Foreign Shocks, Monetary Policy, and Macroeconomic Fluctuations in a Small Open Economy: A SVAR Study of Malaysia

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Abstract: This paper investigates the effect of foreign shocks upon domestic macroeconomic fluctuations and monetary policy, and examines the effectiveness of domestic monetary policy as a stabilization policy in Malaysia. Monetary policy variables (interest rate and money supply) have been measured through a non-recursive structural VAR (SVAR) identification scheme, which allows the monetary authority to set the interest rate and money supply after observing the current value of foreign variables, domestic output and inflation. The results show the important role of foreign shocks in influencing Malaysian monetary policy and macroeconomic variables. There is a real effect of monetary policy, that is, a positive shock in money supply increases domestic output. In contrast, a positive interest rates shock has a negative effect on domestic output growth and inflation. The effects of money supply and interest rate shocks on the exchange rate and stock prices are also consistent with standard economic theory. In addition, domestic monetary policy is able to mitigate the negative effect of external shocks upon domestic economy.

Keywords: Monetary policy; open-economy; SVAR

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1. Introduction

It is generally accepted that a small and highly trade-dependent economy like Malaysia is not insulated from shocks to a variety of external variables. In Malaysia, the degree of economic interdependence or economic openness, as measured by the share of exports and imports as a percentage of GDP, had increased significantly from 86.88 percent in 1970 to 112.59 percent in 1980, and 146.89 percent in 1990. In fact, since 1999 it has been greater than 200 percent. These statistics indicate that the Malaysian economy is highly dependent, and thus vulnerable to external shocks; for example foreign income shocks from large

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countries. Therefore, the monetary authority has to be concerned on how the external shocks are transmitted to domestic macroeconomic and monetary policy variables. The policy maker should also consider the effectiveness of domestic monetary policy in mitigating the negative effects of external shocks (for example, an adverse supply shocks) on economic activity. It is pivotal for the monetary authority to evaluate on what would happen to the domestic economy if there is no action against the external shocks.

The aim of this study is to examine empirically the effects of external shocks, namely world oil price, foreign income and foreign monetary policy shocks upon Malaysian economy and monetary policy. In addition, this study also examines the effectiveness of Malaysian monetary policy in mitigating the negative effects of external shocks upon domestic macroeconomic variables.

The significant contributions of this study have three aspects. First, this study employs an open economy structural VAR model, which permits an identification strategy based on economic theory rather than the sometimes questionable assumptions which underlie a traditional recursive VAR. In Malaysian context, although Tang (2006) considered recursive VAR in open-economy, and Ibrahim (2005) used recursive VAR in closed-economy, their identification of structural shocks is inappropriate. Thus, this study provides a novel contribution to the monetary policy analysis of a small-open economy (i.e. Malaysia) by identifying the structural shocks according to economic theory. Second, this study considers the role of foreign factor in modelling an open-economy SVAR. The previous study of monetary policy effects in Malaysia, for example Azali and Matthews (1999) and Ibrahim (2005) used a small-scale VAR in a closed-economy, and did not consider the role of foreign variables in their analyses. Therefore, it is essential to examine the foreign shocks effects on macroeconomic fluctuations and monetary policy since the Malaysian economy is relatively small and highly trade-dependent. Third, this study uses a shutdown methodology in examining of what would happen to the domestic economy if the monetary authority (for example, BNM) does not respond to the external shocks. It is very important for monetary authority evaluates the effectiveness of monetary policy as a stabilization policy, in particular, to minimize the negative effect of foreign shocks on domestic macroeconomic variables.

The results of the study indicate that foreign shocks appeared to play a prominent role in influencing domestic macroeconomic and monetary policy variables. In general, monetary policy plays a pivotal role in minimizing the negative effect of external shocks to the domestic economy. Therefore, the monetary authority has to consider the external environment in formulating monetary policy; and hence, employs the monetary policy as a stabilization policy.

