Korea and the World Economy, Vol. 11, No. 3 (December 2010) 527-550

Monetary Policy and Foreign Shocks: A SVAR Analysis for Malaysia*

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This paper presents a structural vector autoregressive (SVAR) model of monetary policy in Malaysia. The model takes into account the economic and financial conditions in Malaysia's two most important trading partners, the United States and Japan. Identification of the SVAR is achieved by imposing zero restrictions non-recursively on the contemporaneous interactions among the variables. This identification leads to the interpretation of an interest rate shock as unanticipated monetary policy. We find that unanticipated monetary policy explains very little of the variability in output and inflation at all forecast horizons but does account for some short run variability in the real exchange rate. Foreign variables explain most of the variability of output and inflation, though domestic credit is important for output at the one quarter horizon. We conclude that foreign shocks are the dominant influence on the macroeconomic performance of Malaysia.

JEL Classification: C32, E52, F41

Keywords: Malaysia, monetary policy, Structural Vector Autoregressive (SVAR) Analysis, Foreign Shocks

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* Received August 16, 2010. Accepted October 22, 2010. We thank Glenn Otto for helpful discussion and detailed comments. The first author thankfully acknowledges financial support from the Universiti Kebangsaan Malaysia and the Ministry of Higher Education Malaysia while the second author gratefully acknowledges financial support from the Australian Research Council Grant no. DP0877219.

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1. INTRODUCTION

This paper develops a structural vector autoregressive (SVAR) model of monetary policy in Malaysia. As a small open economy, Malaysia's economic performance is partly dependent on world economic conditions. To reflect this dependence, the model contains variables that reflect economic conditions in the United States and Japan, Malaysia's two most important trading partners. It also includes world commodity prices as a significant share of Malaysia's exports are commodities. Monetary policy is identified as an unanticipated movement in the domestic interbank interest rate. In the model, a positive shock to the interbank rate leads to inflation and exchange rate responses consistent with the responses usually associated with an unanticipated monetary policy contraction. This feature of the model arises from the restrictions that are imposed on the contemporaneous interactions among the variables which define a policy rule for Bank Negara Malaysia (BNM), Malaysia's central bank. Furthermore, the model restricts the domestic variables to have no effect on the foreign variables. The model is used to investigate the following questions. (i) What is the impact of an unanticipated monetary policy contraction on domestic economic activity? (ii) What are the impacts on the domestic economy arising from shocks to the foreign variables? (iii) How important are foreign shocks relative to domestic shocks in accounting for fluctuations in the domestic variables?

There have been several studies of monetary policy in Malaysia using structural vector autoregressive methods. Azali and Mathews (1999) explicitly model the BNM's monetary policy reaction function while Ibrahim (2005) investigates the effects of monetary policy on specific sectors of the Malaysian economy. Both contributions develop a model for monetary policy in a closed economy setting. However, there have been several contributions which model Malaysian monetary policy in an open economy framework in the spirit of Cushman and Zha (1997). Important among these contributions are Fung (2002), Tang (2006) and Raghavan *et al*. (2009). In each paper, the specification of the model includes a block of foreign variables which, apart from commodity or oil prices, are specific to the US economy. In recent times, however, Japan has become as important as the United States in the volume of bilateral trade it conducts with Malaysia.[1)] Moreover, the results in these papers often show "puzzles" which are common to this literature. The "exchange rate" puzzle emerges in Tang's results and the "price" and "exchange rate" puzzle emerges in some of Fung's results.[2)] Raghavan et al present results for two sample periods from three models: a standard VAR where the structural shocks are identified recursively using contemporaneous zero restrictions; a SVAR where the structural shocks are instead identified non-recursively; and, in a methodological innovation, a vector autoregressive moving average (VARMA) model, also identified non-recursively. They find that the results from the VARMA model display fewer of the so-called puzzles (in their late sample the results show no puzzles) and generally accord more with the results expected from standard economic theory. In this paper, we estimate a SVAR where the structural shocks are identified under a set of contemporaneous non-recursive zero restrictions. Neither the "price" nor "exchange" rate puzzle is a feature of our results.

Whereas these papers specify the foreign variables, apart from commodity prices, as variables pertaining to the US economy, this paper specifies each foreign variable as a trade weighted combination of the US and Japanese variable. As indicated earlier, Japan now accounts for as much bilateral trade with Malaysia as does the United States. Other studies have also taken into account the importance of Japan in trade with East Asian countries. Moon and Jain (1995) combine US and Japanese variables in a manner similar to ours to account for foreign economic influences on the Korean economy.

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1) From 1980 to 2007, 18% of Malaysian exports went to the United States and 15% to Japan while imports from the United States comprised 16% of total Malaysian imports and from Japan 22%. In terms of total trade (exports and imports), Japan accounted for 18% and the United States for 17% over this period.

2) The "price puzzle" occurs when an unanticipated tightening of monetary policy causes the price level or inflation to increase instead of falling. The "exchange rate" puzzle occurs when the unanticipated monetary contraction causes the exchange rate to depreciate instead of appreciating.

Chua, Dibooglu, and Sharma (1999) analyze the impact of US and Japanese macroeconomic activity on output variability in Korea and Malaysia, and Ibrahim (2004) analyzes the impact of economic fluctuations in the US and Japan on Malaysian output by sector. All of these studies find that economic disturbances originating in the US and Japan have significant effects on the economic performance of Korea and Malaysia.

