Jurnal Pengurusan 41(2014) 113 - 122

Impact of Singapore, US and Japanese Macroeconomic Shocks on Malaysian Economy: A Sign-Restricted SVAR Analysis

(Kesan Kejutan Makroekonomi di Singapura, Amerika Syarikat dan Jepun terhadap Ekonomi Malaysia: Satu Analisis SVAR dengan Kekangan Tanda)

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ABSTRACT

This paper examines the relative importance of Singapore, US and Japanese macroeconomic shocks on Malaysian economy. Employing structural vector auto regression (SVAR) model with a sign restriction approach, the study estimates four models. Each model consists of four domestic macroeconomic variables (output, inflation, interest rate and exchange rate) and three foreign variables (output, inflation and interest rate) of US, Japan, Singapore and the all countries trade-weighted variables, respectively. The results of the study reveal that, relative to domestic shocks, foreign shocks appear to play more prominent role in influencing domestic macroeconomic variables. Among the three foreign countries being investigated, the effect of shock of Singapore is the most dominant. The US effect comes second and the Japanese effect comes last. When Singapore's variables are the only foreign factors in the system, their shocks bring about significant variation to Malaysian variables especially the output. Consequently, in modeling the effect of foreign factors on Malaysian economy, Singapore effect should be taken into account. This is important as Singapore is not only one of Malaysia's long-term major trading partners, but it is also one of the Malaysia's closest neighbors by geographical distance.

Keywords: Foreign shocks; domestic shocks; monetary policy; SVAR; sign restrictions

ABSTRAK

Kertas ini mengkaji kepentingan relatif kejutan makroekonomi di Singapura, AS dan Jepun terhadap ekonomi Malaysia. Dengan menggunakan model vektor autoregresif berstruktur (SVAR) bersama kaedah kekangan tanda, kajian secara keseluruhan menganggarkan empat model. Setiap satu model mengandungi pemboleh ubah makroekonomi domestik (keluaran, inflasi, kadar bunga dan kadar pertukaran) dan pemboleh ubah makroekonomi asing (keluaran, inflasi dan kadar bunga) yang setiap satunya daripada negara Singapura, AS, Jepun dan kesemua empat negara yang diwakili oleh pemboleh ubah asing yang diterbitkan berdasarkan wajaran perdagangan. Keputusan kajian menunjukkan bahawa kejutan di negara luar memberi kesan yang lebih besar kepada pemboleh ubah makroekonomi domestik. Daripada tiga negara yang diselidiki, didapati kesan kejutan negara Singapura adalah paling dominan. Kesan kejutan negara Amerika syarikat adalah kedua penting dan kesan kejutan Jepun adalah yang paling kurang penting. Apabila pemboleh ubah negara Singapura sahaja dimasukkan dalam model, kejutannya memberi kesan perubahan yang signifikan kepada pemboleh ubah Malaysia terutamanya ke atas output negara. Justeru, dalam pemodelan kesan faktor asing ke atas ekonomi Malaysia, kesan Singapura harus diberi penekanan. Hal ini penting kerana Singapura bukan sahaja rakan dagang jangka panjang Malaysia yang penting, malah ia juga adalah antara yang terdekat dari aspek geografi.

Kata kunci: Kejutan asing; kejutan domestik; dasar monetari; SVAR; kekangan tanda

INTRODUCTION

As a small and highly trade-dependent economy, it is difficult to deny the possibility that Malaysia's economy would be vulnerable to a variety of external shocks such as world oil price, foreign income and foreign monetary policy shocks. Understanding the effect of external shocks on the economy is crucial for policy makers especially the Bank Negara Malaysia (BNM, the central bank of Malaysia) in making better policy formulation for maintaining economic stability.

In studying the effect of foreign shocks on small open economies, most studies mainly take into account the influence of the US or Japan. For Malaysian case, the US and/or Japan are considered in the macroeconomic model because they have contributed substantially in the total trade and investment of the country. In the meantime, Singapore, the neighboring country, has also been one of the country's important trading partners. The exclusion of Singapore in the macro model of the country might have caused the importance of US and/or Japanese effect overrated.[1] In other words, the significant impact of Singapore shock on the economy might have been underestimated but the true consequences of the shock can only be known by empirical study.

In view of this crucial issue, this paper investigates the relative importance of Singapore, US and Japanese shocks on Malaysian economy.[2] This study contributes

to the existing literature by improving and extending the analysis of foreign shocks effect upon a small open economy in three dimensions. First, it considers the role of more than one foreign country, namely Singapore, US and Japan in modeling the open-economy structural vector auto regression (SVAR). Previous studies of monetary policy effects use either small-scale VAR in a closed-economy setup where no role of foreign variables is considered in the analysis or they utilize only one foreign country particularly the US to capture the foreign factors. Some examples of related studies for Malaysia are Azali and Matthews (1999), Ibrahim (2005), and Tang (2006). According to Dungey and Fry (2003), ignoring other important foreign countries in the model would lead to a misspecification in the model and the impact of the foreign country used would be largely overrated. In addition, this study also employs block exogeneity assumption whereby the foreign variables are block exogenous to the domestic variables. Failing to impose these restrictions for a small open economy is not only economically unappealing but may also result in a misspecification of the model (Zha 1999). Zaidi and Fisher (2010) have examined this issue for Malaysia by considering the US and Japan.[3]

Second, the study explores the relative importance of foreign shocks (for example, an increase in foreign income) of the three most important major trading partner countries on domestic economy. Economic theory predicts that there is a positive spillover effect of an increase in foreign income to domestic economy, in which, it boosts home aggregate demand via an increase in home exports. This is usually known as locomotive effects. Knowing which country affects the most would be an important advantage for the policy makers in formulating better policy prescriptions especially through international policy coordination.

