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# EXAMINING THE EFFECTIVENESS OF MONETARY POLICY IN ASIA4: THE PRE- AND POST-1997 ASIAN FINANCIAL CRISIS

*(Mengkaji Keberkesanan Dasar Kewangan di Asia4: Krisis Kewangan Asia Pra- dan Pasca-1997)*

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*ABSTRACT*

One of the main changes experienced by Asian countries due to the 1997 Asian financial crisis was the shift in monetary policy to inflation targeting, along with the release from rigid to flexible exchange rate regimes. This study focuses on four main Asian countries (Korea, Thailand, the Philippines, and Indonesia) that experienced such monetary policy changes. The aim is to evaluate the effectiveness of monetary policy in Asia4 before and after the shift in monetary policy. This research also aims to investigate the behaviour of economic variables (output growth and inflation) in reaction to the monetary policy stances between the two regimes. The data ranges from January 1990 to December 1996 (pre-crisis) and July 1999 to December 2019 (post-crisis). With these two sub-periods of data, a structural vector autoregressive (SVAR) model is applied to examine the performance of monetary policy. Generally, most variables are highly determined by their own shocks, indicating low predictability by other variables in two sub-periods and all of Asia4. However, the economic structure changes across these sub-periods. In the pre-crisis, the economic growth of Indonesia, Korea, and the Philippines was mainly determined by inflationary shocks, whereas output or real shocks are more influential in the post-crisis. The opposite condition holds for Thailand. Nevertheless, real and inflationary shocks are the main sources causing economic fluctuations in these four Asian countries. This study recommends that monetary policy be more accommodating and co-implement fiscal policy.

*Keywords*: monetary policy; Asian financial crisis; inflation; impulse shocks; exchange rate

*ABSTRAK*

Salah satu perubahan-perubahan utama yang dialami oleh negara-negara Asia akibat daripada krisis kewangan Asia 1997 ialah peralihan dasar kewangan kepada sasaran inflasi dan pelepasan daripada rejim kadar pertukaran yang tegar kepada rejim kadar pertukaran yang fleksibel. Kajian ini tertumpu kepada empat negara Asia utama (Korea, Thailand, Filipina, dan Indonesia) yang pernah mengalami perubahan-perubahan dasar kewangan tersebut. Objektif utama adalah untuk menilai keberkesanan dasar kewangan di Asia4 untuk sebelum dan selepas peralihan dalam dasar kewangan. Kajian ini juga bertujuan untuk mengkaji tingkah laku pembolehubah-pembolehubah ekonomi (pertumbuhan pengeluaran dan inflasi) sebagai tindak balas kepada pendirian dasar kewangan antara kedua-dua rejim. Data berkisar dari Januari 1990 hingga Disember 1996 (tempoh pra-krisis) dan Julai 1999 hingga Disember 2019 (tempoh pasca-krisis). Model autoregresif vektor struktur (SVAR) telah digunakan untuk mengkaji prestasi dasar kewangan dengan menggunakan dua sub-tempoh data. Secara amnya, kebanyakan pembolehubah banyak ditentukan oleh kejutan-kejutan mereka sendiri. Hal ini menunjukkan kebolehramalan yang rendah oleh pembolehubah-pembolehubah lain dalam dua sub-tempoh dan semua Asia4. Walau bagaimanapun, terdapat suatu perubahan dalam struktur ekonomi berbandingkan kedua-dua sub-tempoh. Dalam pra-krisis, kebanyakan pertumbuhan ekonomi Indonesia, Korea, dan Filipina telah ditentukan oleh kejutan-kejutan inflasi, manakala kejutan-kejutan pengeluaran atau sebenar lebih berpengaruh dalam pasca krisis. Keadaan sebaliknya berlaku untuk Thailand. Namun begitu, kejutan-kejutan sebenar dan inflasi adalah punca-punca utama yang menyebabkan turun naik ekonomi di empat negara Asia ini. Kajian ini

mengesyorkan agar dasar monetari lebih akomodatif dan melaksanakannya bersama dengan dasar fiskal.

*Kata kunci*: dasar monetary; krisis kewangan Asia; inflasi; kejutan impuls; kadar pertukaran

## 1. Introduction

Asian countries share an abundance of similarities, not just in terms of cultures but also in terms of geographical location, economic structures, and trades. Most of them are developing countries. Therefore, they are relatively small but open economies that might be vulnerable to external shocks and influences. For instance, the global commodity crisis in the 1980s, the Asia financial crisis of 1997, and more crises have had large and long-lasting impacts on the economies of Asian countries in almost a similar way. Among the most affected countries are the four Asian countries, namely Korea, Thailand, the Philippines, and Indonesia. Due to the Asian Financial Crisis in 1997, these countries experienced a large shift from monetary-targeting to inflation-targeting policies and from rigid to flexible exchange rate regimes. All these economic features and changes attract continuous research to evaluate their monetary policy, which might contribute to the monetary policy literature and theoretical framework. For example, in mid-1997, the Asian financial crisis began when Thailand was forced to unpeg its currency to the U.S. dollar. This action triggered a sequence of currency depreciations and massive flights of capital, including in South Korea, Thailand, Singapore, Indonesia, Malaysia, and the Philippines. These countries lost about 70% of their stock markets and currencies during the crisis (Kuepper 2020).

