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Macroeconomic, International Linkage and Effects of External Shocks in Southeast Asian Emerging Economies

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This study is an attempt to examine the effects of external shocks on macroeconomic variables in selective small open emerging economies in Southeast Asia. A quarterly Global Vector Autoregressive (GVAR) model, including 33 countries, was used throughout 1979–2013. The empirical results showed that the target countries were affected by external shocks, especially the shocks in the U.S, Euro area, China, South Korea, Singapore, and oil price, due to a high dependency on exports and a high degree of globalization in financial markets. The difference in the economic structure of these countries has led to different reactions to shocks. Meanwhile, equity price, exchange rate, and the real output were the most important transmitters of shocks to the interior economy. Furthermore, the shock to the macroeconomic situation in the U.S, the U.K, and South Korea is related to the top ten effective factors on Forecast Error Variance Decomposition (FEVD) of these three variables. Concurrently, the domestic shock in GDP and the exchange rate in each country, except Indonesia, have the highest share in FEVD. According to the results, the effects of the mentioned shocks have to be noticed by macro-prudential analysis studies in the target countries to optimally manage the risks in the various areas of the economy.

Keywords: Global VAR, International Linkage, VECM Models, Impulse Response, Error Variance Decomposition, Emerging Economies.
JEL Classification*:* E6, F47, R11

1 Introduction

The recent financial crisis highlighted the role of the macroeconomic condition and its effects on macroeconomic default risk factors in financial institutions. The bankruptcy of a wide range of banks, and even the well-capitalized banks, due to the recent global financial crises in Europe and the U.S was the evidence of this claim. This feature can be seen in the new emerging countries, especially in Southeast Asian developing countries. The

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open economy, together with a high dependence on exports in new developing countries, has led to foreign macroeconomic shocks taken place as the most important part of economic shocks.

After the economic crisis in 1997, the concentration on the exchange rate and price stability through adopting a high flexible exchange rate regime were the essential features in Southeast Asian emerging countries. For example, in Indonesia, due to frequent changes in exchange rates, policymakers adopted and implemented the monetary policy that has always caused high inflation (Ito & Sato 2008). Monetary policy in these economies is still affected by exchange rate policy and foreign capitals. Ogawa and Yang (2008) stated that the exchange rate band could afford room for domestic monetary policy to the monetary authorities. Table 1 indicates some financial indices about the studied countries and compares them with China and Japan, the two dominant economies in the region. A brief look into the financial systems of these countries, including Malaysia, Singapore, Korea, Thailand, and Indonesia, in the international arena shows their vulnerability to internal and external shocks, sudden change in domestic and foreign economic conditions. As it is seen, the studied countries based on the ratio of foreign liability to foreign assets the economy depend on foreign investments more than Japan and China. In contrast, the foreign reserves ratio is less than in China and Japan. Also, the external debt to GDP ratio is higher in these countries.

Along with the economic stability during the last decade in the studied countries, the rapid return of foreign capitals –which were quickly withdrawn due to uncertainty during the global crisis– caused inflation and a robust real asset price increase. In this situation, any reverse macroeconomic shock can lead to a rapid decrease in the asset value. Consequently, a significant proportion of households who own assets with a high leverage ratio would face the debt repayment problem (Tillmann 2013). On the other hand, the heavy dependence on exports[1] and the existing globalized financial markets led to an acceleration in the spread effects of any external shock on these countries. The findings of Thanoon and Baharumshah (2005) also show that the economies of these countries depend on external factors. They indicated that the rate of domestic savings in these countries was highly dependent on the amount of foreign capital. Under these conditions, the probability of another financial crisis gripped these countries. Thus, it is imperative to know the

[1] The average export to GDP ratio within the last decade was 2.3, 1.08, 0.5, and 0.8 for Singapore, Malaysia, Korea, and Thailand, respectively.

transmission mechanism of the effects of any shock to deal with its adverse effects.

Table 1
Financial Features in Studied Countries

	FLFA	FR	EDG	SEDR
China	37.9	23.2	6.3	11.9
Japan	-	15	48.76	-
Malaysia	92.6	8.6	28.6	32
Singapore	106.8	8.3	237.6	73.2
Korea	203.9	7.2	28.8	60.3
Thailand	128.4	9.4	15.8	11.1
Indonesia	156	7.8	17.2	46.5

Source: Asian Economic Monitor extracted from Asian Development Bank (ADB), 2011.
Note: FLFA is the ratio of foreign liability to foreign asset, FR is the ratio of foreign reserve to GDP, EDG is the ratio of external debt to GDP, and SEDR is the ratio of short-term external debt to reserves

This issue is considered in many developed countries including Europe and the U.S after the global financial crisis (Dees et al. 2007a; Pesaran et al. 2010; Castrén et al. 2010; Alessandri et al. 2009, however, in new emerging countries with high degrees of open economy in Southeast Asia, it is still under consideration. This paper depicts the transmission channel of the effects of any external and also internal shocks on the domestic macroeconomic variables in five Southeast Asian emerging countries, including Malaysia, Singapore, South Korea, Thailand, and Indonesia.

The high degree of globalization of financial markets leads these economies to be influenced by the flow of foreign funds. Any adverse shock in the world economy out of these countries can also lead to a reduction in export and foreign incomes through trade channels. The transparent cognition of the transmission mechanism of the effect of external shocks on domestic macroeconomic variables could have a significant role in economic policy decisions to deal with any adverse shock. Recently, a high-performance method called Global Vector Auto-Regressive (GVAR hereafter) model is used to this end in developed countries. Accordingly, this model overcomes limitations such as a large number of countries in systematic studied or a large number of variables in VAR models and estimation large number of coefficients, which requires a considerable amount of time-series data. Change in international trade patterns during the recent decades is one of the other features of these countries that the GVAR model, unlike other systematic research methods, can show.

Based on the literature about the GVAR model, there is no significant research to use this method to investigate the mentioned subject in Southeast Asian emerging countries. Using the GVAR model shows that Southeast Asian developing countries are affected by external shocks. Meanwhile, a sudden change in the U.S equity price, real output in China, and the U.S, increasing the oil price and also change in South Korea economic situation are the main factors that impact domestic economic variables in selected studied countries. The equity price, real exchange rate, real output, and money supply are the main variables that are affected by these shocks.

The following issues will be covered in the next sections of the paper. A review of the related literature is represented in section 2. An explanation of the GVAR Model and sources of data are illustrated in section 3, followed by empirical results in section 4. In section 5, conclusions are represented.

2 Literatures Review

The relationship between macroeconomic variables and monetary and fiscal policy in small open economies has been widely investigated by new Keynesian Models, such as in Mundell (1963) and Fleming (1962) models, which were developed by Dornbusch (1976). This model was extended by Argy and Salop (1983), and Niehans (1987) from different perspectives such as exchange rate regimes and capital movement structure. Most of these studies have been designed with the assumption of two countries in the world.