The rest of the paper is organized as follows. Section 2 presents a literature review relating to monetary policy identification scheme in the SVAR literature. Section 3 briefly discusses the research methodology, and Section 4 presents the empirical results by focusing on structural impulse-response function (SIRF). Section 5 discusses some robustness checking, and Section 6 summarizes and concludes.

2. Literature Review

Most of the SVAR literature has focused on a closed economy, in particular the US economy, in investigating the effects of monetary policy shocks on economic activity[1]. These studies are justified given that the US is a large country and is not much affected by its international surroundings. In small open economy context, a limited number of studies had examined the effect of monetary policy shocks by using an open SVAR approach. For example, the most recent SVAR studies of a small-open economy were conducted by Cushman and Zha (1997), Brischetto and Voss (1999), Dungey and Pagan (2000), Parrado (2001), and Buckle et al. (2007). Most of the studies used block exogeneity restrictions in modelling the international economic linkages to the small-open economy.

Cushman and Zha (1997) and Dungey and Pagan (2000) had imposed two blocks in their structural equation model; a block representing the international economy, and a block representing the domestic economy. In modelling SVAR for the Canadian economy, Cushman and Zha (1997) included four international variables, namely the US industrial production, the US consumer prices, the US federal fund rate, and world total commodity export prices. The main identification scheme in their study has three folds. First, domestic interest rate is assumed to react contemporaneously to foreign interest rate and commodity market, but not on contemporaneous output. Second, the exchange rate is assumed to response contemporaneously to all shocks. Third, foreign variables were treated as a separate block, that is, block (exogenous) for the domestic (small open) economy. The empirical findings stated that Canadian monetary policy responds significantly and contemporaneously with home interest rates, exchange rate, foreign interest rates and foreign price levels.

In contrast, Dungey and Pagan (2000) included five international variables, namely real US GDP, real US interest rates, the Australian term of trade, the Dow Jones Index deflated with the US consumer price index, and real exports. The Australian monetary policy (cash rate) was assumed to follow a standard Taylor-rule, in which responds contemporaneously to Australian gross national expenditure and inflation.

[1]For example, there are studies on the US economy by Sims (1986), Blanchard and Quah (1989), Gali (1992), Gordon and Leeper (1994), Christiano et al. (1996), Bernanke and Blinder (1992), Bernanke and Mihov (1998), and Sim and Zha (2005).

The domestic variables were assumed to not able to affect foreign variables either contemporaneously or with a lags. The main findings indicated that overseas factors are generally a substantial contributor to domestic activity, and domestic monetary policy contributes to stabilize economic activity, but the effect is not large.

In the Malaysian context, there have been few studies relating to the effect of monetary policy shocks on economic activities in the existing literature. For example, Azali and Matthews (1999) employed the Bernanke's (1986) contemporaneous structural VAR approach (six variables in a closed-economy) in investigating the relationship between money-income and credit-income during the pre- and the post-liberalization eras. They found that during the pre-liberalization period, the bank credit shock had more impact compared with the money shock in explaining output variability. In contrast, after the post-liberalization period, money as well as credit innovations were significant in explaining output shocks. In short, aggregate demand was significantly influenced by credit innovation during pre-liberalization, while money innovation played an important role during post-liberalization in explaining output variability.

Another study by Ibrahim (2005) used recursive VAR identification in closed economy in examining the sectoral effect of a monetary policy shock. His results supported the real effect of monetary policy shocks. For example, it was seen that real output declined during monetary tightening (positive shocks of interest rates). In fact, some sectors such as manufacturing, construction, finance, insurance, real estate, and business services seemed to decline more than aggregate production in responding to the interest rates shocks. In short, those sectors that are heavily dependent on bank loans are more sensitive to monetary policy shocks. In comparison, a recent study by Tang (2006) examined the relative importance of the monetary policy transmission mechanism channel (interest rates, credit, asset price, and exchange rate channel) by using 12 variables in an open-economy VAR model. The variables, namely four foreign variables (foreign block), and eight domestic variables (domestic block), were estimated using a recursive VAR identification scheme. The foreign block was assumed to not be completely exogenous to the domestic block, whereby the domestic variables are allowed to affect the foreign variables in lags, but not contemporaneously. His finding concluded that the interest rates channel plays a pivotal role in influencing output and inflation. In addition, the asset price channel is also relevant in explaining output variability, but for inflation, the exchange rate channel is more relevant than the asset price channel.