The paper is organized as follows: section 2 describes the data used in the model and section 3 details the specification of the SVAR model. Section 4 presents the empirical results and section 5 concludes.

2. DATA

We specify a reduced form model which is comprised of two blocks. The first block consists of five foreign variables: an index of real commodity prices and foreign output, inflation, the interest rate and index of stock prices. The commodity price index is the index of nonfuel commodities divided by the US Gross Domestic Product (GDP) deflator, both sourced from the International Financial Statistics (IFS) database. Foreign output is the trade weighted average of the real GDP's of the United States and Japan and foreign inflation is a similarly calculated average of the quarter on quarter percentage change in the consumer price indexes of these countries. The foreign interest rate is the trade weighted average of the US federal funds rate and the Japanese call money rate and the foreign index of stock prices is similarly calculated from the NYSE composite index for the US and the Nikkei index for Japan. Each stock price index is deflated by that country's consumer price index. In the construction of these series, the trade weights are calculated as the ratio of the sum of Malaysian exports to and imports from the United States and Japan, respectively, to the sum of total Malaysian exports and imports with the two countries. Over the full sample (from 1982 to 2008), the average trade weight for the US was 0.49 and for Japan 0.51. All the data are obtained from the IFS database and, for the calculation of the trade weights, from the accompanying Direction of Trade database. Apart from interest rates, the X11 procedure was used to seasonally adjust the component series.

The second block comprises the domestic variables for Malaysia. They are: real GDP, inflation, an interest rate, a measure of real credit, the real Kuala Lumpur composite stock price index and the real effective exchange rate. Inflation is calculated as the quarter on quarter percentage change in the consumer price index (CPI). The interest rate is the 3-month interbank rate. From the mid-1990s, the BNM moved to an interest rate targeting framework where the unannounced policy rate, up until April 2004, was the 3-month interbank rate (Bank Negara Malaysia, 1999; Tang, 2006). Since April 2004, BNM announced the overnight policy rate (OPR) as the official monetary policy rate. Because the interbank and overnight rates have moved closely together since 2004 (from 2004:q2 to 2008:q1, the correlation is 0.978), we decided to use the 3-month interbank rate as the interest rate in our study. The BNM also moved from a managed floating exchange rate regime to a regime pegged to the US dollar after the 1997 Asian financial crisis. The credit measure is the sum of total loans and advances from commercial banks, merchant banks and finance companies. Loans and advances from commercial banks comprise about 75% of the total. This percentage has increased in recent times as finance companies have merged with commercial banks. Both the credit measure and the nominal Kuala Lumpur composite index are deflated by the CPI. The real effective exchange rate is defined as foreign goods per domestic good so that an increase in its value represents a real appreciation of the Malaysian Ringgit. It is sourced from the IMF database. The sourced GDP, CPI, credit and stock price data were seasonally unadjusted and the X11 procedure was applied to obtain seasonally adjusted series.

The variables used in the empirical analysis, apart from both the foreign and domestic interest rate and inflation, enter in natural logarithms. The data are quarterly and the sample period is 1982:q2 to 2008:q1.

3. SPECIFICATION OF THE MODEL

To recap, the model consists of eleven variables: the foreign block comprises the real index of commodity prices (*CP*), real foreign output (*FY*), foreign inflation (*FINF*), the foreign interest rate (*FR*) and the foreign real stock price index (*FSP*); the domestic block comprises real domestic output (*Y*), inflation (*INF*), the 3-month interbank rate (*R*), real credit (*CR*), the Kuala Lumpur real stock price index (*SP*) and the real effective exchange rate (*REEX*). The reduced form model is specified as: [3)]

$$X_t = A_1 X_{t-1} + A_2 X_{t-2} + \Phi D_t + \varepsilon_t, \tag{1}$$

where $X' = (CP\ FY\ FINF\ FR\ FSP\ Y\ INF\ R\ CR\ SP\ REEX)$ and $E(\varepsilon_t \varepsilon_t') = \Omega$. This ordering is maintained throughout the analysis. In the equation, D_t is the vector of deterministic variables which comprise the constant and two intervention dummy variables. The first accounts for the effects on parameter stability of the Asian financial crisis; it takes the value one from 1997:q4 to 1998:q4 and zero otherwise. The second accounts for the unexpected severity of the 1985/86 economic recession; it takes the value one from 1985:q2 to 1986:q2 and zero otherwise. We specify the foreign variables as block exogenous to the domestic variables by placing zero restrictions on the coefficients in A_1 and A_2 so that the first and second lags of the domestic variables have no effect on the foreign variables. This means that the coefficients in the sub-matrix comprising the first five rows and last

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3) The model is specified in levels of the variables even though several variables, notably commodity prices, foreign and domestic output and stock prices, domestic credit and the real exchange rate appear to contain a random walk component and are non-stationary. If there are cointegrating relationships among the variables, the appropriate specification is a vector error correction (VEC) model. However, asymptotically the responses from the levels model will be equivalent to the responses from the VEC model; estimation of the VAR in levels instead of the VEC only entails a loss of efficiency. On the other hand, imposing cointegrating relationships on the levels VAR to form the VEC may lead to misspecification error, particularly if the evidence for such relationships is not strong in the data. Finally, a VAR in first differences is not considered as important correlations in the data are lost with differencing.

six columns of A_1 and A_2 are all zero. This restriction is justified on the grounds that Malaysia is a small open economy which has little effect on world commodity prices and on the US and Japanese economies. Equation (1) is shown with two lags as the Akaike Information Criteria (AIC) selected that lag length from specifications of 1 to 4 lags inclusive. Furthermore, we found no evidence of first order serial correlation in the estimated residuals of each equation in the two lag specification on the basis of the Godfrey-Breusch LM test at the 5% level. There was no evidence either for fourth order serial correlation except in the residuals from the foreign stock price equation. For the two lag model, the eigenvalues of the companion matrix are all strictly less than one in absolute value terms indicating that the model is stable.