The other part of studies that highlighted the relationship between the internal and external macroeconomic variables was related to risk management studies. Following the advent of third-generation financial crisis models from 1999, a significant part of these studies has been expanded. The crises such as the Asian Crisis in 1997 and the Mexican Crisis in 1994 illustrated how the rapid withdrawal of private capital from open economies could lead to the crisis. Following these crises, the “third-generation” crisis models based on Krugman’s (1999) initial model were developed. These groups of studies highlighted the role of external shocks -transferring the problem- besides the dollarization of debts and international illiquidity -market imperfection- in economic crisis with a fixed exchange rate. Under such conditions, any shock or change in foreign economies could impact the domestic currency through international finance and trade channels. So, the imperfect capital market restricts more borrowing, and the devaluated currency impairs the ability to service the debts.

Some other studies were attempts to show the internal and external linkage between macroeconomic variables by using Dynamic Stochastic General

Equilibrium (DSGE) Models (Gali and Monacelli 2005; Narayan et al. 2014). Gali and Monacelli (2005) made this connection with a system of equations, including the Phillips Curve function, equation of IS equilibrium, and Taylor rule by replacing price levels and inflation in the Phillips Curve. Besides, Narayan et al. (2014) show the changes in global prices of oil play a significant role in highlighting the effects of external shocks on domestic variables in each economy.

According to the literature, some studies have shown evidence about international interdependence due to a high degree of financial integration (Mundell 1963; Fleming 1962; Kose et al. 2003; Monfort et al. 2003; Pesaran et al. 2004; Gali and Monacelli 2005); Kose et al. (2003) showed some evidence for the world business cycle in 63 countries by using Bayesian Latent Factor model; Monfort et al. (2003) depicted a dynamic relationship among real economies for G-7 countries.

One of the comprehensive methods to show the interaction between macroeconomic factors is the GVAR that was initially developed by Pesaran et al. (2004). There is strong theoretical support to describe and explain the effects of macroeconomic variables on each other in and out of the economy. In this regard, New Keynesian models for the small open economies, such as Mundell (1963) and Fleming (1962) and the DSGE model of Gali and Monacelli (2005), are noted. Pesaran et al. (2004) measured the long-term relationship among macroeconomic variables and the short-term effects of shocks on domestic and foreign variables by estimating the autoregressive VECM.

Recently, Dees et al. (2007a), by using the GVAR model of Pesaran et al. (2004) extracted the systematic relationships among macroeconomic variables. They have supported their model referring to theories including arbitrage in financial markets and DSGE model with a combination of Solow-Swan neoclassical growth model, Fisher equilibrium model, purchasing power parity, and uncovered interest parity condition. As it is explained by Pesaran et al. (2009b), the GVAR model can minimize the heterogeneity effects arising due to differences in industrialized, emerging, and less developed countries between included countries in the model by separate estimation for each country. Using the weighted average aggregate variables for groups/regions, including countries with different structures, the GVAR model reduces the heterogeneity problem.

After the global financial crisis with strong overseas spillover effects, many studies have been conducted to show the international links of macroeconomic variables (Dees et al. 2007a; Dees et al. 2007b; Pesaran et al.

2006; Pesaran et al. 2009a; Pesaran et al. 2009b; Pesaran et al., 2010; Castrén et al. 2010; Alessandri et al. 2009; De Wet et al. 2009). But in the literature, there is a gap about this issue in Southeast Asian emerging economies with high degrees of open economies. This paper highlighted the international links among macroeconomic variables in some selected economies in this region.

3 Methodology, Model Specification, and Data

3.1 Methodology

Vector Auto-Regressive (VAR) model was initially introduced by Sims (1980) as a multi-variable equation. This model is capable of explaining the interdependence between international/global as well as national macroeconomic variables. But in this situation, as Pesaran et al. (2004) explained, there is an econometric technique limitation due to the inadequate data set to estimate the significant number of coefficients. Considering a large number of countries in the model, even by a limited number of variables, a considerable number of simultaneous equations should be estimated.

A solution to this problem has been provided by Pesaran et al. (2004) for the first time by suggesting the GVAR. This model is a combination of country VECMs. In other words, each state sets a standard VAR model that includes foreign specific macroeconomic variables, which are weighted based on their share from the total national trade. Since the Southeast Asian emerging countries have open economies, the international markets have a significant role in their economic status. Therefore, a global macroeconomic model such as GVAR can depict the effects of various external shocks on the domestic macroeconomic variables. Smith and Galesi (2014) have made comprehensive Software called GVAR Toolbox 2.1 based on the methods used by mentioned studies to estimate GVAR models and its different related econometric tests.

The main framework of the GVAR model used in this study originates from Dees et al. (2007b). Assume that i is the index of regions in the global economy and i =0, 1, 2, ..., N. The i=0 is related to reference country (the U.S in this study). Also, assume that country specifics, including K variables, are shown as a vector (X). Now, the interaction between these variables (X_{it}) can be defined as a dynamic model such as,

$$X_{it} = a_{i0} + \beta_{i1}X_{it-1} + \beta_{i2}X_{it-2} + \theta_{i1}X^{*}_{it} + \theta_{i2}X^{*}_{it-1} + \varepsilon_{it} \quad \mathrm{t} = 1,2,\dots,\mathrm{T} \quad i = 0,1,2,\dots,\mathrm{N} \tag{1}$$

Where, X_{it} $Is\ a\ N \times 1$ matrix that each element is a $T \times K$ matrix including all country-specific variables for each country in t =1, 2, ..., T, X_{it-1} & X_{it-2}

are defined as first and second lags of country-specific variables, β_{i1} & β_{i2} are $N \times K$ matrixes that each element is a $K \times 1$ vector including coefficients for lagged country-specific variables, $X_{it}{}^{*}$is $a\ N \times 1$ Matrix that each element is a $T \times K$ matrix, including all foreign country-specific variables for each country in t = 1, 2,..., T. In general, the GVAR model can be shown by VARX*(p, q), that p and q are respectively the numbers of lags for original and foreign country-specific variables. In this study because of a large number of parameters and data limitations, maximum lags are assumed to be two. It is noticeable that $X_{it}{}^{*}$ is, in fact, representative variable for foreign country-specific variables that are constructed as average weighed by region-specific variables.

$$X_{it}{}^{*} = \sum_{j=0}^{N} W_{ij}^{X} X_{jt} \quad that \quad \sum_{j=0}^{N} W_{ij}^{X} = 1 \quad and \quad W_{ii}^{X} = 0 \tag{2}$$

That W_{ij}^{X} is the share of country j from total foreign trade in country i, θ_{i1}& θ_{i2} are $N \times K$ matrixes that each element is a $K \times 1$ vector including coefficients for foreign country-specific variables, ε_{it} represents $N \times 1$ matrix that each element is a $K \times 1$ vector, including all shocks on country-specific variables for each country. It is assumed that ε_{it} is serially uncorrelated with zero mean and nonsingular variance-covariance matrix. The other assumption is that ε_{it} is correlated between regions since X_{it}^{*} in each country is linked to variables in different areas (X_{it}).

