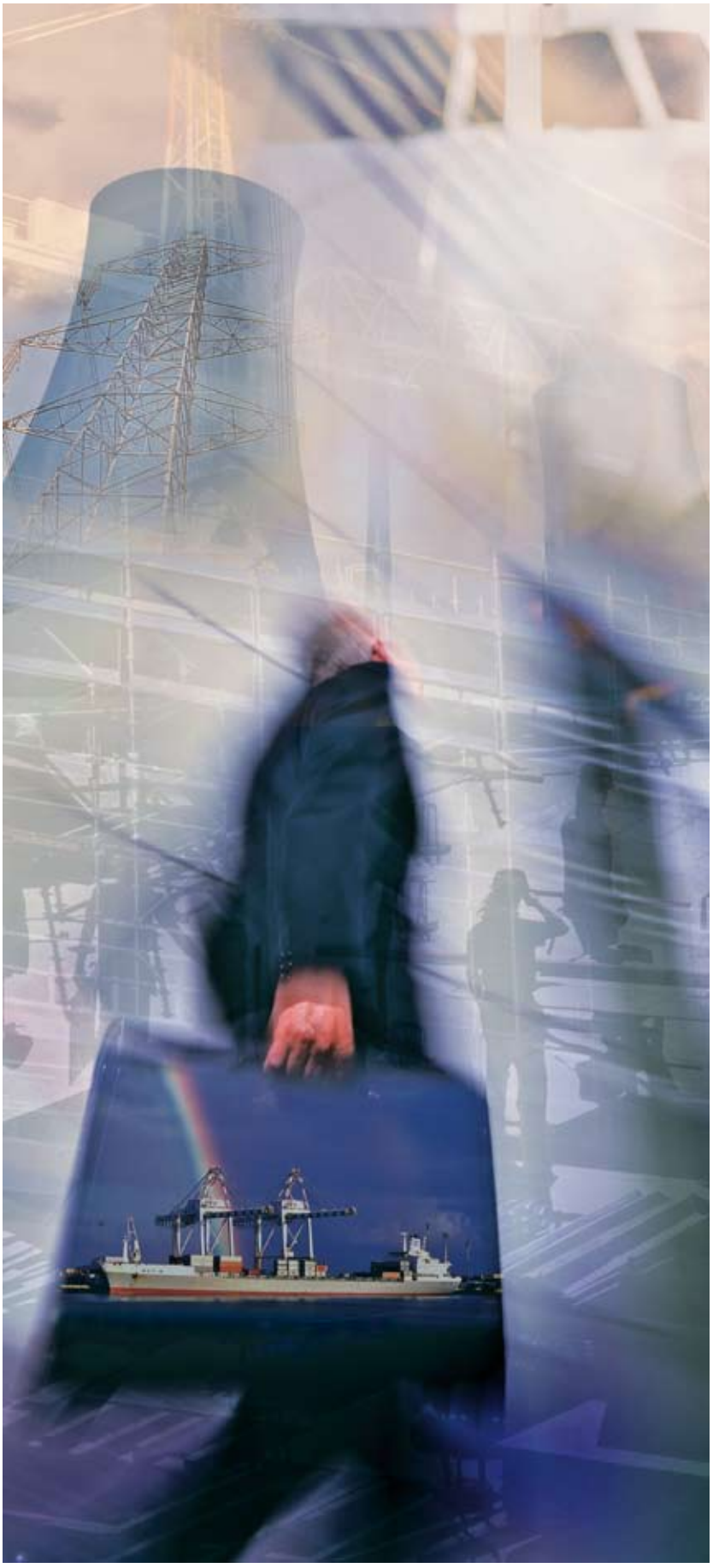

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Monetary Policy and the Role of Credit in Malaysia: A SVAR Analysis

Mohd Azlan Shah Zaidi*

Abstract

Liberalization of Malaysian banking and financial system since the late 1970s has witnessed a strong credit growth which is believed to have played an important role in affecting domestic economy. Previous studies however, find that the relationship between credit and domestic output is rather unimportant. This paper uses a structural vector autoregression (SVAR) model to re-examine the effects of monetary policy and the role of credit on the economic performance of Malaysia. The results of the SVAR estimation, the impulse response functions and the variance decompositions generally support the underlying monetary theory. The selected model does not show empirical anomalies of both price and the exchange rate puzzles and is quite robust to changes in the number of lag, the sample length and the selected fundamental variables. The findings reveal that, credit play a significant role in affecting domestic output over a horizon of two years, while the interest rate and the exchange rate have significant influence on inflation only after a year until 4 years. Furthermore, commodity price persistently influences most of the domestic variables in the long term. The results provide some implications for the role of banking and financial system in shaping domestic economies as well as for the vulnerability of the economy to foreign shock in the long term.

JEL Classification Numbers: E51

Keywords: Monetary policy, Vector Autoregression, Credit, Malaysia

1. Introduction

Structural transformation of the Malaysian economy from an agricultural dependent economy into a manufacturing and services based industry from 1980 has witnessed an increasing role for banks as a source of financing. Moreover, the promotion of the private sector as an

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engine of growth as well as the liberalization and deregulation of the financial system in the post 1982 period are believed to have directly enhanced the role of credit in boosting investments as well as the aggregate demand in the economy.[1] Credit has become an important variable that not only can promote economic activity but it is also dependent on economic activity.

Nevertheless, studies on the role of credit in Malaysia, have been relatively scarce, in particular there are only a few studies that directly relate credit and economic activity. Azali and Matthews (1999) for instance, examine the money-income and the credit-income relationships during the pre- (prior to 1978) and the post-liberalization (post 1978) periods in Malaysia. Using Bernanke's (1986) contemporaneous structural VAR approach, they find that credit plays a significant role in explaining the output variability in both periods, though the impact of credit is much greater during the pre-liberalization period. These findings are rather interesting, as we expect that credit would have played much greater role after financial liberalization period.

A recent study by Tang (2006) looks at the relative strength of the monetary policy transmission channels which include the exchange rate, asset prices, interest rate as well as the credit channel. Using a recursive structural VAR and a channel-shutdown methodology, he finds that the interest rate channel is important in influencing output and inflation over a horizon of about two years, while the influence of the credit channel extends beyond that horizon.[2] The asset price channel is also relevant in the shorter-horizon (more so than the exchange rate channel) particularly in influencing output. For inflation, the exchange rate channel is more relevant than the asset price channel.

Following the ideas in Azali and Matthews (1999) and Tang (2006), this paper empirically investigates the effect of monetary policy, particularly the role of credit in influencing Malaysian economic performance. The study uses a structural or identified VAR model for the period 1981:3 to 2006:4. As such, the study incorporates the post-liberalization period as well as the Asian financial crisis.

[1] Since the late 1970s, Malaysia has liberalized domestic interest rates and lifted controls on credit to allow for more efficient flow of funds in the market. For examples, all banks, since 1978 could set their own individual deposit rates subject to the deposit's maturity period and in 1981, the commercial banks began to introduce their own base lending rate (BLR) which was a rate based on their cost of funds.

[2] Channel-shutdown methodology refers to shutting off one transmission channel at a time and comparing the impulse response that it produces with the baseline model where all transmission channels are in operation.

This study differs from Azali and Matthews (1999) and Tang (2006) in some important aspects. Although Azali and Matthews (1999) use a structural VAR approach, their models do not include foreign variables or the exchange rate. As Malaysia is heavily dependent on the export of agricultural and manufacturing products, the use of closed economy structural VAR model may not capture important aspects of the Malaysian economy.

Tang (2006) on the other hand, uses recursive VAR approach which may not correspond to a reasonable economic theory with regards to looking at the contemporaneous relationships among variables in the economy. Non-recursive structure however has its advantages in that it does not only account for contemporaneous relationships among variables but it also relies on economic theory when imposing the restrictions.

Moreover, particular attentions are given to the issue of the "price puzzle" as well as the "exchange rate puzzle" which are important to evaluate when studying monetary policy.[3] The price puzzle occurs when a shock (say an increase) in the interest rates (a contractionary monetary policy shock) causes an increase in the price level instead of decreasing it. In other words, as the central bank increases interest rates (or contracts the money supply) in an attempt to contain inflation in the economy, the price level tends to increase further. Likewise, the exchange rate puzzle arises when an increase in the interest rates (a contractionary monetary policy shocks) causes domestic currency to depreciate rather than appreciate.

With regard to these puzzles, Tang (2006) finds no evidence of a price puzzle but does find an exchange rate puzzle. Azali and Matthew (1999) do not discuss the price puzzle and do not have an exchange rate variable in their model. Thus the other reason of using the open structural VAR approach is that it could possibly solve both the two puzzles. Cushman and Zha (1997) show that using structural VAR model that specifically accounts for the features of the economy under study could potentially solve the puzzles. Likewise, Sim and Zha (1995) propose the inclusion of variables proxying for expected inflation in the structural

[3] See Sims (1992) and Eichenbaum (1992) for discussion of the price puzzles. Some authors (particularly Zha (1997), Sims (1998) and Christiano et. al. (1999)) argue that the existence of price puzzles in the empirical works may suggest that the model of the monetary policy has not been correctly identified (Hanson 2004).

VAR approach with contemporaneous restrictions in order to address the prize puzzle. Sim (1992) argues that the explanation for prize puzzle might also explain the exchange rate puzzle.

This study finds that credit does play a really significant role in affecting domestic output over a horizon of two years, while the interest rate and the exchange rate have significant influence on inflation only after a year until 4 years. In addition, commodity price has persistent effect on most of the domestic variables in the long term. Unlike previous findings, the selected model does not show empirical anomalies of both price and the exchange rate puzzles and is quite robust to changes in the number of lag, the sample length and the selected fundamental variables.

The organization of this paper is as follows. Section 2 provides some background information on Malaysian economic performance over the period 1981 to 2006. Section 3 discusses monetary policy in Malaysia and previous empirical studies. The data and their sources are described in Section 4, while Section 5 discusses the SVAR model, including selection of variables, identification and estimation. Section 6 presents the results of SVAR estimation, its impulse response functions and variance decompositions while section 7 looks at some robustness tests. Finally section 8 concludes with some implications for monetary policy.

2. Malaysian economic performance: A structural transformation and International exposure

Prior to mid 1980s, Malaysia was heavily dependent on its export of agricultural commodities as a source of economic growth. The agriculture sector accounted for more than 30% of total GDP in 1970 while manufacturing faired only less than 14% in the same year.[4] Being a small open economy however, Malaysian export was vulnerable to changes in commodity prices and global demand for agricultural product. Taking into account the decreasing trend of the commodity prices since 1981 and the recession of 1985, concerted efforts were taken by Malaysian government to diversify the economic base as well as to reduce the role of

[4] The figures are calculated by the author based on data available in Monthly Statistical Bulletin of Bank Negara Malaysia (various issues).

government and to encourage private sector as the engine of economic growth. With the first Industrial Master Plan (IMP), 1986-1995, a broad based manufacturing sector based on export-led industrialization strategy was aggressively developed. Small and medium scale industries (SMIs) were promoted to play important role in strengthening economic linkages among industries. Further liberalization and deregulation of Malaysian economy in the post 1982 period have seen significant increases in private investment, both domestic and foreign.

Malaysia has transformed itself to become a diversified export-oriented country with a multi sector economy based on services and manufacturing. The share of both the manufacturing and services sector is now more than 80% of total GDP as compared to less than 10% coming from the agriculture sector.[5] Currently, Malaysia is one of the world's largest exporters of semiconductor devices, electrical goods, and information and communication technology (ICT) equipments. It is believed that credit from banking institution play significant role in promoting investments, aggregate demand and eventually the economic growth.

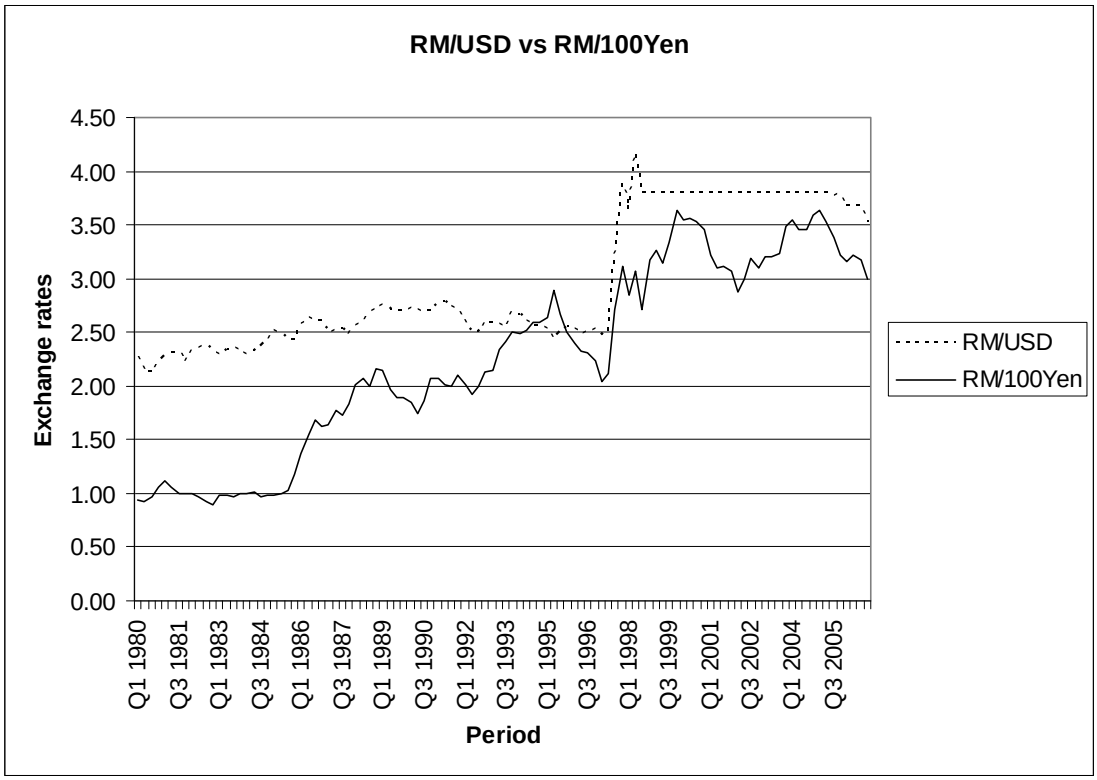
Being an export oriented country, Malaysia is also vulnerable to the effect of business cycles of the world particularly from the two largest trading partners namely the US and Japan. Malaysian total trade with the US and Japan contribute an average of 35% of the total trade. On average, Malaysia exports more to the US (18%) than to Japan (15%) while it imports more from Japan (22%) than from the US (16%).[6] Chua et. al. (1999) and Ibrahim (2004) study the effect of the US and Japanese business cycle shocks on Malaysian economy. Chua et. al. find that the US influence on Malaysian economy has decreased while the Japanese influence has increased. Using two sub periods of monthly data from 1974:1 until 1995:8 with a break point around the Plaza Accord (1985:9), they find that the influence of US shocks (combination of output and monetary shock) slightly declined from the first to the second period whereas the effect of the Japanese shocks increased. Similarly, Ibrahim who investigates the effect of the US and Japanese output on Malaysian aggregate and sectoral output uncovers that Japanese influences seem to be larger. He finds that Japanese influences are more important for the core sector of Malaysian economy namely the Manufacturing

[5] See note 1.
[6] Figures are calculated by the author from annual data of 1980-2006. Data are taken from various issues of Monthly Statistical Bulletin of Bank Negara Malaysia

sector and Finance, Insurance, Real Estates and Business Services Sector. Nevertheless, in some of the sectors the US influences are much bigger than the Japanese.

