1.7%	Australia	2.9%	2.4%	4.3%	2.5%	2.3%
Brunei	5.1%	7.7%	3.9%	7.4%	8.4%	U.S.	0.1%	0.1%	0.2%	0.1%	0.0%
Philippines	3.9%	3.2%	4.7%	1.9%	1.7%						
Laos	7.7%	5.6%	6.0%	5.6%	5.4%						
Indonesia	4.5%	3.9%	5.2%	3.3%	3.3%						
Singapore	5.2%	3.9%	7.1%	2.6%	2.8%						
China	1.3%	1.1%	2.3%	1.0%	1.1%						
Japan	1.9%	1.8%	2.3%	1.9%	1.7%						
Korea	2.3%	1.9%	3.8%	1.7%	1.8%						
Hong Kong	3.2%	1.8%	7.1%	1.9%	2.0%						

(4) $EMP4 = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{IR_t - IR_{t-1}}{M_{t-1}/e_{t-1}} - (i_t - i_{t-1})$

	From 2000	From 2010	2007~ 2009	2013~ 2017	2015~ 2017		From 2000	From 2010	2007~ 2009	2013~ 2017	2015~ 2017
Thailand	6.8%	7.1%	10.3%	5.8%	6.5%	U.K.	1.8%	1.6%	2.4%	1.6%	1.6%
Myanmar	1.6%	2.3%	1.0%	2.8%	2.1%	Switzerland	2.7%	3.2%	2.6%	2.4%	2.8%
Malaysia	8.8%	6.6%	14.8%	5.3%	5.0%	Canada	1.6%	1.4%	2.4%	1.5%	1.9%
Cambodia	3.3%	2.9%	4.8%	3.3%	3.0%	Euro	1.9%	1.7%	2.3%	1.4%	1.6%
Vietnam	2.6%	2.5%	3.8%	2.3%	1.8%	Australia	3.0%	2.4%	4.4%	2.5%	2.3%
Brunei	5.6%	7.7%	3.9%	7.4%	8.3%	U.S.	0.1%	0.1%	0.3%	0.1%	0.1%
Philippines	3.9%	3.2%	4.7%	1.9%	1.7%						
Laos	7.7%	5.6%	6.0%	5.7%	5.4%						
Indonesia	4.5%	3.9%	5.2%	3.2%	3.3%						
Singapore	5.2%	3.9%	7.1%	2.6%	2.8%						
China	1.4%	1.2%	2.3%	1.1%	1.1%						
Japan	1.9%	1.8%	2.3%	1.9%	1.7%						
Korea	2.3%	1.9%	3.8%	1.7%	1.8%						
Hong Kong	3.2%	1.8%	7.1%	1.9%	2.1%						

The results based on the second index are similar to the first index. For all sub-periods, the numbers for the currencies of most ASEAN+3 members are not greater than those numbers of five international currencies. However, results based on the third and fourth indices are somewhat different in that fewer regional currencies have the numbers not greater than those numbers of the five international currencies.

On the basis of the third index, for countries with five better known international reserve currencies (U.K., Switzerland, Canada, E.U. and Japan), the average of the absolute value of the exchange market index ranges from 1.5 percent to 2.7 percent and from 1.4

percent to 3.2 percent for 2000 to 2017 and 2010 to 2017 respectively. Among ASEAN+3 members, five (Myanmar, Vietnam, China, Japan and Korea) have an average value that is not greater than those numbers. From 2007 to 2009, the average of absolute value of the exchange market index ranged from 2.2 percent to 2.5 percent in the U.K., Switzerland, Canada, E.U. and Japan. China and Japan have an average value that is smaller those numbers. Korea, Brunei and Vietnam show 3.8 percent to 3.9 percent, which is larger than those numbers but still smaller than the number for Australia (4.3 percent), which also has a popular international currency. The figure ranges from 1.4 percent to 2.4 percent and from 1.6 percent to 2.8 percent from 2013 to 2017 and from 2015 to 2017 respectively, in countries with five well-known reserve currencies. Among ASEAN+3 members, six members (Vietnam, the Philippines, China, Japan, Hong Kong and Korea) show an average value that is not greater than those numbers.

When we consider periods after 2010 (2010 to 2017, 2013 to 2017 and 2015 to 2017), China, Korea, and Japan have numbers smaller than 2 percent, which are similar to the numbers for the U.K., Canada, and E.U. In addition, the numbers are smaller than those for Switzerland and Australia. Myanmar, Vietnam and Hong Kong also have numbers of about 2 percent, which is not clearly larger than those for Switzerland and Australia.

The results based on the fourth index are similar to those based on the third index. The results based on the third and fourth indices suggest that currencies of at least four members (China, Japan, Korea and Vietnam) are as stable as popular non-U.S. international currencies for various sub-periods, including global financial crisis and recent periods of U.S. interest rate rise. In addition, currencies of members such as Myanmar, Brunei, the Philippines and Hong Kong tend to be as stable as popular non-U.S. international currencies at least for certain sub-periods. As we obtained more positive results based on the first two indices, these results can be regarded as conservative conclusions based on all these indices.

Finally, we review the results based on various exchange market

pressure indices. The most conservative results are based on the third and fourth indices, which are summarized as follows. Several currencies of ASEAN+3 members (China, Japan, Korea, and Vietnam) are as stable as popular non-U.S. international currencies for various sub-periods. In recent years, the currencies of China, Japan and Korea have been as stable as those of the U.K., Canada and the Eurozone, and even more stable than those of Australia and Switzerland. In recent years, currencies of other members such as Myanmar, Vietnam and Hong Kong are also as stable as those of Australia and Switzerland.

2.5.2. Internationalization and Capital Controls

In addition to the stability of the currency, several other features such as internationalization of the currency and liberalization of capital account transactions are important to implement local currency contributions to CMIM arrangements. When currencies are more internationalized and members have more liberalized capital accounts, receiving members are likely to feel more comfortable receiving such currencies given that the management and exchange of such currencies are easier. In this regard, we discuss the degree of internationalization of each currency and the degree of capital controls in each member.

We report three popular measures of currency internationalization in Table 2.12. First, we consider the extent to which each currency is used in official foreign exchange reserves. The proportion of each currency in total international reserves globally is reported. Second, we consider the amount of international debt securities outstanding denominated in each currency. We report the proportions of international debt securities that are outstanding denominated in each currency in total international debt securities of the world. Then, we consider the size of turnover for each currency. The proportion of the size of turnover for each currency in the size of total turnover in foreign exchange market around the world is reported. These three measures are suggested in an IMF Staff

Discussion Note by Maziad et al. (2011). Maziad et al. (2011) discussed "common measures of international use of a currency include a currency's use as an international reserve asset; its use in invoicing and settlement of international transactions; and trading volumes in foreign exchange markets". We report these three measures for certain ASEAN+3 members and countries with popular international currencies for comparison. We report the number for 2010 (or 2014) and 2017 (or 2016).

Table 2.12: Various Measures of Currency Internationalization (Proportion, %)

	Official foreign exchange reserves		International debt securities outstanding		Foreign exchange market turnover	
	2014	2017	2010	2017	2010	2016
U.S. Dollars	63.67	62.72	31.66	45.07	84.86	87.58
Euros	21.03	20.15	46.93	39.20	39.04	31.39
Pounds sterling	4.07	4.54	9.87	8.27	12.88	12.80
Australian dollar	2.11	1.80	1.43	1.19	7.59	6.87
Canadian dollar	1.99	2.02	1.53	0.59	5.28	5.14
Swiss franc	0.23	0.18	1.97	0.88	6.30	4.80
Chinese renminbi	1.11	1.22	0.08	0.43	0.86	3.99
Hong Kong dollar	...	...	0.33	0.37	2.37	1.73
Japanese yen	3.45	4.89	3.70	1.80	18.99	21.62
Korean won	...	...	0.01	0.00	1.52	1.65
Indonesian rupiah	...	...	0.03	0.06	0.15	0.20
Malaysian ringgit	...	...	0.03	0.01	0.28	0.36
Philippine peso	...	...	0.01	0.01	0.17	0.14
Singapore dollar	0.06	...	0.15	0.18	1.42	1.81
Thailand baht	...	...	0.01	0.02	0.19	0.36

Note: "..." indicates that data are not available. Each foreign exchange transaction involves two currencies and the total share of all currencies in foreign exchange market turnover is 200 percent.