Third, this study makes use of a non-recursive open economy structural VAR model which permits an identification strategy based on economic theories rather than the sometimes questionable assumptions which underlie a traditional recursive VAR. The model is used as it provides some theoretical backgrounds on the relationship between the variables used in the study. Furthermore, a sign restriction approach is employed in the identification strategy, as proposed by Uhlig (2005), whereby some impulse responses are constrained to follow economic theory while others are left unrestricted. Thus, some of the puzzles that normally appear in macroeconomic modeling can be largely avoided.

The rest of the chapter is organized as follows. Next section presents a literature review relating to foreign shocks effects upon domestic macroeconomics fluctuation. The section after that briefly discusses the methodological framework and data. Next section that follows presents the empirical results by focusing on the sign restricted impulse-responses function (SIRF). Finally, the last section summarizes and concludes.

LITERATURE REVIEW

The issues of foreign shock effects of a large economy country, such as the US upon domestic macroeconomic fluctuations in a small open economy have been examined quiet extensively using an open-economy VAR/SVAR model. Theoretically, the effect of a foreign country shock on an economy depends on the degree of interdependency among the countries and the channels through which the shock transmits. Some countries might gain benefits from foreign countries shocks (locomotive effect) but others might have disadvantages from foreign policy change (beggar-thy-neighbor effect).

Most of the findings conclude that foreign factors (foreign income and foreign monetary policy) play a dominant role in influencing the domestic economy.[4] For example, Cushman and Zha (1997) find that external shocks (US income, US inflation, US federal fund rate, and world total commodity export prices) have become dominant source of domestic output fluctuations in Canada, whereas, domestic monetary policy shocks (an increase in interest rates) has only a small contribution on output. Similar findings have been repported by Dungey and Pagan (2000) when they find that international factors are generally a substantial contributor to Australian economy while domestic monetary policy contributes to stabilize economic activity, but the effect is not large.

Buckle et al. (2007) study the relative importance of international and domestic shocks in New Zealand and also reveal that international business cycles and export and import prices fluctuations have been dominant influences on the New Zealand business cycle than international or domestic financial shocks. Similarly, Kim and Roubini (2000) conclude that domestic monetary policy is not the major contributor to output fluctuations in the G-7 countries and in the most countries. However, foreign shocks (oil price shocks and US monetary policy) have contributed more to output fluctuations. Kim (2001) finds that a US monetary policy expansion has a positive spillover effect on the G-6 countries' output, which affects the world capital market. Canova (2005) finds that US monetary policy shocks significantly affect the interest rates in Latin America. Moreover, such external shocks are an important source of macroeconomic fluctuations in Latin America. Mackowiak (2007) also unveils that external shocks are an important source of macroeconomic fluctuations in emerging market countries. In fact, the study finds the US monetary policy shocks have strong and immediate effects upon emerging market interest rates and exchange rates.

Besides foreign monetary policy, foreign income from a large economy also plays a significant role in influencing the macroeconomic fluctuations of a small open economy. Rodriguez et al. (2010), for instance, examine the impact of foreign shocks (interest rate, commodity price, and industrial production shocks) upon the macroeconomics variables in ten Central and Eastern European (CEE)

countries using a near VAR model. They uncover that some countries such as Slovakia and Slovenia react stronger to foreign industrial production shocks than other countries. They also find that the effects of foreign income shocks on domestic economy are related to the underlying economic structure, and the credibility of the monetary authority. In contrast, a study by Horvath and Rusnak (2008) in Slovakia finds that domestic prices are driven mainly by foreign factors, whereas, economic growth is primarily driven by domestic factors.

In developing ASEAN countries, studies relating to foreign shock effects upon macroeconomics variables and policy are still limited in the literature. Most of the studies use SVAR in a closed economy setup. For example, in the Malaysian context, Azali and Matthews (1999) and Ibrahim (2005) use a closed economy model in examining the effect of domestic monetary policy shocks on economic activities, and find that there is a real effect of monetary policy. In comparison, Tang (2006) employs an open-economy recursive VAR model in examining the relative importance of the monetary policy transmission mechanism channels (interest rates, credit, asset price, and exchange rate channel). His study concludes that the interest rate channel plays a pivotal role in influencing output and inflation. In addition, the asset price channel is also relevant for explaining output variability, but for inflation, the exchange rate channel is more relevant than the asset price channel.

Recently, new development in empirical studies using VAR/SVAR model focuses on sign restrictions approach as one of the identification strategy. Proposed by Faust (1998), Canova and De Nicolo (2002) and Uhlig (2005), the strategy accepts all the impulses that are in accordance with sign restrictions on impact while others are rejected. Since then a number of researchers have applied this strategy to examine the effect of fiscal, monetary policy as well as the demand and supply shocks (see among others Mountford & Uhlig 2009; Lippi & Nobili 2011; Peersman & Straub 2009; Canova & Pappa 2007).