The influence of the US and Japan on the Malaysian economy can also be looked at their respective bilateral exchange rates performance. Appreciation of the US dollar or the Japanese Yen will suggest higher demand being made for the respective currency (and indirectly their goods and services) compared to the RM and vice versa. Figure 1 shows the trend of RM/USD and RM/100YEN for the period 1980:1 until 2006:4. It can be seen that the bilateral rates of RM/USD and RM/100YEN are generally trending up with YEN appreciating more aggressively then the USD. At the end of 1985, it took only 1 RM to get 100 Yen, but at the end of 2006, the 100 Yen costs about 3 RM.

Figure 1: Trend of RM/USD and RM/100YEN

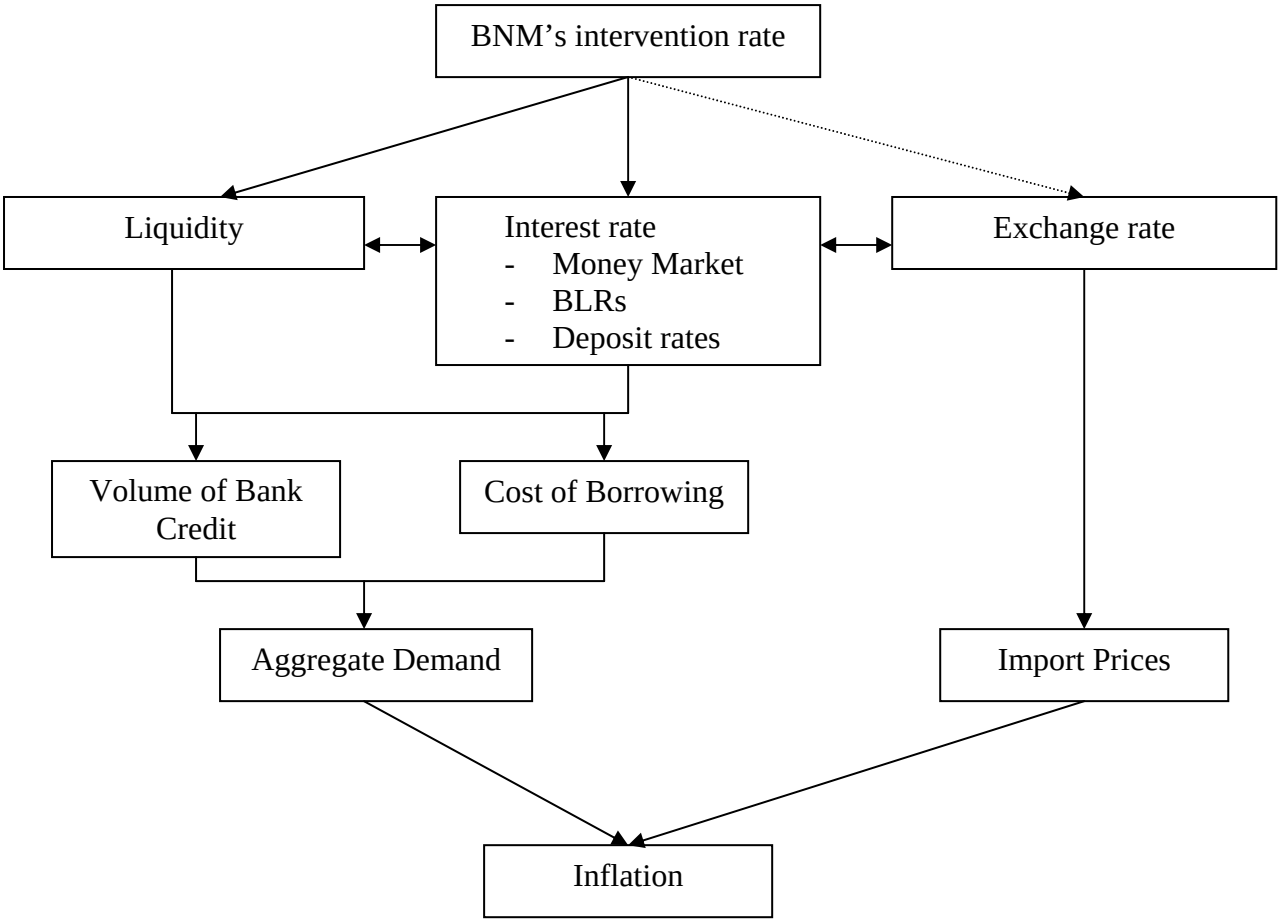


The RM/USD was pegged at RM3.80 per USD on 2nd September 1998 during the Asian Crisis as one of the control measures taken to curb the deteriorating effect of the economy. As economy went well and the external sector was under control, the dollar peg was removed on 21st July 2005 and replaced by a managed float against an undisclosed basket of foreign currencies. Since then, RM stabilizes at around RM3.50 to RM3.00 per USD.

3. Implementation of Monetary Policy in Malaysia

The ultimate goal of Malaysian monetary policy is to attain price stability along with other macroeconomic objectives of sustainable output growth, stable exchange rate, a low unemployment rate and stable financial markets. Prior to the mid-1990s, the Central Bank of Malaysia, namely Bank Negara Malaysia (BNM) targeted monetary aggregates as its monetary policy strategy. This strategy was used due to the fact the monetary aggregates were closely linked to the final objective of monetary policy of price stability. During that period, M1 was used as the main policy target up until 1987. However, due to financial liberalisation and innovation and its impact of broader monetary aggregates, the Bank switched from M1 to M3 as its main policy target (Bank Negara Malaysia, 1999).

Figure 2: Transmission mechanism of monetary policy



Source: Bank Negara Malaysia (1999)

During the early 1990s, developments in the economy and the financial system weakened the relationship between monetary aggregates and inflation. In addition, the large capital flows in 1992-93 and their subsequent reversal in the following year added to the instability in the monetary aggregates and reduced their usefulness as intermediate targets (Bank Negara Malaysia, 1999). Consequently, BNM shifted its focus from monetary targeting to interest rate targeting in the mid-1990s. The use of an interest rate as the target was feasible due to the fact that the liberalization of interest rates since 1978 resulted in a more market-based interest rate determination process. Furthermore, financial deregulation had enhanced the role of interest rates in the monetary transmission mechanism. In addition, the financing pattern of the economy had shifted from an interest-inelastic market to a more interest-sensitive market. Moreover, BNM has maintained positive real rates of return on deposits and regards that the interest rate stability is an important policy variable to promote a stable financial system (Bank Negara Malaysia 1999).

BNM control the market by its daily tender operations and the intervention rate.[7] Figure 2 illustrates transmission mechanism of Malaysian monetary policy. A change in policy affects the whole range of market rates. Specifically, a change in BNM intervention rate affects the interest rates in the market such as the interbank rates, the base lending rates (BLRs) and the deposit rates. This in turn affects the private sector's financial assets and liabilities position as well as the asset prices. It also affects decisions to consume or save, and invest domestically or internationally. All these finally affect aggregate demand, output as well as price level.

3.1 Previous empirical studies on monetary policy

Studies on Malaysian monetary economics have mainly focused on examining the effect of monetary policy on output fluctuation. The methodological approaches of these studies have evolved from bivariate causal relationship analysis (Hashim *et. al.* 1994, Tan and Cheng 1995, Abdullah and Yusop 1996) to more advanced multivariate Johansen cointegration techniques (Masih and Masih, 1996, Tan and Baharumshah 1999), and VAR and SVAR approaches (Azali and Matthew 1999, Domac 1999, Fung 2002, Mansor 2005, Tang 2006).

[7] The intervention rate is only available after 1998. Since it has direct effect on Base Lending Rate (BLR) and also Average Lending Rate (ALR), BLR or ALR will be used as policy variables in this study.

Masih and Masih (1996) and Tan and Baharumshah (1999) use the Johansen's (Johansen, 1988; Johansen and Juselius, 1990) multivariate cointegration approach and a vector error correction model (VECM) in their studies. Masih and Masih use five variables (output, money stock (M1 and M2), an interest rate, the price level and the exchange rate) while Tan and Baharumshah consider four variables (output, money stock (M1, M2 and M3), an interest rate and the price level). Despite using different sample periods and data frequencies; Masih and Masih use annual data from 1955 to 1991, while Tan and Baharumshah use monthly data from 1975:1 to – 1995:12; both studies find some long run equilibrium relationships among their variables. Masih and Masih find that for Malaysian case there exist two cointegrating relationships in the M1 model and one cointegrating relationship in the M2 model.[8] Their results suggest that the money supply (particularly M1) tends to lead (rather than lag) output and the other three endogenous variables. Likewise, Tan and Baharumshah reveal that, each of the M1 and M2 model exhibits one long run relationship among the variables. They also identify that M1 is the most effective intermediate monetary target to curb inflation, while M3 has been regarded as the most appropriate intermediate target to promote sustainable economic growth with contained inflation.

These studies along with other previous researches done by Marashdeh (1993) and Tan and Cheng (1995) generally support that money has real effects on aggregate fluctuation, at least in the short run. Maradesh empirically investigates the Lucas (1972) and Sargent and Wallace (1975) proposition that unanticipated policy changes affect real economic variables of Malaysia while the anticipated policy changes do not influence them. He finds some mixed results in that the anticipated changes in fiscal policy and balance of payment do not affect real output (hence supporting the proposition) while the anticipated monetary policy and inflation do influence real output in the short run (thus rejecting the proposition). Furthermore, the unanticipated changes in monetary policy, fiscal policy and balance of payment do not influence real output while the unanticipated changes in inflation do influence real output in the short run. On the other hand, Tan and Cheng examine causal relationship between money, output and prices in Malaysia and find supports of monetarist view of inflation. Using Geweke's (1982) approach to Weiner-Granger causality, they find

[8] Masih and Masih also find one equilibrium relation in M1 model and two equilibrium relationship in M2 model for the case of Thailand.

evidence of bidirectional causality between money supply and nominal output. With regards to the effect on prices, they find that narrow money supply contributes to inflationary pressure at the consumer level while both narrow and broad money supply consistently cause price variation at the producer's level. They also find that both narrow and broad money supply cause strong feedback towards real output.

Looking at other aspect of the effect of monetary policy, Domac (1999) empirically investigates the response of small and medium size industries (SMIs) as well as large manufacturing firms (LMFs) to monetary policy shifts in Malaysia. Using a VAR model with four variables (log of SMI production, log of real effective exchange rate, overnight money rate and the spread between the average lending rate and the 3 month T bill rate), he discovers that monetary tightening has a larger impact on SMIs than it does on LMFs. The empirical findings point out that the effect of monetary shocks on production is more persistent for SMIs than for LMFs.[9]

A study which is relatively related to Domac's (1999) is done by Mansor (2005) who specifically analyses the effects of monetary policy shocks on aggregate and eight sectoral outputs for Malaysia. Making use of VAR model with four variables (real output, consumer prices, exchange rate and interbank rate), he finds that the manufacturing, construction, finance, insurance, real estate and business services sectors seem to decline more than aggregate production in response to positive interest rate shocks. On the other hands, he observes that agriculture, forestry and fishing, mining and quarrying, electricity, gas and water sectors are relatively insensitive to interest rate changes.

Fung (2002) studies the effects of monetary policy shocks in seven East Asean economies, namely Indonesia, Korea, Malaysia, the Philippines, Singapore, China and Thailand. Using VAR method with the same identification scheme for each country, he finds that most impulse response functions behave consistently with the expected effects of monetary policy, especially in the subsample that ends before the 1997 Asian Crisis. With

[9] In the same study, Domac (1999) also, provides a descriptive analysis of credit and monetary policy in Malaysia in the aftermath of financial crisis. He suggests that "payoff" or "default" risk (as captured by the spread between safe and risky debt) is still well above its pre-crisis level, hence underscoring the increased agency costs of external finance. He also mentions, among others, that the decline in lending activity at the first half of 1998 can be explained by the reduction in bank credit supply relative to demand, while the decline in demand has probably played a more prominent role in contributing to the sharp decline in lending activity during the second half of 1998.

regards to the Malaysian case, prize puzzle occurs in the full sample study (from January 1985 until June 2001), while exchange rate puzzle appears in the first subsample which ends before the Asian Crisis. Both prize puzzles however, disappear in the second subsample period which starts from 1998.

All the studies described above do not include credit as one of the variables under study. As described earlier, only Azali and Matthews (1999) and Tang (2006) focus on credit as one of the channels of monetary policy transmission mechanism. However, the number of variables used in each study is different. Azali and Matthews use 6 variables (Interpolated Gross Domestic product, inflation, total loan extended by banking system to the private sector, 3-month Treasury bill, total government expenditure and monetary aggregate (M2)) to look at the money-income and the credit-income relationships during the pre- and the post-liberalization periods in Malaysia. Tang on the other hand, uses twelve variables which include 4 foreign variables (the commodity price index, the US consumer inflation rate, the US real GDP and the US Federal funds rate) and 8 domestic variables (the consumer price inflation, the real GDP, the monetary aggregate M1, the 3 month interbank interest rate, the Ringgit/US dollar exchange rate, the Kuala Lumpur Composite Index, the base lending rate, the total outstanding loans of the banking system) to look at the relative strength of four monetary policy transmission channels (exchange rate, asset price, interest rate and credit). Our study uses eight variables which are described in details in the next section.

4. Data

This study divides the variables in use into two blocks. The first block consists of two foreign variables, which are real commodity price (LCP) and real trade weighted foreign gross domestic product of the US and Japan (LFY). LFY is used instead of individual real GDP of the US or of Japan as to capture the role of both major trading partners in affecting the Malaysian economy.[10] Given the trade of Malaysia with these two countries accounted for 35% of total trade of Malaysia with the world, we believe that the inclusion of this variable is sufficient enough to capture external factors affecting the Malaysian economy. We also use

[10] The weight for each country is calculated by dividing the total import and export of Malaysia from/to each country with the total import and export of Malaysia with both the US and Japan. The average weight for each country is around 0.5. Malaysia traded more with Japan (the highest weight is 0.63) than with the US before 1998, but the reverse is true after that year.

real GDP of the US and Japan respectively in the model as comparison and the results are discussed in section 7. The SVAR studies for other countries (Sim and Zha 1995, Kim and Roubini 2000, Dungey and Pagan 2000, Berkelmans 2005 to name a few) have used foreign variables and found their roles in the system to be quantitatively important particularly with regards to addressing the price puzzle.

The second block contains domestic variables which are real Malaysian GDP (LMY), the inflation rate (INF), real credit (LCR) (corresponds to total loans and advances given by the commercial banks), real asset price (LAP) (corresponds to the Kuala Lumpur Composite Index), the interest rate (INT) (corresponds to Average Lending Rate) and real effective exchange rate (LER). All variables are in the logarithmic form except for the inflation rate and the interest rate. The inflation rate is calculated as year-on-year percentage change as it provides a smoother trend. Inflation as quarter-on-quarter percentage change is also used as comparison. Section 7 explains robustness of our selected model with regards to changes in one of the fundamental variables with the alternative one.