The theory of the effectiveness of monetary policy between rigid and flexible regimes across countries is a long-standing question, with many different studies over the years. There is no one for all solution applicable to all countries to maximise the effectiveness of the policy. However, it is crucial to unveil the effectiveness of policies from countries with similar economic features, in our case, developing Asian nations. The Asian financial crisis of 1997 was a major global financial crisis that not only destabilised the Asian economy but also the world economy. The affected countries have made changes in their monetary policies to curb the recession in their economies. Since the 1997 crisis, the four Asian countries have unpegged their currencies from the U.S. dollar and started to adopt inflation targeting for more than ten years, but it is not clear if the newly adopted policy is more effective in managing shocks and leads to a better economic outcome. There are studies examining the effects of the crisis and the responses of economies to the crisis, but studies that compare the results across Asian countries are lacking. Furthermore, the results are inconsistent across the different studies. Several studies found that inflation targeting is effective in enhancing the economy, while others found that it is not.

This study aims to evaluate the effectiveness of monetary policy in four Asian countries (Asia4), namely Korea, Thailand, the Philippines, and Indonesia, before and after the shift in monetary policy. This research also seeks to investigate the behaviour of economic variables (output growth and inflation) in reaction to the monetary policy stances between the two regimes. Specifically, the pre-crisis period is from January 1990 to December 1996, while the post-crisis period is from July 1999 to December 2019. The Blanchard and Quah (1989) structural vector autoregressive (SVAR) model is employed in this study. The variables included in this study consist of money supply, exchange rate, CPI (to indicate inflation), and interest rate.

There are plenty of studies researching the Asian financial crisis of 1997. However, the investigation is mostly concerned with the monetary policy after the crisis in one country and its effectiveness in recovering the economy. Thus, this study contributes to analysing the effectiveness of monetary policy in four Asian nations during the pre- and post-crisis periods. Besides, this study applies the SVAR model to estimate the effect of each shock (output, monetary, exchange rate, inflation rate, and interest rate) on each variable in the short and long runs. The changes of each shock to each variable from pre- to post-crisis are also being analysed in this study. The result of the study is crucial for the authorities, especially the policymakers, in designing and planning monetary policies as well as making policy decisions.

## 2. Literature Review

Over the past decades, many research have been undertaken to study the effectiveness of monetary policy. The effectiveness of monetary policy is affected by several factors, including financial development, inflation targeting, central bank communications, financial innovations, and the uncertainty of economics. Ma and Lin (2016) reported that the effectiveness of monetary policy is affected by financial development. In the study, effectiveness across countries increased when financial development decreased. The money growth coefficients were used to measure the effectiveness of monetary policy. The higher the coefficients, the larger the influence of monetary policy on inflation and output. de la Horra *et al.* (2021) claimed that the effectiveness of monetary policy relies on monetary authorities' ability to minimise uncertainty using expectations-based monetary instruments.

In evaluating the effectiveness of monetary policy, Rasche and Williams (2007) used the moving average of the inflation rate to determine if a monetary policy is strong. The uncertainty of economics also affects the effectiveness of monetary policy. Ironically, the higher the uncertainty, the less monetary policy is in effect. On top of that, financial innovation can complicate the environment in which monetary policy operates, thus making it less effective (Mishra & Pradhan 2008). The implementation of monetary policy restricts the activities of profit-seeking of financial institutions, thereby reducing their profits. Thus, financial innovations occur as the firm innovates and maximises profits, and the effectiveness of monetary policy decreases. According to Ferreira de Mendonça and Simão Filho (2007), central bank communications, also known as transparency, also affect the effectiveness of monetary policy. It is shown in the study that inflation and output can be lowered by higher transparency, thus showing the high effectiveness of monetary policy. Hence, economic transparency helps improving monetary policy implementation.

In terms of the effectiveness of inflation targeting, various studies found no evidence that the inflation-targeting regime helps reduce variability, output volatility, and output growth. The studies include Angeriz and Arestis (2007), Lin and Ye (2007), Brito and Bystedt (2010), and Thornton (2016). Their work showed that targeters and non-targeters improved their economic performance and a reduction in inflation. However, Krušković (2020) reported that nations with inflation targeting experience slower economic growth and increased unemployment. On the contrary, other past studies, including Vega and Winkelried (2005), Mishkin and Schmidt-Hebbel (2007), Creel and Hubert (2010), Abu Asab *et al.* (2018), and Fratzscher *et al.* (2020), found that inflation targeting may contribute to keeping the inflation rate low and stable as well as improving economic performance. According to Mishkin and Schmidt-Hebbel (2001), the inflation-targeting regime reduces inflation expectations, output volatility, and sacrifice ratio, besides inflation and inflation variability.

Furthermore, Gonçalves and Salles (2008) disclosed that inflation targeting works well in emerging countries in reducing inflation rates and enhance economic growth. The findings by

Mishkin and Schmidt-Hebbel (2007) and Walsh (2009) showed that inflation targeting works better in emerging countries than in developed countries. They claimed that inflation targeting could improve the central bank's credibility in monetary policy since its initial credibility in emerging markets is low, leading to a better macroeconomic outcome. Meanwhile, Dotsey (2006) showed that inflation targeting in developed countries is compatible with robust economic activity. Numerous studies, such as Bernanke and Woodford (2004), Mishkin (2004), Caballero and Krishnamurthy (2005), and Sims (2005), claimed that developing countries are lacking in institutional maturity and macroeconomic fundamental consistency, and hence, inflation targeting might perform better in developed countries as compared to emerging countries.