In view of the importance of foreign shock, this study adds to the existing literature especially for Malaysian case by employing a sign restriction technique to investigate the impact of Singapore effect on domestic economy.

RESEARCH METHODOLOGY

This section describes the estimation procedures and the variables used in the SVAR model for Malaysia. Essentially, there are four models to be estimated. The first model takes into account the trade-weighted variables of Singapore, the US and Japanese variables as representing the foreign sector. The second, third and the fourth model use Singapore, US and Japanese variables, respectively to represent the external sector. The preferred model is the first model as it takes into account the dynamics of more foreign countries as in the real world.

For each model, the variables are divided into two blocks; the foreign and domestic blocks. The foreign block consists of real foreign aggregate output, inflation and interest rate, while the domestic block comprises real output, inflation, interest rate, and real effective exchange rate. The international block is assumed to be block-exogenous to each of the domestic macroeconomic variable (c.f., Cushman & Zha 1997; Zha 1999). In other words, there are no contemporaneous or lagged effects from the domestic variables to the international variables.

The real foreign aggregate output (Y*) is a trade-weighted gross domestic product (GDP) of Singapore, the US and Japan. To construct this measure all foreign GDPs are converted to a common currency. In this case, GDPs of Singapore and Japanese are converted to US dollars. For foreign inflation and interest rate, a similar trade-weighted approach is employed. Foreign inflation (π^*) is calculated by a change in the consumer price index (CPI) in all the respected countries. Meanwhile, the foreign interest rates (i*) are measured by the 3-month interbank rate for Singapore, the Federal Funds rate for US and the call money rate for Japan.[5] For the internal block, the variables are real gross domestic product for aggregate output (Y), quarter-on-quarter percentage change in CPI for inflation (π), the interbank overnight money rate for the interest rate (i) and the real effective exchange rate of Malaysia, Singapore, US and Japan for the exchange rate variable (e).

All variables are transformed into natural logs except for foreign and domestic inflation and interest rates, respectively. Quarterly data for the variables are taken from International Financial Statistics database, DataStream and various publications of Monthly Bulletin of Bank Negara Malaysia (BNM). The sample period runs from 1985: 1 until 2010: 4, covering the two major economic crises of 1985/86, and 1997/98. To capture the effects of the economic recessions, two dummies are used; a 1985/86 economic recession dummy (DER) and a dummy for the 1997/98 Asian crisis (DAC). DER is set to equal to one from 1985: 2 to 1986: 2 and zero otherwise, while DAC is one from 1997: 4 to 1998: 4 and zero otherwise.[6]

With the possible exception of inflation, all of the variables in the study are potentially non-stationary due to the presence of either deterministic or stochastic trends. This raises the question as to whether the SVAR model should be specified in first-differences rather than in levels. Ramaswamy and Slok (1998) discuss the trade-off between the loss of efficiency (when the VAR is estimated in levels, but without imposing any cointegrating relationships) and the loss of information (when the VAR is estimated in first-differences). In essence, they recommend that in cases where there is no prior economic theory that can suggest either the number of long-run relationships or how they should be interpreted, it is realistic not to impose cointegration restrictions on the VAR model. This paper follows their recommendation and thus, the SVAR model is specified in levels.

SVAR MODELS

In the SVAR approach the dynamic relationship for the selected economic variables is given by the following equation;

$$BY_t = C + (\Gamma_1 L + \Gamma_2 L^2 + \ldots + \Gamma_k L^k)Y_t + \varepsilon_t \quad (1)$$

where B is a square matrix that captures the structural contemporaneous relationships among the economic variables, Y_t is n × 1 vector of macroeconomics variables, C is a vector of deterministic variables, $\Gamma(L)$ is a kth order matrix polynomial in lag operator, L and ε_t is a vector of structural innovations that satisfies the conditions that $E(\varepsilon_t) = 0$, $E(\varepsilon_t \varepsilon_s') = \Sigma_\varepsilon$ for all $t = s$ and $E(\varepsilon_t \varepsilon_s') = 0$ otherwise.

Pre-multiplying equation (1) with B^{-1} yields a reduced form VAR equation;

$$Y_t = B^{-1}C + B^{-1}(\Gamma_1 L + \Gamma_2 L^2 + \ldots + \Gamma_k L^k)Y_t + B^{-1}\varepsilon_t \quad (2)$$

where $e_t = B^{-1}\varepsilon_t$ is a reduced form VAR residual which satisfies the conditions that $E(e_t) = 0$, $E(e_t e_s') = \Sigma_{e'}$. Σ_e is a (nxn) symmetric, positive definite matrix which can be estimated from the data. The relationship between the variance-covariance matrix of the estimated residuals, Σ_e and the variance-covariance matrix of the structural innovations, Σ_e is such that,

$$\begin{aligned} \Sigma_\varepsilon &= E(\varepsilon_t \varepsilon_t') \\ &= E(Be_t e_t' B') = BE(e_t e_t')B' \\ &= B\Sigma_e B' \end{aligned} \quad (3)$$

In order for the system to be identified, sufficient restrictions must be imposed so as to recover all structural innovations from the reduced form VAR residuals, e_t. Thus for (nxn) symmetric matrix Σ_e, there are $(n^2 + n)/2$ unknowns and hence $(n^2 - n)/2$ additional restrictions need to be imposed to exactly identify the system.