The choice of the domestic variables reflects the important macroeconomic variables that are believed to have great influence in the economy. The use of real GDP and inflation are standard in any VAR approach as they represent the target variables of the monetary policy. In the meantime, real asset price, real credit, the interest rate and real effective exchange rate variables are used to represent the asset price channel, the credit channel, the interest rate channel and the exchange rate channel of monetary policy transmission mechanism respectively.

The choice of the KLCI to represent asset price channel is reasonable as it is the only price available throughout the period under study. An alternative price such as the property price index, as Tang (2006) mentioned starts only in the late 1990s. Particular attention is given to the effect of credit in influencing domestic output which is reflected in the contemporaneous relationship implied in our model. The inclusion of credit in the model can also serve other purposes. It represents one of the factors that affect the broad definition of monetary aggregate of M3 (Bank Negara Malaysia 1999). Consequently, we do not have to use monetary aggregate variable in the model. Furthermore, as Malaysia has changed its policy from monetary targeting to interest rate targeting in the late 1990s, the use of monetary aggregates in the model seems inappropriate, especially when the period under study passes

the year 1990. In this study, total loans and advances from commercial banks represent the credit variable as they constitute about 75% of total loans given by banking and financial system as a whole. Other financial institutions like merchant banks and finance companies also provide loans but their contributions have gradually been reducing especially after 2000 when more finance companies have merged with the larger commercial banks.

With regard to interest rate variable, several proxies are of interest. Azali and Matthews (1999) use the 3 month Treasury Bills, Fungs (2002) utilizes the 3 month interbank rates while Tang (1999) uses two interest rate variables (the 3 month interbank rates and the base lending rate, BLR). As for this study, we employ average lending rate (INT) which refers to the weighted average lending rates on loans extended by the commercial banks. We provide comparison of results when using different interest rate variables and these are discussed in section 7.

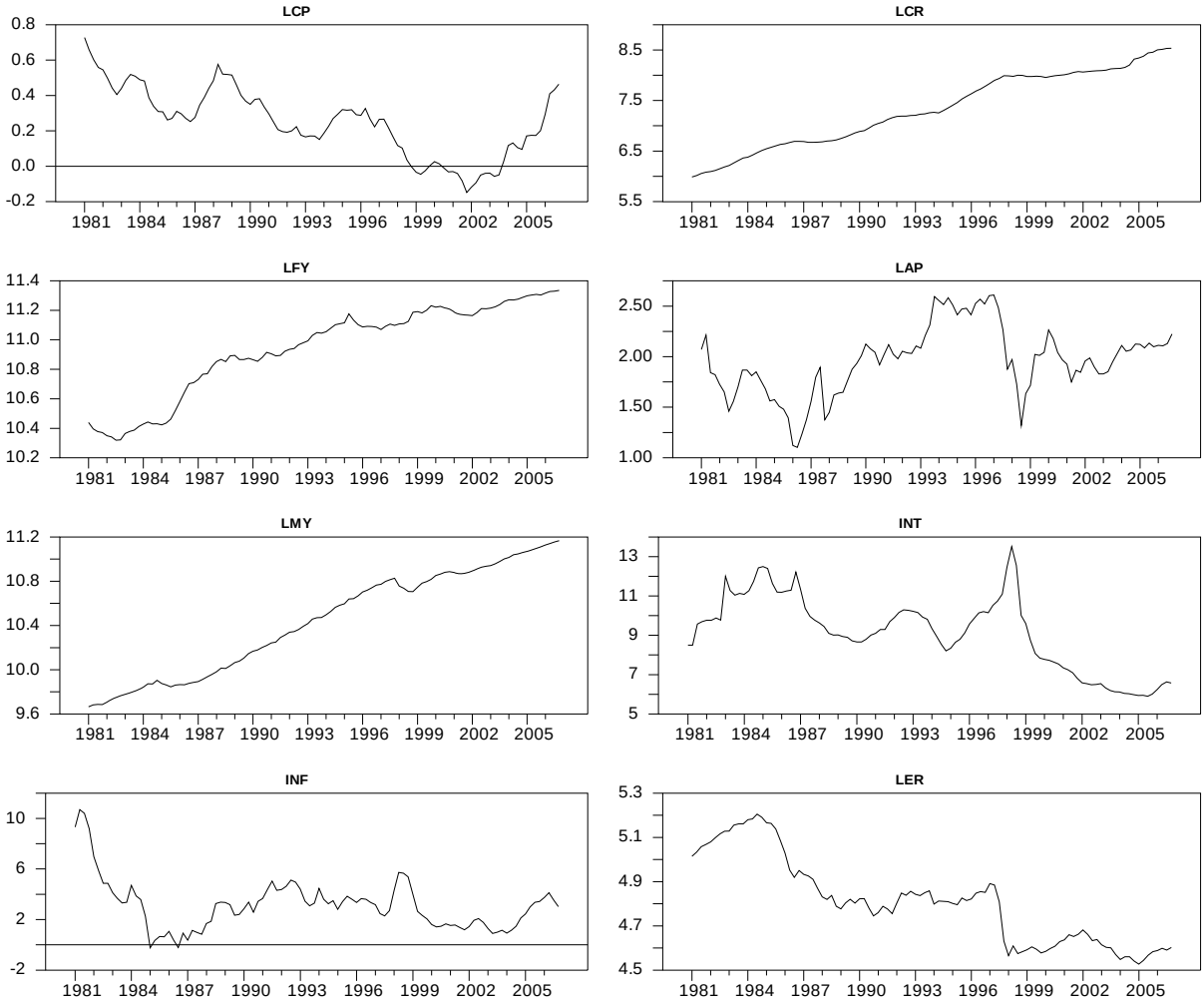
Like credit, we believe that interest rate can also capture the behaviour of monetary aggregates and thus the monetary policy. In other words, the increase in interest rate will suggest the contractionary of monetary policy and vice versa. For the exchange rate variable, the real effective exchange rate is used as it reflects the behaviour of the major currencies of countries that trade with Malaysia. In this case, an increase in the exchange rate means that the domestic currency which is the Ringgit Malaysia (RM) appreciates relative to the currencies of its major trading partners. We also believe that putting the real effective exchange rate in the model can help solve the exchange rate puzzle which has been captured in the past study, particularly in the Tang's (2006) case.

Data are collected from various publications of Monthly Statistical Bulletin of Bank Negara Malaysia, DataStream and International Financial Statistics online database. Details about each of the variables used are also described in appendix 1. Period under study covers from 1981:1 until 2006:4, thus taking into account the effect of Asian financial crisis and the period of exchange control implemented by Malaysian government as well as the period of economic liberalization and deregulation.

Figure 2 plots each of the variables concerned in the analysis. As shown, the commodity price had generally been trending down, though not as smooth, until the end of 2001 when it then began to show a pronounced change in the direction. On the other hand,

three of the variables (foreign GDP, real Malaysian GDP and real credit) have been trending up all the way. Due to Asian financial crisis however, real Malaysian GDP got a short drop off in 1997/1998 period before coming back to its normal course after that. Real credit was also down in 1990 but trended up afterward (beginning in 1992). Since 1997 however, its progress has been slowing down. It is believed that the increase in interest rate during the financial crisis to contain inflationary pressure plays important role in slowing down the credit progress.[11] As seen, the interest rate also increased several times before it peaked during the economic recession of 1998.

Figure 3: Macroeconomic Time Series of Malaysia and Foreign Sector



[11] During the financial crisis, inflationary pressure came from the external sector. As Ringgit Malaysia depreciated drastically against US dollar, the demand for domestic goods and services rose drastically as well. This in turn put more pressure on the price.

It is interesting to note that the trend of the LAP looks like a mirror image of the trend of the INT. The sharp trough corresponds to the economic recession of 1998. During the Asian financial crisis, the KLCI dropped almost 80% from the highest point of 1278.94 in February 1997 to the lowest point of 261.33 in September 1998.[12] The seemingly close relationship between the KLCI and the interest rate is to be taken into account in deciding the contemporaneous effect of the shock in the SVAR system.

Finally, the trend of real effective exchange rate shows that the value of Ringgit Malaysia (RM) against a basket of foreign currency is relatively high before the crisis. During the financial crisis however, RM devalued aggressively until it was less than USD0.25 per USD (equivalent to RM4.00/USD; it was around RM2.70/USD before the crisis occurred). Realizing that further depreciation would put inflationary pressure on the economy, Bank Negara Malaysia had to peg the Ringgit Malaysia to US Dollar at RM3.80/USD in September 1998. The RM is flexible with other foreign currencies however, making the trend of the real effective exchange rates smoother (devalue at about 20% from 1997:4 till 1998:3) than its bilateral rate (RM/USD not shown- devalues at about 36% from the same period).

5. Methodological and Theoretical Framework

In the SVAR approach, a dynamic relationship between time series economic variables can be shown as below

$$BY_t = C + (\Gamma_1 L + \Gamma_2 L^2 + ... + \Gamma_k L^k)Y_t + \varepsilon_t \qquad [1]$$

where B is a square matrix consisting of structural contemporaneous parameters of the variables, Y_t is n x 1 matrix of macroeconomics variables, C is a vector of deterministic variables, $\Gamma(L)$ is a *k*th order matrix polynomial in lag operator, L and ε_t is the structural

[12] Figures are calculated by the author based on the data available at http://www.econstats.com/eqty/eqem_ap_13.htm

innovation which satisfies the conditions that $E(\varepsilon_t) = 0$, $E(\varepsilon_t \varepsilon_s^{'}) = \Sigma_\varepsilon = I$ for all $t = s$ and $E(\varepsilon_t \varepsilon_s^{'}) = 0$ otherwise.

Multiplying equation [1] with B^{-1}, gives a reduced form VAR equation

$$Y_t = B^{-1}C + B^{-1}(\Gamma_1 L + \Gamma_2 L^2 + ... + \Gamma_k L^k)Y_t + B^{-1}\varepsilon_t \qquad [2]$$

where $e_t = B^{-1}\varepsilon_t$ is a reduced form VAR residual which satisfies the conditions that $E(e_t) = 0$, $E(e_t e_s^{'}) = \Sigma_e$ for all $t = s$ and $E(e_t e_s^{'}) = 0$ otherwise. Σ_e is a (kxk) symmetric, positive definite matrix which can be estimated from the data. 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 (kxk) symmetric matrix, there are $(k^2 + k)/2$ unknowns and hence $(k^2 - k)/2$ restrictions need to be imposed to exactly identify the system.

The relationship between the structural innovation ε_t and the reduced form residual, e_t is given by $Be_t = \varepsilon_t$. In recursive SVAR model elements above the diagonal of the matrix are set to be equal to zero. In this study however, restrictions are guided by economic theory, thus we use a structural non-recursive VAR.

$$BY_t \equiv \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \beta_{21} & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ \beta_{31} & \beta_{32} & 1 & 0 & \beta_{35} & 0 & 0 & 0 \\ \beta_{41} & \beta_{42} & \beta_{43} & 1 & \beta_{45} & 0 & 0 & 0 \\ \beta_{51} & \beta_{52} & \beta_{53} & \beta_{54} & 1 & 0 & 0 & 0 \\ \beta_{61} & \beta_{62} & \beta_{63} & 0 & \beta_{65} & 1 & \beta_{67} & 0 \\ \beta_{71} & 0 & \beta_{73} & \beta_{74} & \beta_{75} & 0 & 1 & 0 \\ \beta_{81} & \beta_{82} & \beta_{83} & \beta_{84} & \beta_{85} & \beta_{86} & \beta_{87} & 1 \end{bmatrix} \begin{bmatrix} LCP_t \\ LFY_t \\ LMY_t \\ INF_t \\ LCR_t \\ LAP_t \\ INT_t \\ LER_t \end{bmatrix} \qquad [3]$$

Equation [3], the right-hand side term of equation [1], shows the restrictions that we impose on some of the contemporaneous parameters of the Malaysian macroeconomic variables. The coefficients β_{ij} indicate that variable j affects variable i contemporaneously.

The coefficients on the diagonal are normalized to one while the number of coefficient restricted (indicated by the zeros) is 28, thus showing that the system is exactly identified. We also test recursive decomposition and Berkelmans (2005) type restriction as for comparison and basis for model selection. Discussion about the results is presented in section 7.

Two foreign variables (commodity prices and foreign GDP) are assumed to contemporaneously affect most of the domestic variables. This assumption is reasonable given that Malaysia is an open economy where it exports a great amount of agricultural commodities such as palm oil, rubber, saw logs and sawn timber.[13] Any change in the commodity prices, for instance, is expected to influence Malaysian exports of the commodities and eventually the economy. There is one exception in that the foreign GDP does not contemporaneously affect domestic interest rate. This exception reflects that the policy makers in the BNM face informational-lags during the decision making process. On the other hands, domestic variables are assumed not to affect the foreign variables due to the fact that Malaysian economy is relatively small in size and could not have great impact internationally.

Restrictions in equation [3] explain that credit affects Malaysian real output, inflation, real asset prices, interest rates and real effective exchange rate contemporaneously. The effect of credit on output and inflation is quite straightforward as an increase in aggregate demand stimulated by an increase in credit causes output and inflation to increase as well. Moreover, as people have more money through borrowing, they will spend it in both domestic and foreign goods and services and financial assets. As the demand for financial assets rises, their prices rise as well. Similarly, an increase in import resulted from a rise in credit will cause a depreciation in domestic currency and thus a decrease in exchange rate. With regard to the effect on interest rate, the interest rate will be forced upward if the credit keeps on increasing and proves to be inflationary.

Equation [3] also proposes that interest rate contemporaneously affects real asset prices and real effective exchange rate. As the domestic interest rate rises, so does the cost of borrowing, people will hold less money. This will result in less investment being made in

[13] Malaysia also exports mining commodities such crude oils and natural gas. But since the commodity prices are non fuel prices index, the commodities are not mentioned as they are not directly affected.

financial assets, thus causing real asset prices to fall. Correspondingly, a rise in interest rate will also draw attention of foreign investors to invest in domestic financial assets. This, in turn will affect the demand for domestic currency which will then affect the exchange rate.