Source: IMF COFER (for 2017) and IMF survey on the holdings of currencies in official foreign currency assets (for 2014); BIS Quarterly Review; and BIS Triennial Central Bank Survey, Net-net basis, daily average in April, in percent

The Japanese yen is clearly one of the most popular international currencies in the world, following the U.S. dollar and the euro, based on all three criteria. In 2016 or 2017, it was third in the world in terms of its share in global international reserves and in foreign exchange market turnover. Its share in international debt securities outstanding is fourth in the world, meanwhile. On the other hand, the RMB appears to be close to the level of minor international currencies such as the Swiss franc. The RMB is seventh in the world in terms of its share in global international reserves, just above the Swiss franc. Its share of international debt securities outstanding is below

the other seven popular international currencies in foreign exchange market turnover rate is slightly lower than the Swiss franc and Canadian dollar. Among other local currencies, the Hong Kong dollar has a relatively high share in international debt securities outstanding, albeit slightly lower than that of China; and it enjoys a higher of foreign exchange market turnover than other ASEAN+3 members' currencies. The Singapore dollar and Korean won have relatively high shares in foreign exchange market turnover.

Table 2.13 reports the capital control measures constructed by Fernandez, Klein, Schindler, and Uribe (2016) for ASEAN+3 members and countries with popular international currencies. The measure of overall restrictions, inflow restrictions and outflow restrictions are reported. The number is between 0 and 1. A higher number implies stronger restrictions. We report the measure for ASEAN+3 members and countries with popular international currencies. We consider Germany as a representative country from the euro area.

Table 2.13: Capital Control Measure
(Fernandez, Klein, Schindler, and Uribe, 2016)

	Overall restrictions	Inflow restrictions	Outflow restrictions
US	0.13	0.10	0.15
Germany	0.30	0.10	0.50
UK	0.05	0.10	0.00
Switzerland	0.35	0.15	0.55
Canada	0.05	0.10	0.00
Australia	0.18	0.30	0.05
Brunei	0.05	0.10	0.00
Cambodia	...	...	...
Indonesia	0.63	0.65	0.60
Lao P.D.R.	...	...	...
Malaysia	0.88	0.80	0.95
Myanmar	0.90	0.90	0.90
Philippines	0.88	0.75	1.00
Singapore	0.13	0.10	0.15
Thailand	0.73	0.70	0.75
Vietnam	0.88	0.85	0.90
China	0.80	0.80	0.80
Hong Kong	0.05	0.10	0.00
Japan	0.00	0.00	0.00
Korea	0.15	0.15	0.15

For the six countries with popular international currencies, the number of overall restrictions ranges from 0.05 to 0.35. Members

such as Brunei, Singapore, Hong Kong, Japan and Korea have similar numbers but others such as Indonesia, Malaysia, Myanmar, the Philippines, Thailand, Vietnam and China have higher numbers, ranging from 0.63 to 0.90. The two Asian countries with the most popular currencies have very different numbers. Japan has the lowest number of 0, showing the lowest degree of capital controls, while China's number stands at 0.80, suggesting a high degree of capital controls.

In sum, the Japanese yen is one of the most popular international currencies in the world with a liberalized capital account. On the other hand, the RMB's internationalization is at about the same level as for the Swiss franc, but a high degree of capital controls is still in place in China. The Singapore dollar, Hong Kong dollar and Korean won are next in terms of their level of internationalization, and the degree of capital controls in these economies is low.

Finally, the results relating to currency stability, internationalization of the currency and liberalization of capital account transactions indicate that the Japanese yen, the RMB and the Korean won could be considered first as being eligible for local currency contribution to CMIM.

2.6. Concluding Remarks

This study investigates the plausibility of local currency contribution to Chiang Mai Initiative Multilateralization (CMIM) arrangements. The results are summarized as follows.

First, receiving members would need local currencies to settle trade or finance matters when faced with balance of payments and/or short-term liquidity difficulties, considering the estimated size of (net) demand for local currencies in foreign exchange reserves/CMIM. The demand for local currencies in foreign exchange reserves is inferred by combining the demand for foreign exchange reserves and information on local currency usage in the region. The results show that there exists substantial demand for local currencies in foreign exchange reserves. We further calculated the net demand

for local currencies in CMIM arrangements by subtracting estimated actual foreign exchange reserves from the estimated demand for foreign exchange reserves. The results show that net demand for local currency in CMIM tends to be positive, which further suggest room for introducing local currency contribution to CMIM arrangements. These results may imply that some potential benefits can be achieved but some potential costs can be reduced by introducing local currency contribution to the CMIM.

Results on the stability of local currencies also tend to support local currency contribution to the CMIM arrangements. We calculated the exchange market pressure index. Some conservative results indicate that the currencies of several ASEAN+3 members (China, Japan, Korea, and Vietnam) are as stable as popular non-U.S. international currencies for various sub-periods. In recent years, the currencies of China, Japan and Korea have been as stable as those of the U.K., Canada and the E.U., and even more stable than those of Australia and Switzerland while the currencies of other members such as Myanmar, Vietnam and Hong Kong, have also been as stable as those of Australia and Switzerland.

In addition, we investigate the internationalization of a currency and the liberalization of capital account transactions because they are important in implementing local currency contributions to CMIM arrangements. The Japanese yen is one of the most popular international currencies in the world with liberalized capital accounts. The level of internationalization of the RMB is at about the same level as the Swiss franc, but China still has a high degree of capital controls in place. The Singapore dollar, Hong Kong dollar and Korean won are next in terms of level of internationalization, and the degree of capital controls in these economies is low.

Finally, the results on currency internationalization and liberalization of capital account transactions in addition to the results relating to currency stability indicate that the Japanese yen, RMB and the Korean won could first be considered as eligible for local currency contribution to the CMIM arrangements.

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Appendix

(1) Chiang Mai Initiative Multilateralization (CMIM)*

* Based on AMRO web page(https://www.amro-asia.org/about-amro/amro-and-the-cmim/)

Chiang Mai Initiative Multilateralization (CMIM) is a Regional Financial Arrangement (RFA) for the ASEAN + 3. RFAs are mechanisms or agreements through which groups of countries mutually pledge financial support to countries experiencing financial difficulties in their regions.

In May 2000, The Chiang Mai Initiative (CMI) is launched by the ASEAN+3 countries as a regional currency swap arrangement to address the short-term liquidity difficulties in the region and to supplement the existing international financial arrangements. CMI is composed of: (a) the ASEAN Swap Arrangement (ASA) among ASEAN countries, and (b) a network of bilateral swap arrangements (BSAs) among the ASEAN+3 countries.

CMIM was Established on 28 December 2009 and came into effect on 24 March 2010 with a total size of USD 120 billion drawing from a foreign exchange reserves pool. The CMIM is a multilateral currency swap arrangement among the ten members, governed by a single contractual agreement, while the CMI is a network of bilateral swap arrangements among the "Plus Three" and ASEAN-5 4 countries' authorities. The core objectives of the CMIM are (i) to address balance-of-payments and short-term liquidity difficulties in the region and (ii) to supplement the existing international financial arrangements.

The amended CMIM came into effect on 17 July 2014. The amendment aims to strengthen the CMIM through the following: (i) to double its total size of USD 240 billion from USD 120 billion, (ii) to introduce CMIM Precautionary Line, and (iii) to increase the IMF de-linked portion from 20% to 30%.