The relationship between the structural innovations and the reduced-form residuals e_t is given by $Be_t = \varepsilon_t$. In a purely recursive SVAR model, the elements in B above the diagonal of the matrix are all set equal to zero. Equation (4) indicates the set of restrictions that are imposed on the contemporaneous parameters of the first SVAR model for the Malaysian economy. The coefficient β_{ij} indicates how variable j affects variable i, contemporaneously. The coefficients on the diagonal are normalized to unity, while the number of zero restrictions on the coefficients is 23, so the model is over identified.

$$BY_t \equiv \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ \beta_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ \beta_{31} & \beta_{32} & 1 & 0 & 0 & 0 & 0 \\ \beta_{41} & \beta_{42} & \beta_{43} & 1 & 0 & 0 & 0 \\ \beta_{51} & \beta_{52} & \beta_{53} & \beta_{54} & 1 & 0 & 0 \\ 0 & 0 & \beta_{63} & 0 & \beta_{65} & 1 & \beta_{67} \\ \beta_{71} & \beta_{72} & \beta_{73} & \beta_{74} & \beta_{75} & \beta_{76} & 1 \end{bmatrix} \begin{bmatrix} Y_t^* \\ \pi_t^* \\ i_t^* \\ Y_t \\ \pi_t \\ i_t \\ e_t \end{bmatrix} \quad (4)$$

The three foreign variables which are foreign output, inflation and interest rate are assumed to contemporaneously affect most of the domestic variables. The only exceptions are that foreign output does not contemporaneously affect domestic policy interest rate. The zero restriction is based on the assumption that policy-makers in the BNM do not observe contemporaneous values of foreign output. This type of identifying assumption has been widely used in SVAR models. For instance, see Kim and Roubini (2000) for the application to the G7 economies and Berkelmans (2005) for the case of Australia. Domestic variables are assumed not to contemporaneously affect the foreign variables (the restriction is also imposed on lagged values of the domestic variables) due to the fact that Malaysian economy is relatively small in size and therefore unlikely to have much impact on foreign variables.

Restrictions in Equation (4) indicate that all domestic financial variables (the interest rate and the exchange rate) respond contemporaneously to inflation shocks. Since the ultimate goal of monetary policy is to have low and stable inflation, a shock in inflation will require policy-makers to respond immediately by adjusting the policy rate. In Equation (4), it is assumed that policy-makers in the BMN respond more rapidly to an inflation shock than they do to a shock to domestic output.

Finally, the exchange rate only affects the interest rate contemporaneously. The interdependence of the exchange rate and the interest rate (as indicated by β_{67} and β_{76}) has been assumed in Kim and Roubini (2000) and Brischetto and Voss (1999) as it helps solve the exchange rate puzzle. It is known from Tang's (2006) study of Malaysia that when this structure is not assumed, there is an exchange rate puzzle. As in other VAR studies, the exchange rate responds contemporaneously to all variables in the model. Even though some variables do not affect the others contemporaneously, lagged effects among variables are unrestricted, except that the foreign and domestic sectors are assumed to be block exogenous.

Technically, SVAR model is estimated in its reduced VAR form. In order to estimate the SVAR parameters, this study follows a two-step procedure suggested by Bernanke (1986). First, from the reduced form VAR estimates, the residuals, e_t and the variance-covariance matrix, Σ are calculated. Second, through the sample estimates of Σ_e the contemporaneous matrix B is estimated. In this study, B is estimated using the maximum likelihood.[7] The log likelihood function is;

$$-\frac{T}{2}\ln\left|B^{-1}\Sigma_\varepsilon(B')^{-1}\right| - \frac{1}{2}\sum_{t=1}^{T}(\hat{e}_t' B'\Sigma_\varepsilon^{-1}B\hat{e}_t) \quad (5)$$

If there are more than $(n^2 - n)/2$ additional restrictions, the system is over-identified. In this case the χ^2 test statistic;

$$\chi^2 = \left|\Sigma_e^R\right| - \left|\Sigma_e\right| \quad (6)$$

with R (number of restrictions exceeding $(n^2 - n)/2$) degrees of freedom can be used to test the restricted system. Σ_e^R is the restricted variance-covariance matrix while Σ_e is the unrestricted variance-covariance matrix.

In choosing an appropriate lag length for the VAR model, information criteria for the full system of equations are considered using Akaike's (1973) Information

Criterion (AIC), Schwarz (1978) and Bayesian Criterion (SBC). As a simple indicator of model stability test, the eigenvalues of the companion matrix of the VAR model are calculated. If all the eigenvalues are inside the unit circle, the model is stable (see Lutkepohl 1993).

From the SVAR models, variance decompositions are generated to estimate the forecast error variance of each of the variable in the system that can be explained by exogenous shocks to the other variables. Impulse response functions (IRF) are then produced to describe the direction of response of a variable of interest (e.g. the Malaysian output) to an exogenous shock (e.g. foreign interest rate shock). Following Uhlig (2005), the study employs sign restrictions to select the impulses that are in accordance with the theory. Specifically, restrictions are made so that a domestic monetary policy shock (an increase in the interest rate) will affect the domestic output and inflation negatively for the impact period (say for *k* quarters) while it affects the exchange rate positively (an appreciation of domestic currency) on impact. In this study, *k* is 4 quarters. Thus all puzzles, namely output, price and exchange rate puzzles can be avoided. The responses of domestic variables to all foreign shocks are left unrestricted for analysis and comparison purposes. Table 1 provides a summary of sign restrictions imposed.