According to Calvo and Reinhart (2002), fear of the floating phenomenon caused by a lack of monetary authorities' credibility combined with high exchange rate pass-through (ERPT) to domestic prices limits the effectiveness of inflation targeting in emerging countries. The major findings by Nasir *et al.* (2020) indicate that ERPT has important consequences for inflation expectations in the Czech Republic, the first developing nation to implement inflation targeting. Schmidt-Hebbel and Tapia (2002) and Fraga *et al.* (2003) exposed that emerging countries had a higher degree of ERPT than developed economies. In addition, a high ERPT implies greater difficulty in attaining inflation targets in emerging countries. Furthermore, Calvo and Mishkin (2003) and Mishkin (2004) argued that the factors that explain the behaviour of emerging countries to be reluctant to float the nominal exchange rates include low monetary institutions' credibility, weak fiscal institutions, vulnerability to sudden stops, liability dollarisation, and high ERPT into domestic prices.

## 3. Background Study

The four Asian countries (Korea, Thailand, the Philippines, and Indonesia) have undergone an evolution of monetary policy since the Asian financial crisis of 1997. The evolution of monetary policy in these countries has stabilised their economies after the crisis. Thailand's central bank, i.e., the Bank of Thailand (BoT), was vague about its primary objectives, but BoT always aims to maintain monetary and financial stability to achieve sustainable economic growth practically. During the 1997 crisis, the BoT changed from pegged to floating exchange rates. Furthermore, BoT also adopted monetary targeting and conducted liquidity management daily to prevent excessive interest rate volatility and financial system instability. After the crisis of 1997, the association between output growth and money supply had become more unstable; therefore, in 2000, the BoT adopted explicit inflation targeting by using the 14-day repurchase rate to control short-term money market rates.

In Indonesia, the ultimate goal of Bank Indonesia is to maintain and achieve currency stability. During the 1997 crisis, Bank Indonesia switched from a crawling peg to a floating exchange rate under a more restrictive base monetary-targeting framework to re-establish currency confidence and to control inflation. Besides, Bank Indonesia also sold Bank Indonesia certificates (SBI) through the open market. In 2005, Bank Indonesia adopted an inflation-targeting regime by setting an inflation target every year. Bank Indonesia also set a direct monetary policy, changing the operating target from base money targeting to interest rate targeting.

The Philippines' central bank, i.e., the Bangko Sentral ng Pilipinas (BSP), has achieved monetary policy independence since 1986, managing its monetary policy to maintain price stability. The BSP implemented a stringent monetary-targeting system until mid-1995, as there was a predictable and stable linkage between price stability and monetary target. During the 1997 crisis, the BSP implemented a floating exchange rate and abandoned the pegged exchange

rate to recover economic growth. Later on, the BSP focused on inflation targeting instead of monetary aggregate targeting, and the policy tool was also progressively shifted from quantity targeting to interest rate targeting. BSP has officially adopted inflation targeting and has been classified as an independent floater for its exchange rate regime since 2002.

The monetary policy in Korea aims to maintain price stability. Before the crisis, Korea adopted monetary targeting, which was based on the European Community (EC) method. In this method, the Bank of Korea determined the money supply target by taking into account several expected economic factors such as economic growth, price increasing rate, and monetary velocity changes. During the crisis, the currency in Korea changed from pegged to floating freely, and the statutory ceiling on annual interest rates increased from 20 percent to 40 percent. From the year 1998 onwards, the Bank of Korea adopted an inflation-targeting regime to achieve its objective of maintaining price stability.

Before the 1997 Asian financial crisis, most East Asian economies pegged exchange regimes to the U.S. dollar and intended to control monetary aggregates. Lack of foreign exchange regulations resulted in the lacking of independence of central banks. In the pre-crisis period, only Thailand and the Philippines were considered to have fixed exchange rates, while Indonesia and Korea were not far off. Following the crisis, fewer East Asian nations adopted fixed exchange rate regimes, whereas more economies implemented inflation-targeting frameworks (Morgan 2013). The interaction between domestic prices and exchange rate differed from country to country during the Asian currency crisis. Some Asian currencies immediately depreciated after the Thai baht was floated on July 2, 1997, while others maintained a de facto dollar peg for a number of months before suffering a significant devaluation. Thailand, Indonesia, the Philippines, and Korea changed their exchange rates to free or managed float to recover their economies during the financial crisis (Ito & Sato 2008).

## 4. Data and Methodology

### 4.1. *Data*

In this study, the analysis is focused on Korea, Thailand, the Philippines, and Indonesia. The main purpose of this study is to compare the policy performance between the two policy regimes due to the financial crisis of 1997. Therefore, the data is divided into the pre-crisis period from January 1990 to December 1996 and the post-crisis period from July 1999 to December 2019. The crisis period from January 1997 to June 1999 is excluded from our study to prevent large fluctuations. The data are obtained from the online databases of the World Bank and the International Monetary Fund. The data are in monthly, covering real output (Y), real money (M), exchange rate (ER), consumer price index (CPI), and interest rate (IR).

The variables employed in this study are illustrated in Table 1. The CPI is based on the constant price of 2010. All variables are transformed into percentage through natural log form except IR. All variables are converted into the first differenced term (growth rate) as they are stationary after first differencing. Broad money, M2 is used to represent real money instead of M1 because M2 is more stable than M1. M2 includes assets that are not cash but highly liquid, and hence, when the assets get shifted between M1 and M2, only M1 will be affected but not M2.