To the author's best knowledge, so far there has been no empirical study in Malaysia that linked foreign shocks, monetary policy, and domestic macroeconomics fluctuations by using an open economy SVAR framework. The inclusion of foreign variables in the SVAR model is reasonable given that

Malaysian is a small and highly trade-dependent economy; thus, it is expected that Malaysian macroeconomic fluctuations and monetary policy will be vulnerable to external shocks. In fact, no empirical study has examined the effectiveness of monetary policy in stabilizing the macroeconomics variables (domestic output and inflation) from external shocks. Therefore, based on this backdrop, this study provides a novel contribution to the monetary policy analysis in a small-open economy (i.e. Malaysia) by using an open-economy SVAR study.

3. Estimation Procedures

3.1. Data and Variables Description

All data are at a monthly frequency spanning from January 1980 until May 2009 and collected from the IMF's International Financial Statistic (IFS), except for asset price, whereby the data were collected from Thompson Datastream. All variables were transformed into logs except for FFR, INF and IBOR, which are stated in percentage points. Specifically, the endogenous variables included in the VAR are;

(i)Oil Price $(LOIL)$ in US $ per barrel; (ii)US Industrial Production Index $(IPIUS)$ as a proxy for foreign income; (iii) Federal Fund Rate (FFR) as a proxy for foreign monetary policy; (iv) Malaysian Industrial Production Index (IPIM) as a proxy for domestic income; (v)Malaysian inflation (INF) rate in which is calculated from the changes in the Consumer Price Indices (CPI); (vi)Narrow monetary aggregate, M1 (LM); (vii)interbank overnight rate (IBOR) as an indicator for a monetary policy variable; (viii)Kuala Lumpur Composite Index $(KLCI)$, and (x) Nominal Effective Exchange Rate $(NEER)$.

In addition to the endogenous variables, the model also includes three dummy variables for breaks in the intercept, which coincide with major economic events. Specifically, the events are: the regime shift from monetary targeting to the interest rates targeting, the period in which the Ringgit was pegged to the US dollar, and the Asian financial crisis. It is assumed these three events only influence variables in the domestic block rather than the foreign block. In addition, the seasonal dummy has also considered for all endogenous variables.

3.2. Structural VAR Modelling

It is assumed that a small-open economy like Malaysia is described by a structural form representation. The dynamic relationship of the system of equation in the structural model can be written as follows;

$$A_0 Y_t = \Gamma_0 D_0 + A(L) Y_t + \varepsilon_t \quad (1)$$

Where, A_0 is an invertible square matrix of coefficients relating to the structural contemporaneous interaction between the variables in the system, Y_t is a (9×1) matrix that is the vector of system variables or $[\Delta LOIL \quad \Delta LIPIUS \quad FFR \quad \Delta LIPIM \quad INF \quad \Delta LM \quad IBOR \quad \Delta LNEER \quad \Delta LKLCI]'$, D_0 is a vector of deterministic variables (constant, trend and dummy variables), $A(L)$ is a k^{th} order matrix polynomial in the lag operator L $\left[A(L) = A_1 L - A_2 L^2 - \ldots\ldots - A_k L^k\right]$,

$\varepsilon_t = \left[\varepsilon_t^{\Delta LOIL} \quad \varepsilon_t^{\Delta LIPIUS} \quad \varepsilon_t^{FFR} \quad \varepsilon_t^{\Delta LIPIM} \quad \varepsilon_t^{INF} \quad \varepsilon_t^{\Delta LM} \quad \varepsilon_t^{IBOR} \quad \varepsilon_t^{\Delta LNEER} \quad \varepsilon_t^{\Delta LKLCI}\right]$ is the vector of structural shocks which satisfies the conditions that $E(\varepsilon_t) = 0$, $E(\varepsilon_t \varepsilon_s^{'}) = \Omega_\varepsilon = I$ (identity matrix] for all $t = s$.