The structural model associated with equation (1) is:

$$A_0 X_t = A_1^* X_{t-1} + A_2^* X_{t-2} + \Phi^* D_t + \nu_t, \tag{2}$$

where $A_i^* = A_0 A_i$, $i = 1, 2$; $\Phi^* = A_0 \Phi$ and $E(\nu_t \nu_t') = \Sigma$, a diagonal matrix. The relationship between the structural shocks (innovations) ν_t and the reduced form shocks is given by $\nu_t = A_0 \varepsilon_t$. To identify the structural shocks, we must specify a set of restrictions on the matrix of contemporaneous interactions among the variables, namely, on A_0. A common approach is to make A_0 lower triangular which imposes enough zero restrictions on the contemporaneous interactions among the variables for exact identification of the structural shocks. In this case, the contemporaneous interactions among the variables are recursive.

When we estimated the recursive structural model, we found that the response of the exchange rate to the positive shock in the interest rate displayed the "exchange rate puzzle". Specifically, the Malaysian real exchange rate depreciated in the immediate quarter in response to the shock. Had the positive shock in the interbank rate been associated with monetary policy, one would reasonably expect an immediate real appreciation of the Malaysian currency. Thus, identification of monetary policy as an innovation in the interbank rate is questionable under the recursive identification scheme.

In view of this finding, we decided to impose a set of non-recursive zero restrictions on A_0. The restrictions we impose imply the following contemporaneous relationships for domestic output, inflation and the interest rate:

$$\begin{aligned} Y_t = & -a_{61}CP_t - a_{62}FY_t - a_{63}FINF_t - a_{64}FR_t \\ & - a_{65}FSP_t - a_{68}R_t - a_{69}CR_t, \end{aligned} \tag{3}$$

$$INF_t = -a_{71}CP_t, \tag{4}$$

$$\begin{aligned} R_t = & -a_{81}CP_t - a_{83}FINF_t - a_{84}FR_t - a_{85}FSP_t \\ & - a_{87}INF_t - a_{89}CR_t - a_{811}REEX_t. \end{aligned} \tag{5}$$

The contemporaneous relationships among the three remaining domestic variables are recursive so that the submatrix comprising the last three rows of A_0 is lower triangular.

Equation (3) shows Malaysian real GDP is allowed to respond contemporaneously to all the foreign variables and to the interbank rate and to domestic credit conditions. A justification is that recent efficiency gains in the Malaysian banking sector have meant that changes in the interbank rate and credit conditions have passed more quickly to the real sector (Kuang, 2008). The assumption that output responds contemporaneously to credit conditions has also been used in the SVAR models of Safaei and Cameron (2003) for Canada and Berkelmans (2005) for Australia. Equation (4) says that inflation in Malaysia responds contemporaneously to commodity prices only. This can be justified on the grounds that inflation is sticky and that it responds within the quarter only to ‘news’ about future inflation conveyed in the current level of commodity prices. Equation (5) can be thought of as the BNM monetary policy reaction function. We assume that the BNM adjusts the interest rate in response to contemporaneous movements in commodity prices, foreign inflation, interest rate and stock prices, domestic inflation and credit, and the exchange rate. The justification is that the BNM is likely to be concerned with the impact that current movements in commodity prices, foreign financial developments, domestic credit conditions, the exchange rate and inflation itself have on future inflation. We make the policy interest rate dependent on the foreign interest rate because this relation has been found to be important in other SVAR models of monetary policy, notably by Brischetto and Voss (1999). Also, Chinn and Frankel (1995) provide evidence that Malaysian interest rates are influenced by both US and Japanese rates. It is assumed that the interest rate does not depend on contemporaneous movements in foreign and domestic output because they are not observed in the current quarter due to information lags. In Tang (2006), the exchange rate is excluded from the (implicit) monetary policy rule so that contemporaneous movements in the exchange rate do not affect the current policy interest rate. This is a consequence of the recursive identification that he uses. In view of the exchange rate puzzle that arises in his model, he conjectures that the interest rate may have a contemporaneous relationship with the exchange rate (Tang, 2006, p. 24). We take his conjecture seriously and allow the interest rate to respond contemporaneously to the exchange rate as shown in equation (5).