On 23 June 2020, another amendment came into effect. This amendment aims (i) to create more flexibilities for the financing period of the IMF Linked Portion of the CMIM to secure consistency

with the IMF-supported programs and strengthen coordination mechanism with the IMF; (ii) to introduce an overarching legal basis for conditionality in order for the CMIM to support members in addressing their risks and vulnerabilities through policy recommendations as well as financial support; and (iii) To address other legal ambiguity issues.

(2) Literature On Demand for Foreign Exchange Reserves

Past studies have investigated demand for foreign exchange reserves, foreign exchange reserve adequacy, or optimal level of foreign exchange reserves. During the Bretton Woods period, the main role of foreign exchange reserves was as a buffer against real external shocks, such as export drops. Exchange rates were fixed, and international financial market integration was limited; thus, such shocks had more important effects than financial shocks. For instance, past studies suggested a simple rule of three months of imports as a guideline for an adequate level of foreign exchange reserves. In addition to such a simple rule, academic studies (such as Heller, 1966) analyzed the optimal level of foreign exchange reserves based on cost-benefit analysis. Although using the results of these studies in recent years has been difficult, basic ideas from these studies, such as cost-benefit analysis and dependency of foreign exchange reserve demand on country characteristics, are still considered essential elements for foreign exchange reserve demand.

The Tequila and Asian crises of the 1990s suggest that preparation for external financial shocks in addition to external real shocks is crucial. Since then, the precautionary role of foreign exchange reserves as a buffer against abrupt capital outflows has been emphasized. For instance, the Greenspan-Guiddoti rule (100 percent of short-term debt) has been suggested in such a context. In addition, many formal studies on the optimal level of foreign exchange reserves were conducted based on various theoretical models. Ben-Bassat and Gottlieb(1992) studies optimal precautionary reserves for a borrowing country. Flood and Marion(2002) find buffer stock model has little explanation power on reserve holdings, while exchange rate stability matters. In addition, some studies argue emerging markets have excessive exchange rate reserve(Edison, 2003) and try to give reasons such as export promotion(Dooley, Folkerts-Landau, and Garber, 2003), higher crisis risk, loss aversion and/or higher fiscal liabilities(Aizenman and Marion, 2003), financial integration and crises(Aizenman and Lee,

2007). Meanwhile, some literatures focus on change of motivation to hold reserves. Cheung and Ito(2009) shows that greater importance for financial factors and lesser importance for trade factors over time to explain reserve holding. Obstfeld, Shambaugh, and Taylor(2010) argues that deeper financial integration and domestic financial depth, and the fear of floating explain exchange rate reserve patterns.

After the Global Financial Crisis, more studies have discussed that foreign exchange reserve adequacy depends on country characteristics, such as economic development. Cheung and Qian(2009) shows that there exists keeping up with the Joneses effect in reserve holding. Cheung and Ito(2009) reveals a developed economy tends to hold less reserve than developing economy. Calvo, Izquierdo, and Loo-Kung(2012) shows that differences in reserves across regions and argues that they are partly explained by the perceived presence of a lender of last resort, or characteristics such as being a large oil producer.

The IMF (2011) reviewed existing approaches to reserve adequacy and developed some new measures. It summarized the traditional measures as follows: import cover, short-term debt, broad money, GDP and current account. The first is the size of imports that can be sustained for a period, such as three months of imports. That is, a country must pay reserve currencies for imports with foreign exchange reserves when other sources are unavailable. The second is the measure of the size of short-term debt – for example, 100 percent of short-term debt in the Greenspan-Guiddoti rule. This means a country needs foreign exchange reserves to pay off short-term debts in a short period when short-term debts cannot be rolled-over and other sources are unavailable. The third is a fraction of broad money, such as M2 – for example, 20 percent of M2. During a capital account crisis, the capital outflows of domestic deposits of residents are observed. This measure captures the risks of capital flight. The last is GDP – it is sometimes used, but no theoretical or empirical backing is available. GDP may be used as a scale factor in cross-country analysis. Finally, current account deficits (surpluses) imply that foreign exchange reserves are

required (provided) if other sources are unavailable. For instance, an extension of the Greenspan-Guidotti rule is the size of short-term debt plus the current account deficit (if it is in deficit). IMF (2011) also mentioned a modified rule that considered the size of short-term debt minus the current account.

In addition to these traditional measures, IMF (2011) suggested other measures that encompass a broad set of risks based on recent experience as follows: export earnings and medium- and long-term debt and equity liabilities. Export earnings reflect the potential loss that could arise from a drop in external demand or terms of trade shock. External liability stocks, such as medium- and long-term debt and equities other than short-term debt, can be considered. Although short-term debt would be riskier, the sudden outflows of other external liabilities can lead to exchange rate depreciation and volatility in foreign exchange and financial markets. In addition, even FDI liabilities can be a source of drain, as observed in recent years.

Table 2.14: Standard Deviation of Exchange Market Index

(1) $\boldsymbol{EMP1} = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{IR_t - IR_{t-1}}{IR_{t-1}}$

	From 2000	From 2010	2007 ~2009	2013 ~2017	2015 ~2017		From 2000	From 2010	2007 ~2009	2013 ~2017	2015 ~2017
Thailand	3.1%	2.9%	3.8%	2.7%	2.8%	U.K.	4.8%	3.5%	7.8%	3.6%	4.0%
Myanmar	10.2%	7.2%	11.8%	8.7%	5.6%	Switzerland	7.3%	7.8%	9.1%	3.0%	3.2%
Malaysia	3.7%	3.8%	4.8%	3.7%	3.9%	Canada	3.4%	2.6%	5.6%	2.4%	2.6%
Cambodia	2.8%	2.7%	3.6%	3.0%	1.5%	Euro	3.9%	2.8%	6.5%	2.5%	2.8%
Vietnam	5.0%	5.6%	5.5%	4.8%	4.4%	Australia	9.8%	9.9%	12.0%	10.8%	11.7%
Brunei	7.6%	9.2%	8.1%	6.2%	7.0%	U.S.	4.8%	1.7%	10.5%	1.5%	1.6%
Philippines	3.5%	2.8%	3.8%	1.9%	1.8%						
Laos	7.3%	9.2%	4.7%	9.2%	8.0%						
Indonesia	5.1%	4.1%	6.3%	3.5%	3.5%						
Singapore	2.6%	2.6%	3.3%	2.0%	2.2%						
China	2.1%	1.9%	1.7%	1.8%	1.9%						
Japan	3.4%	2.9%	3.3%	2.8%	2.6%						
Korea	3.7%	2.6%	6.8%	2.3%	2.4%						
Hong Kong	1.8%	1.3%	3.0%	1.4%	1.5%						

(2) $\boldsymbol{EMP2} = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{IR_t - IR_{t-1}}{IR_{t-1}} + (i_t - i_{t-1})$

	From 2000	From 2010	2007 ~2009	2013 ~2017	2015 ~2017		From 2000	From 2010	2007 ~2009	2013 ~2017	2015 ~2017
Thailand	3.1%	2.9%	3.9%	2.7%	2.8%	U.K.	4.8%	3.5%	7.7%	3.6%	4.0%
Myanmar	10.2%	7.2%	11.8%	8.7%	5.6%	Switzerland	7.4%	7.8%	9.0%	3.0%	3.3%
Malaysia	3.7%	3.8%	4.8%	3.7%	3.9%	Canada	3.4%	2.6%	5.5%	2.4%	2.6%
Cambodia	2.9%	2.7%	3.7%	3.0%	1.5%	Euro	3.9%	2.8%	6.4%	2.5%	2.8%
Vietnam	5.3%	5.9%	6.0%	4.9%	4.7%	Australia	9.8%	9.9%	12.0%	10.8%	11.7%
Brunei	8.1%	9.2%	8.1%	6.2%	7.0%	U.S.	4.8%	1.7%	10.5%	1.5%	1.6%
Philippines	3.6%	2.8%	3.9%	1.9%	1.8%						
Laos	7.3%	9.2%	4.7%	9.2%	7.9%						
Indonesia	5.2%	4.1%	6.4%	3.6%	3.6%						
Singapore	2.6%	2.6%	3.3%	2.0%	2.1%						
China	2.1%	2.1%	1.7%	2.0%	2.0%						
Japan	3.4%	2.9%	3.3%	2.8%	2.6%						
Korea	3.7%	2.6%	6.7%	2.3%	2.4%						
Hong Kong	1.8%	1.3%	3.0%	1.4%	1.5%						