5.1 Estimation of the reduced form

From equation [1], the vector of C consists of intercepts, trends and all dummy variables as shown in the full reduced form of equation [4].[14] The time trend will only be used in three equations, namely the LFY, LMY and LCR equations to capture any trending behaviour. The dummy variables are used to capture the Asian financial crisis period which begins from 1997:3 to 1998:4 as well as to interact with the commodity price, the domestic output and the credit. The dummy variable for Asian financial crisis period (DAC) is 1 from 1997:3 until 1998:4 and 0 otherwise while the dummy variable interacting with the commodity price (DCP) is the price itself from 2001:4 onwards and 0 before that year. Likewise, the dummy variable that interacts with the domestic output (DMY) and the one that interacts with credit (DCR) are the data themselves respectively from 1997:4 onward and 0 before that.

$$\begin{bmatrix} LCP_t \\ LFY_t \\ LMY_t \\ INF_t \\ LCR_t \\ LAP_t \\ INT_t \\ LER_t \end{bmatrix} = \begin{bmatrix} \delta_{11} & 0 & \delta_{13} & \delta_{14} & \delta_{15} & \delta_{16} & \delta_{17} & \delta_{18} & \delta_{19} \\ \delta_{21} & \delta_{22} & \delta_{23} & \delta_{24} & \delta_{25} & \delta_{26} & \delta_{27} & \delta_{28} & \delta_{29} \\ \delta_{31} & \delta_{32} & \delta_{33} & \delta_{34} & \delta_{35} & \delta_{36} & \delta_{37} & \delta_{38} & \delta_{39} \\ \delta_{41} & 0 & \delta_{43} & \delta_{44} & \delta_{45} & \delta_{46} & \delta_{47} & \delta_{48} & \delta_{49} \\ \delta_{51} & \delta_{52} & \delta_{53} & \delta_{54} & \delta_{55} & \delta_{56} & \delta_{57} & \delta_{58} & \delta_{59} \\ \delta_{61} & 0 & \delta_{63} & \delta_{64} & \delta_{65} & \delta_{66} & \delta_{67} & \delta_{68} & \delta_{69} \\ \delta_{71} & 0 & \delta_{73} & \delta_{74} & \delta_{75} & \delta_{76} & \delta_{77} & \delta_{78} & \delta_{79} \\ \delta_{81} & 0 & \delta_{83} & \delta_{84} & \delta_{85} & \delta_{86} & \delta_{87} & \delta_{88} & \delta_{89} \end{bmatrix} \begin{bmatrix} 1 \\ t \\ dac \\ dcp_{t-1} \\ dcp_{t-2} \\ dmy_{t-1} \\ dmy_{t-2} \\ dcr_{t-1} \\ dcr_{t-2} \end{bmatrix} + \begin{bmatrix} \theta_{11} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \theta_{21} & \theta_{22} & 0 & 0 & 0 & 0 & 0 & 0 \\ \theta_{31} & \theta_{32} & \theta_{33} & \theta_{34} & \theta_{35} & \theta_{36} & \theta_{37} & \theta_{38} \\ \theta_{41} & \theta_{42} & \theta_{43} & \theta_{44} & \theta_{45} & \theta_{46} & \theta_{47} & \theta_{48} \\ \theta_{51} & \theta_{52} & \theta_{53} & \theta_{54} & \theta_{55} & \theta_{56} & \theta_{57} & \theta_{58} \\ \theta_{61} & \theta_{62} & \theta_{63} & \theta_{64} & \theta_{65} & \theta_{66} & \theta_{67} & \theta_{68} \\ \theta_{71} & \theta_{72} & \theta_{73} & \theta_{74} & \theta_{75} & \theta_{76} & \theta_{77} & \theta_{78} \\ \theta_{81} & \theta_{82} & \theta_{83} & \theta_{84} & \theta_{85} & \theta_{86} & \theta_{87} & \theta_{88} \end{bmatrix} \begin{bmatrix} LCP_{t-1} \\ LFY_{t-1} \\ LMY_{t-1} \\ INF_{t-1} \\ LCR_{t-1} \\ LAP_{t-1} \\ INT_{t-1} \\ LER_{t-1} \end{bmatrix} +$$

$$\begin{bmatrix} \psi_{11} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \psi_{21} & \psi_{22} & 0 & 0 & 0 & 0 & 0 & 0 \\ \psi_{31} & \psi_{32} & \psi_{33} & \psi_{34} & \psi_{35} & \psi_{36} & \psi_{37} & \psi_{38} \\ \psi_{41} & \psi_{42} & \psi_{43} & \psi_{44} & \psi_{45} & \psi_{46} & \psi_{47} & \psi_{48} \\ \psi_{51} & \psi_{52} & \psi_{53} & \psi_{54} & \psi_{55} & \psi_{56} & \psi_{57} & \psi_{58} \\ \psi_{61} & \psi_{62} & \psi_{63} & \psi_{64} & \psi_{65} & \psi_{66} & \psi_{67} & \psi_{68} \\ \psi_{71} & \psi_{72} & \psi_{73} & \psi_{74} & \psi_{75} & \psi_{76} & \psi_{77} & \psi_{78} \\ \psi_{81} & \psi_{82} & \psi_{83} & \psi_{84} & \psi_{85} & \psi_{86} & \psi_{87} & \psi_{88} \end{bmatrix} \begin{bmatrix} LCP_{t-2} \\ LFY_{t-2} \\ LMY_{t-2} \\ INF_{t-2} \\ LCR_{t-2} \\ LAP_{t-2} \\ INT_{t-2} \\ LER_{t-2} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \\ e_{4t} \\ e_{5t} \\ e_{6t} \\ e_{7t} \\ e_{8t} \end{bmatrix} \quad [4]$$

[14] The reduced form showed in equation 4 employs two lags of each variable including the interacting dummies. The exact number of lags will be chosen based on certain criteria as discussed.

The order of variables in the structural VAR model follows that of Cushman and Zha (1997), Dungey and Pagan (2000) and Berkelmans (2005) where the foreign variables are both placed at the beginning of the order. They are followed then, by real Malaysian GDP, inflation, real credit, real asset price, the interest rate and real effective exchange rate. The commodity price is affected only by its own lags while the foreign GDP is affected by the lags of the commodity price, and the lags of itself. For all domestic variables, the right hand side terms of the equations are all the same except for the two equations, namely the LMY and the LCR equations where both include the trend variable as well. Even though optimum number of lag to be used in this model will be determined by AIC and SBC method, the final number of lag will be selected based on its effect on the stability of the model and to account fully for serial correlation.

From the VAR, standard impulse response functions and variance decomposition will be generated. The impulse response functions describe the direction of response of a variable of interest (e.g. the Malaysian GDP) to an exogenous shock (e.g. interest rate shock) while variance decompositions indicate the percentage of a variable's forecast error variance attributable to innovations in all variables considered in the system.

6 Findings

This section discusses the result of lag length test, SVAR estimation, impulse response function and variance decomposition. Specific attention will be given to analyse the effect of a shock in interest rate which acts as monetary shock, and to a shock in credit.

Table 1: Diagnostic Tests

Equation Diagnostics: Serial Correlation and Arch of Residuals

			Equation							
		k	LCP	LFY	LMY	INF	LCR	LAP	INT	LER
AR(1)	F	1	19.278	6.548	1.185	2.994	2.522	0.223	0.577	0.017
			(0.000)	(0.012)	(0.279)	(0.087)	(0.115)	(0.637)	(0.449)	(0.897)
		2	0.023	0.237	1.247	0.904	0.395	1.337	0.854	0.794
			(0.879)	(0.628)	(0.267)	(0.344)	(0.531)	(0.250)	(0.358)	(0.375)
		3	0.082	0.004	1.430	0.634	0.121	0.268	4.367	2.787
			(0.775)	(0.950)	(0.235)	(0.428)	(0.729)	(0.606)	(0.039)	(0.098)
		4	0.024	0.309	2.059	1.876	1.113	0.732	5.469	2.486
			(0.877)	(0.579)	(0.155)	(0.174)	(0.294)	(0.394)	(0.021)	(0.118)
AR(4)	F	1	5.117	2.474	0.277	2.189	0.929	1.423	2.975	0.381
			(0.001)	(0.050)	(0.892)	(0.076)	(0.450)	(0.232)	(0.023)	(0.822)
		2	0.270	1.590	0.696	2.626	0.543	1.050	2.410	0.511
			(0.897)	(0.184)	(0.596)	(0.039)	(0.704)	(0.386)	(0.055)	(0.728)
		3	0.452	0.759	1.970	3.579	0.778	0.622	2.806	0.895
			(0.770)	(0.555)	(0.106)	(0.009)	(0.542)	(0.648)	(0.030)	(0.470)
		4	0.251	0.431	1.737	4.519	1.421	0.345	4.542	1.341
			(0.908)	(0.786)	(0.149)	(0.002)	(0.234)	(0.847)	(0.002)	(0.261)
ARCH(1)	F	1	3.807	5.675	1.754	0.043	0.206	3.248	2.242	4.306
			(0.054)	(0.019)	(0.188)	(0.836)	(0.651)	(0.075)	(0.137)	(0.041)
		2	2.557	4.139	13.990	0.226	0.017	9.588	4.687	0.665
			(0.113)	(0.045)	(0.000)	(0.636)	(0.897)	(0.003)	(0.033)	(0.417)
		3	3.104	8.706	6.127	0.624	0.021	4.845	2.365	0.084
			(0.081)	(0.004)	(0.015)	(0.431)	(0.884)	(0.030)	(0.127)	(0.773)
		4	3.546	7.627	1.630	0.838	0.101	8.694	1.943	0.001
			(0.063)	(0.007)	(0.205)	(0.362)	(0.751)	(0.004)	(0.166)	(0.980)
ARCH(4)	F	1	1.202	1.766	0.658	3.634	1.416	1.702	1.970	1.860
			(0.315)	(0.142)	(0.622)	(0.008)	(0.235)	(0.156)	(0.105)	(0.124)
		2	0.997	1.338	3.532	6.648	0.827	2.267	1.314	0.324
			(0.413)	(0.262)	(0.010)	(0.000)	(0.511)	(0.068)	(0.271)	(0.861)
		3	1.100	3.104	2.628	6.644	1.902	1.448	0.660	0.128
			(0.361)	(0.019)	(0.039)	(0.000)	(0.117)	(0.225)	(0.621)	(0.972)
		4	1.193	2.522	1.257	3.107	1.139	2.698	0.579	0.137
			(0.319)	(0.046)	(0.293)	(0.019)	(0.343)	(0.036)	(0.679)	(0.968)

System Diagnostics

k	AIC	SBC
6	-4703.820	-3491.470
5	-4685.625	-3663.147
4	-4658.617	-3827.567
3	-4667.275	-4029.185
2	-4712.744	-4269.124
1	**-4713.750**	**-4466.086**

Note: k is the number of lag. F is the F statistics and figures in parentheses are the marginal significance level. AIC is Akaike Information Criterion and SBC is Schwarz Criterion.

6.1 Results of lag length test

Table 1 shows the results of lag length test based on equation as well as on system diagnostics. Based on equation diagnostics, the first order (AR(1)) and the fourth order (AR(4)) serial correlation of residuals are examined for each equation in the system. The results indicate that at 5% significant level, there is no serial correlation of residuals in AR(1) when a lag length of two is used. Other lag lengths produce at least one serial correlation of residuals. With regard to the test in AR(4), a lag length of two produce only one serial correlation in residuals, specifically in the inflation equation. Other lag lengths unfortunately produce at least two serial correlations in residuals. Thus, taking these results into account, a lag length of two can be regarded as a plausible choice. The results of ARCH(1) and ARCH(4) of residuals however, give support to the lag length of one. In addition, the lag length of one is also supported by the system diagnostic where both Akaike Information Criterion (AIC) and Schwarz Criterion (SBC) are in favour of it.

In determining the number of lags to be used in the model, we proceed with the lag length of two as it does not contributes to the first order serial correlation and it is also a reasonable lag to account for the dynamics of the system.

6.2 Results of SVAR estimation

Estimates of contemporaneous coefficients are indicated in table 2. As shown, only 7 out of 28 coefficients are significant at least at 10 percent significant level. The signs of the coefficients should be read in opposite direction to the signs shown. With regards to the role of domestic variables, the contemporaneous effects of the interest rates on asset prices and on the exchange rate are of interest. The findings reveal that the interest rate has contemporaneously negative influence on the asset price. As interest rate rises, people will hold less money on hand and thus demand less of domestic assets such as stocks. A decrease in the demand for financial assets will then decrease their prices, assuming the supply remains constant.

Table 2: Estimates of Contemporaneous Coefficients

Variable	Coefficients	Significance value	
β_{21}	-0.1251	0.0208	**
β_{31}	-0.1214	0.1175	
β_{32}	-0.0614	0.6102	
β_{35}	-0.6454	0.2696	
β_{41}	0.9755	0.4968	
β_{42}	0.4484	0.8550	
β_{43}	0.4433	0.6964	
β_{45}	-0.0590	0.9609	
β_{51}	0.0718	0.3099	
β_{52}	-0.3884	0.0812	*
β_{53}	1.2475	0.3030	
β_{54}	0.0066	0.1283	
β_{61}	-0.4001	0.2199	
β_{62}	0.7701	0.1831	
β_{63}	-2.5747	0.0071	***
β_{65}	0.7245	0.2795	
β_{67}	0.0617	0.0192	**
β_{71}	0.3292	0.7574	
β_{73}	0.4492	0.8909	
β_{74}	-0.0244	0.7413	
β_{75}	2.4717	0.3095	
β_{81}	0.0827	0.1831	
β_{82}	0.3238	0.0047	***
β_{83}	0.1985	0.2954	
β_{84}	-0.0069	0.1027	
β_{85}	0.1791	0.1760	
β_{86}	-0.0711	0.0003	***
β_{87}	-0.0099	0.0622	*

Note
*- *, ** and *** indicates significant at 10%, 5% and 1% respectively*

In the meantime, the interest rate and the asset prices have positive contemporaneous impact on the exchange rate. An increase in either variable will attract foreign investments to come in. Believing that the trend will continue, foreign investors will make more investments (such as in bonds) or demand more of domestic financial assets. Consequently, more domestic currency will be demanded and this will result in appreciation of domestic currency and thus a rise in the exchange rate.

6.3 Results of impulse response functions

Figure 4 shows the impulse response function to shock to each of the endogenous variables used in the study. Given the range of y-axis is the same for all responses of a particular variable to the shock of each of the dependent variable, figure 4 can also depict relative size of responses of the variable to different shocks. It can be seen that a shock to commodity price brings about a sizable response of each of the variable compared to responses to a shock to other variables.

Figure 5 and 6 illustrate the impulse response function to a shock to the interest rate and credit respectively. From figure 5, both domestic output and inflation respond negatively to a rise in the interest rate. In the meantime, a shock in the interest rate causes asset price to fall and exchange rate to increase as domestic currency appreciates. The expected negative effect of inflation and positive effect of the exchange rate to a rise in the interest rate reveals that both prize puzzles do not appear. The only thing of concern is the initial positive response of credit following a positive shock in interest rate. It only decreases after about 3 quarters, showing that it has lagged negative response. This result is however, similar to Tang's (2006).

As depicted in figure 6, a shock to credit brings about positive response on domestic output and asset price but negative response on inflation, the interest rate and exchange rate. As for the inflation, the initial negative response and subsequent positive responses after 4 quarters shows that the impact of the shock on inflation is with lag. One possible explanation for this is that, a large proportion of the credit might have initially been used to invest in financial assets rather than acquiring goods and services. This is why the response of asset price is positive when responding to the rise in the credit. Bacha (1998) provides some insights about Malaysian credit performance and its relationship with property and stock market boom of 1990s. According to him, Malaysia has experienced excessive credit growth where a great amount of loan has inappropriately been channelled into risky investments such as in property and stock markets which are prone to speculative activity.