Turning to the foreign variables, we make the following identifying restrictions. First, the domestic variables do not have a contemporaneous impact on the foreign variables so the sub-matrix comprising the first five rows and last six columns of A_0 is null. This implies that the restriction in the reduced form model where the lags of the domestic variables do not affect the foreign variables carries over to the structural model. Second, contemporaneous movements in the other foreign variables do not affect commodity prices contemporaneously. Third, the assumed contemporaneous interactions among the other foreign variables are:

$$FY_t = -a_{21}CP_t - a_{24}FR_t, \tag{6}$$

$$FINF_t = -a_{31}CP_t, \tag{7}$$

$$FR_t = -a_{41}CP_t - a_{43}FINF_t. \tag{8}$$

In addition, the foreign real index of stock prices depends contemporaneously on all the other foreign variables. Equation (6) is analogous to equation (3) in that both GDP's depend on commodity prices and the respective interest rate. Foreign inflation like domestic inflation responds contemporaneously to commodity prices only while the foreign interest rate responds to commodity prices and foreign inflation.

4. RESULTS

4.1. Estimation

Because the foreign variables are unaffected by the domestic variables, the right-hand side variables are not all the same in all of the equations of the reduced form model. Accordingly, equation (1) is estimated by the method of seemingly unrelated regressions (SUR) which gives consistent and efficient estimates of the coefficients. The structural model is overidentified as there are four more zero restrictions than that required for exact identification. In that case, estimates of the coefficients in A_0 are obtained by maximum likelihood estimation. Specifically, the log-likelihood function is:

$$-\frac{T}{2}\ln|A_0^{-1}\Sigma A_0'^{-1}| - \frac{1}{2}\sum_{t=1}^{T}(\hat{\varepsilon}_t' A_0' \Sigma^{-1} A_0 \hat{\varepsilon}_t), \tag{9}$$

where $\hat{\varepsilon}_t$ is the vector of residuals obtained from the estimated reduced form model. The maximum likelihood estimates of $\hat{A}_0$ and $\hat{\Sigma}$ are obtained by maximizing (9) with respect to the free parameters in A_0 and Σ. The

Table 1 Estimates of Coefficients in Contemporaneous Impact Matrix

Equation	Coefficient	Estimate	t-statistic	p-value
Y_t	$-a_{61}$	0.0548	1.319	0.187
	$-a_{62}$	0.0344	0.553	0.581
	$-a_{63}$	**0.0106**	2.344	0.019
	$-a_{64}$	–0.0035	–0.818	0.414
	$-a_{65}$	0.0323	1.443	0.149
	$-a_{68}$	**–0.0049**	–1.996	0.046
	$-a_{69}$	**0.5564**	2.105	0.035
INF_t	$-a_{71}$	–0.0557	–0.055	0.956
R_t	$-a_{81}$	–2.9683	–1.771	0.077
	$-a_{83}$	–0.2395	–1.240	0.215
	$-a_{84}$	0.2305	1.271	0.204
	$-a_{85}$	0.1135	0.113	0.910
	$-a_{87}$	0.2205	1.740	0.082
	$-a_{89}$	–1.4437	–1.234	0.217
	$-a_{811}$	**–10.903**	–2.397	0.017
FY_t	$-a_{21}$	**0.1494**	2.046	0.041
	$-a_{24}$	–0.0099	–1.220	0.222
$FINF_t$	$-a_{31}$	0.7714	0.788	0.431
FR_t	$-a_{41}$	–0.0934	–0.093	0.926
	$-a_{43}$	0.0673	0.647	0.518

Note: Coefficients that are statistically significant at the 5% level are shown in boldface.

econometric analysis in this paper is undertaken with the software program *WinRATS Pro Version 7.0*.