Table 1: List of variables

| Variable | Description | Remark |
|---|---|---|
| LM2 | Log of M2 | M2 = Broad Money (Domestic Currency) |
| LGDP | Log of GDP | GDP = Nominal GDP (Domestic Currency) |
| IR | Interest Rate | IR = Interest Rate, Money Market Rate (Percent per annum) |
| LCPI | Log of CPI | CPI = Consumer Price Index (Constant 2010) |
| LER | Log of ER | ER = Exchange Rate (Per $USD) |
| M | Real Money | M = LM2 - LCPI |
| Y | Real Output | Y = LGDP - LCPI |
| DIR | First Difference of IR | IR = Interest Rate, Money Market Rate (Percent per annum) |
| DLCPI | First Difference of LCPI | CPI = Consumer Price Index (Constant 2010) |
| DLER | First Difference of LER | ER = Exchange Rate (Per $USD) |
| DM | First Difference of M | M = LM2 - LCPI |
| DY | First Difference of Y | Y = LGDP - LCPI |

### 4.2. *Methodology*

The structural vector autoregressive (SVAR) model is employed in this study. The model applies the Blanchard-Quah decomposition approach to study the dynamic effects of shocks. First, preliminary tests such as unit root tests are performed to check the stationarity of the variables. If the variables are not stationary, then first differencing will be applied to make them stationary. The study is proceeded by undergoing model estimation using SVAR analysis. Then, the portmanteau and multivariate ARCH-LM tests are performed to check the autocorrelation and the autoregressive conditional heteroscedasticity, respectively.

As explained by Lütkepohl *et al.* (2006), each variable in a vector autoregressive (VAR) system is regressed on a constant (and, if necessary, a deterministic time trend) and on k of its own lags, as well as on k lags of the other variables. In simple terms, the determining variables used in each VAR equation are the same. This enables us to use ordinary least squares (OLS) to estimate the VAR. The basic VAR model is as follows:

$$y_t = \mathbf{A}_1 y_{t-1} + \cdots + \mathbf{A}_p y_{t-p} + \mathbf{B}_0 x_t + \cdots + \mathbf{B}_q x_{t-q} + \mathbf{C}\mathbf{D}_t + u_t, \quad (1)$$

where $y_t = (y_{1t}, \ldots, y_{kt})'$ represents a vector of $\mathbf{K}$ observable endogenous variables, $x_t = (x_{1t}, \ldots, y_{Mt})'$ denotes a vector of $\mathbf{M}$ observable exogenous variables, $\mathbf{D}_t$ comprises all deterministic variables, and $u_t$ indicates a $\mathbf{K}$-dimensional unobservable zero mean white noise process with positive definite covariance matrix $\mathbf{E}(u_t u'_t) = \sum_u$. The $\mathbf{A}_i, \mathbf{B}_j$ and $\mathbf{C}$ are parameter matrices of suitable dimension. In our study, Eq. (1) will be estimated, where $y_t$ consists of variables *DY*, *DIR*, *DLCPI*, *DLER*, and *DM* by SVAR general model.

The parameter matrices can be subjected to various restrictions. If zero restrictions are imposed, the right-hand side's variables may be unidentical in all equations. Some equations, for example, may comprise specific dummy or exogenous variables that are absent in other equations. Moreover, $\mathbf{B}_0 = 0$ can be stated if the exogenous variables should only show in lagged form only. If there are no exogenous variables, Eq. (1) is a standard VAR($p$) model with deterministic terms $\mathbf{D}_t$. When only one *y* variable is examined ($K = 1$), a univariate AR model is attained. Therefore, the current model framework may also be applied to single equation or univariate analysis. Model selection criteria can be used to determine the AR or VAR order $p$.

The model in Eq. (2) is estimated by feasible generalised least squares (GLS). The OLS is used to estimate the individual equations of the system first. Then, the residuals are utilised for computing the white noise covariance matrix $\sum_w$ as such, $\widehat{\sum_u} = \mathbf{T}^{-1} \sum_{t=1}^{T} \widehat{u_t}\widehat{u_t}'$. It is followed

by using this estimator to obtain the GLS estimator. The estimator simplifies to an OLS estimator for each equation if all regressors are identical in all equations.

By setting constraints on matrices **A** and **B** in Eq. (2), the SVAR model may be utilised to recognise the shocks to be tracked in the impulse response analysis. Eq. (2) is as follows:

$$\mathbf{A}y_t = \mathbf{A}_1^* y_{t-1} + \cdots + \mathbf{A}_p^* y_{t-p} + \mathbf{B}_0^* x_t + \cdots + \mathbf{B}_q^* x_{t-q} + \mathbf{C}^* \mathbf{D}_t + \mathbf{B}\varepsilon_t, \quad (2)$$

where the structural errors $\varepsilon_t$ are assumed to be white noise with (0, $\mathbf{I_K}$). The structural coefficients in the coefficient matrices may differ from the reduced form coefficients in Eq. (2). A reduced form model serves as the departure point for structural analysis. Consequently, a reduced form model should be indicated before the begin of the SVAR analysis. The constraints for **A** and **B** can only be introduced to the SVAR analysis. The reduced form residual $u_t$ is recovered from the structural model as $\mathrm{u_t} = \mathbf{A^{-1}B}_{e_t}$ so that $\sum_u = \mathbf{A^{-1}BB'A^{-1'}}$.