(3) $\boldsymbol{EMP3} = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{IR_t - IR_{t-1}}{M_{t-1}/e_{t-1}}$

	From 2000	From 2010	2007 ~2009	2013 ~2017	2015 ~2017		From 2000	From 2010	2007 ~2009	2013 ~2017	2015 ~2017
Thailand	8.6%	8.9%	11.4%	7.3%	7.7%	U.K.	2.3%	2.1%	3.2%	2.1%	2.3%
Myanmar	3.6%	5.1%	1.3%	6.3%	3.1%	Switzerland	3.7%	4.3%	3.2%	2.9%	3.2%
Malaysia	13.6%	11.9%	21.2%	7.8%	7.5%	Canada	2.1%	1.8%	3.3%	1.9%	2.3%
Cambodia	3.9%	3.4%	5.2%	3.8%	2.1%	Euro	2.4%	2.2%	3.0%	1.9%	2.1%
Vietnam	3.3%	3.2%	4.9%	2.8%	2.4%	Australia	3.8%	3.0%	5.8%	3.1%	3.0%
Brunei	8.7%	11.6%	6.3%	9.2%	10.3%	U.S.	0.2%	0.1%	0.5%	0.1%	0.1%
Philippines	5.4%	5.0%	5.1%	2.6%	2.2%						
Laos	10.9%	7.2%	7.9%	7.1%	6.9%						
Indonesia	6.1%	5.1%	6.8%	4.1%	4.2%						
Singapore	6.5%	5.0%	8.0%	3.2%	3.3%						
China	1.4%	1.5%	1.4%	1.4%	1.4%						
Japan	2.5%	2.4%	2.9%	2.6%	2.3%						
Korea	3.4%	2.4%	6.3%	2.1%	2.2%						
Hong Kong	5.0%	2.4%	8.8%	2.6%	2.7%						

(4) $\boldsymbol{EMP4} = \frac{e_t - e_{t-1}}{e_{t-1}} - \frac{IR_t - IR_{t-1}}{M_{t-1}/e_{t-1}} - (i_t - i_{t-1})$

	From 2000	From 2010	2007 ~2009	2013 ~2017	2015 ~2017		From 2000	From 2010	2007 ~2009	2013 ~2017	2015 ~2017
Thailand	8.6%	8.9%	11.2%	7.2%	7.6%	U.K.	2.4%	2.1%	3.4%	2.1%	2.3%
Myanmar	3.6%	5.1%	1.3%	6.3%	3.1%	Switzerland	3.7%	4.3%	3.3%	2.9%	3.3%
Malaysia	13.6%	11.8%	20.9%	7.8%	7.3%	Canada	2.1%	1.8%	3.4%	1.9%	2.3%
Cambodia	4.0%	3.4%	5.2%	3.8%	2.1%	Euro	2.5%	2.2%	3.0%	1.9%	2.1%
Vietnam	3.4%	3.3%	4.8%	3.1%	2.5%	Australia	3.9%	3.0%	5.8%	3.0%	2.9%
Brunei	9.3%	11.5%	6.2%	9.1%	10.1%	U.S.	0.3%	0.1%	0.5%	0.1%	0.1%
Philippines	5.4%	5.0%	4.9%	2.6%	2.2%						
Laos	11.0%	7.2%	7.8%	7.1%	6.8%						
Indonesia	6.0%	5.0%	6.7%	4.0%	4.1%						
Singapore	6.5%	5.0%	7.9%	3.2%	3.3%						
China	1.5%	1.6%	1.5%	1.4%	1.4%						
Japan	2.5%	2.4%	2.8%	2.5%	2.2%						
Korea	3.4%	2.4%	6.3%	2.1%	2.2%						
Hong Kong	5.0%	2.4%	8.7%	2.6%	2.7%						

3. 국가별 특징이 통화정책의 환율경로에 미치는 영향

3.1. 서 론

본 연구에서는 통화정책이 명목환율에 미치는 영향이 국가별 특징에 따라 어떻게 변하는지를 살펴보았다. 통화정책은 Boivion et al.(2010)이 정리하였듯이 다양한 전달경로를 가진다. 이자율, 주가, 환율 등의 가격 변수를 변화시켜 궁극적으로 인플레이션이나 경제성장에 영향을 미치는 경로가 있는가 하면 신용공급과 같은 수량 변수의 변화를 통해 궁극적 목적에 도달하는 경로도 존재한다. 이 중에서 환율경로는 통화정책이 명목환율에 영향을 끼침에 따라 실질환율이나 수입가격의 변화, 기업 경쟁력 변화에 따른 마크업(mark-up) 가격 변화 등을 초래하여 생산과 물가에 영향을 미치는 경로를 의미하며, 그 시작이 되는 것이 바로 통화정책에 따른 환율의 변화이다. 여기서는 통화정책의 환율경로 중에서도 통화정책이 명목환율에 미치는 영향이 국가별 특징에 따라 어떻게 달라지는지 살펴보고자 한다.

통화정책이 환율에 미치는 영향에 대한 이론적 연구로는 국내외 이자율 차이로 환율 변동을 설명하는 유위험 이자율 평형이론(Uncovered Interest Parity; UIP)이나 이를 기반으로 하는 Dornbusch(1976)의 오버슈팅 이론 등을 들 수 있다. UIP에 따르면 국내 금리가 해외 금리에 비해 높은 경우 환율은 절상하게 된다. 또 오버슈팅 이론에 따르면 환율은 단기에 UIP가 예측하는 것보다 더 절상(오버슈팅)하였다가 정상수준으로 돌아오게 된다. 그러나 실증 연구에서는 이론적 예측과는 다른 결과들이 다수 제시되었다. 본 논문과 같이 벡터자기회귀(Vector autoregressive; VAR) 분석을 사용한 연구들의 결과를 개관해 보면, Sims (1980)가 제안한 축차적인 VAR(recursive VAR) 모형을 사용한 Eichenbaum and Evans (1995)의 연구에서 지연된 오버슈팅(delayed overshooting)과 UIP 조건 위배가 발견되었다. 이후 다른 식별 방법을 사용한 Kim and Roubini (2000)와 Faust and Rogers (2003)에서는 지연된 오버슈팅이나 UIP 조건 위배가

약하거나 확실하지 않은 것으로 나타났으나 부호 제약을 사용한 Scholl and Uhlig (2008)는 다시 지연된 오버슈팅과 UIP 조건 위배를 강하게 시사하는 결과를 제시하였다.

한편 통화정책과 관계없이 UIP 조건이 충족되는지를 실증적으로 살펴본 일군의 논문들도 있는데 그 중 다수는 UIP 조건이 위배된다는 결론을 보이고 있다. 환율 변화율을 내외금리차에 회귀분석하는 소위 Fama 회귀식을 추정하는 경우 UIP의 예측에 따르면 그 계수는 1이 되어야 하지만 이전의 실증분석 논문들을 정리한 Froot and Thaler (1990)은 평균적인 계수 추정치가 −0.88로 UIP 조건이 성립하지 않는다고 보고하였다. 이후 장기적인 시계에서는 UIP 조건이 좀 더 성립한다는 Chinn and Meredith (2004)의 논문도 있었으나 적어도 단기에서는 대부분의 국가에서 UIP 조건이 위배되고 있는 것으로 보인다. 우리나라의 경우도 박찬호·김아름 (2008) 등이 UIP 조건이 성립하지 않음을 보였다.