Since the weights (W_{ij}^{X}) are the trade shares of each country with other countries; they can be changed during the time because of the movement in business cycles. This feature leads to the creation of bias in the analytical results as the measure of foreign specific variables will be changed. Hence, many discussions have been held in this regard, such as Glick and Rose (1999), Imbs (2004), and Forbes and Chinn (2004). In this study, the main concentration is on time-varying, moving average for 3 years of trade weight to counter the foreign specific variables. Is some parts, the results have been compared by fixed trade weights to show the effects of change in trade patterns.

The full systematic coefficient of the GVAR model can be estimated subject to the availability of sufficient time-series data because of a large number of parameters. Since the collection of data in a particular period is not feasible for the entire countries, hence, it is suggested to estimate the individual models for each country, separately. The other advantage of individual estimation is that the heterogeneity on monetary policies, exchange

rates, and different capital control systems in targeted Southeast Asian countries are considered.

In this model, the countries were grouped according to their geographical similarities or monetary and fiscal policies. It was done to facilitate the analysis of national and regional shocks. Meanwhile, the heterogeneity between the grouped countries should be overcome to calculate the realistic aggregated data. In this regard, the weights of GDP in Purchasing Power Parity (PPP) were used to adjust the data of subgroups countries, as noted in Pesaran et al. (2006).

3.2 Model Specification and Data

It is necessary to refer to some important assumptions to build up the GVAR model, before exhibiting the model specification. First of all, this model is built based on the cointegrated vectors between the variables with a correct lag length. In this regard, initially, unit root tests were done based on the standard Augmented Dickey-Fuller (ADF) statistics, and Park and Fuller's (1995) Weighted Symmetric (WS) estimated of ADF statistics. The rank of cointegration is determined based on Johanson's trace or the maximum eigenvalue statistics[1]. It is noteworthy that several long-term relationships may exist in any of the individual models. In this study, since the outputs of impulse response functions were concentrated, the model was allowed to be run with just identifying the assumption without any restriction. Under these conditions, a linear combination of long-term equations is estimated as a cointegrated equation.

Considering the small size of countries in comparison with the global economy, it was also assumed that the foreign variables were weakly exogenous and stationary with the first difference (The U.S is the exception, of course, due to the large size of the economy). Accepting this assumption leads to the elimination of long-term equation related to foreign specific variables, but it allows their short-term effects to appear as a short-term lag in the model. In other words, this variable cannot be included as the endogenous variable in the model. Hence the weak exogeneity of variables needs to be tested before the estimation of long-run relationships to remove the variables that are not weak exogenous from the write-hand side of the model. It is a jointly F test of significance of error correction terms in cointegrated functions for foreign-specific variables.

[1] The result of these test are available on request

The other important assumption is the weakly correlation of shocks in individual models. It is another criterion to show the weak exogeneity of foreign variables. The comparison of pairwise cross-section correlation of residuals, resulting from the constrained model with foreign variables (Here is shown by VARX) and non-constrained model (VAR), shows that importing the weak exogenous foreign country-specific variables in GVAR model leads to a reduction in the cross-sectional correlation of endogenous variables and shocks. However, as is explained by Dees et al. (2007a), in fact, in VARX models, there is some evidence of a positive correlation between the shocks in cross-section of countries. It leads the standard Impulse Response Function (IRF) and Forecast Variance Error Decomposition (FVED) to be less efficient for GVAR. Koop et al. (1996) expanded a generalized impulse response function to deal with this problem. Pesaran et al. (1998) modified these functions for VAR models, and especially in the GVAR model.

Finally, it has to be noted that in most emerging countries, the economic structure changes due to the different economic and political crises and developments. The probability of a structural break in the GVAR model is much higher than the single-equation models. Since, in this model, the effect of short-term shocks is considered more than long-term coefficients, in the related empirical studies, the structural break tests have been used to test the impact of structural breaks on short-term coefficients and error terms' variance. These tests include Ploberger and Krämer's (1992) maximal OLS Cumulative Sum (CUSUM) and its mean square variant statistics denoted by PKsup and PKms, respectively. Also, the test for parameter constancy against non-stationary hypotheses has been done by the statistic suggested by Nyblom (1989). Besides, different Wald-type tests have been used to test the once-structural break at an unknown time point. These include the likelihood ratio (QLR) test of Quandt's (1960), the Andrews and Ploberger (1994), Wald (APW) statistic, and the Mean Wald (MW) test proposed by Andrews and Ploberger (1994), and Hanson (2002). The robust version of the above mentioned statistics has also been used to test heteroskedasticity.The estimation GVAR model with less bias requires sufficient time-series observations, such as quarterly data. Unfortunately, most countries do not have adequate data for some variables and have been dropped from the model. The most famous GVAR model used in many studies is provided by Pesaran et al. (2006). This model includes GDP, consumer price index, money supply, equity price, exchange rate, and oil price.

According to quarterly data access and empirical studies, the following variables are used to make the final time-series data in the model: nominal

gross domestic product denotes by GDP_{it}, nominal equity price index illustrates by EQ_{it}, consumer price index indicates by CPI_{it}, exchange rate in terms of the U.S dollars demonstrates by E_{it}, nominal money supply ($M3$) shows by M_{it}, annual short-term interest rates display by R_{it}, annual long-term interest rates denote by lR_{it}, oil price indicates by PO_t, and metal price displays by $Pmetl_t$. All variables are based on the domestic currency and are deflated by Consumer Price Index (CPI) except interest rates, oil prices, and metal prices. Moreover, all of them are transformed into logarithms. Therefore, the following calculations have been initially done on the variables,

$$ep_{it} = ln\left(\frac{E_{it}}{CPI_{it}}\right), \qquad m_{it} = ln\left(\frac{M_{it}}{CPI_{it}}\right), \qquad eq_{it} = ln\left(\frac{EQ_{it}}{CPI_{it}}\right)$$

$$y_{it} = ln\left(\frac{GDP_{it}}{CPI_{it}}\right), \qquad dp_{it} = \ln(CPI_{it}) - \ln(CPI_{it-1})$$

$$po_t = l\,n(PO_t), \qquad pmetal_t = ln(Pmetal_t)$$

$$r_{it} = 0.25 * ln(1 + R_{it}), \qquad lr_{it} = 0.25 * ln(1 + LR_{it})$$

In which dp_{it} depicts the inflation and is the percentage of change in CPI between two time-period, r_{it} and lr_{it} are the quarterly short and long term interest rates. The logarithm is multiplied by 0.25 to calculate the quarterly rate. Therefore, the vector of macroeconomic variables (X_{it}) for the country (i) in period (t) includes the following variables,

$$X_{it} = (y_{it}, eq_{it}, ep_{it}, m_{it}, r_{it}, lr_{it}, dp_{it}, po_t, pmetal_t)$$

It is noticeable that oil and meal prices as a global factor are the same for all countries. This model includes 33 countries categorized into 9 individual countries and four groups. Individual countries include the U.S, Germany, China, Japan, and the 5 targeted economies in this study. The created groups are Central Europe; Austria, Belgium, Finland, France, Germany, Italy, Netherlands and Spain, Latin America; Argentina, Brazil, Chile, Mexico, Peru, the other developed countries; Australia, Canada, Norway, New Zeeland, Sweden and Switzerland, and the rest of the world; India, Philippines, South Africa, Saudi Arabia and Turkey.