Figure 4: Impulse Response Function to a shock to

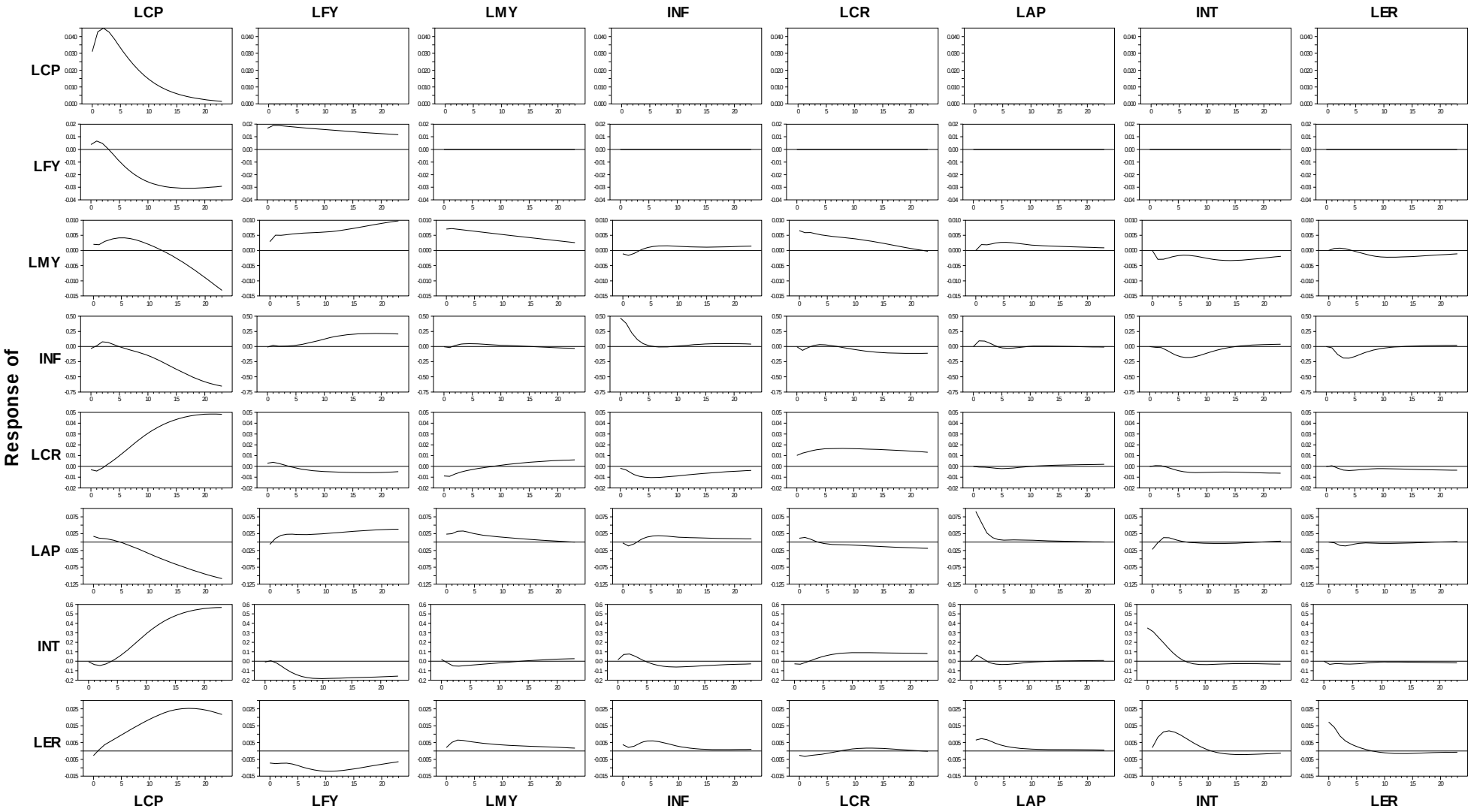


Figure 5: Impulse response functions to a shock to the interest rate

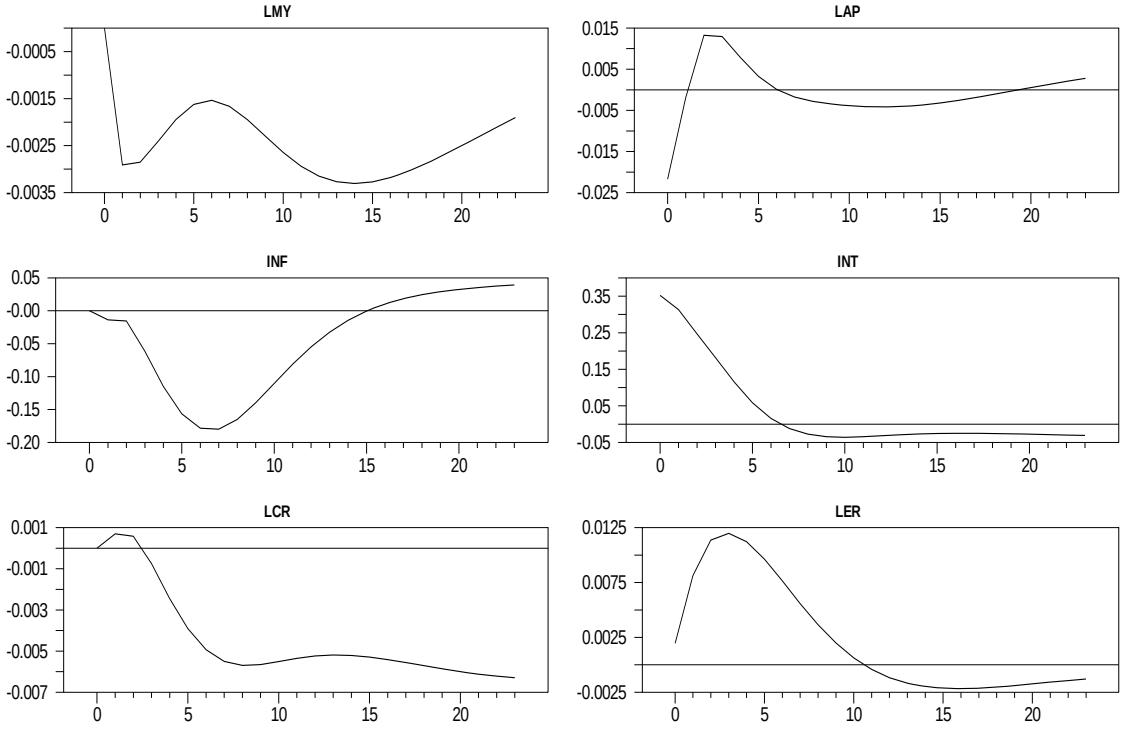
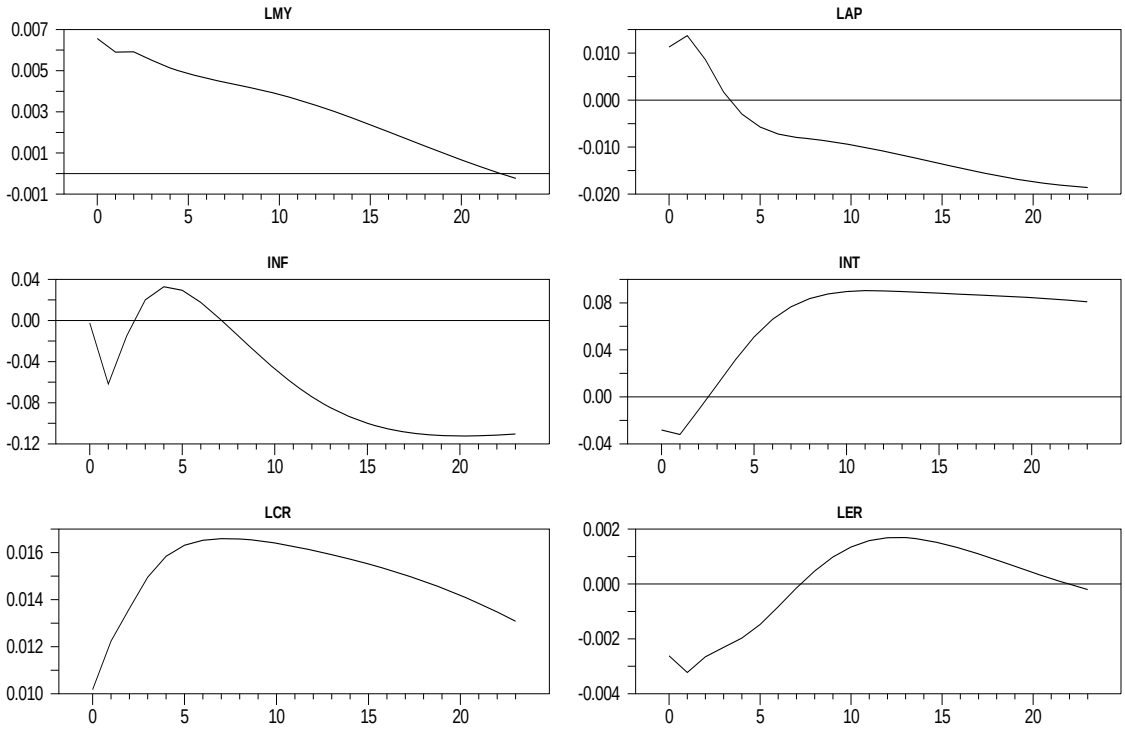


Figure 6: Impulse response functions to a shock to credit



Other responses of interest are the impulse response functions to a shock to exchange rate and asset price. A positive rise in exchange rate does not lower domestic output as expected. The domestic output, in fact, falls after more than a year, showing a j curve phenomenon really exits. A rise in the exchange rate also causes inflation to fall as the demand for domestic goods and services decreases. In the meantime, credit initially shows small positive response in few quarters before responding negatively while both asset prices and interest rate react negatively to the shock. An appreciation in domestic currency increases the likelihood of domestic residents to invest (possibly in financial assets) in foreign countries. As a result, less domestic financial assets will be demanded and consequently this lowers the asset prices. The relationship between exchange rate and interest rate however is not as what we expect. Uncovered interest parity condition requires that interest rates to go up when there is an appreciation to domestic currency.

Consistent with economic prediction, a shock to asset price causes an increase in domestic output and inflation as well as an appreciation in domestic currency. The expected negative response of the interest rate only occurs after 3 quarters. Credit however responds negatively.

6.4 Results of variance decomposition

Table 3 summarizes variance decomposition of domestic variables used in the model for 6 years period (only quarter 1, 8, 16 and 24 are reported). It can be seen that besides shocks to domestic output itself, shocks to credit plays a very important role in explaining the movement in domestic output, in fact at the very first quarter (about 40%). It remains significant for two years period. As time expands, foreign sectors particularly the foreign GDP play a greater role. Brischetto and Voss (1999), Dungey and Pagan (2000), Kim and Roubini (2000) and Berkelmans (2005) report similar pattern of the foreign role in their studies for other open economies case.

For inflation, its own shocks explain more than three years of the forecast error. As horizon expands, commodity price dominates. The interest rate and the exchange rate also play their part during the second year until the fourth year. The finding that the exchange rate

plays its part in influencing domestic inflation is also supported by Cheng and Tan (2002) and Pauls (1997).

Table 3: Variance Decomposition

Decomposition of Variance for Series LMY									
Quarters	Std Error	LCP	LFY	LMY	INF	LCR	LAP	INT	LER
1	0.0104	3.8677	7.9907	46.8705	1.1414	40.1298	0.0000	0.0000	0.0000
8	0.0314	9.6018	21.6907	35.9230	1.1263	23.7165	4.0358	3.4332	0.4727
16	0.0424	7.1730	30.7746	30.9516	1.3639	18.3885	3.5477	5.6213	2.1793
24	0.0570	23.6589	36.0641	19.8426	1.1588	10.4742	2.2627	4.7828	1.7560
Decomposition of Variance for Series INF									
Quarters	Std Error	LCP	LFY	LMY	INF	LCR	LAP	INT	LER
1	0.4733	0.4892	0.0336	0.0060	99.4688	0.0024	0.0000	0.0000	0.0000
8	0.8648	2.3714	0.6889	1.3887	58.5332	0.8960	2.8681	14.1879	19.0658
16	1.2310	30.8442	13.1185	0.8960	29.2294	2.9844	1.4452	11.6072	9.8751
24	2.1196	65.8069	12.4654	0.3710	10.2414	3.1711	0.4923	4.0734	3.3785
Decomposition of Variance for Series LCR									
Quarters	Std Error	LCP	LFY	LMY	INF	LCR	LAP	INT	LER
1	0.0142	4.5882	4.2658	38.5251	1.4552	51.1657	0.0000	0.0000	0.0000
8	0.0586	20.5869	1.5205	7.7016	15.5749	50.2792	0.4310	2.2493	1.6566
16	0.1281	64.3317	1.5224	1.8762	6.4391	23.2137	0.1187	1.8917	0.6066
24	0.1926	77.0244	1.3217	1.4345	3.3449	14.6818	0.1110	1.5897	0.4920
Decomposition of Variance for Series LAP									
Quarters	Std Error	LCP	LFY	LMY	INF	LCR	LAP	INT	LER
1	0.0988	3.0138	0.5024	5.6686	0.0697	1.3016	84.6090	4.8349	0.0000
8	0.1592	3.2824	12.2941	22.0944	5.3160	2.1633	49.9356	3.5376	1.3766
16	0.2312	34.9910	17.0825	12.9673	5.4617	2.8100	23.9801	1.8786	0.8287
24	0.3689	64.3495	14.3896	5.1810	2.7773	2.7765	9.4363	0.7569	0.3328
Decomposition of Variance for Series INT									
Quarters	Std Error	LCP	LFY	LMY	INF	LCR	LAP	INT	LER
1	0.3544	0.0155	0.0615	0.2740	0.2099	0.6315	0.0000	98.8077	0.0000
8	0.7110	5.8494	16.3776	2.4201	3.3900	3.1459	1.8056	65.9484	1.0630
16	1.3827	56.4629	17.8031	0.7347	2.1839	4.1144	0.5373	17.8382	0.3256
24	2.1430	75.3791	12.2002	0.3748	1.1289	2.9600	0.2301	7.5570	0.1700
Decomposition of Variance for Series LER									
Quarters	Std Error	LCP	LFY	LMY	INF	LCR	LAP	INT	LER
1	0.0207	1.7539	12.1687	0.9423	3.3281	1.6097	9.7931	0.8985	69.5056
8	0.0546	17.1466	18.6849	7.1631	5.8726	1.2225	6.8460	21.8177	21.2466
16	0.0880	51.5519	21.0351	3.9418	2.9122	0.6775	2.7517	8.7976	8.3321
24	0.1142	66.3391	16.7208	2.6386	1.7739	0.4350	1.6640	5.4207	5.0078

With regards to credit, its forecast error variance is explained more by its own shocks than by the shocks to domestic output and inflation in the short horizon. Over longer horizon, shocks to commodity price are increasingly dominant. Similar pattern is observed in the movement of asset price and the interest rate. For these variables, their own shocks are responsible for their short term forecast error. In the long term, foreign variables particularly commodity price takes the role. Only in the asset price forecast error, domestic output has its contribution. Finally, with respect to the exchange rate, its own shocks as well as the shocks to foreign GDP, asset price and the interest rate explain its movement in the short term while commodity price, as expected, play the role in the long horizon.