3.2.1. Identification Scheme

In identifying the structural VAR model, this study employed the SVAR-A model proposed by Amisano and Giannini (1996). Sufficient restrictions have to be imposed on matrix A_0. According to the order condition, for the system to be just identified or exactly identified, it requires $K(K-1)/2 = 9(8)/2 = 36$ zero restrictions on the contemporaneous matrix A_0. However, since the contemporaneous matrix A_0 in equation (2) has 40 zero restrictions, the SVAR model is over-identified. In matrix form, it can be represented as follows;

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21}^0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{31}^0 & a_{32}^0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{41}^0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{51}^0 & 0 & 0 & a_{54}^0 & 1 & 0 & 0 & 0 & 0 \\ a_{61}^0 & a_{62}^0 & a_{63}^0 & a_{64}^0 & a_{65}^0 & 1 & 0 & 0 & 0 \\ a_{71}^0 & a_{72}^0 & a_{73}^0 & a_{74}^0 & a_{75}^0 & a_{76}^0 & 1 & 0 & 0 \\ a_{81}^0 & a_{82}^0 & a_{83}^0 & a_{84}^0 & a_{85}^0 & a_{86}^0 & a_{87}^0 & 1 & 0 \\ a_{91}^0 & a_{92}^0 & a_{93}^0 & a_{94}^0 & a_{95}^0 & a_{96}^0 & a_{97}^0 & a_{98}^0 & 1 \end{bmatrix} \begin{bmatrix} \mu_t^{\Delta LOIL} \\ \mu_t^{\Delta LIPIUS} \\ \mu_t^{FFR} \\ \mu_t^{\Delta LIPIM} \\ \mu_t^{INF} \\ \mu_t^{\Delta LM} \\ u_t^{IBOR} \\ \mu_t^{\Delta LNEER} \\ \mu_t^{\Delta LKLCI} \end{bmatrix} = \begin{bmatrix} \varepsilon_t^{\Delta LOIL} \\ \varepsilon_t^{\Delta LIPIUS} \\ \varepsilon_t^{FFR} \\ \varepsilon_t^{\Delta LIPIM} \\ \varepsilon_t^{INF} \\ \varepsilon_t^{\Delta LM} \\ \varepsilon_t^{IBOR} \\ \varepsilon_t^{\Delta LNEER} \\ \varepsilon_t^{\Delta LKLCI} \end{bmatrix} \tag{2}$$

Identification of Foreign Blocks.

The variables in foreign blocks have been assumed to be completely exogenous to the domestic blocks. It is common to identify that the foreign variables do not

respond contemporaneously or with lags to the movement in the domestic variables in a small-open country. This assumption is reasonable given that Malaysia is a small-open economy and has no powerful impact on the international level. Specifically, the world oil price is a structural disturbance or exogenous variable that is uncorrelated with other contemporaneous shocks. Meanwhile, the US income and FFR can influence world oil price in lags. The US income is assumed to respond contemporaneously to the world oil price and all foreign variables lag. This means that the US income has a negative response to the world oil price because the US is a major net oil importer country in the world. The FFR is assumed to respond contemporaneously to the innovations in world oil price and the US income and all foreign variables lag. The FFR reacts positively to the world oil price in minimizing the inflationary pressure due to the positive shocks of world oil price. This assumption is also consistent with prior studies, for example, Hamilton (1996) and Bernanke et al. (1997) who found that oil price movements have a significant forecast power for the stance of monetary policy in the US economy. In contrast, FFR responds negatively to the US income in minimizing the output gap.