TABLE 1. Sign restrictions

Shock to	Response of						
	Y*	π*	i*	Y	π	i	e
Y* (Demand)	↑	↑	↑	-	-	-	-
π* (Supply)	↑	↓	↓	-	-	-	-
i* (Foreign Monetary Policy)	↓	↓	↑	-	-	-	-
I (Domestic Monetary policy	0	0	0	↓	↓	↑	↑

Notes: ↑(↓)means positive (negative) response of the variables in column to shocks in row. – means no constraint is imposed while 0 means no response as to block exogeneity assumption

One issue of concern when using a sign restriction approach is the practice of using the median of the distribution of responses as a location measure. As criticized by Fry and Pagan (2011), the median at each horizon and for each variable may be obtained from different candidate models. They suggest using a unique draw that is closest to the median impulse responses for all variables. This study takes this matter into account when presenting the selected impulse response for discussion.

RESULTS

This section briefly describes the results of diagnostic tests conducted prior to estimating the SVAR models and presents selected results of the variance decomposition and the impulse response functions from the sign restricted impulses responses.

The results of lag length test, as shown in Table 2, indicate that for the baseline model, two lag lengths are the optimal lag based on AIC but one lag length based on SBC. Similar optimum lag length is shown by model with the US factors. However, other models show different lag level. The paper chooses two lag order since it is sufficient to capture the dynamics of the variables and does not involve the loss of too many degrees of freedom. Furthermore, for stability indicator, all the eigenvalues for the baseline model in absolute value are less than one, indicating that the model is stable.[8]

TABLE 2. Lag length tests

Baseline model		
K	AIC	SBC
4	-2884.07	-2445.49
3	-2895.45	-2551.56
2	-2897.17	-2648.74
1	-2880.19	-2727.94
Model with the US Factors		
K	AIC	SBC
4	-3154.52	-2715.95
3	-3166.65	-2822.76
2	-3200.54	-2952.11
1	-3117.06	-2964.81
Model with Japanese Factors		
K	AIC	SBC
4	-2908.18	-2469.61
3	-2954.44	-2610.56
2	-2949.4	-2700.96
1	-2965.98	-2813.74
Model with Singapore Factors		
K	AIC	SBC
4	-2788.5	-2349.93
3	-2812.73	-2468.85
2	-2856.99	-2608.56
1	-2862.57	-2710.32

Note: AIC is the Akaike Information Criterion and SBC is the Schwarz Bayesian Criterion

Table 3 reports variance decomposition for domestic variables, namely Y, π, I and e from the baseline model is the preferred model to capture the integration effect of all foreign countries considered in the model. As shown, foreign shocks explain most of the variation in the domestic variable. For example, foreign shocks explain about 22.56 percent (the sum of the proportions of forecast error variance of Y explained by Y*, π* and i*) of the variation in Y after 24 periods compared to only 6.55 percent, the sum of the proportion of forecast error variance of Y explained by other domestic variables namely π, I and e. Similarly, foreign shocks explain more than 50 percent variation in domestic interest rate, i after 2 years and the percentage increases significantly to 80 percent after 6 years. This indicates that foreign factors appear to play more prominent role in influencing domestic macroeconomic variables. This finding is in line with the results of the previous studies done by Ibrahim (2003), Mackowiak (2007), Tang (2006), and Zaidi and Fisher (2010).

TABLE 3. Variance decomposition for domestic variables from the baseline model

Decomposition of Variance for Y							
Steps	Y*	π*	i*	Y	π	i	e
4	3.62	7.23	0.96	85.63	1.59	0.50	0.47
8	8.87	4.20	1.11	81.64	1.67	2.01	0.50
12	12.31	3.24	0.77	78.30	1.54	3.32	0.51
16	14.80	2.66	0.90	75.59	1.44	4.09	0.51
20	16.81	2.25	1.40	73.15	1.37	4.51	0.51
24	18.51	1.95	2.10	70.89	1.31	4.74	0.50
Decomposition of Variance for π							
Steps	Y*	π*	i*	Y	π	i	e
4	1.49	27.25	2.96	1.37	61.55	3.62	1.76
8	3.25	26.23	7.68	1.53	55.20	3.44	2.69
12	5.59	25.06	9.92	1.65	51.75	3.22	2.81
16	7.48	23.97	11.83	1.74	49.18	3.06	2.74
20	8.92	23.01	13.69	1.82	47.00	2.93	2.63
24	10.03	22.18	15.41	1.88	45.15	2.82	2.53
Decomposition of Variance for i							
Steps	Y*	π*	i*	Y	π	i	e
4	3.77	6.46	22.72	5.54	0.09	53.24	8.18
8	20.40	8.60	29.36	6.18	0.27	29.88	5.31
12	29.79	6.68	33.27	5.84	0.31	20.30	3.81
16	33.26	5.41	37.58	5.42	0.29	15.17	2.87
20	34.28	4.68	41.24	5.09	0.26	12.14	2.29
24	34.48	4.25	43.98	4.88	0.24	10.25	1.93
Decomposition of Variance for e							
Steps	Y*	π*	i*	Y	π	i	e
4	8.38	4.54	4.03	0.94	9.86	13.63	58.63
8	7.25	9.17	4.31	0.69	9.67	12.27	56.64
12	7.59	8.79	8.36	0.64	9.28	11.58	53.76
16	8.39	8.21	12.04	0.62	8.83	10.96	50.95
20	9.31	7.81	14.66	0.61	8.46	10.47	48.69
24	10.23	7.53	16.51	0.61	8.15	10.07	46.89