7. Robustness of the selected model

Since SVAR model is vulnerable to the assumptions used in the estimation, several tests are done to check for robustness of our selected model. In particular we categorize the tests into three parts. In the first part, we compare results of our non recursive restriction model with other alternative models namely the recursive restriction and Berkelman's (2005)- type model.[15] Since the type of variables used in this study are almost similar to that of Berkelman, comparison such as this does help us choose an appropriate and better model. In the second part, we test our model with different number of lags as well as with truncated sub periods as the SVAR model can also be very sensitive to changes to the number of lags and the sample length used. The first sub period removes the first two years (1983:3-2006:4) while the second sub period removes the last two years (1981:3-2004:4). Finally, we compare our results of impulse response functions to the interest rate and credit shocks with the ones that use alternative variables that correspond to foreign output, price fluctuation and the interest rates. Specifically, we compare our model that contains LFY with the one that use the US GDP (LYUS) or Japan GDP (LYJP) as a proxy for foreign output. With regards to price, we also use inflation measured quarterly (INFQ) and the log of CPI (LCPI) as comparison. Lastly we also put the 3 month Treasury Bills (TB3) as well as the 3 month interbank rate (IBR3M) into the model, replacing the average lending rate which is our selected variable for the interest rate. All comparisons are presented in graphs.

[15] We make some adjustments in the restrictions to suit the Berkelmans model that has only 7 variables in the model. Specifically, Berkelmans does not have asset price variable and among the restrictions that he makes are that foreign GDP does not have immediate effect on domestic inflation as well as the interest rate. Similarly, on the account of information lags, domestic output and inflation do not immediately influence the interest rate.

Figure 7: Impulse Response Functions: Shock to the interest rate
Comparison between models

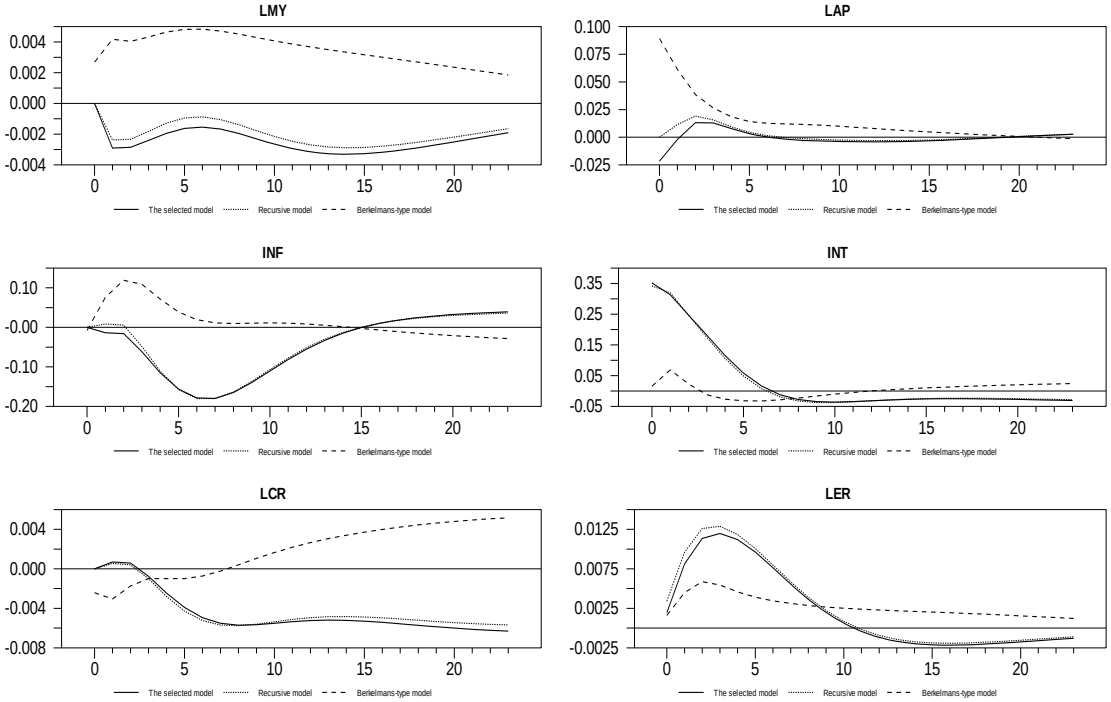


Figure 8: Impulse Response Functions: Shock to credit
Comparison between models

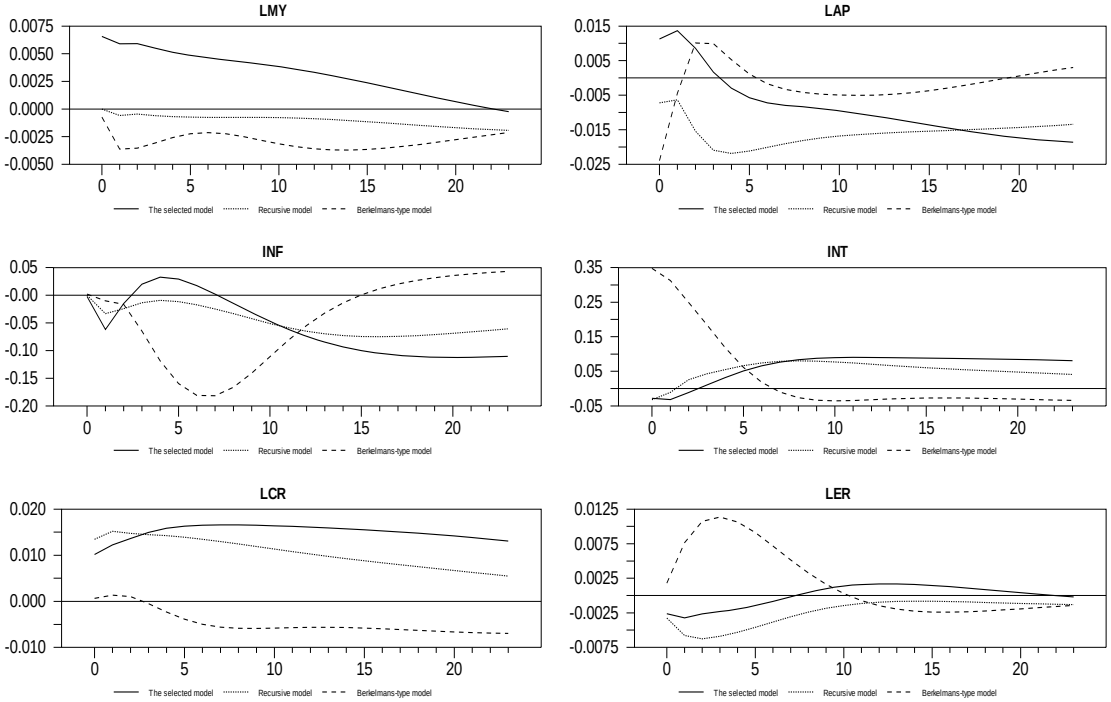


Figure 9: Impulse Response Functions: Shock to the interest rate
Comparison between different lag lengths

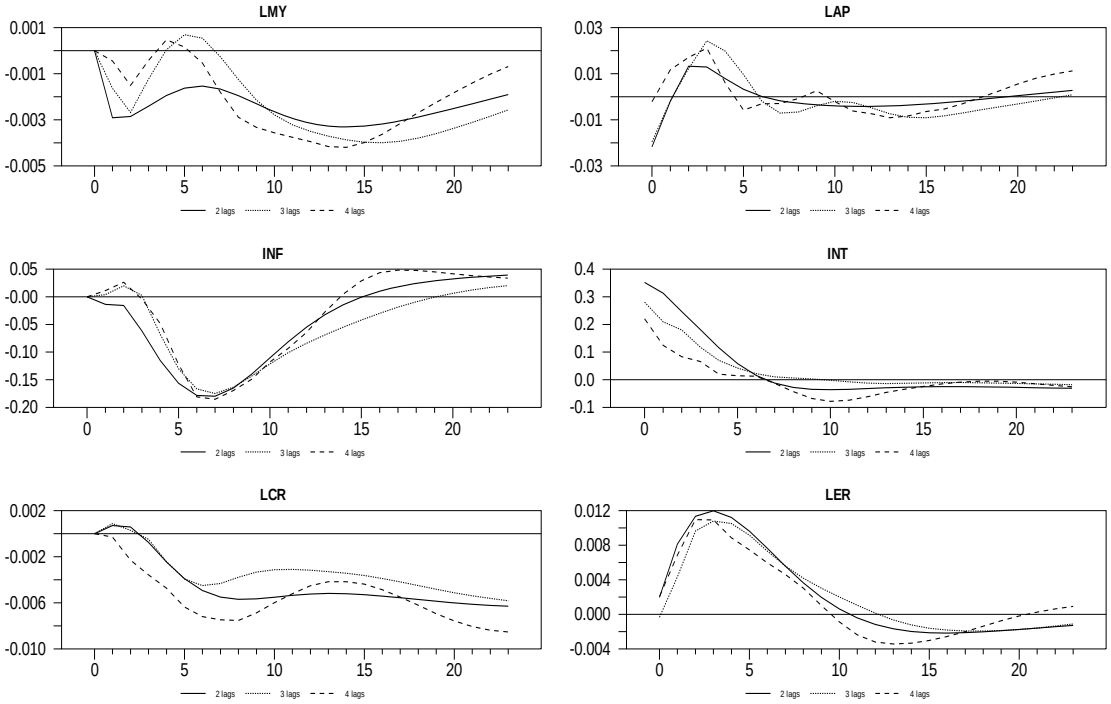


Figure 10: Impulse Response Functions: Shock to credit
Comparison between different lag length

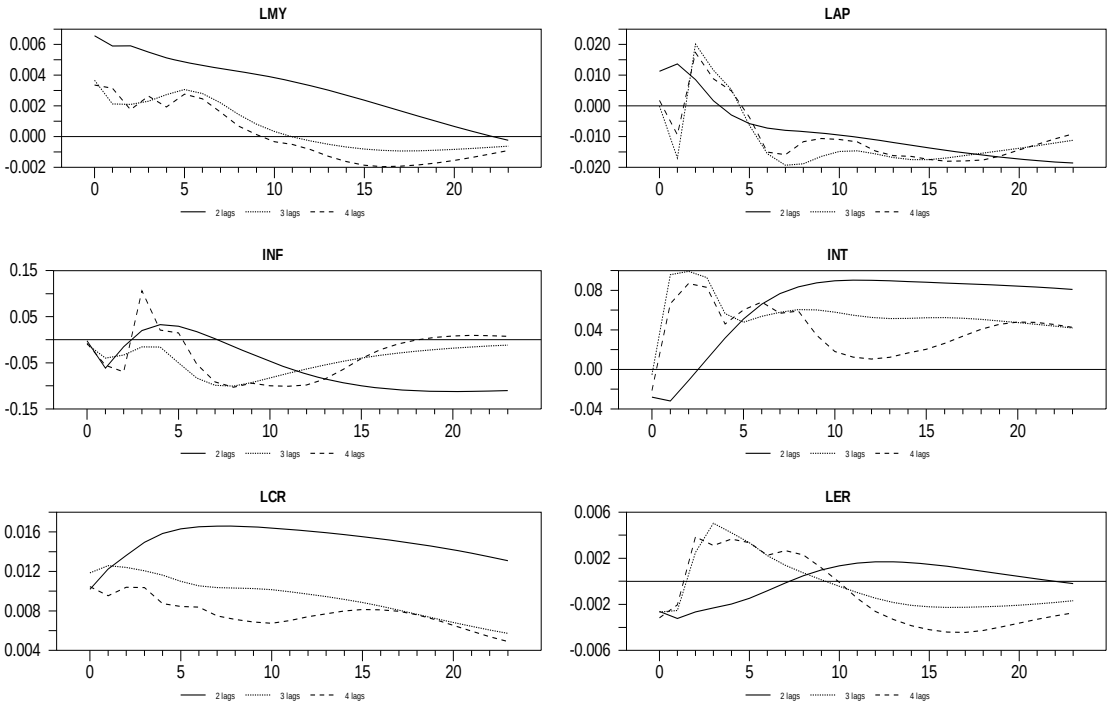


Figure 11: Impulse Response Functions: Shock to the interest rate
Comparison between different sample periods

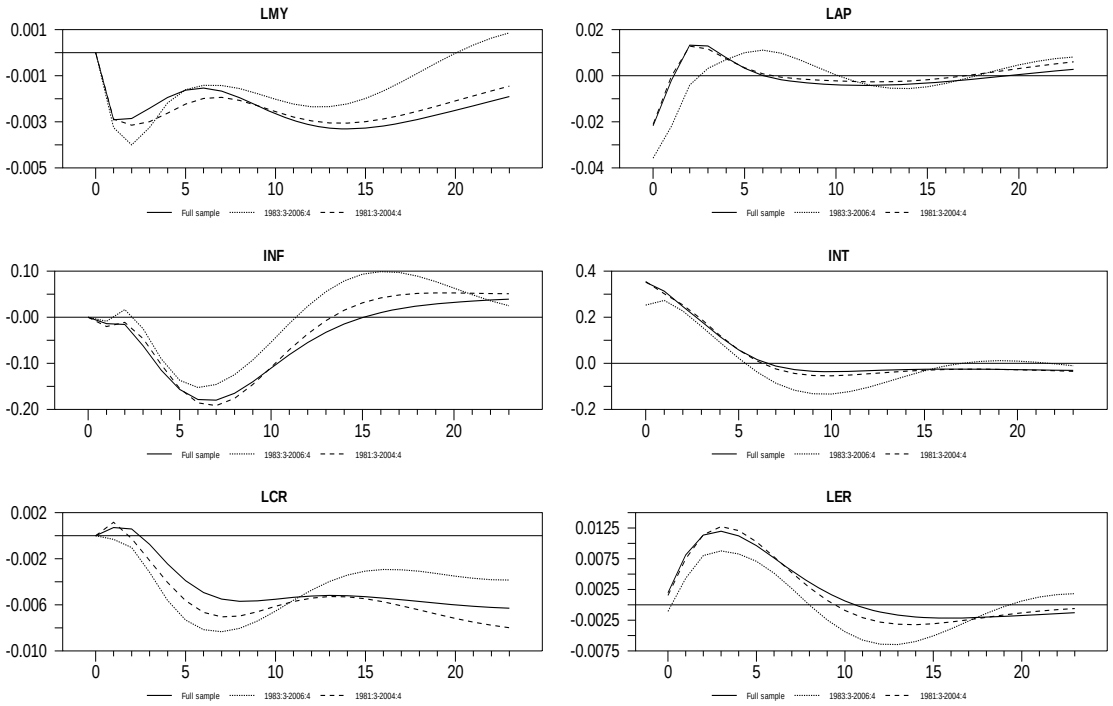


Figure 12: Impulse Response Functions: Shock to credit
Comparison between different sample periods