그런데 이론적 예측과 부합하지 않는 실증 분석 결과들은 일부 국가별 특성에 기인할 수도 있다. 가령 Kim and Lim (2018, 2021)은 소규모 개방경제에 대한 분석을 통해 소규모 개방경제나 선진경제 여부 등의 특성이 통화정책의 환율에 대한 영향에 차이를 발생시킴을 보였으며, Ito & Chinn (2007)은 회귀분석을 통해 다양한 국가별 특성에 따라 UIP 조건의 위배 정도가 달라짐을 보였다.

본 연구에서는 선행연구들이 시사하는 바와 같이 국가별 특성이 통화정책의 환율에 대한 효과에 차이를 발생시킬 것으로 보고 Miniane & Rogers (2007)가 제안한 2단계 방법론을 사용하여 이를 분석하였다. 패널 VAR이나 특성별로 그룹을 나누어 분석 결과를 비교하는 방법을 사용할 수도 있었으나 이 경우 한 번에 하나의 변수만 고려할 수 있어 다양한 변수를 한 번에 분석할 수 없고 변수 간 상관관계에 따른 왜곡도 해소하기 힘들다. 반면에 2단계 방법론은 1단계에서 각 국가의 충격반응함수를 추정한 후 이를 통해 도출한 관심 변수 – 본 연구에서는 긴축 통화 충격에 따른 환율의 변화 정도 – 를 2단계에서 국가별 특성 변수에 회귀분석함으로써 다양한 국가별 특성이 통화정책의 환율에 대한 영향을 어떻게 변화시키는지 분석할 수

있었다.

자료가 가용한 34개 국가에 대해 Scholl and Uhlig (2008)를 원용한 부호제약 VAR 모형을 통해 통화정책이 환율에 미치는 영향을 추정하였으며, 이 추정 결과가 금융발전 정도나 자본시장 개방도, 무역개방도, 환율 제도 유연성, 경제 규모 및 선진경제 여부에 영향을 받음을 다중회귀분석을 통해 보였다.

3.2에서는 실증분석에 사용한 자료와 실증분석 방법을 설명하였다. 3.3에서는 실증분석 결과를 제시하였으며 3.4에서는 추가적인 분석을 통해 모형의 강건성을 확인하고자 하였다. 3.5에서는 분석 결과를 요약하면서 논문의 결론을 제시하였다.

3.2. 연구방법론 및 데이터

본 논문은 다음에 설명할 변수들의 월별 자료가 최소한 10년치 이상 확보되는 34개 국가[⑧]를 대상으로 하였으며 각 자료의 기간은 국가마다 다르고 1982년 1월부터 2019년 1월 사이에 있다. 연구방법론은 Miniane & Rogers (2007)의 두 단계 추정방법을 따랐다. 먼저 개별 국가에 대해 통화정책에 대한 환율의 반응을 VAR모형을 통해 추정(1단계)한 뒤에 그 반응을 축약한 변수를 국가별 특성 지표에 다중회귀분석(2단계)하였다.

모형에 사용된 변수는 외생변수로 미국 산업생산지수와 소비자물가, 연방기금실효금리(effective federal funds rate)의 3가지, 내생변수로 각국의 산업생산지수와 소비자물가, 시중금리(money market rate),

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⑧ Bangladesh, Bulgaria, Brazil, Canada, Chile, Colombia, Costa Rica, Czech Republic, Denmark, United Kingdom, *Croatia*, Hungary, Indonesia, India, Iceland, *Jordan*, Japan, Korea, Latvia, Mexico, *Mongolia*, Malaysia, Norway, Pakistan, Peru, Philippines, Poland, Romania, Russia, Sweden, Tunisia, Turkey, Ukraine, South Africa
여기서 이탤릭체는 CAP2가 없는 국가

외환보유고, 본원통화(monetary base), 대미환율의 6가지를 사용하였다. 분석 대상이 되는 국가들이 대부분 소규모 개방경제의 특성을 지니고 있기 때문에 Kim and Lim (2018, 2021)과 같이 국제경제상황의 대용지표로 3가지 외생변수를 추가하였으며 통화정책 충격의 식별과 그 환율에 대한 영향을 살펴보기 위해 내생변수들을 설정하였다.

[외생변수]

미국 산업생산지수	: log × 100
미국 소비자물가지수	: log × 100
연방기금실효금리	: %, 연율

[내생변수]

산업생산지수	: log × 100
소비자물가지수	: log × 100
시중금리	: %, 연율
외환보유고	: log × 100
본원통화	: log × 100
대미환율	: log × 100, 지역통화/미 달러화

Scholl and Uhlig (2008)을 따라 내생변수의 시차는 6, 외생변수의 시차는 0으로 두고 상수항과 추세항은 포함하지 않았다. 이자율 변수를 제외하고는 로그값에 100을 곱한 값을 사용하였으며 이자율 변수는 연율(%)을 사용하였다.

한편 통화정책 충격은 Uhlig (2005)와 Scholl & Uhlig (2008)을 따라 부호제약(sign restriction)을 통하여 식별하였다. 통화충격은 물가지표에 대해서 1년간 음의 효과를, 본원통화에 대해서도 1년간 음의 효과를, 시중금리에 대해서는 1년간 양의 효과를 나타내는 것으로 설정하였다.

모형의 계수에 대한 사전분포는 정보가 없는 정규확률분포-역위샤트분포로 가정하였으며 추정 결과를 통해 추정한 우도함수(likelihood function)와 결합하여 사후분포를 도출하였다. 이 후 각 국의 사후분포에서 각각 1,000개의 충격반응함수(impulse response function; IRF)를 추출하였다.

이렇게 추출한 각 국의 IRF는 아래와 같이 통화정책 충격의 환율에 대한

영향을 나타내는 변수(R_RER)로 축약하여 두번째 단계의 분석에서 피설명변수로 활용하였다. 이 때 통화정책 충격이 환율에 미치는 영향이 시간에 따라 달라짐을 고려하여 6개월, 1년, 2년에 대해 변수를 계산하였다.

$$R\_RER \equiv \left(\sum_{k=1}^{K} RER_k\right) / \left(\sum_{k=1}^{K} RMMR_k\right) \qquad (3.1)$$

RER_k은 통화정책 충격에 대한 k기의 환율의 충격반응 값을 나타내며 $RMMR_k$은 통화정책 충격에 대한 k기의 시중금리의 충격반응 값을 나타낸다. 이때 통화정책 충격의 크기가 국가별로 상이하므로 표준화하기 위해 RER_k를 $RMMR_k$로 나눠 주었으며 기간 중 평균적인 반응을 살펴보기 위해 RER_k와 $RMMR_k$의 누적합을 사용하였다.

한편 국가별 특성이 통화정책 충격이 환율에 미치는 영향을 어떻게 변화시키는지 분석하기 위해 식 (3.1)의 R_RER을 피설명변수로 하는 다중회귀분석을 실시하였는데, 설명변수로는 금융발전도(FD), 환율제도 유연성(EXR), 자본시장개방도(CAP), 경제규모(SIZE), 무역개방도(OPEN), 선진경제여부 더미변수(ADV)를 설정하였다. 회귀식은 아래와 같다.

$$\begin{aligned} R\_RER_i = {} & c + b_{FD}FD_i + b_{EXP}EXP_i + b_{CAP}CAP_i + b_{SIZE}SIZE_i \\ & + b_{OPEN}OPEN_i + b_{ADV}ADV_i + u_i \end{aligned} \qquad (3.2)$$

이때 FD는 IMF의 금융발전지표(financial development index)를 사용하였다. 0에서 1사이의 값을 가지며 높을수록 해당 국가의 금융이 발전하였음을 의미한다. 내외 금리차가 커지는 경우라도 금융시장이

발전하지 않은 국가에 자금을 추가적으로 투여하거나 자금을 빼내는 것은 힘들 것이기 때문에 자본이동이 제한되게 되며 따라서 환율의 움직임도 제한될 수 있다는 점을 고려하여 설명변수에 포함하였다.