Figure 1 depicts the responses of domestic macroeconomic variables to domestic monetary policy shock. As shown, the directions of all responses are as expected. The responses of domestic output and inflation are negative for at least the impact period of four quarters, while the response of the exchange rate is positive (i.e., the domestic currency appreciates). The results do not show any of the price puzzles and this is most probably due to the application of the sign restrictions method. There are four responses in each graph. Each indicates which foreign factors are under investigation. The solid line is the baseline impulse response in which the trade-weighted foreign factors are used in the model. One pattern that is clearly seen is the similarity of the pattern between the responses in the baseline model and the responses when Singapore is the only foreign factor. In other words, the

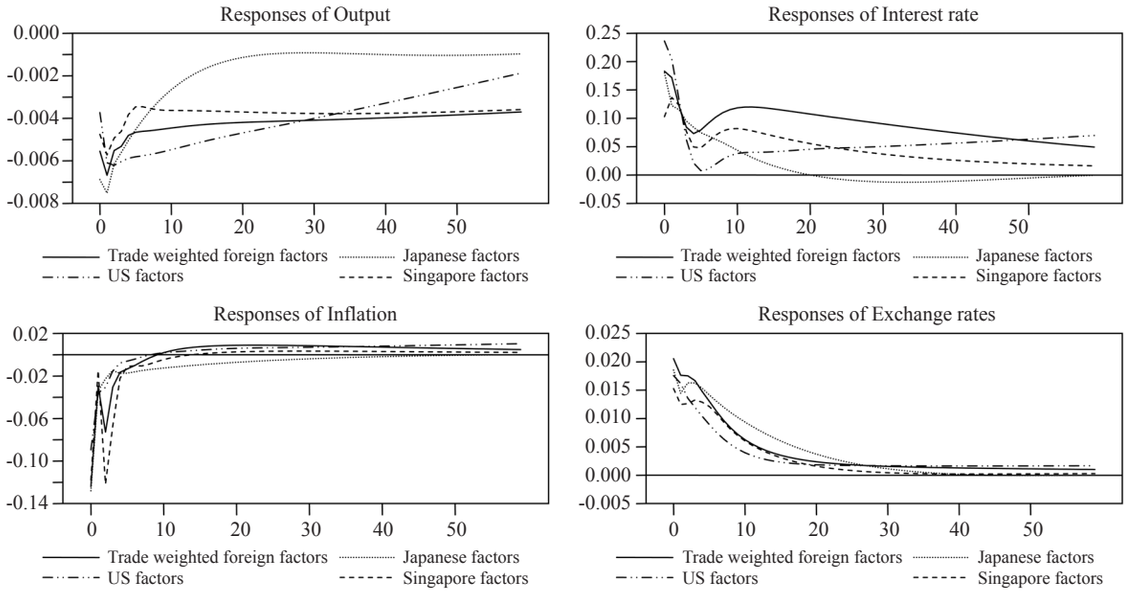

FIGURE 1. Response of Malaysian variables to monetary policy shock: Sign restrictions approach

impulse response with Singapore effect resembles the baseline impulse response. This indicates that Singapore factor contributes a considerably large portion of the formation of the baseline responses. Thus, the effect of Singapore can be said as more dominant to other foreign factor effects.

Figures 2 to 4 show more clearly the effect of Singapore compared to other foreign factors. Figure 2 shows the responses of domestic variables to foreign output shock, while Figures 3 and 4 depict the responses to foreign inflation and monetary policy shock, respectively. All the responses are not sign restricted so that the data reflect the true responses.

As shown, the Singapore effect is more dominant compared to the other impulse responses which represent other foreign factors. This can be observed in two ways. First, the responses of domestic variables to foreign variables shock, when Singapore is taken as the foreign factor, are relatively large. For example, a shock to foreign output, as shown in Figure 2, results in a relatively high response of domestic output, inflation, interest rate as well as exchange rate when Singapore effect is considered. Similar patterns can also be observed in the responses of domestic inflation and domestic interest rate to foreign inflation shock (Figure 3). Second, as mentioned before, the impulse response with Singapore effect resembles the baseline impulse response. This can be seen clearly in Figures 2 to 4 which show that the path and direction of the domestic responses with Singapore factor are in line with that of the baseline model.