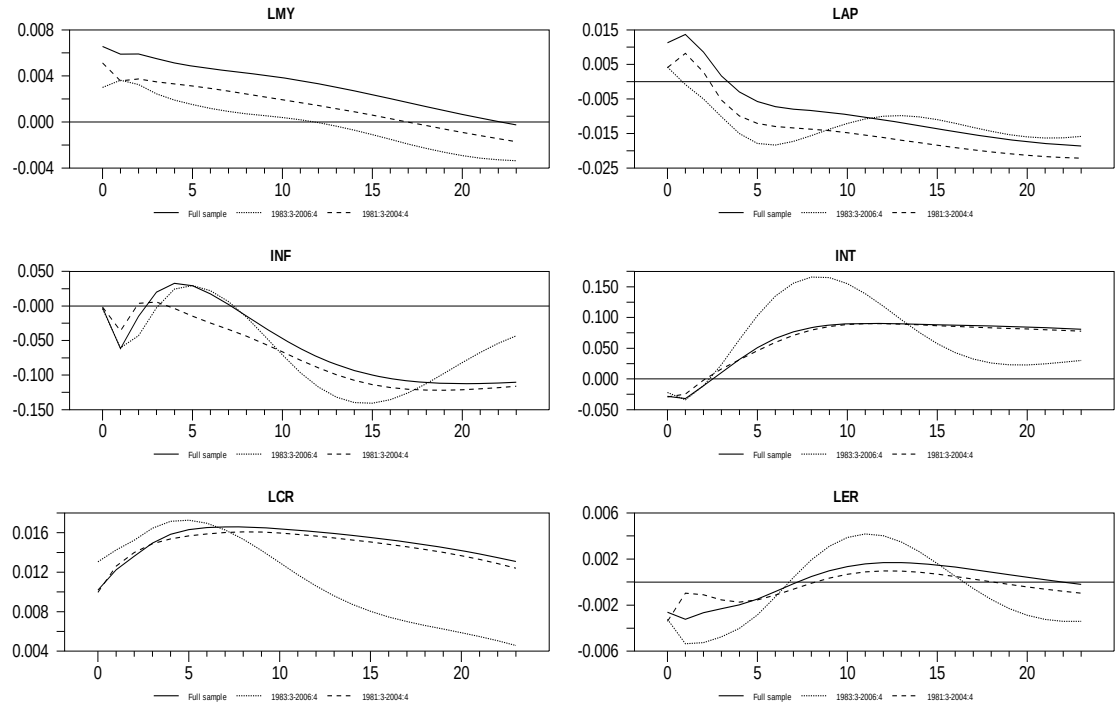


Figure 7 and 8 reveals that the responses of our selected model and the recursive model to the interest rate shock are about the same except that in the recursive model, inflation tends to rise in response to the shock, thus showing evidence of price puzzle. Responses in Berkelmans model are no good either as it produces the same prize puzzle. In fact, the model does not converge; implying that the restrictions imposed might not work for Malaysian case. As for responses to credit shock, similar pattern is observed. Our model's response is similar to the recursive's except for the response in domestic output. This is due to the difference in restriction setting. Based on this observation, our model produces better results and in line with economic grounds.

Figure 9 shows the impulse response functions to the shock to the interest rate in the different lag length setup, while figure 10 correspond to the shock to credit in the same manner. Visual inspection of the magnitude and timing of the responses to their respective shocks indicates that the model is quite robust in responses to the interest rate shock rather than to credit shock. Most of the initial responses however begin at the same point. As mentioned earlier in the paper, we employ two lags model as it does not produce first order serial correlation among the residuals in each equation in the system. In addition, the responses that it produces are much smoother than that of the model with different lag length.

The Impulse responses functions of different sample length are shown in figure 11 (responses to the interest rate shock) and figure 12 (responses to credit shock). The responses of the variables to both shocks are almost identical, thus showing that our selected model is robust to different sample length used.

Figure 13: Impulse Response Functions: Shock to the interest rate
Comparison between different foreign GDP variables

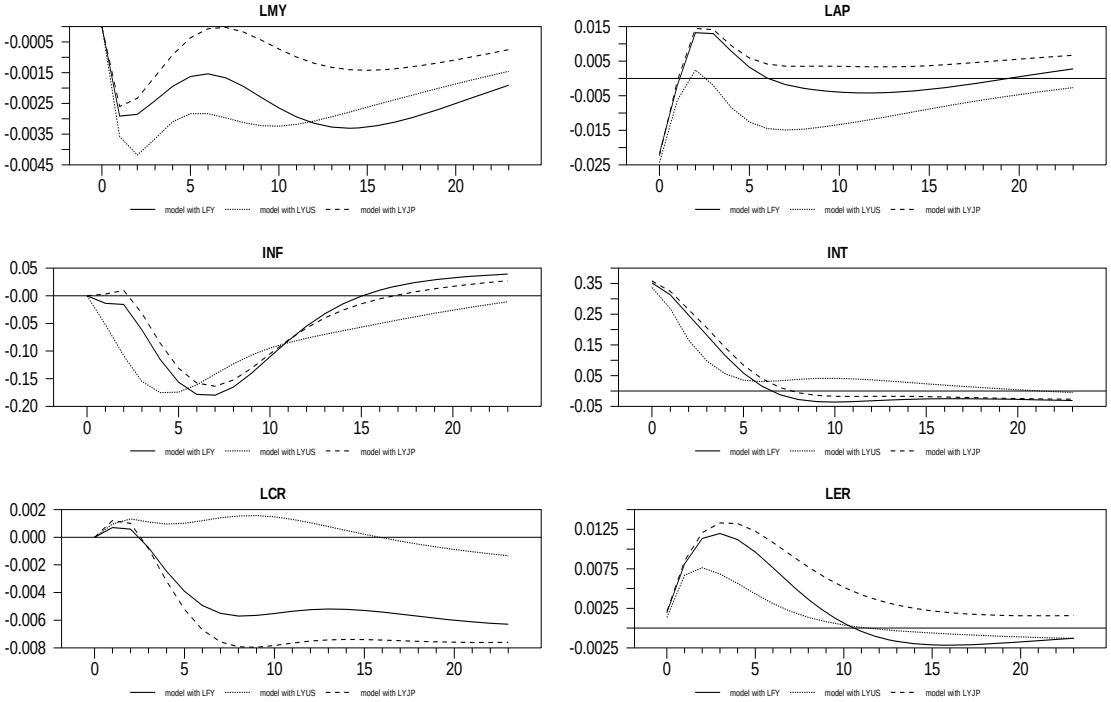


Figure 14: Impulse Response Functions: Shock to credit
Comparison between different foreign GDP variables

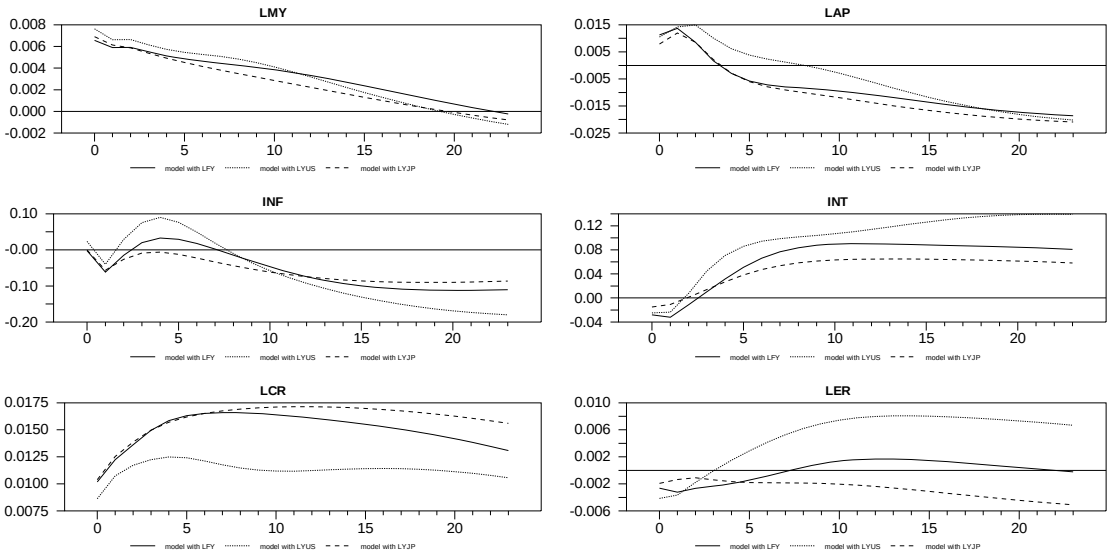


Figure 15: Impulse Response Functions: Shock to the interest rate
Comparison between different types of price variables

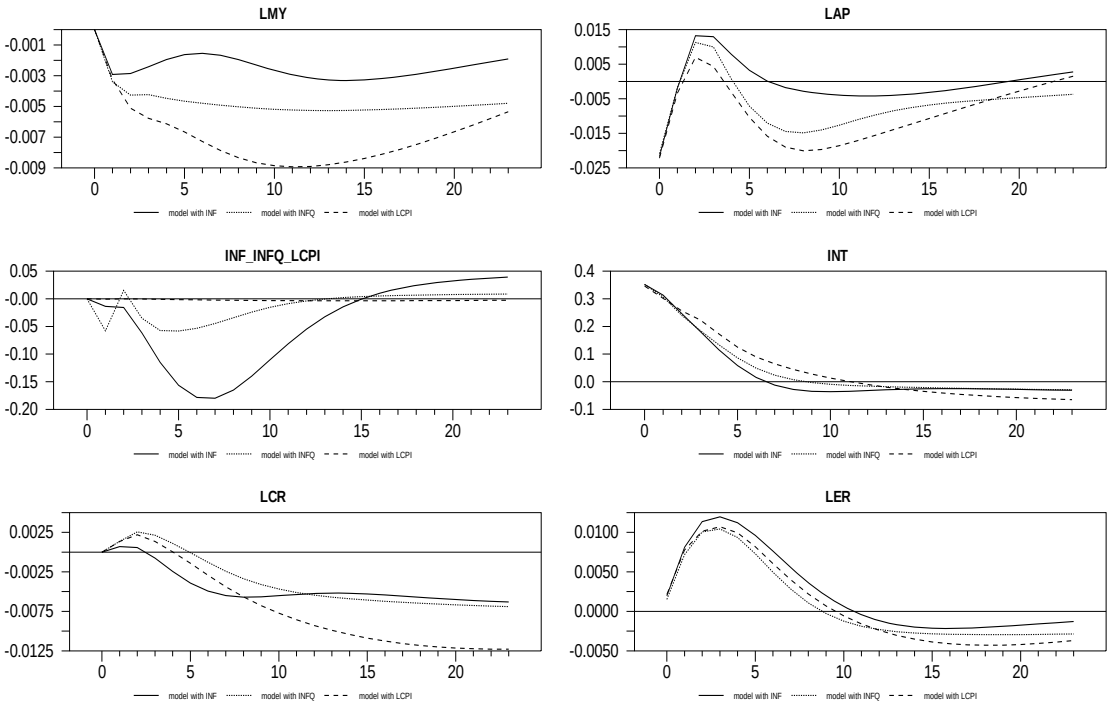


Figure 16: Impulse Response Functions: Shock to credit
Comparison between different type of price variables

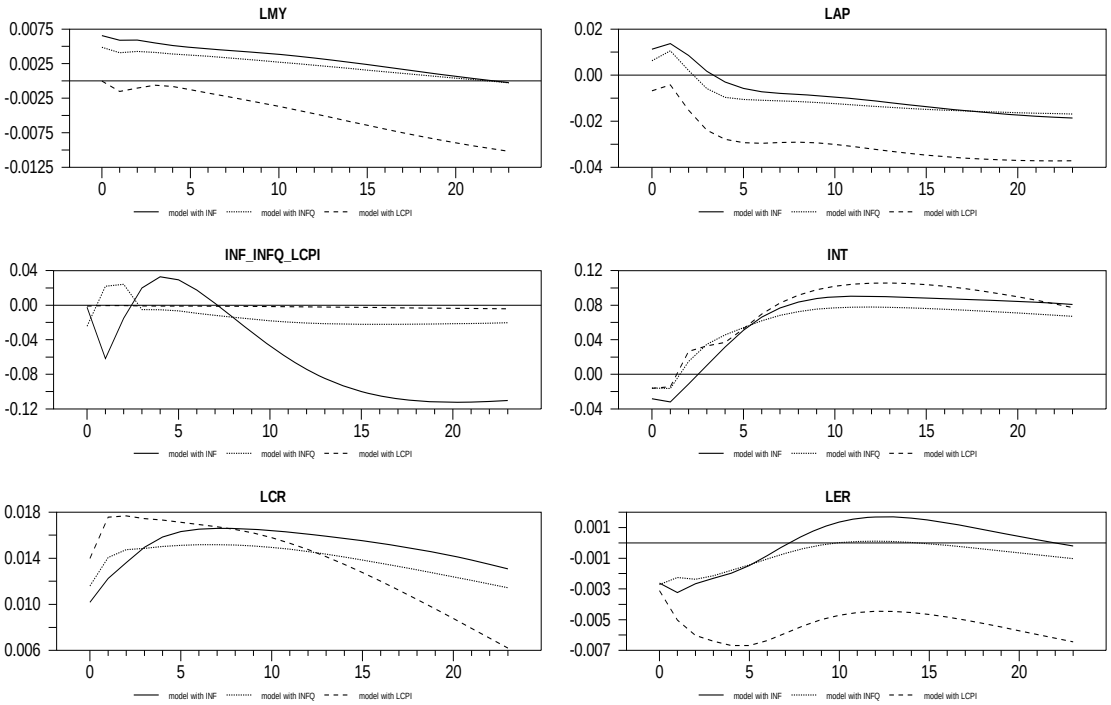


Figure 17: Impulse Response Functions: Shock to the interest rate
Comparison between different interest rate variables