Identification of Target Variables

Domestic output growth has been assumed to respond contemporaneously only to the world oil price shocks, and respond in the lags to all endogenous variables. Domestic output growth reacts positively to the current growth of world oil price. This assumption is reasonable given that Malaysia is net exporter of oil. However, in the long run, the relationship between oil price and output is expected to be negative because an increase in world oil price will increase the cost of production, whereas the firms will respond by cutting the level of production or investment. In addition, it is assumed that Malaysian output does not respond contemporaneously with other variables in the system. For instance, the monetary policy variables, namely the monetary aggregate and interest rates, cannot influence output contemporaneously. The main plausible justification for this assumption is that firms do not change their output and prices instantaneously in responding to the monetary policy signal within a month, due to the inertia, adjustment costs and planning delay; but they will respond immediately to the current oil prices following their mark-up rule (Kim and Roubini, 2000). This type of restriction is also imposed by Bernanke and Blinder (1992), and Bernanke and Mihov (1998).

Domestic inflation has been assumed to respond contemporaneously to the innovations in oil prices and domestic output. The positive innovation in oil prices and domestic output will spontaneously accelerate the domestic price level. However, other variables in the system cannot influence domestic inflation spontaneously because inflation is a slow-moving variable. However, all endogenous variables are assumed to affect the inflation rate in the lags.

Identification of Monetary Policy Shocks

The main issue relating to monetary policy analysis in the SVAR study is the appropriate identification of monetary policy shocks. In market economies, the use of the interest rates as a major instrument of monetary policy does not imply that it can ignore the role of money supply. This is because the interest rates are determined by financial markets. For example, if the monetary authority wants to lower the interest rates but not supporting the required increase in the money supply, it would find the market interest rates to deviate from the desired level. As a result, the intended effects on expenditures will not be achieved. Therefore, an interest rate policy must be accompanied by an appropriate money supply (Handa, 2009). For that reason, this study will consider two types of monetary policy shocks, namely, money supply and interest rates.

It is assumed that the monetary authority (the BNM) sets the money supply after observing the current level of all foreign variables, domestic output growth and inflation. This is reasonable given that monetary authority can observe the data on a monthly basis and chooses the amount of money supply to offset any negative effect resulting from foreign shocks, domestic aggregate demand and inflation shocks on the domestic economy. Besides money supply, the monetary authority can also use interest rates as a policy target. Thus, it is assumed that the monetary authority sets the interest rates after observing the current value of domestic variables, those are domestic output, inflation and money supply, and all foreign variables; but not the current value of other variables. The inclusion of output, inflation and money in the monetary policy reaction function is reasonable given that the central bank can observe these data on a monthly basis. For instance, if the amount of money supply has grown rapidly, interest rates will decline, which in turn increases the inflation rate due to the aggregate demand pressure. As a result, the central bank will respond immediately by increasing the policy interest rates (interest rates smoothing) to minimize the inflationary pressure. The inclusion of foreign monetary policy in the domestic monetary policy reaction function is reasonable given that the Malaysian economy is highly dependent on the US economy. Therefore, it is reasonable to assume that the BNM will response positively to the US monetary policy in minimizing the capital outflow as well as stabilizing the domestic currency. The justification of the monetary policy reaction function is also consistent with previous studies, for example, Kim and Roubini (2000), Cushman and Zha (1997), and Sim and Zha (2005).

Identification of exchange rate and asset price shocks

The exchange rate is assumed to be respond contemporaneously with all foreign and domestic variables (except stock prices). In contrast, the asset price is assumed to respond contemporaneously to all foreign and all domestic variables. This assumption is reasonable given that exchange rate and stock market are fast-moving variables in the system. The asset price is assumed to respond contemporaneously to the exchange rate because any changes in the exchange rate will influence international capital mobility, which in turn affects the stock market. For instance, an appreciation in domestic currency makes domestic assets more expensive to the international investors, and therefore decreases the demand for domestic asset, subsequently leading to a decline in the asset price.