The quarterly data for the period 1979-2013 have been used in this model. The source of data is the GVAR database for (1979Q1-2009Q4), which has been extended by Pesaran et al. (2009b) until (2006Q4) and then continued until (2009Q4) by Smith and Galesi (2011). The forward extrapolation method has been used to expand the data from 2009Q4 to 2013Q1. To this end, initially, quarterly data were extracted from DataStream, and after computing

the quarterly growth rate, it was applied to expand the data from 2009Q4 upward.

The computed data are precisely matched with extracted data by Smith and Galesi (2014) in the last verso of the GVAR toolbox (GVAR2.1). Since the data in the GVAR model must be balanced, in terms of the lack of data in each country, some of the variables have been dropped from the model. This limitation on the studied countries includes stock prices in Indonesia, money supply in South Korea and Thailand, and long-term interest rates in all five countries except South Korea. Based on these domestic variables the foreign country-specific variables are defined as follows,

$$X_{it}^{*} = (y_{it}^{*}, eq_{it}^{*}, ep_{it}^{*}, m_{it}^{*}, r_{it}^{*}, lr_{it}^{*}, dp_{it}^{*})$$

The W_{ij}^{X} in equation (2) is measured based on the average imports and exports from 2005 to 2013 for all countries extracted from International Financial Statistics (IFS) database. As mentioned earlier, all foreign country-specific variables, as well as oil and metal prices, are assumed weak exogenous (subject to relative tests) in individual models. However, these assumptions for the U.S are different, as discussed by Dees et al. (2007a). The U.S has a large size of the economy so that the oil price is included as an endogenous variable. Also, based on the weak exogeneity tests, the combination of weak exogenous variables in each country can be identified.

4 Empirical Results

Table 2 shows a summary of descriptive statistics for variables that are used in the GVAR model. It is important to determine the maximum shock that may occur for any variable. According to this table, the maximum deviation of most of the variables was between 2 and 3 standard deviations, with some cases more than three. Thus, in this study, the biggest shock can be considered to be equivalent to 3 standard deviations from the mean. So that to make optimum usage of the results, after estimating the coefficient of effective factors, the maximum amount of shocks were applied to measure their effects on domestic variables in each of the target countries. According to the results of stationary tests, all variables, except for real money supply in the central European region with small differences in statistics, are integrated with the first-order difference.[1]

[1] The results of all stationary tests are available in request.

Table 2
Descriptive Statistics of Domestic Macroeconomic Variables

Country /region	y				Dp					eq				ep			
	Max	Min	Mean	Std. d	Max	Min	Mean	Std. d.	Max	Min	Mean	Std. d.	Max	Min	Mean	Std. d.
Central Europe	4.74	4.15	4.48	0.19	0.03	0.00	0.01	0.01	2.58	0.51	1.67	0.57	-3.93	-5.23	-4.67	0.34
China	6.01	2.70	4.29	0.97	0.08	-0.02	0.01	0.02					-2.11	-3.08	-2.56	0.23
Indonesia	5.27	3.58	4.46	0.46	0.18	-0.02	0.02	0.03					5.05	3.58	4.05	0.27
Japan	4.72	4.09	4.51	0.18	0.02	-0.01	0.00	0.01	2.11	0.47	1.28	0.40	1.19	-0.23	0.34	0.40
Korea	5.08	3.16	4.27	0.60	0.09	0.00	0.01	0.01	1.37	-0.57	0.50	0.57	2.95	2.00	2.46	0.29
Latin America	5.01	4.06	4.50	0.27	0.92	0.01	0.13	0.16	2.10	-0.91	0.82	0.68	-2.27	-3.60	-2.96	0.38
Malaysia	5.16	3.26	4.28	0.58	0.04	-0.02	0.01	0.01	2.15	0.33	1.48	0.43	-3.06	-3.76	-3.37	0.17
Other developed countries	4.88	4.02	4.47	0.26	0.03	-0.01	0.01	0.01	2.69	0.65	1.74	0.57	-3.27	-4.55	-3.88	0.34
Rest of the world	5.34	3.69	4.44	0.49	0.07	0.00	0.03	0.01	3.07	0.23	1.62	0.79	-1.75	-2.59	-2.02	0.23
Singapore	5.20	3.06	4.23	0.64	0.04	-0.01	0.01	0.01	1.58	-0.09	0.86	0.36	-3.32	-4.67	-3.99	0.33
Thailand	5.12	3.36	4.37	0.54	0.06	-0.03	0.01	0.01	2.55	0.00	1.33	0.71	-0.51	-1.56	-0.99	0.24
U.K	4.80	4.09	4.47	0.23	0.07	0.00	0.01	0.01	3.75	2.09	3.10	0.47	-4.11	-5.48	-4.91	0.36
U.S	4.81	3.95	4.42	0.28	0.04	-0.02	0.01	0.01	2.57	0.48	1.66	0.63	3.42	4.81	2.41	0.63

	r				Lr				ln			
	Max	Min	Mean	Std. d	Max	Min	Mean	Std. d	Max	Min	Mean	Std. d.
Central Europe	0.04	0.00	0.02	0.01	0.02	0.00	0.02	0.01	6.81	5.83	6.30	0.32
China	0.03	0.00	0.01	0.01	0.07	0.01		0.01				
Indonesia	0.14	0.01	0.03	0.02					9.49	6.32	8.19	0.98
Japan	0.03	0.00	0.01	0.01			0.01		9.61	8.46	9.19	0.35
Korea	0.05	0.00	0.02	0.01	0.03	0.01	0.03	0.01				
Latin America	0.88	0.02	0.14	0.15	0.04	0.02		0.01				
Malaysia	0.02	0.00	0.01	0.00					9.27	6.29	7.91	0.88
Other develope countries	0.03	0.00	0.02	0.01			0.02		9.39	8.23	8.68	0.35
Rest of the world	0.06	0.01	0.03	0.01	0.04	0.00	0.03	0.01	6.62	4.24	5.32	0.75
Singapore	0.03	0.00	0.01	0.01	0.03	0.00		0.01	8.26	5.61	7.09	0.79
Thailand	0.05	0.00	0.02	0.01								
U.K	0.04	0.00	0.02	0.01			0.02		9.83	8.14	8.96	0.51
U.S	0.04	0.00	0.01	0.01			0.02		4.47	3.96	4.16	0.11
Oil price	3.42	4.81	2.41	0.63								
Metal price	4.37	5.52	3.81	0.47								

Note: y is Ln of real GDP, eq is Ln of real equity price, dp is inflation (first difference of ln consumer prices), ep is Ln of real exchange rate, r is short-term interest rate, Lr is long-term interest rate and m is Ln of real money supply

Before revealing the rest of the results, it should be said that the findings based on time-varying trade weight are more significant in comparison with the fixed weights. Hence, the following parts of the analysis are based on time-varying trade weights. The next important test is the weak exogeneity test of foreign-specific variables. Based on certain empirical studies such as Pesaran et al. (2006) and Dees et al. (2007b), some restrictions imposed about foreign-specific variables in the initial specified model. As demonstrated in Table 3, the F-test statistics of VECMX* models rejected the null hypothesis, which is all error correction terms are jointly zero, for some variables with a 5 percent significance level. These variables included real money supply (m*) for China, Japan, and the other developed countries in the region, short and long-

term interest rates (r* & Lr*) for Malaysia, Lr* for Singapore and equity price (eq*) for South Korea and Malaysia. Of course, given the significant level of 3 percent, the null hypothesis was accepted in these cases, and all weak exogeneity tests were significant. Hence, the above-mentioned variables except equity price were excluded from the list of foreign-specific variables for the relevant countries, and the model was rerun. At the same time, the foreign real equity price remained in the models because of its essential role in the transmission of the effects of external shocks on the domestic variables.