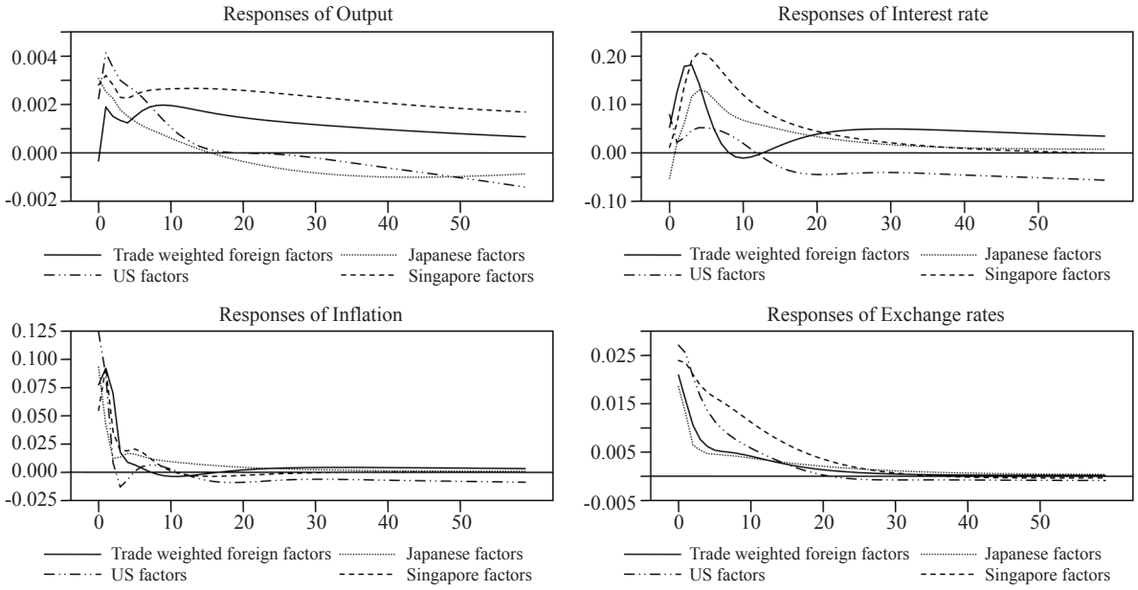

FIGURE 2. Response of Malaysian variables to foreign income shock: Sign restrictions approach

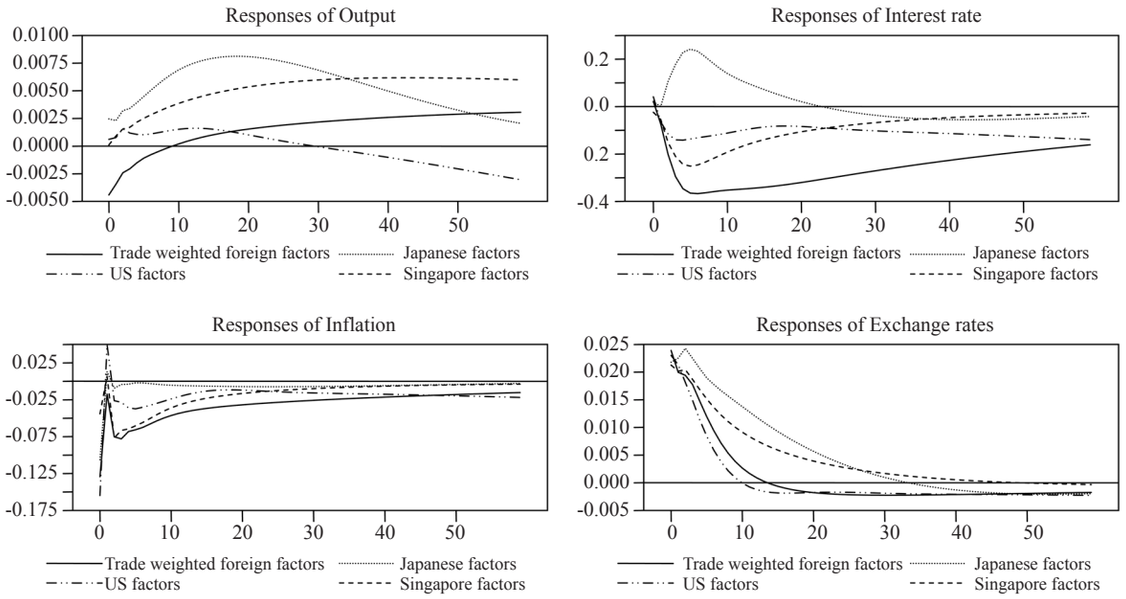

FIGURE 3. Response of Malaysian variables to foreign inflation shock: Sign restrictions approach