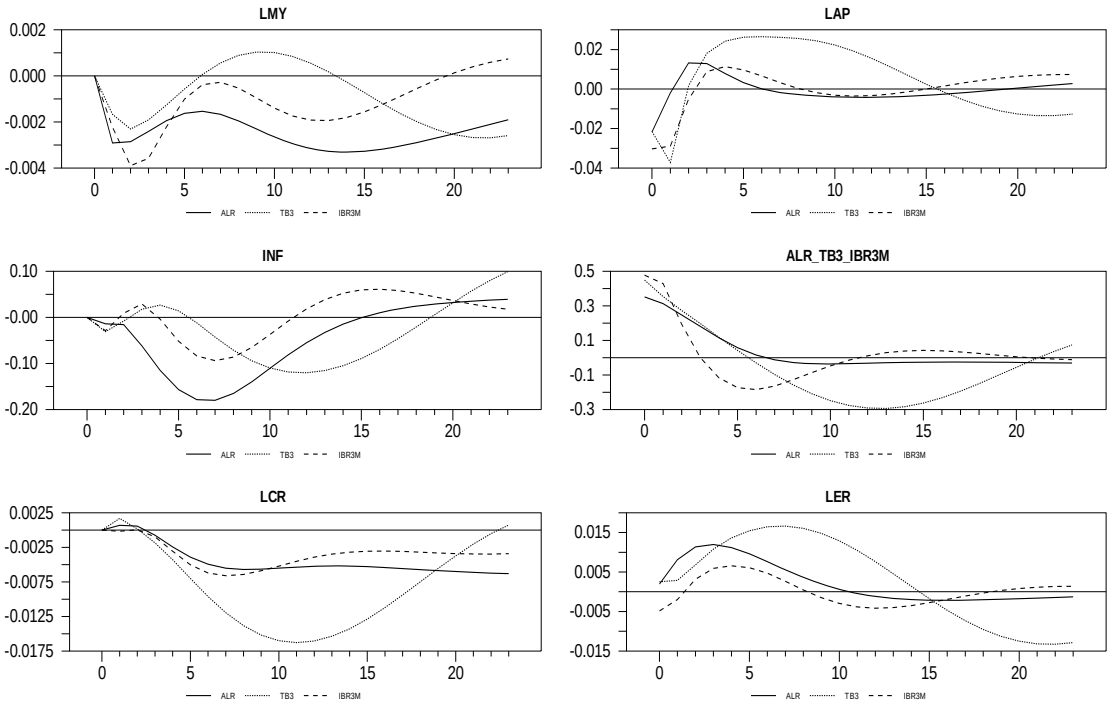
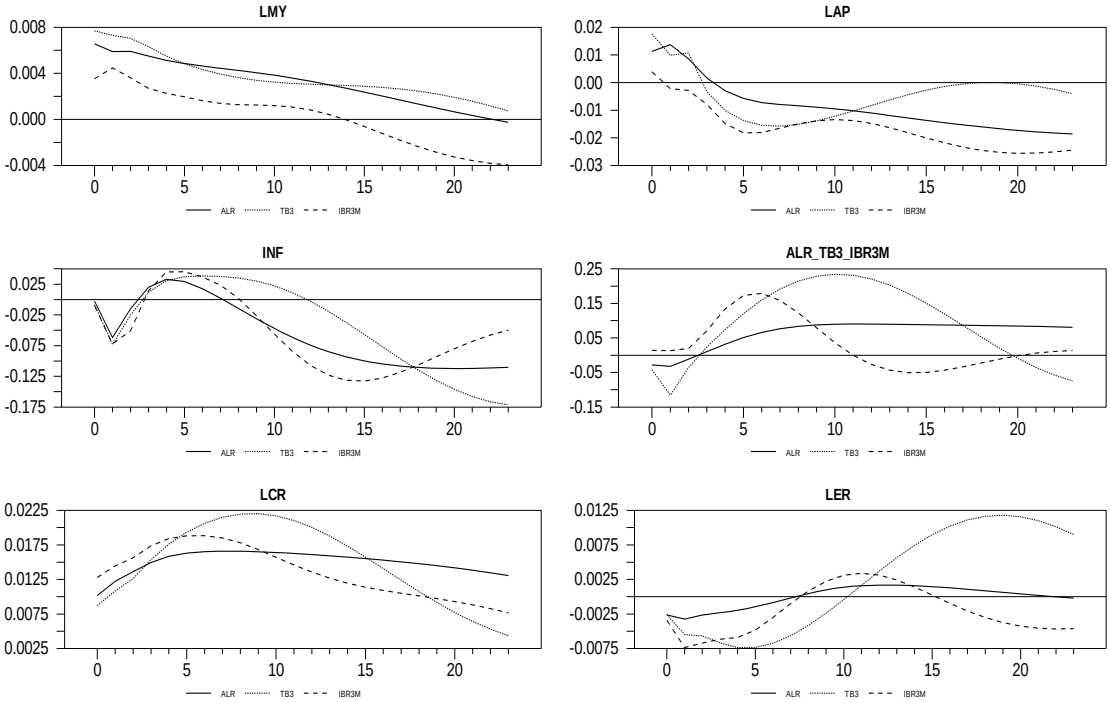


Figure 18: Impulse Response Functions: Shock to credit
Comparison between different interest rate variables



In the meantime, figure 13 through figure 18 compare the impulse response functions to the interest rate shock and to credit shock of the selected models with the ones that use alternative variables with regards to foreign GDP, price level and the interest rate. Specifically, figure 13 and figure 14 correspond to responses with different foreign GDP in the models (trade weighted foreign GDP (LFY), the US GDP (LYUS) and Japan GDP (LYJP)). Likewise, figure 15 and figure 16 correspond to responses with different measurement of price variables (inflation measured annually (INF), inflation measured quarterly (INFQ) and price in level and logarithmic form (LCPI)) while figure 17 and figure 18 correspond to responses with different type of the interest rate (Average lending rate (INT), 3-month Treasury Bills (TB3) and 3-month interbank rate (IBR3M)). Most of the responses are interestingly similar in magnitude and timing, thus suggesting that the selected model is robust to different alternative fundamental variables.

8. Conclusion

This paper examines the use of small open structural VAR method to describe the effect of monetary policy and particularly credit on economic performance of Malaysia. The variables used in the model are in accordance with the fundamental variables depicted by Bank Negara Malaysia in explaining the transmission mechanism of Malaysian monetary policy. The results of SVAR estimation, impulse response functions and variance decomposition generally support the underlying monetary theory. Both the price puzzle and the exchange rate puzzle significantly disappear and the selected model is robust to some changes in the number of lags, the sample length and the selected fundamental variables.

The findings reveal that, credit does play a significant role in affecting domestic output even at early stage until over a horizon of two years. This is in contrast to Tang's (2006) findings which suggest otherwise. Consequently, this implies that Bank Negara Malaysia has greater chance of shaping the domestic economy by utilising and monitoring the credit channel. Both the central bank and banking and financial institutions have indeed far greater role in shaping Malaysian economy. Apparently, the government policy in promoting private sector as an engine for economic growth has indeed enhanced the role of the credit channel. Thus, continuing with this policy for the future will significantly bring positive outcome for the economy.

As for inflation, the interest rate and exchange rate play rather significant role after about 4 quarters. Thus in order to control for inflation, both the interest rate channel and the exchange rate channel can be of important. Since the interest rate has contemporaneous influence on exchange rate, controlling the interest rate might have faster effect in controlling inflation as long as the exchange rate does not go in opposite way especially when it is also influenced by the foreign output.

In addition, the findings also show that foreign factors are important in influencing most of the Malaysian macroeconomics variables under study. As the horizon expands from one quarter to 6 years, commodity price and real foreign GDP become increasingly relevant in explaining the movement of all the domestic variables. This shows that as Malaysia become more diversified and export-oriented economy, foreign factors increasingly play important role in influencing the Malaysian economy. Thus, in modelling Malaysian economy, foreign factors must be taken into consideration and policy makers should be alert of any adverse effect that they can pass on to Malaysian economy in the long term.

References

Abdullah, A. Z. and Yusop, Z., "Money Inflation and Causality: The case of Malaysia(1972-92)," *The Asian Economic Review*, 1996, Vol XXXVIII, 44-51.

Abeysinghe, T. and Gulasekaran, R., "Quarterly real GDP estimates for China and ASEAN4 with a forecast evaluation", *Journal of Forecasting*, 2004, 23, 431-447.

Azali, M. and K. Matthews, "Money-Income and Credit-Income Relationships during the Pre-and the Post-Liberalisation Periods: Evidence from Malaysia," *Applied Economics*, 1999, *31*, 1161-1170.

Bacha, Obiyathulla Ismath, "Malaysia: From Currency to Banking Crisis," *Malaysian Journal of Economic Studies*, 1998.

Brischetto, A. and G. Voss, "Structural Vector Autoregression Model of Monetary Policy in Australia," *Research Discussion Paper, Reserve Bank of Australia*, 1999, 11.

Bank Negara Malaysia, *The Central Bank and the Financial System in Malaysia : A Decade of Change 1989-1999*, 1999, Bank Negara Malaysia, Kuala Lumpur.

Bank Negara Malaysia, *Monthly Statistical Bulletin*, various issues.

Berkelmans, Leon, "Credit and Monetary Policy: An Australian SVAR," *Research Discussion Paper, Reserve Bank of Australia*, 2005, 2005-06

Bernanke, B. S., "Alternative explanations of the money-income correlation, *Carnegie-Rochester Conference Series on Public Policy*, 1986, 25, 49-100.

Bernanke, B. S. and Mark Gertler. "Inside the black box: The Credit Channel of Monetary Policy Transmission." *Journal of Economic Perspectives*, 1995, 9(4), 27-48.

Chua, Soo Y., Selahattin Dibooglu and Subhash C. Sharma. "The Impact of the US and Japanese Economies on Korea and Malaysia after the Plaza Accord," *Asian Economic Journal*, 1999, 13, 19-37.

Cheng, Ming Yu and Hui Boon Tan, "Inflation in Malaysia". *International Journal of Social Economics*, 2002, 29, 5, 411-425.

Christiano, L.J., Eichenbaum, M., Evans, C., " Monetary policy shocks: what have we learned and to what end?" In: Woodford, M., Taylor, J. (Eds.), *Handbook of Macroeconomics*, vol. 1A. Elsevier Science, North-Holland, New York, 1999, 65–148.

Cushman, D. and T. Zha, "Identifying Monetary Policy in A Small Open Economy under Flexible Exchange Rates," *Journal of Monetary Economics*, 1997, *39*, 433-448.

DataStream online database

Domac, Iker. "The Distributional Consequences of Monetary Policy: Evidence from Malaysia," Policy Research Working Paper, 1999, No. 2170, World Bank.

Dungey, M. and A. Pagan, "A Structural VAR Model of the Australian Economy," *The Economic Record*, 2000, *76* (235), 321-343.

Eichenbaum, M., "Comment on Interpreting the macroeconomic time series facts: the effects of monetary policy," *European Economic Review*, 1992, 36 (5), 1001–1011.

Fung, B. S. C., "A VAR analysis of the effects of monetary policy in East Asia," *BIS Working Papers*, 2002, 119.

Gertler, M. and S. Gilchrist, "Monetary-Policy, Business Cycles, and the Behavior of Small Manufacturing Firms," *Quarterly Journal of Economics*, 1994, 109 (2), 309-340.

Geweke, J., "Measurements of linear dependence and feedback between multiple time series." *Journal of American Statistical Association*, 1982, 77, 304-13.

Hashim, A., Koshy, M, Yem, A., Abidin, Z. and Alwani, S. "Economic Growth and Inflation: Macro Economic Perspectives, " Discussion Paper No. 23, Economic Department, Bank Negara Malaysia, 1994.

Hanson, Michael S. "The "price puzzle" reconsidered." *Journal of Monetary Economics,* 2004, 51, 1385-1413.

Ibrahim, Mansor, "A VAR Analysis of US and Japanese Effects on Malaysian aggregate and sectoral output. *International Journal of Applied Econometrics and Quantitative Studies*, 2004, 1, 5-28.

International Financial Statistics online database

Kim, S. and Roubini, N. "Exchange rate anomalies in the industrial countries: A solution with a structural VAR approach.", *Journal of Monetary Economics*, 2000, 45, 561–586.

Lucas, R. E. "Expectations and the neutrality of money" *Journal of Economic Theory*, 1972, 4, 103-24

Mansor Ibrahim. "Sectoral Effects of Monetary Policy: Evidence from Malaysia," *Asian Economic Journal*, 2005, 19(1), 83-102.

Marashdeh, Omar "Anticipated and unanticipated money: A case study of Malaysia," *Applied Economics*, 1993, 25, 919-925.

Masih, Abul M.M and Rumi Masih, "Empirical Tests to Discern the Dynamic Causal Chain in Macroeconomic Activity: New Evidence From Thailand and Malaysia Based on a Multivariate Cointegration/Vector Error-Correction Modeling Approach", *Journal of Policy Modeling*, 1996, 18(5), 531-560.

Mishkin, Frederic S., " The channel of monetary transmission: Lessons for monetary policy," *NBER working paper series*, 1996, 5464.

Paul, M.T., "Inflation in Asian countries: 1970-1992", *Asian Economic Review*, 1997 248-75.

Sargent, T. J. and Wallace, N. "Rational expectations, the optimal monetary instruments and optimal money supply rule." *Journal of Political Economy*, 1975, 83, 241-54.

Sims, C.A., "Interpreting the macroeconomic time series facts: The effects of monetary policy," *European Economic Review*, 1992, 36, 975-1000.

Sims, C.A. and Zha, T., "Does monetary policy generate recessions?: Using less aggregate price data to identify monetary policy," *Working paper, Yale University, CT*, 1995.

Sims, C.A., "Comment on Glenn Rudebusch's Do measures of monetary policy in a VAR make sense?" *International Economic Review*, 1998, 39 (4), 933–941.

Sim, C.A. and Tao Zha. "Error Bands for Impulse Responses," *Econometrica*, 1999, 67(5), 1113-1156.

Tan, Hui Boon And Ahmad Zubaidi Baharumshah. "Dynamic Causal Chain Of Money, Output, Interest Rate And Prices In Malaysia: Evidence Based On Vector Error Correction Modeling Analysis," *International Economic Journal* 1999, 13 (1), 103-120.

Tan, K. G. and Cheng, C. S., "The Causal Nexus of Money, Output and Prices in Malaysia," *Applied Economics* 27, 1995, 1245-1251.

Tang, Hsiao Chink, "The Relative Importance Of Monetary Policy Transmission Channels In Malaysia" *CAMA working paper series*, 2006, 23.

Zha, T., " Identifying monetary policy: a primer," *Federal Reserve Bank of Atlanta Economic Review*, 1997 82 (2), 26–43.

Appendix 1

Data Description and Sources

The data used in this study are quarterly from 1981:3 to 2006:4. Each of the variables used is described below.

Data	Description
CP	Non Fuel Commodities Index (2000=100) obtained from the International Financial Statistics (IFS) database (series code 00176NFDZF...).
The US GDP	The US Gross Domestic product (GDP) (USD million) obtained from the IFS database (series code 11199B.CZF...). The series are converted into real GDP by deflating with GDP deflator (2000=100) (series code 11199BIRZF...)
Japanese GDP	Japan Gross Domestic Product (GDP) (Yen billion) obtained from the IFS database (series code 15899B.CZF...). The series are converted into real GDP by deflating with GDP deflator (2000=100) (series code 15899BIRZF...)
Malaysian GDP	Real seasonally unadjusted Malaysian GDP estimates (RM million) obtained from http://courses.nus.edu.sg/course/ecstabey/gdpdata.xls. The method of estimating the real GDP is based on Abeysinghe and

	Rajaguru (2004) paper.
INF	Annual inflation calculated quarterly by using quarterly consumer price index (CPI). The quarterly CPI series are derived from averaging the monthly CPI series. The monthly CPI series (2000=100) are obtained from Department of Statistics as well as Monthly Statistical Bulletin of Bank Negara Malaysia (BNM), various issues.
CR	Loans and advances of Commercial Banks obtained from Monthly Statistical Bulletin of Bank Negara Malaysia (BNM), various issues. The quarterly CR series are derived from averaging the monthly CR series.
INT	The quarterly average lending rate (ALR) derived by averaging the monthly series. The data are obtained from DataStream database (MYI60P..).
REER	Real effective exchange rate (2000=100) obtained from IFS database (series code 548..RECZF...)
Import and Export to/from The USA and Japan.	Annual data of all import and export are obtained form Monthly Statistical Bulletin of Bank Negara Malaysia (BNM), various issues. Data are interpolated to quarterly form by using Interpol.src interpolation procedure from WinRATs Pro 7.0