Table 3
Weak Exogeneity Test for Foreign Country-Specific Variables

Country	F test	F.05	y	dp	eq	ep	r	lr	m	poil	pmetal
Central Europe	F(5,113)	2.29	0.36	1.13	0.70		0.23	0.81	1.44	0.29	1.78
China	F(2,119)	3.07	0.87	0.18	0.37		1.04	2.75		1.70	0.23
Indonesia	F(3,117)	2.68	0.52	0.24	0.75		0.41	0.56	0.20	0.22	0.51
Japan	F(3,115)	2.68	0.87	0.58	2.02		1.12	1.30		1.00	0.86
Korea	F(5,114)	2.29	1.95	2.40	2.46*		0.91	2.18	1.41	1.04	0.29
Latin America	F(2,118)	3.07	1.11	3.44	0.43		0.11	0.72	1.12	2.62	0.44
Malaysia	F(2,117)	3.07	3.04	0.51	4.26*				0.21	0.31	1.73
Other developed countries	F(7,111)	2.09	1.09	1.80	1.64		0.44	0.56		0.77	0.96
Rest of the world	F(1,117)	3.92	0.01	0.05	1.16		0.71	0.04	0.24	2.17	0.46
Singapore	F(3,116)	2.68	0.25	1.73	1.43		2.91		0.66	1.58	0.64
Thailand	F(2,118)	3.07	2.24	1.31	0.55		0.17	0.04	3.58*	0.76	1.07
U.K	F(4,114)	2.45	3.38*	1.61	0.27		0.79	1.52	1.17	1.26	3.51*
U.S	F(7,114)	2.09	0.26	1.39		1.34			1.00		1.21

Note: The definition of all variable is like table 2 and the letter‘s’ has been added to show the foreign variables in the model.
The null hypothesis in this F-test assumes that all error correction terms are jointly zero in regression of foreign-specific variables’ error correction models.
The lag-length is up to 2 lags selected by Akaike information criterion (ACI)
* denotes the significance statistics at 5 percent level

Table 4 shows the structural break tests. As illustrated in this table, all different types of tests refer to the existence of structural breaks in all of the countries or regions. It is noticeable that all tests have also been done with a heteroskedasticity-robustness version that allows the variances of error terms to change. Based on the results, the main part of the null hypothesis rejection (stability of coefficients) is related to the change of residual variances. In the target countries, the results of structural break tests and their heteroskedasticity-robustness version strongly confirm these results. Overall, 18 percent of the estimated parameters were affected by the structural break. To deal with this problem, as Dees et al. (2007b) suggested, the robust standard errors and bootstrap estimation were used to analyze impulse response functions instead of point estimation.

Table 4
Structural Break Tests' for Domestic Variables

Test statistics	y	Dp	Eq	ep	R	lr	M	poil	Total variables
PK sup	23%	23%	9%	8%	8%	0%	11%	0%	13%
PK msq	15%	8%	18%	8%	8%	0%	11%	0%	10%
Nyblom	46%	31%	18%	50%	15%	43%	56%	0%	35%
Robust Nyblom	31%	15%	18%	33%	15%	43%	44%	0%	27%
MW	54%	46%	45%	58%	31%	43%	67%	100%	49%
Robust MW	31%	31%	55%	42%	23%	43%	56%	100%	39%
APW	62%	62%	64%	58%	77%	57%	78%	0%	65%
Robust APW	15%	31%	45%	33%	15%	57%	56%	100%	34%
QLR	62%	69%	55%	67%	77%	57%	78%	0%	66%
Robust QLR	15%	23%	45%	33%	23%	57%	67%	100%	35%

Percentage of Total Rejections of Null Hypotheses in Target Countries

PK sup	PK msq	Nyblom	Robust Nyblom	MW	Robust MW	APW	Robust APW	QLR	Robust QLR
29%	18%	29%	7%	32%	7%	57%	7%	61%	7%

Notes: All numbers show the percentage of tests that null hypothesis was rejected with 5% significance level.
The statistics of PKmsq and PKsup are related to maximal cumulative sum of residuals raised from OlS estimation. Nyblom statistics shows the change of parameters within the time.
MW, APW and QLR denote the different types of Wald test for structural break at one unknown time-point of time.
The robustness tests refer to the test result after removing residuals heteroskedasticity.

After adjusting the variables in individual countries' models based on the weak exogeneity tests, cointegration functions were estimated concerning the minimum rank restriction for each country. The appropriate numbers of lagged variables (up to two) for each model were selected based on the Akaike Information Criterion (AIC). Table 5 indicates the number of lag orders of long-run regressions (VARX*) and also shows the number of cointegration functions for each country/region, which was identified based on the statistics of 'maximum eigenvalue', and 'trace' tests. The estimated eigenvalue for all equations is less than one that means all long-run relations between variables are cointegrated[1]. The persistence profiles figure (see Appendix) shows that the effects of any shock, in the long run, converge to zero within forecasting time. This evidence indicates that the GVAR model is stable. According to Table 5, in 70 percent of the regressions, the residual of VECMX* does not have serial correlations. However, this ratio reached 85% at 0.01 significant levels. In target countries, only 7 out of 33 regressions had serial correlation in residuals.

[1] All eigenvalues are available in request.