In 1989, Blanchard and Quah introduced an econometric technique based on the SVAR approach for recognising aggregate demand and supply shocks using a bivariate framework. The introduction of an identification technique based on long-run identifying constraints was a key contribution. In this study, there are three forms of the AB model, an A model with $\mathbf{B} = I_K$, a B model with $\mathbf{A} = I_K$, and a general AB model, with constraints on both matrices. Additionally, there is also a Blanchard-Quah model with constraints on the long-run impact of shocks. For the A and B models, a minimum of $K(K-1)/2$ constraints should be imposed to identify a system with $K$ endogenous variables. Contrarily, a minimum of $K^2 + K(K-1)/2$ constraints are required for the AB model (Breitung *et al.* 2004). Maximum likelihood is estimated via a scoring algorithm (Amisano & Giannini 1997; Breitung *et al.* 2004). Some manual superior alterations may be required if the algorithm fails to converge. When computing an overidentified model, the likelihood ratio statistic is $\mathrm{LR} = \mathrm{T}(\log\det(\widetilde{\sum_u^r}) - \log\det(\widetilde{\sum_u})$, where $\widetilde{\sum_u^r}$ denotes the maximum likelihood estimator of the reduced form model and $\widetilde{\sum_u^r}$ indicates the corresponding estimator gained from the restricted structural form estimation. In the Blanchard-Quah model, $\mathbf{A} = I_K$ and the matrix of long-run effects is assumed to be lower-triangular, i.e., $\left(\mathrm{I}_K - A_1 - \cdots - A_\mathrm{p}\right)^{-1}\mathbf{B}$.

In simple terms, the second residual does not have a long-run effect on the first variable, which implies a zero long-run impact. The third residual also have no long-run effect on the first and second variables, so on and so forth. Therefore, it may be required to change the order of variables to achieved plausible constraints. This must be accomplished in the specification panel. The Blanchard-Quah model is estimated by a Cholesky decomposition of the matrix, $\left(I_K - \hat{A}_1 - \cdots - \hat{A}_p\right)^{-1}\widehat{\sum_u}\ \left(I_K - \hat{A'}_1 - \cdots - \widehat{A'}_p\right)^{-1}$, where a hat designates a reduced form estimate.

Consider a SVAR model that incorporates measures of real output ($y_t$) and other endogenous variables that have been differenced sufficiently to achieve stationarity. Then, the Blanchard-Quah identification is applied by setting long-run constraints on the cumulative impulse response function. This study has a total of $K(K-1)/2 = 10$ constraints, where $K = 5$ variables. The long-run impact matrix is constructed as in Eq. (3) using the Blanchard-Quah identification:

$$\begin{pmatrix} y_t^Y \\ y_t^M \\ y_t^{lER} \\ y_t^{lCPI} \\ y_t^{IR} \end{pmatrix} = \begin{pmatrix} C(1)_{11} & 0 & 0 & 0 & 0 \\ C(1)_{21} & C(1)_{22} & 0 & 0 & 0 \\ C(1)_{31} & C(1)_{32} & C(1)_{33} & 0 & 0 \\ C(1)_{41} & C(1)_{42} & C(1)_{43} & C(1)_{44} & 0 \\ C(1)_{51} & C(1)_{52} & C(1)_{53} & C(1)_{54} & C(1)_{55} \end{pmatrix}, \quad (3)$$

where $C(1)$ is the $C(L)$ long-run matrix. Because the long-run impact matrix has a lower triangular Cholesky decomposition, the variable ordering may have dissimilar consequences on the dynamic structure of the shocks. For instance, the first variable is arranged on top so that it has an impact on all variables that are placed below it; however, it is unaffected by the other variables below it. Next, except for the first variable, the second variable influences all three variables below it. Similarly, it is affected by the variable above it, i.e., the first variable. This rule applies to all following variables as well. In this research, real output is the first variable, followed by real money, exchange rate, CPI, and lastly, interest rate or money market rate. The real output variable, which is supply or production, is anticipated to impact the macroeconomic variable, so it is rational to be at the top. Policy tools such as real money, exchange rate, and interest rate may react to the economic situation. The government may adjust policy tools accordingly when the economic condition changes, so they are ordered below the output (Sek & Lim 2016).

## 5. Results

In this study, the SVAR Blanchard-Quah model is estimated and the performance of monetary policies is compared using the data of Indonesia, Korea, the Philippines, and Thailand. First, unit-root tests are performed, specifically the Augmented Dicky-Fuller (ADF) test, the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test, and the unit-root with structural break test. All variables are not stationary at levels but getting stationary after the first differencing transformation. Hence, we proceed with the SVAR model analysis using the first differenced variables. The Akaike Info Criterion (AIC) and Schwarz Criterion (SC) are referred to in selecting the number of lags for all five endogenous variables.

Table 2 and Table 3 indicate the results of the contemporaneous matrix and the long-run impact matrix of these four countries, respectively. In both tables, the column variables are the types of shocks, while the row variables are the economic variables that received the impulses of shocks. The variables are in the first difference. The contemporaneous impact matrix captures short-run or temporary shocks. There is no restriction imposed on the short-run impact matrix. Note that *, ** and *** denote the significance of results at 10%, 5% and 1% respectively.