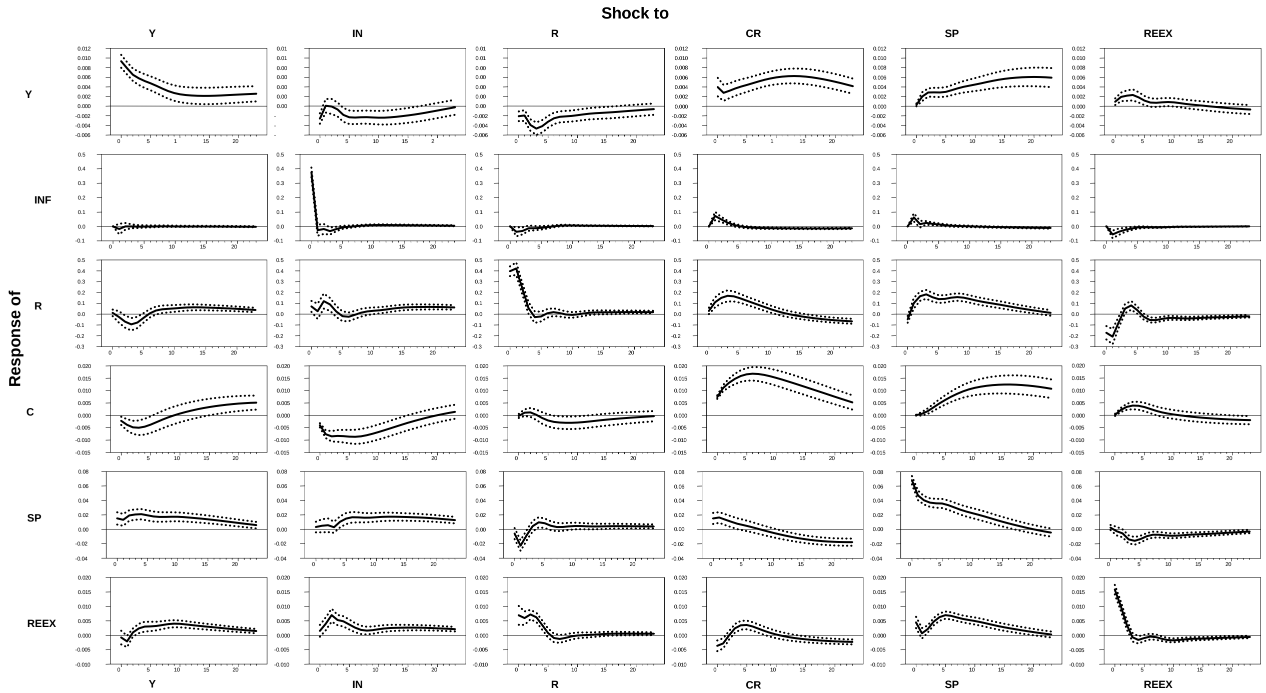
Table 1 presents the estimates of the coefficients in A_0 associated with equations (3) to (8). For domestic output, the coefficient on foreign inflation ($-a_{63}$), the domestic policy rate ($-a_{68}$) and credit ($-a_{69}$) are of the expected sign and each is significant at the 5% level. Output increases contemporaneously with an increase in domestic credit and foreign inflation, and falls contemporaneously with an increase in the domestic policy rate. Now consider the monetary policy rule shown by equation (5). The coefficient on the real exchange rate ($-a_{811}$) and domestic inflation ($-a_{87}$) are of the expected sign and are significant at the 5 and 10% levels, respectively. The policy rate is increased in response to an increase in domestic inflation and decreased in response to an appreciation in the real effective exchange rate within the quarter. The policy rate is reduced as an appreciation of the real exchange rate reduces the price competitiveness of Malaysian exports in international markets and lowers domestic inflation as imports are cheaper. Finally, the statistical significance of the coefficient on both the policy rate and credit in the domestic output equation and on the real exchange rate in the monetary policy rule provides support for the non-recursive structure we have adopted.

As indicated earlier, there are four overidentifying restrictions on the structural model. The test statistic of the overidentifying restrictions is distributed as a chi-squared with four degrees of freedom. We obtained the value of 7.4398 for the test statistic which has the *p*-value of 0.1144. Thus the overidentifying restrictions cannot be rejected even at the 10% significance level.

4.2. Responses to Domestic Shocks

Figure 1 shows the responses of the domestic variables to a positive one standard error shock in each domestic variable. Also shown are the one standard error confidence bands about each response. These were calculated by taking the estimated coefficients in the structural model to form the data generating process which was then bootstrapped 2500 times.

Figure 1 Responses of Domestic Variables to Domestic Shocks



In response to the positive innovation in the interest rate, both inflation and output initially fall (third column of figure 1). There is no price puzzle here: inflation falls initially in response to an unexpected increase in the 3-month interbank rate. Output decreases further over the next few quarters before gradually increasing to its level prior to the innovation. After initially falling, inflation begins to revert back to its original level which takes about eight quarters. The real effective exchange rate appreciates in value initially and for the next two quarters and then begins to revert back to its original level reaching that after six quarters. There is no exchange rate puzzle here: there is a real appreciation of the exchange rate. Because there is no price or exchange rate puzzle, the responses of inflation, output and the exchange rate accord with the anticipated effects of an innovation in the monetary policy rule. Thus, we may reliably interpret an innovation in the 3-month interbank rate as a monetary policy innovation or as an innovation in the policy rate. Thus a positive innovation in the interbank rate (i.e. the policy rate) can be interpreted as a tightening of monetary policy.

The stock price index falls initially in response to a tightening of monetary policy as the higher policy rate results in a higher discount factor which reduces the present value of expected future earnings of firms. After falling for a further quarter, the stock price index begins to rise and at long horizons settles at a level marginally higher than prior to the shock. An unexpected result is that credit increases over the first three quarters before falling in response to the tightening of monetary policy. Tang (2006) also reports this finding and offers explanations that have been forwarded in the literature; one is that loans are semi-contractual agreements whose volume cannot be altered quickly in response to shocks.