Table 5
Lag Orders, Cointergration Relation and Serial Correlation Test of VECMX Residuals*

Country/region (p,q), C.V	Serial Correlation (order 4) Test of Residuals for the VECMX*								
		F .05	Y	dp	Eq	ep	r	lr	m	poil
Central Europe (2,1), 5	F(4,120)	2.455	3.210*	3.031*	1.330	0.433	0.715	0.606	1.680	
China (2,1), 2	F(4,113)	2.450	2.600*	3.069*		1.097	4.131*			
Indonesia (2,1), 3	F(4,112)	2.452	2.577*	2.624*		3.423*	1.471		2.893*	
Japan (2,1), 3	F(4,110)	2.453	0.805	0.491	1.283	3.594*	3.650*	0.433	0.419	
Korea (2,1) ,5	F(4,115)	2.454	3.878*	6.128*	1.472	1.269	0.847	0.477		
Latin America (2,1), 2	F(4,120)	2.451	3.260*	1.417	1.419	1.729	0.179			
Malaysia (1,1), 2	F(4,117)	2.447	1.405	0.525	0.781	6.320*	1.396		0.621	
Other Developed Countries (1,1), 7	F(4,122)	2.451	1.457	1.491	0.109	2.418	2.231	0.957	3.613*	
Rest of the World (1,1), 1	F(4,112)	2.447	1.723	0.907	3.561	3.603	1.088	1.483	8.270*	
Singapore (2,1), 3	F(4,112)	2.452	1.168	3.795*	1.253	1.103	4.270*		2.860*	
Thailand (1,1), 2	F(4,118)	2.448	1.603	3.700*	0.524	6.260*	0.428			
U.K (1,1) 4	F(4,114)	2.449	0.257	2.841*	1.007	4.601*	0.661	0.867	1.433	
U.S (2,1), 7	F(4,112)	2.454	0.167	1.286	1.834		3.426*	0.997	2.177	2.245

Notes: p and q is the lag order for domestic and foreign variables.
C.V: Cointegrating vectors is determined through trace and maximum egienvalue tests.
Serial correlation for VECMX* residual has been done by F-test.
X* includes: y is Ln of real GDP, eq is Ln of real equity price, dp is inflation, ep is Ln of real exchange rate, r is short-term interest rate, Lr is long-term interest rate and m is Ln of real money supply.
* denotes the significance at 0.05 or less level that the null hypotheses, no serial correlation, can be rejected.

In sum, based on the above conditions, there is ample justification for the use of the GVAR model to predict the effects of shocks as the primary purpose of this study. The persistence profiles[1] also show that long-run function is highly cointegrated, and all variables reach their long-term equilibrium within 10 years after any shock (see Figure A.1 in Appendix). This feature means that the GVAR model is stable, and the effect of any shock is reduced to zero during the forecast period.

As discussed earlier, the domestic variables in the studied economies are affected by external shocks due to the openness of the economy. The coefficients in Table 6 are the modulus of elasticity of domestic variables concerning their foreign counterparts. For example, in Malaysia, if the specified foreign real output increases by 1%, domestic production will rise by 1.24%. As it is seen, just 6 out of 22 of coefficients in target countries were not significant with an expected positive sign.

[1] It refers to the moving average of effects of systematic shocks on the long run relations during the time in the GVAR model (Pesaran & Shin, 1996).

Table 6
Contemporaneous Effects of Foreign Variables on Domestic Variables in the Targeting Countries

Country	Y	Dp	Eq	R	Lr	m
Indonesia	0.43	0.27		1.03		-0.39
	1.59*	0.61		1.71*		-1.96**
Korea	0.19	1.14	0.73	-0.26	0.23	
	1.00	5.08***	4.69***	-2.37**	0.84	
Malaysia	1.24	0.55	1.29			0.06
	4.29***	3.30***	7.11***			0.57
Singapore	1.06	0.51	1.21	0.53		-0.03
	4.00***	3.07***	9.05***	2.99***		-0.24
Thailand	0.48	1.22	1.00	0.87		
	1.23	4.80***	8.37***	2.18**		

Note: For each country the first row is coefficient, the second row is the White's heteroskedastic robust standard error and the numbers in brackets are the White's t-ratios.
*, ** and *** denote the significant level of 0.1%, 0.05% and 0.01%

Table 6 shows whether the internal macroeconomic variables are affected by their foreign counterparts or not. Therefore, regarding the variables with an insignificant coefficient, it cannot be said that these variables are not affected by foreign shocks. The generalized impulse response functions are used to depict the dynamic system-wide effects of any innovation on the domestic variables. To this end, the robust standard errors and the bootstrap estimation were used to analyze the impulse response function instead of point estimation. It has been done because, overall, 27 percent of the estimated parameters were affected by the structural break.

The shocks that are used in this study were categorized into three groups, including one Standard Deviation (SD) shock to global oil and metal price; one standard deviation shock on all endogenous variables belonging to foreign countries, and one standard deviation shock on a domestic variable in the studied countries. As explained before, the expected time horizon in this study is 40 quarters. Since the highest effects of any shock have always happened within the first years, the main focus of this study is on the impact of shocks during the first-year forecast period.[1]

As it is seen, the shocks to oil prices led to an increase in most of the macroeconomic variables except the real exchange rate. It is because of the dollar strengthens by the main developed countries as the primary buyers of oil. This result is consistent with the results of the study by Aziz et al. (2013) that shows the negative relationship between oil price and the real exchange rate in ASEAN-5 countries. Meanwhile, the equity price is affected positively

[1] The results of the average and maximum effects of these shocks are available in request.

more than the other variables, which is between 20 to 42 percent. One standard deviation positive shock to oil price led to a reduction in the exchange rate in Korea by -12.53 percent and Singapore by -3.57 percent that was affected more than the other countries. Korea, because of being among the high industrial countries and Singapore with the most significant financial market, was affected more than the other countries.

At the same time, this shock led to a three to four percent increase in the real output in target countries except for Indonesia, which is considered an oil export country. The major part of budget and development plans depend on oil renew. Any increase in the oil price does not impact immediately on output. On the other hand, Indonesia has a vital role in oil price throat, the Organization of Petroleum Exporting Countries (OPEC). The imports of capital goods also faced with rising prices due to lower exchange rates, and therefore ultimately, the entire production process takes reducer. Also, the prices of imported capital goods will increase due to exchange rate depreciation. Finally, the whole production is confronted with a decreasing trend and furthermore 4 to 4.5 percent increases in the money supply in Malaysia and Singapore. The big international capital market in these countries, besides decreasing the exchange rate has made the potential to grave extra founds coming from the oil-exporting countries due to high-level oil prices. These features lead to more money supply in these two countries. The other common global factor is the metal price that one S.D. shock to this variable led just to a tangible increase in the equity prices in all studied countries, between 5.2 to 5.7 percent, and somewhat the exchange rate in Korea as an industrial country with a noticeable export. As it is mentioned increasing the oil price due to change in the exchange rate has the most effects on the studied economy in this study because of the open economy and international capital market. Therefore, economists have to use the monetary policy to deal with the adverse effects of shocks on the exchange rate. Moreover, they have to select useful exchange rate regimes to more certainty in the economy.

Regarding the effects of shocks on macroeconomic variables in foreign areas, it can be said that the equity price in all target countries and the real exchange rate in Korea and Indonesia are affected more than the others. It was observed that the mentioned exchange rates were changed negatively by shock to equity price in Euro area and positively by shock in the U.S. The negative shock to equity price in the U.S and Central Europe led to a decrease, and the global collapse led to an increase in the equity price of the studied countries. It means that the deficit in the European stock market will influence faster to

the stock market in the studied countries. Furthermore, this market is the best to invest in the outflow founds from the American stock market due to crisis time.

The shock to real GDP in the U.S and China also influenced the equity price, but with a different sign, the U.S has a higher and positive effect, but China has negative and less impact. Regarding to these results and comparing them with the estimated results with fixed trade weights, it can be said that China is one of the most essential alternative trade partners against the U.S in recent years In this condition any decrease in growth rate in China will lead to adverse effects on profitability for most companies and less stock price and exchange rate due to high trade relationship. In the meantime, the less economic growth in the U.S led to inflows of the founds to these countries and caused to high stock price and exchange rate. As it is shown during the negative shock to the U.S, GDP, the financial markets in the studied countries were considered riskless markets for investment. But the adverse effects of GDP decrease in China on the equity price denotes the important role of China in the studied countries.