3.3. Shutdown Methodology

In order to examine the effectiveness of monetary policy in mitigating the effect of foreign shocks on domestic macroeconomic variables (output and inflation), the baseline impulse response function must be compared with the constrained model. In the constrained model, both monetary policy variables (money supply and interest rates) are shut down by setting the monetary policy coefficient equal to zero in the domestic output and inflation equations. To shutdown the effect of monetary policy variable on domestic output, the estimated contemporaneous coefficient and all lagged coefficients of monetary policy variable in the domestic output equation are set to zero. Similarly, to shut down the effect of monetary policy on inflation, the estimated contemporaneous coefficient and lagged coefficients of monetary policy in the inflation rate equation are set to zero. By shutting down the estimated coefficients of monetary policy, the effects of foreign shocks on domestic macroeconomics variables can be examined without allowing endogenous responses of the monetary policy variables. Therefore, the deviation or difference of the constrained impulse response from the baseline impulse response represents the relative importance of monetary policy in stabilizing the macroeconomics variable in response to foreign shocks.

4. Empirical Results

This section discusses the main empirical findings that consist of the results of preliminary analysis and the structural impulse response function (SIRF). The results of shutdown methodology are also discussed in examining the relative importance of monetary policy in mitigating the negative effect of external shocks to domestic economy. Before estimating the SVAR model, the unit root test was conducted to investigate the stationary of the data. Using Augmented Dickey-Fuller test, we found that only three variables, namely the federal fund rate (FFR), inflation (INF), and inter-bank overnight rate (IBOR) to be stationary at level form,

at least at 10 percent significance level; meanwhile other variables are stationary in first difference form. According to Blanchard and Quah (1989), Gali (1992), and Bjørnland and Leitemo (2009), the level and difference form variables can be combined in the VAR system as long as the system is stationary. An excellent survey about the issue of stationary systems, non-stationary I(1) systems, and a mixture of I(1) and I(0) variables in the SVAR model can be found in Levtchenkova et al. (1998). However, we do not report the unit root test results in order to safe space.

Since the baseline SVAR model is over-identified, we need to test the validity of the over-identification restrictions. The value of χ^2 (with four degrees of freedom) is 7.97 and the probability is 0.11; indicating that the over-identification restrictions are valid[1].

4.2. Structural Impulse Response Function (SIRF)

Figures 1–4 illustrate the structural impulse response functions of the endogenous variables in this study. The main focus is to analyze the foreign shock effects on domestic variables (monetary policy and macroeconomic variables), and the effectiveness of monetary policy in mitigating the negative effects of external shocks on domestic economy. The solid line represents the estimated responses; meanwhile the two dashed lines represent the confident bands or error bands. The error bands of the SIRF are derived from Hall's bootstrapping methodology, which has a 68 percent confidence interval with 300 being the number of bootstrap replications[2]. Accumulated impulse-response functions will be discussed for the first difference variables responses, while the usual IRF will be used for the level form variable responses. By accumulating the responses of the first-difference variable on its structural shocks, we can interpret the impact of structural shocks on the level form of endogenous (Y) variables.

4.2.1. Foreign Shocks Effects on Domestic Variables

Response of domestic monetary policy

Panel A in Figure 1 shows the accumulated response of money supply to the innovation in foreign shocks, meanwhile Panel B describes the response of interest rates to the innovation in foreign shocks. As can be seen in Figure 1 (Panel A), there was no significant response of money supply to the positive innovation in oil price growth in the first six months. However, after 6 months and up to 30 months,

[1]The full result of SVAR contemporaneous coefficient estimation is available upon request.
[2]The SVAR model has been estimated by using J-Multi statistical software developed by Lutkepohl and Kratzig (2004).