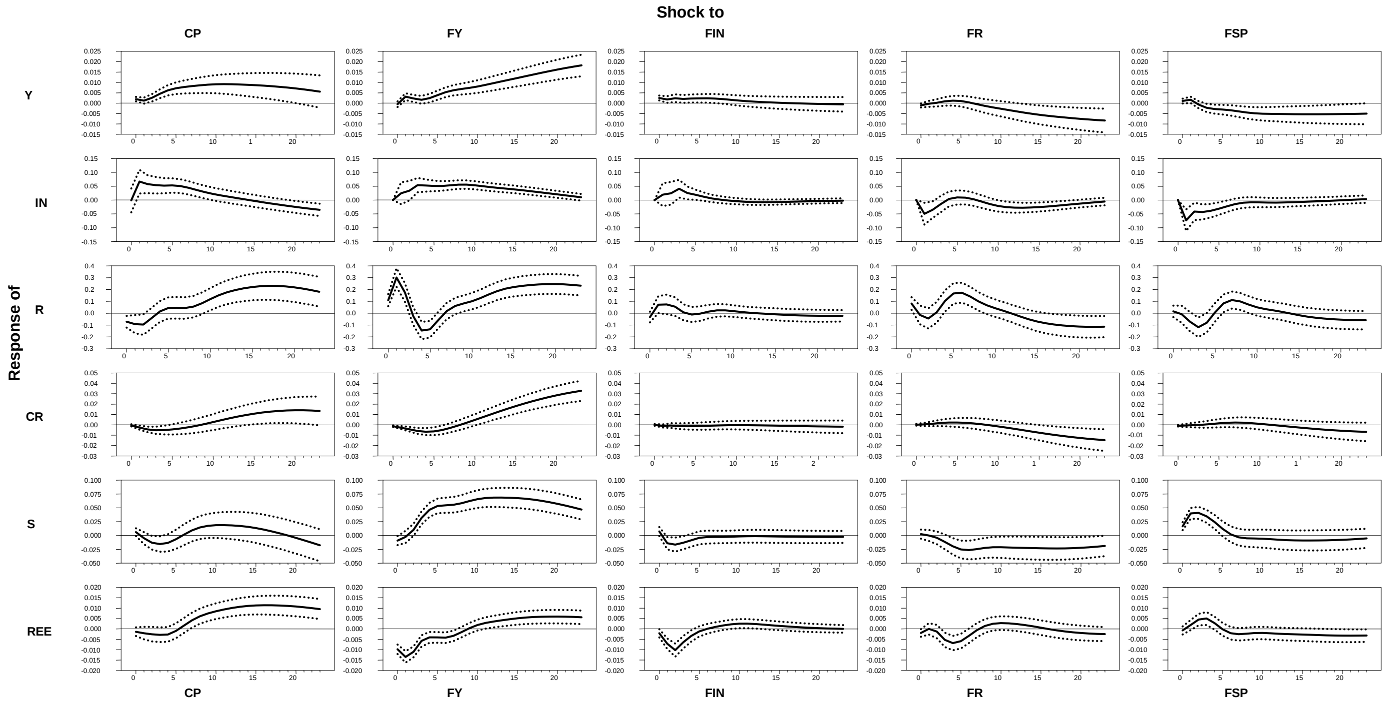
There are some other interesting responses as well. In response to an unexpected appreciation of the real exchange rate, inflation falls initially and then returns to its initial level after about six quarters. The appreciation of the Ringgit results in lower prices of final and intermediate imported goods. The policy rate is reduced initially in response to the fall in inflation and output increases significantly over the next six quarters. The combined effect of the fall in the policy rate and in the prices of imported intermediate goods, both of which reduce production costs, more than offsets the fall in exports arising from the currency appreciation so the net effect is that output rises. In response to a positive innovation in inflation, the policy rate rises and output falls. The real exchange rate appreciates; one reason may be that foreign portfolio investment in Malaysia is more attractive if the increase in the policy rate results in an upward shift in the real term structure of interest rates. Finally, in response to a positive innovation in output, inflation immediately falls but only marginally and then returns quickly to its original level. The policy rate initially falls and then increases leading to an appreciation of the real exchange rate after two quarters.

4.3. Responses to Foreign Shocks

Figure 2 shows the responses of the domestic variables to a positive one standard error shock in each of the foreign variables together with the one standard error band around each response. The shock to commodity prices causes output to rise over all horizons and for inflation to rise in the short and medium terms (first column). These responses are expected as Malaysia is a small open economy with a large share of exports in commodities. There appears to be a lagged monetary policy response to these developments as it is only after a year that the policy rate rises. As this happens, the real exchange rate appreciates.

In response to the foreign output shock, domestic output and inflation increase over all horizons (second column), with the output response much stronger as the forecast horizon increases. The policy rate initially increases but then oscillates before settling at a permanently higher level. In the medium and long term, stock prices and credit increase and the real exchange rate appreciates. The shock to foreign inflation (third column) has little impact on domestic output at all horizons. Inflation increases initially somewhat and there is an immediate real depreciation of the domestic currency. In response to the shock to the foreign interest rate (fourth

Figure 2 Responses of Domestic Variables to Foreign Shocks



column), the Ringgit depreciates over the next six quarters. The depreciation is most pronounced at four quarters by which time the policy rate has increased as the BNM leans against the currency depreciation. The increase in the policy rate leads to a fall in output after six quarters. Inflation initially falls but is largely unchanged in the long run. We do not interpret the shock to the foreign interest rate as an innovation in foreign monetary policy because this shock causes foreign inflation to rise initially thus producing a price puzzle in the foreign block of the model.[4)]

Finally, in response to a shock in foreign stock prices, the domestic stock price index increases over the next six quarters and the real exchange rate appreciates in response to the stronger demand for the Ringgit by foreign investors. The policy rate is reduced over this period as the BNM leans against the currency appreciation. Taken together, the results from this section show that foreign shocks have an important impact on the domestic variables.[5)]

4.4. Variance Decompositions

Table 2 presents the relative contributions of the variables to the forecast error variance in each of the domestic variables over short and medium term quarterly horizons.[6)] The second last column of the table shows the sum of

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4) The responses of the foreign variables to an innovation in each foreign variable are available on request.