As observed in Table 2, the short-run effects of each shock are relatively smaller than the impact of the long-run counterparts. In the pre-crisis period, the money supply shock (DM) did not show any significant impact on economic variables in all countries. By contrast, the interest rate policy shock (DIR) had a relatively large impact on economic variables. Its impact had the largest influence on the policy rate itself. Besides, an increase in DIR shock also caused a drop in output growth (DY), money supply growth (DM), and exchange rate changes (DLER), as well as higher inflation in Indonesia. It was the main source that led to economic fluctuations in the pre-crisis period in Indonesia. DIR showed large fluctuations and was highly affected by its own shock (which happened in all countries) and the exchange rate shock (Korea and Thailand). In Korea and the Philippines, the main economic shock was inflationary shocks

(DLCPI). The primary cause of the economic fluctuation in Thailand was the output shock (DY) in the pre-crisis period.

In the post-crisis period, DIR and DLER are highly fluctuating. They are mainly impulses from their own shocks, with the largest impulses shown in Indonesia. DLER is fluctuating due to the drastic change in the exchange rate from rigid to flexible. Although highly fluctuating, the exchange rate shock does not have a significant influence on economic variables in the short run in the post-crisis period. The same condition applies to the interest rate shock. This indicates that the interest rate is not influential in monitoring economic variables in all countries except the Philippines and Thailand. In these two countries, the interest rate shock effectively reduces the inflation rate in the post-crisis period. The main sources of economic fluctuations in the post-crisis period are output and inflationary shocks. These two shocks contribute to larger economic fluctuations in the post-crisis period in Asia-4 compared to the pre-crisis period.

Table 3 shows the results of the long-run impact matrix. In this impact matrix, the variable shocks in the column will influence the row variables in the long run, which contrasts with the contemporaneous matrix. Besides, the matrix is restricted via Blanchard-Quah identification, which uses the lower triangular Cholesky decomposition. In the long-run impact matrix, the ordering of the variables matters. The estimated coefficients on the diagonal show significant, implying the respective shocks to their own movements. By contrast, the estimated coefficients on the off-diagonal are the interaction influence of shocks on each variable. The results reveal that the real output had a significant effect on the real money only in the long run for all countries except Indonesia in the pre-crisis period. DIR is highly fluctuating in both periods. It is an impulse by its own shock. However, DIR does not have a significant impact on economic variables in both periods, indicating that the money market rate is not effective in influencing economic changes in both periods. Inflationary and exchange rate shocks are also fluctuating, induced by their own shocks in both periods, but they have a limited impact on economic variables in the long run in both periods. Output shock seems to be the primary source of economic fluctuations in the long run for the majority of countries, particularly in the post-crisis period.

In general, most variables show high responses to their own shocks and have low reactions to other shocks, indicating that each variable is highly determined by its own shocks. For instance, the real output is highly affected by itself in pre-crisis and post-crisis while having relatively low reactions to the other variable shocks. In the post-crisis period, changes in both the exchange rate and money market rate are highly sensitive to their own shocks as well. This indicates that they are hardly predicted by other variables. It is also noteworthy that these two variables reacted to their own shocks in the pre-crisis period too. For the money market rate, the change in the rate is determined by its own shocks in both periods, except in Korea and the Philippines. This indicates that the money market rate in Korea and the Philippines are more accommodating to economic changes as compared to Thailand and Indonesia. On the other hand, the money market rate shock is not influential to affect other variables, and the same goes for the exchange rate shock. Hence, the results show that these two policy tools are not effective at stimulating changes in economic variables.

For the diagnostic tests, the lags are added until the p-values are greater than 0.1 so that the null hypotheses fail to be rejected. This implies that the variables have no autocorrelation or ARCH. Hence, the estimation results are reliable.