The exchange rate in Korea and Indonesia were also affected by the shocks to GDP in the U.S and China and even any foreign shock to equity price. Money supply in Indonesia is the other useful variable, and except for the shock to the money supply in the U.S and to the exchange rate in the Euro area, the other shocks have adverse effects. The results show that the GDP in target countries is highly sensitive to negative global shock to equity price, and the other foreign shocks do not have important effect on this variable.

The shocks to macroeconomic factors in the target countries had essential effects. Based on the global impulse response function (GIRF hereafter) results, one standard deviation shock to the inflation had the most significant impact on the Indonesian macroeconomic factors. It was observed that the real exchange rate in Indonesia, Korea, and Malaysia was negatively affected by shocks in inflation in /outside of these countries. Of course, there is an exception in the case of Korea and Indonesia that had positively affected by the internal inflationary shock in Singapore and Thailand. The shocks to inflation led to a decrease in the equity price in these countries (except the shock in Korea with positive effects on the Korean equity price and the shock to inflation in Singapore with positive effects on equity price in Malaysia and Singapore). The effects of shock to inflation on the other variables were not so much discussed. As it is seen, the equity price in all countries and the exchange rate in Korea and Indonesia were affected more than the other countries.

One standard deviation negative shock to real exchange rate continued negatively within one year by -6.6 percent, -11.9 percent, -2.7 percent, -3.9 percent, and -1.8 percent in Indonesia, Korea, Malaysia, Thailand, and Singapore, respectively. Some of these results are consistent with the findings of Chang (2008). The exchange rate in each of these countries was negatively affected by the negative shock to the exchange rate in the other studied countries. These shocks all together led to an increase in the equity price in the studied countries. Meanwhile, the shock had a more significant effect on the Korean exchange rate than the other studied countries. The overvaluation of domestic currency led to an increase in the value of foreign assets that were invested in the stock market, and it consequently led to a rise in the equity price. This shock in Korea just led to an increase of 2.9 percent in Korean inflation. The money supply in Indonesia was also affected by the shock to the exchange rate in Indonesia (negatively) and Korea (positively). Regarding the GDP, just the Korean GDP was increased by 1.9 percent due to the shock to the exchange rate in this country. There was not any noticeable impact of these shocks on other variables.

The effects of one standard deviation negative shock in real output showed that the real exchange rate in Indonesia by 1.7 to 3.8 percent and Korea by 1.5 to 8.8 percent were positively affected except for the shock to GDP in Singapore with adverse effects on GDP, especially in Indonesia and Korea. The real exchange rate in Indonesia was also susceptible to shock to GDP in other countries. The equity price was changed negatively due to the negative shock to the output in the studied countries.

Regarding the equity price, it can be said that one standard deviation negative shock in all studied countries led to a decrease in equity prices in other countries. The exchange rate in Korea and Indonesia were positively affected more than the other countries by the shock to equity price except for the shock to Singapore that had adverse effects on the exchange rate of target countries. Meanwhile, the shock to equity price in Korea had more effect on the variables in the other countries, such as an increase in the exchange rate in Indonesia and Thailand, and a decrease in money supply in Indonesia. As was observed in this study, the shock to equity price in Korea and Thailand had more impact on the different macroeconomic variables than in the other countries.

According to the results, the equity price, exchange rate, real output, and money supply were the most critical variables to transfer the effects of external shocks on domestic macroeconomic variables. Regarding the shocks in target countries, equity price, exchange rate, and to some extent, the money supply

has more important roles in transferring the effects of shocks. However, based on the individual characteristics of each of these countries, some of these variables were more effective for only a particular country and had less impact on the others. For example, Singapore with its biggest global financial market, Korea with the most significant industrial economy, and Indonesia with a high degree of inflation have different responses to each shock. The shocks to variables that are related to these countries have more effects on the economy in comparison with the other shocks.

The most crucial feature of GIRF outputs was that all forecasted domestic macro-variables carried the indirect systematic effects of other shocked variables, as well. To show the contribution of different factors to create one standard deviation in each of these variables, the forecast error variance decomposition (FEVD hereafter) is employed.

Unlike the impulse response function that shows the effects of one shocked variable on the other variables, the FEVD indicates the share of other endogenous variables to create a standard deviation shock in each variable. The results showed which variable was more affected by which region and variable. According to our findings, the positive correlation between the shocks resulted from different variables leads to the sum of the share of all effective variables to be more than 100 percent. This feature would be emphasized when the time-varying weights were used to create foreign specific variables.[1]

Based on our findings, most of the share of the equity price forecast error variance is different in each country. In the case of Singapore and Malaysia, the U.S long–term interest rate, and for Korea and Thailand, the Korean GDP and equity price are the most effective factors.[2] The next effective variables were the U.K money supply for Korea and the U.S, the inflation for Malaysia and Singapore, and the equity price in the target region for Thailand. Hence, it was observed that the equity price in the U.S, the U.K, and Korea have the most share to determinate forecast error variance for one standard deviation shock in the equity price of the studied countries.

The greatest part of the real exchange rate forecast error variance in Malaysia, Singapore, and Thailand is explained by their real exchange rate. For Korea and Indonesia, the U.S long-term interest rate has the highest share. Money supply, inflation, GDP, long-term interest rate, and (global) oil price

[1] The results are available in request.

[2] As quarterly data for equity price in Indonesia is not sufficient, this variable is not included in the model.

in the U.S and GDP and interest rates in Korea have the maximum shares in determining the real exchange rate forecast error variance in all countries.

Regarding the real GDP, the real domestic GDP in all countries explains most of the real GDP forecast error variance. Furthermore, like real exchange rate for real GDP, the money supply in the UK, inflation, long-term interest rate, oil price (global) in the U.S, interest rates, GDP, equity price and somewhat inflation in Korea are the other essential variables to explain the forecast error variance of the real GDP.

Overall, the macroeconomic variables in the U.S, the U.K, Korea, and also the global U.S oil price have important roles in determining the forecast error variance of equity price, exchange rate, and GDP in all studied countries. The impulse response function also confirms these results. As mentioned earlier, the shocks on the main macroeconomic variables in these countries have more impacts on three variables, equity price, exchange rate, and GDP, in the target countries.