EXR은 Reinhart and Rogoff (2004)가 제안한 환율유연성 지표를 사용하였다. 이 지표는 1에서 4 사이의 값을 지니며 높은 값일 수록 환율유연성이 높음을 의미한다. 환율제도가 유연할수록 통화정책으로 발생하는 내외금리차에 따른 자본이동이 환율을 더 크게 변화시킬 것으로 짐작된다.

CAP은 Chinn and Ito (2008)가 개발한 자본이동 지표를 사용하였다. 범위는 0에서 1 사이이고 높을수록 자본이동이 자유로움을 나타낸다. 추가적으로 강건성을 확인하기 위해 0에서 1사이의 값을 가지고 자본 규제가 강할수록 커지는 Fernández, Klein, Rebucci, Schindler and Uribe (2016)의 자본이동규제지표(CAP2)도 따로 사용하였다. 이 또한 내외금리차에 따른 자본이동이 얼마나 쉬운지를 예측할 수 있는 지표로서 환율의 변화폭에도 영향을 줄 수 있다.

SIZE는 대상국가들의 달러표시 명목 국내총생산(nominal GDP)이 총합에서 차지하는 비율을 사용하였다. 국제경제의 분석에 있어서 규모는 중요한 변수로서 일반적으로 규모가 큰 국가의 경우 국제경제의 균형에 영향을 미치는 것으로 가정되고 반대로 규모가 작은 국가의 경우 국제경제의 균형에는 영향을 미치지 못하고 이를 그대로 받아들이는 것으로 가정된다. 이 논의를 그대로 가지고 오면, 어떤 국가의 긴축적 통화정책이 국제 이자율에 영향을 미치는지 여부는 그 국가의 규모에 영향을 받게 된다. 즉, 규모가 큰 국가의 경우 긴축적 통화정책으로 국내 금리만 오르는 것이 아니라 국제 금리도 일정 부분 오르게 되므로 같은 크기로 국내 금리를 올리는 통화정책이 각 국에서 시행되었을 때, 규모가 큰 국가의 내외 금리차가 규모가 작은 국가의 경우에 비해 작을 가능성이 크며, 따라서 환율에 대한 영향도 차이 날 수 있다.

OPEN은 무역의 명목 국내생산량 대비 비율을 사용하였다. 경제의 전반적인 개방도를 나타내는 지표로서 위의 변수들에 미쳐 고려되지 못한

개방성에 따른 영향이 있을 경우 이를 파악하고자 포함시켰다.

한편 ADV는 IMF의 기준에 따라 선진경제인 경우 1을, 아닌 경우에는 0을 부여하는 더미변수이다. 선진경제의 경우 가령 규모가 작더라도 국제금융시장에서의 중요도가 더 클 수 있다. 예를 들어 중국의 경제규모는 일본이나 영국 등에 비해 크나 통화의 국제화 정도는 오히려 일본이나 영국이 더 크고 따라서 국제금융시장에서의 영향력이 경제 규모가 시사하는 것보다 더 클 수 있다. 이는 선진경제의 통화정책이 국제금융시장에 미치는 영향이 그렇지 않은 경우보다 상대적으로 더 클 수 있고 따라서 규모에서 살펴본 것처럼 통화정책에 따른 내외금리차 변화가 선진국일 경우 상대적으로 더 작아 환율 변화가 더 작을 가능성을 시사한다.

더미 변수인 ADV를 제외한 이상의 변수들은 2000부터 2012년 사이의 평균값으로 설정하였다.

3.3. 실증분석 결과

표 3.1, 3.2, 3.3에 각각 통화정책 충격 후 6개월, 1년, 2년간의 평균적인 환율 변화(R_RER)를 종속변수로 하는 실증분석 결과를 수록하였다. 이에 따르면 ADV 외 모든 계수들이 6개월과 1년에 유의하게 음의 값을 가지는 것으로 나타났으며 ADV는 FD가 포함되는 모형에서는 모두 6개월과 1년에 유의한 양의 값을 갖는 것으로 나타났다. FD는 2년의 결과에서도 유의하게 음의 값을 가지는 것으로 나타났다.

이 때 추정된 계수가 음의 값을 가진다는 것은 해당 변수가 커지면 통화정책 충격에 반응하는 환율의 값이 작아짐을 의미한다. 이 때 통화정책 충격은 이자율이 높아지는 긴축적 통화정책 충격이며 사용된 대미 환율은 자국통화표시법으로 표기한 것으로 작아질수록 통화가치가 커지므로, 추정된 계수가 음의 방향으로 클수록 해당 변수가 커질 때 긴축적 통화정책 충격에 따라 통화가치가 커지는 정도가 더 커짐을 의미한다.

한편 추정된 계수의 방향은 일반적인 견해나 이론과 대체로 일치한다. FD의 계수는 2년까지 유의하게 음수를 나타내는데, 긴축적 통화정책에 따른

시중금리 상승이 동일한 경우 금융시장이 발전할수록 자본유입을 더 큰 폭으로 불러일으킴으로써 통화가치가 올라가는 것으로 해석할 수 있으며, 금융시장이 발달하여 금융상품이 다양하고 금융시장이 효율적일수록 자본의 해외 유입이나 반출이 자유로울 것이라는 점에서 받아들일 만하다. 또한 이 결과는 금융시장의 발달이 (환율 경로 측면에서) 통화정책의 효과성을 높일 가능성을 시사한다.

EXR과 CAP, OPEN의 계수는 1년까지는 유의하게 음수값을 가지는데, 이는 환율제도가 유연할수록, 자본시장이 자유로울수록, 경제의 개방도가 높을수록 긴축적 통화정책이 환율을 하락시키는, 즉 통화가치를 높이는 정도가 크다는 것을 의미한다. 만약 고정환율제도라면 외환시장이 안정되어 있는 경우 통화정책 충격에도 환율이 변동하지 않을 것이고 변동환율 제도라면 환율이 변할 여지가 크다는 점에서 EXR의 계수가 음수인 것은 타당해 본인다. 또한 자본시장이 규제가 없이 자유로운 경우 내외 금리차가 조금만 있더라도 대량의 자본이 이동할 수 있을 것이고 따라서 환율 변동도 커질 것이라는 점에서 CAP이 음수의 계수를 갖는 것은 일반적인 견해에 부합한다고 하겠다. 한편 표의 마지막 열의 CAP를 CAP2로 대체한 결과에서는 CAP2의 계수가 양의 값으로 추정되었는데, CAP2는 자본시장의 규제를 나타내며 규제가 강할수록 큰 수를 가지므로 CAP과 반대되는 부호를 가지는 결과가 도출되었다. 또한 경제의 전반적인 개방도가 높은 경우 자본이동이 자유로울 것으로 예상할 수 있으므로 OPEN의 계수가 음의 값을 가지는 것도 CAP과 비슷한 이유로 합리적이다.

그런데 SIZE의 계수가 6개월과 1년의 기간에 유의한 음수인 것은 일반적인 견해와 다소 상이한 결과라 할 수 있다. SIZE가 클 수록 해당 국가의 통화정책이 국제금융시장에도 영향을 미칠 가능성이 크며, 따라서 긴축적 통화정책을 시행할 경우 국내금융시장의 금리뿐 아니라 국제금융시장의 금리도 낮아지게 되어 국내외 금리차가 작게 벌어지므로 환율 절상 폭이 작을 것이기 때문이다.

한편 ADV의 계수는 1년까지의 계수가 유의한 양의 값을 지닌다. 이는 경제가 선진화될 수록 긴축적 통화정책이 환율의 절상에 미치는 영향이

작아짐을 의미하는데, 이는 SIZE보다 ADV가 해당 국가의 통화가 국제금융시장에서 차지하는 위상을 더 잘 나타내기 때문일수도 있다. 왜냐하면 선진경제일수록 통화정책이 국내 금리 뿐 아니라 국제 금리에도 영향을 주어 내외금리차가 상대적으로 크지 않기 때문에 환율의 절상에 미치는 영향이 작은 것으로 해석할 수 있기 때문이다.