Table 2: Contemporaneous matrix of SVAR estimation for four countries

| Pre-Crisis | | | | | | |
|---|---|---|---|---|---|---|
| Country | Forecast Horizon | Output shock | Monetary shock | Exchange rate shock | Inflationary shock | Interest rate shock |
| Indonesia | DY | 0.0033* | 0.0021 | -0.0003 | -0.0021* | -0.2718** |
| | DM | 0.0011 | 0.0023* | -0.0016* | -0.0011** | -0.2390** |
| | DLER | 0.0020 | 0.0026 | 0.0021 | -0.0022 | -0.0764* |
| | DLCPI | -0.0047 | -0.0047 | 0.0004 | 0.0056** | 0.3132** |
| | DIR | 0.0012 | 0.0014 | 0.0004 | -0.0012 | 1.9117* |
| Korea | DY | 0.0019* | -0.0001 | 0.0013 | -0.0033** | -0.0005 |
| | DM | 0.0017* | 0.0005 | 0.0012 | -0.0032** | -0.0005 |
| | DLER | -0.0033** | 0.0003 | 0.0047* | 0.0018 | -0.0010* |
| | DLCPI | -0.0005 | 0.0000 | -0.0012 | 0.0039* | 0.0002 |
| | DIR | 0.2427 | -0.1548 | 0.4666** | 0.1407 | 1.1925* |
| Philippines | DY | 0.0026 | 0.0001 | 0.0024 | -0.0058** | 0.0009** |
| | DM | 0.0022 | 0.0014 | 0.0021 | -0.0058** | 0.0009** |
| | DLER | -0.0075** | 0.0015 | 0.0135* | 0.0026 | 0.0006 |
| | DLCPI | -0.0006 | -0.0004 | -0.0017 | 0.0070* | -0.0009** |
| | DIR | 0.1149 | -1.0979 | -0.6784 | -0.0353 | 4.8513* |
| Thailand | DY | 0.0044* | -0.0009 | 0.0006 | -0.0015 | 0.0001 |
| | DM | 0.0043* | 0.0010 | 0.0009 | -0.0027 | 0.0000 |
| | DLER | 0.0009 | 0.0005 | 0.0038* | 0.0004 | 0.0010* |
| | DLCPI | -0.0041* | 0.0013 | -0.0008 | 0.0019 | -0.0002 |
| | DIR | 0.2690 | 0.4122 | -1.1420* | 0.0293 | 1.7372* |
| Post-Crisis | | | | | | |
| Country | Forecast Horizon | Output shock | Monetary shock | Exchange rate shock | Inflationary shock | Interest rate shock |
| Indonesia | DY | 0.0042*** | 0.0016 | 0.0016 | -0.0057*** | -0.0002 |
| | DM | 0.0037*** | 0.0025* | 0.0016 | -0.0056*** | -0.0002 |
| | DLER | -0.0047* | -0.0043 | 0.0290*** | 0.0056* | 0.0014 |
| | DLCPI | -0.0013 | -0.0015 | -0.0015 | 0.0065*** | 0.0002 |
| | DIR | 0.1080 | 0.0189 | -0.1379 | 0.0441 | 1.2950*** |
| Korea | DY | 0.0030*** | -0.0002 | 0.0006 | -0.0029*** | 0.0005 |
| | DM | 0.0007 | 0.0027*** | 0.0004 | -0.0032*** | 0.0001 |
| | DLER | -0.0066** | -0.0015 | 0.0194*** | 0.0009 | -0.0021 |
| | DLCPI | -0.0004 | 0.0002 | 0.0000 | 0.0033*** | -0.0004 |
| | DIR | -0.0039 | 0.0109 | 0.0043 | 0.0202* | 0.0851*** |
| Philippines | DY | 0.0023*** | 0.0000 | 0.0003 | -0.0027*** | 0.0005 |
| | DM | 0.0024*** | 0.0018** | 0.0005 | -0.0023*** | 0.0007** |
| | DLER | -0.0022 | -0.0018 | 0.0134*** | 0.0014 | -0.0011 |
| | DLCPI | -0.0004 | -0.0002 | -0.0001 | 0.0028*** | -0.0006** |
| | DIR | 0.0130 | -0.0866* | 0.0727 | 0.0635 | 0.2828*** |
| Thailand | DY | 0.0024*** | -0.0001 | 0.0001 | -0.0038*** | -0.0014*** |
| | DM | 0.0010 | 0.0019*** | 0.0001 | -0.0039*** | -0.0016*** |
| | DLER | -0.0015 | -0.0014 | 0.0121*** | 0.0000 | 0.0000 |
| | DLCPI | -0.0005 | 0.0005 | 0.0000 | 0.0041*** | 0.0010** |
| | DIR | 0.0207 | 0.0292 | 0.0032 | -0.0226 | 0.1516*** |

Table 3: Long-run impact matrix

| Pre-Crisis | | | | | | |
|---|---|---|---|---|---|---|
| Country | Forecast Horizon | Output shock | Monetary shock | Exchange rate shock | Inflationary shock | Interest rate shock |
| Indonesia | DY | 0.0131* | 0 | 0 | 0 | 0 |
| | DM | 0.0009 | 0.0176* | 0 | 0 | 0 |
| | DLER | -0.0018 | -0.0003 | 0.0026* | 0 | 0 |
| | DLCPI | -0.0025 | -0.0023 | -0.0027 | 0.0070** | 0 |
| | DIR | -0.5246 | 1.0047 | -0.5194 | 0.2472 | 1.7384* |
| Korea | DY | 0.0188** | 0 | 0 | 0 | 0 |
| | DM | 0.0131** | 0.0034** | 0 | 0 | 0 |
| | DLER | -0.0125 | 0.0003 | 0.0077* | 0 | 0 |
| | DLCPI | 0.1116 | -0.0006 | -0.0009 | 0.0067** | 0 |
| | DIR | 0.1059 | 0.003 | 0.4758* | 0.3724 | 1.1433* |
| Philippines | DY | 0.0248** | 0 | 0 | 0 | 0 |
| | DM | 0.0287* | 0.0183* | 0 | 0 | 0 |
| | DLER | -0.0189 | 0.0185 | 0.0207* | 0 | 0 |
| | DLCPI | -0.0097** | -0.0016 | 0 | 0.0073* | 0 |
| | DIR | 0.0922 | -0.1023 | 1.2384 | -0.0565 | 3.2907* |
| Thailand | DY | 0.0063* | 0 | 0 | 0 | 0 |
| | DM | 0.0073* | 0.0033* | 0 | 0 | 0 |
| | DLER | 0.0006 | 0.0001 | 0.0059* | 0 | 0 |
| | DLCPI | -0.0024 | 0.0033 | -0.0018 | 0.0048* | 0 |
| | DIR | 0.1877 | 0.2821 | -0.2758 | -0.3028 | 1.6847* |
| Post-Crisis | | | | | | |
| Country | Forecast Horizon | Output shock | Monetary shock | Exchange rate shock | Inflationary shock | Interest rate shock |
| Indonesia | DY | 0.0397*** | 0 | 0 | 0 | 0 |
| | DM | 0.0373*** | 0.0097*** | 0 | 0 | 0 |
| | DLER | -0.0197 | -0.0149 | 0.0360*** | 0 | 0 |
| | DLCPI | -0.0058** | -0.0037* | -0.0009 | 0.0072*** | 0 |
| | DIR | -0.483 | -0.3575 | -0.0914 | -0.0959 | 0.9028*** |
| Korea | DY | 0.0301*** | 0 | 0 | 0 | 0 |
| | DM | 0.0164 | 0.0392** | 0 | 0 | 0 |
| | DLER | -0.0220** | -0.0006 | 0.0251*** | 0 | 0 |
| | DLCPI | -0.0009 | -0.0012 | -0.0001 | 0.0026*** | 0 |
| | DIR | 0.2377** | 0.0523 | -0.0981** | 0.0880*** | 0.1453*** |
| Philippines | DY | 0.0284*** | 0 | 0 | 0 | 0 |
| | DM | 0.0293** | 0.0170*** | 0 | 0 | 0 |
| | DLER | -0.0193** | -0.0005 | 0.0190*** | 0 | 0 |
| | DLCPI | 0.0019 | -0.0021 | 0.0002 | 0.0052*** | 0 |
| | DIR | 0.0578 | -0.3249** | 0.1695* | 0.0597 | 0.4481*** |
| Thailand | DY | 0.0223*** | 0 | 0 | 0 | 0 |
| | DM | 0.0145** | 0.0120*** | 0 | 0 | 0 |
| | DLER | -0.0101** | -0.0024 | 0.0018*** | 0 | 0 |
| | DLCPI | 0.0018 | 0.0022 | 0.0007** | 0.0008*** | 0 |
| | DIR | -0.0039 | 0.0295 | 0.0198 | 0.0463 | 0.0396*** |