the accumulated response of money supply was significant and negatively responded to the innovation in world oil price growth. For example, within 17 months the accumulated responses of money supply was -0.4 percent in response to the one percent increase in world oil price growth. The negative response of money supply shows that the policy maker was concerned in stabilizing domestic price level to offset an inflationary pressure due to the adverse supply shock from an increase in the world oil price. However, after 30 months, the accumulated response of money supply positively affects the innovation in world oil price growth. The positive response is because the policy maker had acted by stimulating aggregate demand to offset the adverse supply shocks. The response of the interest rates to the innovation in world oil price growth was negative within 3 months, that is, the interest rate declined by 0.15 percentage points in response to the one percent increase in world oil price growth. However, after 3 months and up to 10 months, the interest rate reacted positively to the world oil price growth, and reached the maximum point at 0.20 percentage points in 10 months. After 10 months, the response of interest rates gradually decreased, decaying after 40 months.

Money supply reacted negatively to foreign income shocks. For instance, an accumulated response of money supply in response to one percent increase in foreign income growth was appropriately at -1 percent after a 15 month period. One possible explanation is that the monetary authority was concerned in stabilizing the domestic price level, since the expansion of foreign income had triggered an increase in domestic inflation due to an increase in external demand. In contrast, the interest rate responded significantly and positively to foreign income shocks with the highest response being 0.22 percentage points within 10 months. However, after 10 months the positive response of the interest rate began to reduce and decayed after 50 months.

Money supply has positively responded to the positive innovation in FFR. For instance, the highest accumulated response recorded is within a 10 month period, whereby a one percentage point increase in FFR led to an increase in money supply of 0.6 percent. However, after 10 months, the accumulated response of money supply gradually declined and reached zero after 50 months. The positive response of money supply implies that the monetary authority was concerned to off-set the negative effect of monetary tightening in the foreign country (US). The domestic interest rate had responded positively to the FFR shocks, recording a 0.05 percentage point change in three months. However, after three months up to 5 months, the domestic interest rates responded negatively, having fallen by 0.10 percentage point in response to a one percentage point increase in FFR. In contrast, after 15 months the domestic interest rate responded positively to the positive innovation in FFR. The positive response of domestic interest rates implies that the monetary authority was concerned about the capital inflow from domestic country

to the US due to the monetary tightening in the US. Therefore, to ensure that portfolio investment in Malaysia is competitive, the BNM has to respond by increasing the domestic interest rates.

Response of domestic macroeconomic variables

Figure 2 in Panel A-Panel C describes the response of domestic macroeconomic variables to the innovation in foreign shocks. As depicted in Figure 2 in Panel A, a positive innovation in world oil prices growth led to an increase in domestic output for up to four months. However, after four months the positive innovation of the world oil price growth led to a decline in domestic output. For instance, within 9 months, the accumulated output declined by 1.5 percent before reducing to 1.0 percent after 25 months. The positive response of output within a four month period is reasonable given that Malaysia is a net oil exporter country. An increase in world oil price has generated higher income to the petroleum industry, and subsequently leads to an increase in domestic output. However, after four months, output responded negatively to the world oil price because of the adverse supply shocks. For example, an increase in the world oil price will lead to an increase in firms' production costs, and subsequently the firms will respond by contracting their investment spending. Domestic inflation also positively responds to the positive shocks in the growth of world oil price. For instance, the highest effect is recorded in a 5 month period, whereby every 1 percent increase in world oil prices growth led to an increase in the inflation rate of 0.225 percent. However, after 5 months the response of inflation gradually declined, and vanished within 40 months.