5) We also estimated the SVAR with, respectively, the US and Japanese variables in place of the trade weighted variables. We found that the responses of Malaysian output to shocks to the Japanese variables closely resembled the corresponding output responses in the trade-weighted model. This suggests that Japanese disturbances are more important than those from the US in influencing Malaysian output. The response of Malaysian inflation to the US interest rate shock is very similar to the corresponding response in the trade-weighted model. This suggests that interest rate movements in the US are more important for Malaysian inflation than those from Japan. However, the response of Malaysian inflation to a shock in the Japanese stock price index resembles the inflation response to a shock in the trade weighted stock price index suggesting that asset price developments in Japan are relatively more important for inflation in Malaysia.

6) Because many of the variables contain unit roots, the results of the variance decompositions at long horizons should be interpreted with caution. With unit root process, the forecast error variances become very large (approach infinity) as the forecast horizon becomes very large.

Table 2 Forecast Error Variance Decompositions

Decomposition of Variance for Series *Y*

Step	*CP*	*FY*	*FINF*	*FR*	*FSP*	*Y*	*INF*	*R*	*CR*	*SP*	*REEX*	*FF*	*DF*
1	2.94	0.25	4.80	0.93	0.84	68.41	5.29	3.51	12.31	0.05	0.67	9.76	**21.83**
4	7.33	3.95	4.29	0.47	2.13	51.04	1.64	10.47	10.69	4.61	3.37	18.17	**30.78**
8	23.13	9.51	3.60	0.45	5.10	28.05	2.49	7.91	12.20	5.67	1.89	**41.79**	30.16
16	26.38	24.19	1.44	3.72	7.92	10.38	2.01	3.26	12.55	7.47	0.69	**63.65**	25.98
24	18.70	40.02	0.71	8.00	7.00	5.63	1.12	1.68	9.12	7.66	0.36	**74.43**	19.94

Decomposition of Variance for Series *INF*

Steps	*CP*	*FY*	*FINF*	*FR*	*FSP*	*Y*	*INF*	*R*	*CR*	*SP*	*REEX*	*FF*	*DF*
1	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	**0.00**	0.00
4	5.45	2.39	1.37	1.99	4.58	0.17	73.41	1.29	4.24	2.47	2.63	**15.79**	10.80
8	9.26	6.99	1.75	1.83	5.45	0.15	64.59	1.25	3.82	2.43	2.47	**25.28**	10.13
16	9.39	13.67	1.66	3.28	5.04	0.13	57.31	1.21	3.89	2.18	2.25	**33.03**	9.66
24	10.64	14.67	1.63	3.82	4.80	0.13	54.42	1.17	4.26	2.32	2.13	**35.56**	10.02

Decomposition of Variance for Series *R*

Steps	*CP*	*FY*	*FINF*	*FR*	*FSP*	*Y*	*INF*	*R*	*CR*	*SP*	*REEX*	*FF*	*DF*
1	2.35	5.38	0.51	3.00	0.10	0.06	2.33	71.29	0.39	1.07	13.52	11.34	**17.37**
4	2.89	15.63	1.71	1.04	2.29	1.71	3.33	45.80	7.48	8.58	9.52	23.57	**30.63**
8	2.57	14.70	1.25	8.04	3.76	1.91	2.50	32.70	11.59	13.28	7.70	30.32	**36.98**
16	13.07	19.82	0.91	6.61	3.52	2.65	2.43	21.44	8.39	15.40	5.77	**43.93**	34.64
24	21.19	28.55	0.69	7.37	2.95	2.38	2.73	13.75	6.11	10.41	3.88	**60.75**	25.50

Decomposition of Variance for Series *CR*

Steps	*CP*	*FY*	*FINF*	*FR*	*FSP*	*Y*	*INF*	*R*	*CR*	*SP*	*REEX*	*FF*	*DF*
1	0.36	2.26	0.01	0.03	0.96	6.28	20.67	0.10	69.32	0.00	0.02	3.62	**27.06**
4	5.37	6.11	0.32	0.50	0.11	6.67	21.15	0.25	55.17	1.34	3.01	12.41	**32.42**
8	4.07	6.17	0.31	0.73	0.46	3.92	17.48	0.82	56.63	7.18	2.24	11.74	**31.64**
16	6.20	14.90	0.15	2.30	0.47	2.00	10.64	1.05	44.06	17.27	0.94	24.03	**31.91**
24	10.45	39.31	0.16	7.50	1.51	1.75	4.39	0.47	20.79	13.15	0.51	**58.94**	20.27

Decomposition of Variance for Series SP

Steps	*CP*	*FY*	*FINF*	*FR*	*FSP*	*Y*	*INF*	*R*	*CR*	*SP*	*REEX*	*FF*	DF
1	0.64	1.52	0.92	0.12	4.85	4.03	0.18	0.63	4.11	82.88	0.12	8.05	**9.06**
4	2.37	5.99	3.48	0.79	23.54	5.87	0.36	3.16	3.97	49.29	1.18	**36.17**	14.54
8	1.86	28.88	1.90	5.85	12.89	6.09	2.23	1.95	2.15	34.28	1.92	**51.38**	14.34
16	3.24	50.85	0.91	6.94	6.38	5.02	3.48	1.03	1.62	19.12	1.41	**68.31**	12.57
24	2.89	57.03	0.69	7.92	4.91	4.13	3.86	0.84	2.87	13.72	1.14	**73.43**	12.85