한편 표 3.1~3의 2번째 열의 기본모형의 강건성과 변수의 중요성 등을 확인하기 위해 3번째 열부터는 변수를 하나씩 뺀 모형을 추정한 결과를 수록하였고 마지막 열에는 CAP대신 CAP2를 사용한 모형의 추정 결과를 보였다. 3번째열에서 확인할 수 있듯 FD를 제외하고 추정할 경우 모형의 적합도를 나타내는 AIC, BIC 등의 결정계수들이 크게 악화되는 것으로 나타났다. 이는 다른 변수들에서는 볼 수 없는 현상으로 FD가 통화정책의 환율 효과를 가장 크게 좌우하는 요인으로 보인다. 또한 다른 변수들을 제외한 경우의 계수 추정치는 기본모형의 계수 추정치와 크게 다르지 않으니 FD를 제외한 경우의 계수 추정치는 특히 EXR과 SIZE, ADV의 계수에서 크게 차이난다. EXR과 SIZE의 경우 FD가 없는 경우 음의 방향으로 더 커지고 ADV의 계수는 양수에서 음수로 바뀌게 되는데, 이는 FD가 EXR, SIZE, ADV가 높은 양의 상관관계⑨를 가지고 있어 FD가 없는 경우 그 효과가 과장되게 추정되었음을 시사한다.

표 3.1 회귀분석 결과(6개월)

	기본 모형	FD 제외	EXR 제외	CAP 제외	SIZE 제외	OPEN 제외	ADV 제외	CAP2

⑨

	EXR	CAP	SIZE	OPEN	ADV	FD	CAP2
EXR	1.0000						
CAP	−0.0030	1.0000					
SIZE	0.6047	0.1795	1.0000				
OPEN	−0.4511	0.2364	−0.4523	1.0000			
ADV	0.2472	0.5302	0.3588	0.0595	1.0000		
FD	0.4735	0.3907	0.5828	−0.0271	0.6771	1.0000	
CAP2	−0.0879	−0.9133	−0.2334	−0.0951	−0.5924	−0.4490	1.0000

상수항	1.553 (0.000)	1.221 (0.000)	1.378 (0.000)	1.361 (0.000)	1.670 (0.000)	1.333 (0.000)	1.276 (0.000)	1.469 (0.000)
EXR	−0.076 (0.032)	−0.277 (0.000)		−0.049 (0.164)	−0.140 (0.000)	−0.037 (0.272)	−0.080 (0.023)	−0.131 (0.003)
CAP	−0.424 (0.000)	−0.490 (0.000)	−0.403 (0.000)		−0.491 (0.000)	−0.482 (0.000)	−0.202 (0.003)	
SIZE	−0.078 (0.000)	−0.172 (0.000)	−0.085 (0.000)	−0.087 (0.000)		−0.059 (0.000)	−0.081 (0.000)	−0.085 (0.000)
OPEN	−0.003 (0.000)	−0.007 (0.000)	−0.002 (0.001)	−0.004 (0.000)	−0.001 (0.264)		−0.003 (0.000)	−0.004 (0.000)
ADV	0.491 (0.000)	−0.140 (0.008)	0.493 (0.000)	0.358 (0.000)	0.506 (0.000)	0.497 (0.000)		0.351 (0.000)
FD	−3.204 (0.000)		−3.301 (0.000)	−3.246 (0.000)	−3.624 (0.000)	−3.366 (0.000)	−2.538 (0.000)	−3.062 (0.000)
CAP2								0.130 (0.100)
AIC	42,035.5	42,426.2	42,038.1	42,066.9	42,076.7	42,047.7	42,098.0	39,118.5
BIC	42,086.1	42,469.6	42,081.5	42,110.2	42,120.1	42,091.1	42,141.4	39,168.5
대상국가	34	34	34	34	34	34	34	31

주: ( ) 안은 p−value

표 3.2 회귀분석 결과(1년)

	기본 모형	FD 제외	EXR 제외	CAP 제외	SIZE 제외	OPEN 제외	ADV 제외	CAP2
상수항	1.867 (0.000)	1.558 (0.000)	1.396 (0.000)	1.716 (0.000)	1.968 (0.000)	1.581 (0.000)	1.618 (0.000)	2.006 (0.000)
EXR	−0.204 (0.000)	−0.391 (0.000)		−0.183 (0.000)	−0.260 (0.000)	−0.154 (0.000)	−0.208 (0.000)	−0.325 (0.000)
CAP	−0.332 (0.000)	−0.394 (0.000)	−0.276 (0.000)		−0.390 (0.000)	−0.408 (0.000)	−0.133 (0.025)	
SIZE	−0.068 (0.000)	−0.156 (0.000)	−0.087 (0.000)	−0.075 (0.000)		−0.044 (0.000)	−0.071 (0.000)	−0.069 (0.000)
OPEN	−0.004 (0.000)	−0.007 (0.000)	−0.002 (0.000)	−0.004 (0.000)	−0.002 (0.002)		−0.004 (0.000)	−0.004 (0.000)
ADV	0.440 (0.000)	−0.146 (0.002)	0.446 (0.000)	0.337 (0.000)	0.454 (0.000)	0.449 (0.000)		0.213 (0.000)
FD	−2.979 (0.000)		−3.241 (0.000)	−3.012 (0.000)	−3.346 (0.000)	−3.190 (0.000)	−2.381 (0.000)	−2.713 (0.000)
CAP2								−0.020 (0.773)
AIC	39,080.2	39,530.5	39,122.6	39,105.5	39,122.2	39,110.1	39,147.6	36,400.2
BIC	39,130.8	39,573.9	39,165.9	39,148.9	39,165.6	39,153.5	39,191.0	36,450.2
대상국가	34	34	34	34	34	34	34	31

주: ( ) 안은 p−value

표 3.3 회귀분석 결과(2년)

	기본 모형	FD 제외	EXR 제외	CAP 제외	SIZE 제외	OPEN 제외	ADV 제외	CAP2
상수항	1.980 (0.025)	1.637 (0.062)	0.918 (0.128)	2.406 (0.004)	1.893 (0.030)	1.662 (0.028)	2.280 (0.007)	3.505 (0.001)
EXR	−0.460 (0.102)	−0.667 (0.013)		−0.520 (0.062)	−0.412 (0.128)	−0.404 (0.133)	−0.455 (0.106)	−0.704 (0.048)
CAP	0.939 (0.108)	0.870 (0.136)	1.066 (0.066)		0.989 (0.087)	0.854 (0.134)	0.699 (0.196)	
SIZE	0.058 (0.539)	−0.040 (0.647)	0.015 (0.865)	0.079 (0.397)		0.085 (0.322)	0.062 (0.511)	0.081 (0.409)
OPEN	−0.004 (0.494)	−0.008 (0.152)	−0.001 (0.828)	−0.002 (0.728)	−0.005 (0.301)		−0.004 (0.513)	−0.002 (0.743)
ADV	−0.532 (0.274)	−1.182 (0.004)	−0.519 (0.285)	−0.238 (0.598)	−0.543 (0.263)	−0.523 (0.282)		−0.894 (0.103)
FD	−3.303 (0.010)		−3.894 (0.001)	−3.209 (0.012)	−2.990 (0.011)	−3.537 (0.004)	−4.024 (0.000)	−2.882 (0.051)
CAP2								−1.265 (0.045)
AIC	84,349.2	84,354.0	84,349.9	84,349.8	84,347.6	84,347.7	84,348.4	77,762.8
BIC	84,399.9	84,397.3	84,393.3	84,393.2	84,391.0	84,391.1	84,391.8	77,812.7
대상국가	34	34	34	34	34	34	34	31