The U.S, as the biggest economy in the world and Korea, as the most industrial economy with more trade share in the studied area, includes the most important and useful foreign shocks in the studied countries. Although the shocks to the macro-variables of China have significant effects on the target economies in recent years, these shocks are not among the ten top effective factors. Hence, to depict the effects of shocks on these more effective variables within the forecast horizon, the impulse response function of two particular foreign variables, the oil price, and the U.S real GDP, are shown by Figure A.2 in the Appendix.[1]

5 Conclusions

This article, considering the open economy and its dependence on exports and foreign funds in the new emerging Southeast Asian countries, investigated the vulnerability of these economies against external and internal macroeconomic shocks. To this end, an unrestricted global vector autoregressive model was designed for 33 countries, including 5 target countries, Malaysia, Korea, Singapore, Thailand, and Indonesia. The existence of less correlation between the residuals and the domestic explanatory variables in the GVAR model in comparison with the VAR model highlights the importance of foreign specific variables and the international links between macroeconomic variables in the studied countries. The relative eigenvalues and also the persistence profiles show the stability of the GVAR model and the credibility of impulse response

[1] The figures of all other impulse response functions are available on request.

functions. According to the empirical results of the generalized impulse responses, the functions of real output, equity price, real exchange rate, and to some extent, the money supply is the most important variable to translate the effects of external shock into the domestic economy in studied countries.

Based on the results, any sudden change in the economic environment of the U.S, China, global oil price, and Euro area leads to a noticeable change in the domestic economic variables in the target countries. Meanwhile, each of these countries behaves variously to response to different shocks, since their economic structures are not similar. Then adverse shocks to GDP in the U.S and China have different effects on the studied countries, and especially on the equity price. This result indicates the relative significant impact of China on economy among the target countries. Also, the macroeconomic shocks in Korea, Singapore, and to some extent Malaysia are documented to have significant effects on the domestic variables.

According to the forecast error variance decomposition, macroeconomic variables in the U.S, the U.K, Korea, and also the global oil price belong to the top ten effective factors in determining the forecast error variance of equity price, exchange rate, and GDP in all studied countries. In the meantime, domestic change in GDP and exchange rate (except in Indonesia) have the highest share.

Based on these results, it is suggested that the policymakers pay more attention to the shocks to macroeconomic conditions in the foreign area especially in the U.S, the U.K, and the global oil price. The shocks to macroeconomic variables in Korea and Singapore should also be paid enough attention by economists in their macro-prudential analyses, such as in their stress test regarding risk management in the financial systems.

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Appendix

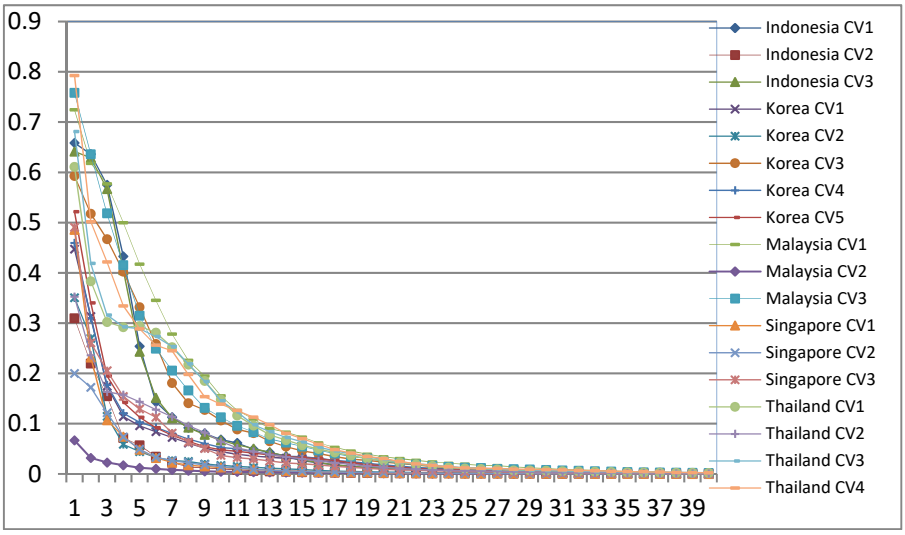

Figure A.1. Persistence Profiles of System-Wide Shocks on the Cointegrating Relations of the GVAR Model in the Studied Countries. CVn is related to nth cointegrating vector. *Source:* Research Findings.

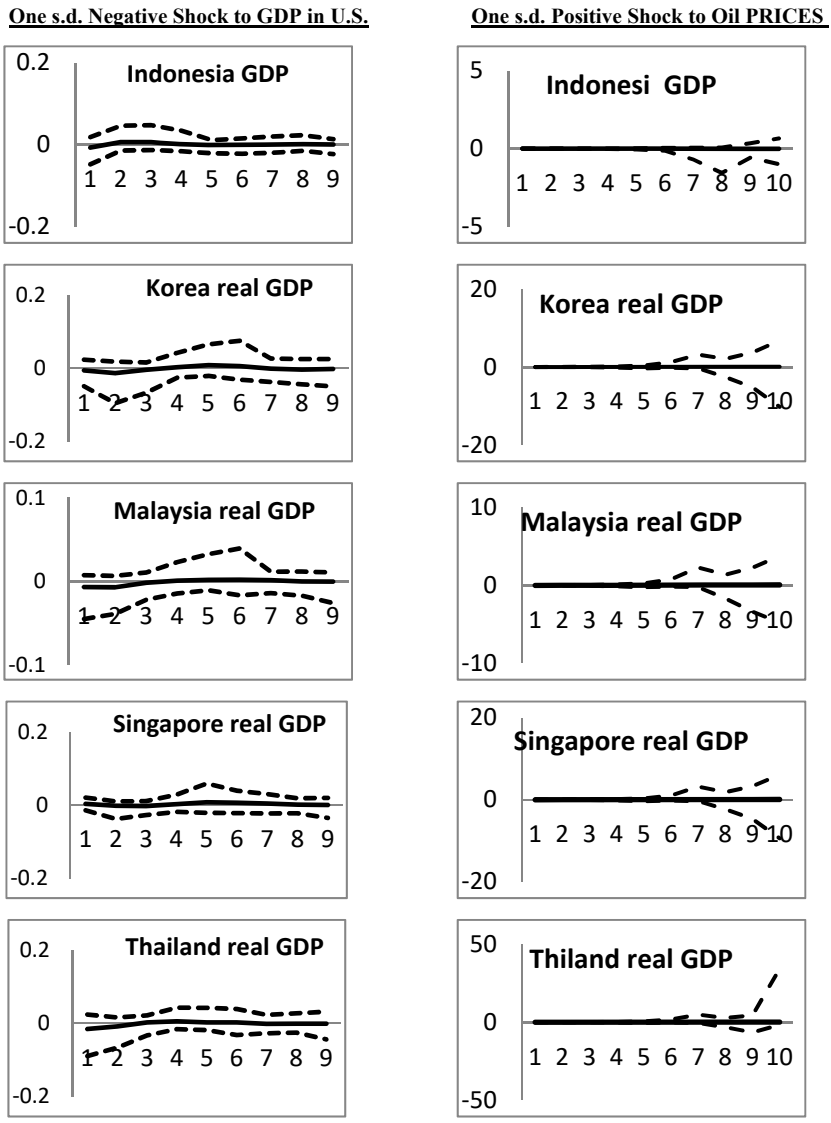

Figure A.2. Generalized Impulse Response of real GDP in the Studied Countries Against one S.D. Shocks to Oil Price and the GDP of the U.S. *Source:* Research Findings.