Decomposition of Variance for Series *REEX*

Steps	*CP*	*FY*	*FINF*	*FR*	*FSP*	*Y*	*INF*	*R*	*CR*	*SP*	*REEX*	*FF*	*DF*
1	0.42	21.80	1.01	0.89	0.13	0.14	0.54	10.83	3.03	4.47	56.73	**24.26**	19.01
4	1.41	29.69	13.85	2.32	3.32	0.80	6.41	11.87	1.85	3.20	25.28	**50.59**	24.13
8	2.44	24.88	10.83	6.43	3.37	2.61	7.06	9.48	3.31	10.88	18.71	**47.94**	33.35
16	23.80	18.10	7.73	4.97	3.46	4.70	5.66	5.88	2.28	11.38	12.04	**58.06**	29.90
24	36.35	18.13	5.41	4.00	4.10	3.98	4.93	4.12	2.28	8.23	8.45	**68.00**	23.55

the contributions of the foreign variables (denoted FF) to the forecast error variance in a domestic variable. The last column shows the sum of the contributions of the domestic variables to the forecast error variance in a domestic variable excluding that variable's own contribution (denoted DF).

For output, the contribution of the domestic shocks (excluding its own shock) to the forecast error variance is 20% at the one quarter horizon whereas the contribution of the foreign shocks is about 10%. Among the domestic variables, the credit shock is most important accounting for about 12% while the policy rate shock accounts for only 4%. Unanticipated monetary policy is relatively unimportant for output fluctuations in Malaysia since the policy rate shock accounts for only 11% of the forecast error variance at four quarters and considerably less at all other horizons. Even at the four quarter horizon, the credit shock accounts for as much of the variability in output as the shock to the policy rate. At longer horizons, the contribution of the foreign shocks dominates, accounting for around 65% of the forecast error variance at four years. Of this, the commodity price and foreign output shocks contribute about 25% each. By the six year horizon, the foreign output shock is singularly most important accounting for 40% of the variability in Malaysian output.

Turning to inflation, own shocks contribute most to the forecast error variance at all horizons. The foreign shocks become relatively more important as the forecast horizon increases, accounting together for 16% at the four quarter horizon and for 33% by four years. Among the foreign shocks, both commodity prices and foreign output are important. Commodity prices account for around 10% of the variability of inflation at all forecast horizons and the contribution of foreign output reaches around 15% at long horizons. The contribution of the policy rate shock is negligible at all horizons so that innovations to monetary policy do not appear to explain much of the variability in domestic inflation. Moreover, shocks to domestic credit do not contribute much to the forecast error variance in inflation either, accounting for less than 5% at all horizons.

For the policy rate, the contribution of the domestic shocks (excluding its own shock) is most important up to horizons of two years. Among these, the real exchange rate is most important at the one quarter horizon accounting for about 13% of the forecast error variance. While the contribution of credit and stock prices is negligible at this horizon, they each contribute about 13% to the forecast error variance after that out to two years. At longer horizons, the foreign shocks together account for most of the variability in the policy rate, the most important of which are commodity prices and foreign output.

The policy rate, however, contributes about 10% to the forecast error variance of the real exchange rate at the one quarter horizon, second only to foreign output which contributes around 20%. The contribution of foreign output remains at near this level as the forecast horizon increases while the contribution of commodity prices increases to about 25% at the four year horizon. These two foreign variables account for most of the variability in the real exchange rate over medium to long run horizons. For real credit, the inflation shock is most important (apart from credit's own contribution) at the one quarter horizon accounting for 20% of the forecast error variance while the contribution of stock prices (17%) and foreign output (15%) is about the same at the four year horizon. Lastly, the shock to foreign output is most important for stock prices at long horizons explaining around half of the forecast error variance at four years, while in the near term the shock to foreign stock prices is important accounting for about 25% of the decomposition at the one year horizon.

5. CONCLUSION

We present the results from a small open economy SVAR model for Malaysia. This model takes account of the influence of commodity prices and economic and financial conditions in Malaysia's two most important trading partners, the United States and Japan. This is done by including foreign variables which are formed as the trade weighted combination of the US and Japanese variable. For identification of the SVAR, zero restrictions were imposed non-recursively on the contemporaneous interactions among the variables. Under this identification, an innovation in the domestic policy rate is interpreted as unanticipated monetary policy as there was no “price” or “exchange rate” puzzle. A positive innovation in the policy rate caused output and inflation to both fall and for the exchange rate to appreciate within the quarter.

There are two key findings from the SVAR model. First, innovations in the policy rate, which can be interpreted reliably as unanticipated monetary policy, contribute negligibly to the forecast error variance of output and inflation over all horizons. Thus monetary policy innovations account for very little of the variability in output and inflation in Malaysia. Innovations in the policy rate are important for fluctuations in the real exchange at the one quarter horizon but are not as important as foreign output. Second, the foreign variables are more important than the domestic variables (excluding the domestic variable’s own contribution) in accounting for variability in output and inflation in Malaysia at short to long forecast horizons. The domestic variables, particularly credit, are more important for output at the one quarter horizon. In conclusion, the impacts of innovations in monetary policy in Malaysia on output and inflation are small at all forecast horizons. On the other hand, foreign variables, particularly foreign output, explain most of the forecast error variance in output and inflation after one quarter. Thus, foreign variables are the dominant influence on the macroeconomic performance of Malaysia.

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