주: ( ) 안은 p−value

3.4. 추가적인 분석

글로벌 금융위기(Global Financial Crisis; GFC)가 구조적 변화를 유발했을 가능성을 고려하여 실증분석의 첫 단계(VAR 모형)에 글로벌 금융위기 이전 자료만을 사용하여 분석해보았다. 이 경우 자료의 부족으로 10년치 이상의 정보가 가용한 국가는 14개[⑩]로 줄어들게 되는데 이를 34개국 전체를 이용한 결과와 비교할 경우 국가 선택에 따른 차이가 추정 결과에 오류를 발생시킬 수 있을 것으로 보아 해당하는 14개 국가의 전체기간에 대한 결과만을 대상으로 비교하였다. 다만 GFC 이전에 10년 이상의 자료가 확보되는 국가가 선택된 것이기 때문에 알려지지 않은

[⑩] Brazil, Canada, Chile, Czech Republic, Denmark, United Kingdom, Croatia, Hungary, Indonesia, Japan, Mexico, Norway, Poland, Russia

편의(bias)가 있을 수 있고 대상 국가가 줄어들어 추정의 정확성도 낮아졌기 때문에 전체기간의 추정결과가 3.3과는 다른 점에는 유의할 필요가 있다.

추가적인 분석의 결과는 표 3.4에 요약하였다. 여기서도 3.3에서 가장 중요한 특성으로 나타난 FD가 가장 중요한 특성으로 나타났다. 다만 FD는 GFC 이전에는 1년 미만의 기간에 대해서만 통화정책의 환율 효과에 유의한 영향이 있었고 전체 기간에서는 1년 미만의 기간에 있어서 영향력이 다소 감소하였지만 2년 이상의 기간에 대해서도 유의한 것으로 나타났다.

한편 ADV는 GFC 이전이나 전체기간 모두에서 6개월과 1년에서는 유의한 양의 값을 가지는 것으로 추정되었다. 또 GFC 이전의 계수 추정치가 전체기간의 추정치보다 커서 GFC 이전에 선진경제의 통화정책이 환율에 미치는 영향은 이후보다 더 작았음을 시사한다.

FD와 ADV 이외의 변수들은 34개국의 전체기간을 분석한 결과에 비해 대체로 유의성이 떨어지고 GFC 이전과 전체기간의 계수의 부호가 바뀌는 등 불안정한 모습을 보여 특정한 결론을 내기 어려웠다. CAP과 SIZE는 6개월의 계수의 경우 GFC 이전에는 5% 유의수준에서 유의한 양수였다가 전체 기간에서는 각각 유의하지 않은 음수와 유의한 음수로 바뀌었다. 한편 CAP은 전체 기간에서 1년의 계수도 유의한 음수가 되었다. EXR은 GFC 이전에는 6개월에서만 유의한 음의 값을, 전체기간에서는 1년에서만 유의한 음의 값을 보였다. 또, OPEN은 전체기간에만 6개월과 2년에서 유의한 계수 추정치를 보였는데 6개월에서는 음의 값으로, 2년에서는 양의 값으로 추정되었다.

여기서 FD와 ADV는 GFC 이전의 제한된 자료로 분석해도 강건한 결과를 보여주어 다른 변수들보다 통화정책의 환율 경로에 뚜렷한 영향을 끼치는 것으로 판단할 수 있겠다.

표 3.4 글로벌 금융위기(GFC) 이전 이후 비교

	6 개월		1 년		2 년	
	GFC 이전	전체기간	GFC 이전	전체기간	GFC 이전	전체기간

상수항	3.383 (0.000)	3.110 (0.000)	3.766 (0.000)	3.846 (0.000)	−1.612 (0.713)	3.445 (0.054)
EXR	−0.152 (0.013)	−0.050 (0.471)	−0.057 (0.325)	−0.100 (0.098)	0.799 (0.460)	0.153 (0.729)
CAP	1.115 (0.001)	−0.369 (0.351)	−0.168 (0.611)	−1.833 (0.000)	−4.873 (0.427)	−3.592 (0.151)
SIZE	0.039 (0.034)	−0.056 (0.008)	−0.016 (0.349)	−0.014 (0.438)	−0.017 (0.959)	0.157 (0.235)
OPEN	−0.001 (0.530)	−0.009 (0.000)	0.001 (0.718)	−0.001 (0.570)	0.043 (0.202)	0.027 (0.045)
ADV	1.533 (0.000)	0.934 (0.000)	1.770 (0.000)	1.422 (0.000)	3.417 (0.182)	0.953 (0.361)
FD	−9.559 (0.000)	−6.074 (0.000)	−8.934 (0.000)	−6.364 (0.000)	−2.831 (0.672)	−7.646 (0.005)
대상국가	14	14	14	14	14	14

주: ( ) 안은 p−value

3.5. 결　론

본 연구는 VAR 모형과 다중회귀분석의 2단계 추정방법을 사용하여 통화정책이 환율에 미치는 영향이 국가별 특성에 따라 어떻게 달라지는지 분석하였다. 이를 위해 각국의 통화정책 충격이 환율에 미치는 영향을 VAR 모형을 통해 추정하고 이를 국가별 특성에 회귀분석하였다. 분석 결과 금융발전도가 가장 큰 영향을 지니는 것으로 드러났으며 이 외에도 선진경제 여부, 환율제도 유연성, 자본시장개방도, 경제규모, 그 밖의 개방도 등도 영향을 끼치는 것으로 나타났다.

금융발전도와 환율제도의 유연성, 자본시장 개방도, 경제규모, 그 밖의 개방도가 커질수록 긴축적 통화정책 충격이 환율을 절상시키는 효과는 커지는 것으로 나타났으며 특히 금융발전도가 결정적인 요인으로 보인다. 또 선진경제는 긴축적 통화정책 충격이 환율을 절상시키는 효과는 그렇지 않은 경우보다 작은 것으로 나타났다. 한편 경제규모가 통화정책의 환율 효과에 미치는 영향의 방향은 이론과 배치되어 추가적인 연구가 필요해 보인다.

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국문초록

개방경제 중앙은행의 고려사항에 대한 논문

본 학위논문은 개방경제에서 중앙은행이 고려해야 될 사항들에 관한 세 개의 소논문으로 구성되어 있다. 제1장에서는 한국과 인도네시아, 말레이시아, 필리핀, 태국의 다섯 개 국가에 대해 인플레이션의 결정요인이 무엇이며 시간에 따라 그 영향이 어떻게 변화하였는지를 시변계수 벡터자기회귀모형(TVC-VAR)을 통해 살펴보았다. 해당 국가들의 인플레이션은 국제 상품가격과 노년부양비(old-age dependency ratio)에 크게 영향 받는 것으로 나타났고 노년부양비는 시간이 갈수록 더욱 중요해지는 것으로 나타났다. 이어지는 제2장에서는 치앙마이 이니셔티브 다자화 협정에 지역통화로 분담금을 제공하는 것이 가능한지 평가해 보았다. 이를 위해 외환보유액 내 지역통화에 대한 수요와 지역통화의 안정성을 살펴보았으며 통화의 국제화 정도와 자본이동의 자유도도 함께 고려하였다. 제3장에서는 통화정책이 환율에 미치는 효과가 국가별 특성에 따라 어떻게 변하는지 살펴보았다. 다양한 국가별 특성들을 동시에 고려할 수 있도록 VAR과 회귀분석의 2단계 실증분석을 실시하였는데, 그 결과 환율이 통화정책 충격에 반응하는 정도는 환율제도나 자본시장 개방도, 경제규모와 선진경제 여부 등의 특성에 영향 받으며 특히 금융시장의 발달 정도에 가장 크게 영향 받는 것으로 나타났다.

핵심어: 인플레이션, 시변계수 벡터자기회귀모형, 통화 수요, 2단계 분석, 통화정책, 환율

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