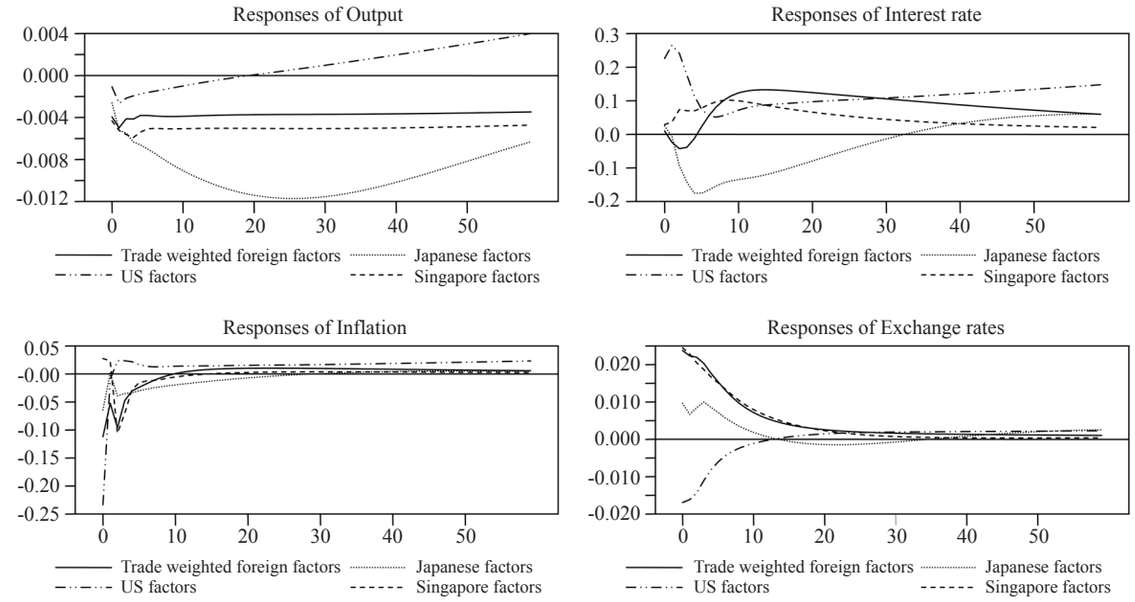

FIGURE 4. Response of Malaysian variables to foreign monetary policy shock: Sign restrictions approach

Although it is not very clear, the US factor can be considered as the second most influential factors while the Japanese factor is the least influential. Interestingly, Figure 2 also indicates the existence of locomotive effect. Shocks to foreign output (income) bring about positive effects on Malaysian output. It seems that the effect of Singapore output shock is much longer and bigger than that of the other countries. For policy consideration (especially the monetary policy), giving more weight to Singapore effect is a good policy approach. Moreover, as the effect of exchange rate is more pronounced when the Singapore output shock is considered, similar recommendation can also be advised for formulating exchange rate policy.

SUMMARY AND CONCLUSIONS

This paper provides new empirical evidence on the impact of foreign shocks (foreign income and foreign monetary policy) of Malaysia's major trading partners, namely Singapore, Japan, and the US on the domestic macroeconomic variables. A non-recursive SVAR identification scheme is employed in examining the relative importance of the foreign shocks. In total, four SVAR models are estimated to deal with various measures of foreign factors that have often been ignored in previous studies. The first model which is the baseline model takes into account the dynamics of all foreign factors.

Specifically the three foreign countries variables are combined using trade-weighted approach. The other three models make use of each foreign country, separately. Block exogeneity assumption is particularly emphasized in building and estimating the structural VAR models. In order to identify the structural parameters, the paper utilizes short-run restriction as well as a sign restriction technique. The sign-restricted impulse responses are generated in accordance with the suggestion of Uhlig (2005) and Fry and Pagan (2011).

Overall, the findings of the study reveal that foreign shocks appear to play dominant role in influencing domestic macroeconomic variables. This further emphasizes the importance of understanding the behavior of foreign variables so that any adverse effects from external sector can be effectively mitigated by appropriate policy formulation. In addition, the results show that applying the sign restriction approach helps the researchers to overcome the price puzzles. Since not all impulses are sign-restricted, the procedure manages to indicate the true responses of domestic variables to foreign factor shocks. More importantly, the results also indicate that Singapore is an important foreign factor that should be taken into account in modeling the effect of foreign factors on Malaysian economy apart from inclusion of the US and Japanese factors. In other words, Malaysian policy makers might have to consider any change in the policies undertaken by Singapore policy authority (such as Monetary Authority of Singapore) as they might influence Malaysian economic performance. This is important as Singapore is not only one of Malaysia's major trading partners, but it is also one of Malaysia's closest neighbors in geographical proximity. Citizens of the two countries come and go between the two countries every day. Any disturbance that occurs in one country will surely affect the other almost instantaneously.

ENDNOTES

1 Generally, the Japanese share of total import and export with Malaysia is more than the US and Singapore's share before early 1997. However, the US takes control after that period. The Singapore's share, in the meantime, is moderate during the period under study. On average (from 1985: 1 to 2010: 4), the US contributes about 16.76% while Japan and Singapore contribute about 16.65% and 15.74%, respectively to the total import and export of Malaysia.

2 China is currently among Malaysia's largest trading partner countries. This study does not take China into account as the importance of China is only apparent since the middle of 2000. As the study's sample period runs from 1985: 1 to 2010: 4, the effect of China would not be captured adequately.

3 Since Singapore is also a small open economy, there might be two way relationships between Malaysia and Singapore. Thus, block exogeneity assumption might not be appropriate. This study also takes this matter into consideration and upon observing the results for Singapore without imposing the block exogeneity assumption; the main conclusion remains the same.

4 See, for example, Cushman and Zha (1997), Kim and Roubini (2000), Dungey and Pagan (2000), Kim (2001), Canova (2005), and Mackowiak (2007).

5 Singapore uses the exchange rate as its monetary policy variable. The inclusion of the interest rate as a monetary policy variable for Singapore is for comparison purpose.

6 The recent global crisis of 2008/09 is not taken into account as it does not affect Malaysian economy as bad as the other two recessions.

7 In RATS, *B* is estimated using the Broyden, Fletcher, Goldfarb and Shanno (BFGS) algorithm. The initial starting values for *B* are found using the genetic method.

8 The values are not shown in this paper.

ACKNOWLEDGEMENTS

The authors thankfully acknowledge financial support from the UKM research grant: UKM-GGPM-PLW-016-2011. The authors would also like to thank conference participants of Persidangan Kebangsaan Ekonomi ke VII (PERKEM VII) for the useful comments and suggestions to the earliest paper.

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