## 6. Conclusion

In this study, the structural VAR model is applied to examine the effectiveness of monetary policy between pre- and post-crisis periods in four Asian countries, namely Korea, Thailand, the Philippines, and Indonesia. These nations are chosen because of drastic changes in their exchange rate regime from rigid to flexible to curb the Asian financial crisis of 1997. These countries also started to adopt the inflation-targeting monetary policy after the 1997 crisis. Such changes in the monetary policy regime and framework have attracted studies to evaluate the

effectiveness of their monetary policy. This study seeks to examine the economic conditions and the effectiveness of monetary policy between pre- and post-crisis 1997.

A structural VAR model is applied because this approach provides results on the responses of each variable in the system equation due to the impulses or a one unit increase in the orthogonalized shock. The evaluation can be observed through the influences of shocks of the exchange rate, money supply, and interest rate. Our results reveal that all monetary policy tools are not influential as their impacts on economic variables (GDP growth and inflation) are limited in both pre- and post-crisis periods in all countries examined. These policy tools are most responsive to their own shocks and not sensitive to other shocks, apart from the interest rate tool in Korea and the Philippines. The interest rate in these two countries is reactive to output/ GDP and inflationary shocks. This implies that the interest rate tool is more accommodating to economic changes in both periods.

This study shows that although the drastic shift of exchange rate regimes from a rigid system to a flexible one leads to larger fluctuations, the impact on economic stability is limited. Inflationary and output shocks are the more influential factors in economic stability, and their impacts may relatively differ across countries. Different countries have different effects when adopting virtually similar policies. In the pre-crisis, the economic growth of Indonesia, Korea, and the Philippines was mainly determined by inflationary shocks, while in the post-crisis, it is more determined by output or real shocks. On the contrary, the opposite condition holds for Thailand. Nevertheless, both real output and inflationary shocks are the two primary sources leading to economic fluctuations in these four Asian countries, namely Korea, Thailand, the Philippines, and Indonesia.

Moreover, the study also discovers the change in economic structure and behaviour between the two sub-periods. In the pre-crisis period, the exchange rate and inflation showed lower variations or volatilities. In the post-crisis period, a flexible exchange rate regime is adopted. Hence, the variation in the exchange rate is greater. A higher variation is also detected in inflation after the crisis. This is due to the recovery plan to stimulate economic growth, which unavoidably causes higher price fluctuations. Indonesia experiences the highest increment rate and variation in inflation. Although the output values exhibit an increment in the post-crisis period in all countries except Indonesia, the output growth rate does not show an increment and is even lower than the pre-crisis rate in certain countries.

This study might provide useful recommendations for governments making decisions to improve economic growth. As results show that monetary policy in Asia4 is not influential and is less sensitive to economic changes, policymakers in Asia4 are suggested to be more accommodative and sensitive to economic changes when adjusting monetary policy tools. Results show that real output is the main concern or target, which deviates from the inflation-targeting framework. These countries are implementing inflation targeting in the post-crisis period, but the money market rate does not react to price changes, indicating the low effectiveness of inflation targeting. The policymaker should be concerned about price stability. This is important as price stability might provide a good condition for economic development and investment. The policymakers are suggested to implement price control schemes when adopting inflation targeting to have better monitoring of price stability, especially on the necessary goods. Also, to stimulate economic growth, monetary policy could coexist with fiscal policy. Government expenditure is to encourage economic activities and welfare, and taxation is to generate government income and funding allocation. Apparently, this fiscal policy helps stimulate more economic activities.

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