The exchange rate responded positively and significantly to the positive shock in the world oil price growth, and the accumulated effect was approximately 1.2 percent after 36 months. In other words, an increase in the world oil price triggers an appreciation in the domestic currency relative to other currencies because Malaysian is a net exporter of oil. In contrast, the stock market responded negatively to the positive shock in the world oil price growth after 4 months. For example, the highest accumulated effect is in 14 months, that is, a one percent increase in world oil price growth led to a decline in domestic asset prices of approximately 3 percent. One possible explanation is that firms will shrink their production and investments due to an increase in the costs of production, which in turn will reduce the firms' profit (cash flow), and subsequently reduce asset prices.

Panel B in Figure 2 plots the response of domestic macroeconomic variables to innovation in foreign income (US output). As can be seen, domestic output growth positively responded to the foreign demand shock. For example, after 30 months, the accumulated response of domestic output growth is 3.25 percent in response to a one percent increase in foreign income growth. The positive response of domestic income is reasonable since most of the Malaysian exports are concentrated in the

US market. The effect of the US income shock to domestic inflation was positive within 10 months, whereas after 10 months domestic inflation had responded negatively. For example, in a five month period, a positive shock in US output led to an increase in domestic inflation by 0.5 percent. On the contrary, within a 35 month period, a one percent of increase in the US income growth led to a reduction in domestic inflation of 0.3 percent.

A positive shock in the US income had caused the exchange rate to respond negatively within 5 months; however, after 5 months the negative response started to dwindle until it reached zero in 25 months, and a positive effect after 25 months. The positive response of exchange rate (appreciation in domestic currency) occurs because an increase in foreign income has stimulated domestic exports, and afterwards has increased the demand for domestic currency. In contrast, the asset price shows no significant effect in responding to the foreign income shock within 5 months. However, between 5 and 10 months, there was a strong response of the asset price, which decline at 3 percent in 10 months in responding to one percent increase in foreign income growth. In contrast, after 10 months, the negative response of the asset price was beginning to reduce, and had positive effect after 30 months. This might be due to an increase in foreign income which stimulated the demand for domestic assets from the foreign country, and subsequently increased the asset price.

Panel C in Figure 2 shows the effect of foreign monetary shocks on domestic macroeconomic variables. As can be seen, the accumulated response of domestic output was positive within a 5 month period; however, the effect is relatively small. After 5 months, the accumulated response of domestic output had declined. For example, within 60 months period; the accumulated response of domestic output decreased by 1 percent in response to a one percentage point increase in FFR. A possible explanation is that an increase in the foreign interest rate contracted the foreign economic activity, which afterwards decreased foreign demand, and subsequently contracted the domestic economy. Domestic inflation had responded negatively to positive innovation in FFR after 5 months. For example, in 20 months, domestic inflation had decreased by 0.125 percent in responding to one percentage point increase in foreign monetary policy.

The accumulated response of exchange rate to the innovation in FFR was negative within a 5 month period. This could be due to the capital inflow to the US because an investment in the US's financial assets is more competitive than financial investment in Malaysia. Thus, demand for the US currency will increase; while, demand for domestic currency decreases, which subsequently depreciates domestic currency. However, after 5 months, the accumulated response of exchange rate to the FFR is positive. A possible reason is that the BNM has increased the domestic interest rates to offset the capital outflow to the foreign country. The accumulated response of stock market to the FFR shocks is relatively small, which indicates that

foreign monetary policy is not important in influencing the domestic stock market. For instance, a one percentage point increase in the FFR led to a decrease in domestic asset price by 1 percent within a 3 month period. However, between 3 months up to 15 months, the stock price had responded positively with the positive innovation in FFR. After 15 months, the accumulated effect of stock price had gradually decreased in response to the foreign monetary policy tightening.

4.2.2. Shutdown Methodology

Figure 3-4 reports the results of foreign shocks effects on domestic macroeconomic variables (output and inflation) by comparing the constrained IRF and baseline model. The constrained IRF is reported in the left column, and the baseline model in the right column. As can be seen in the left column of Figure 3-4, the effect of world oil price shocks on domestic output and inflation is larger by shutting off an endogenous response of monetary policy as compared with the baseline impulse response. For example, after 25 months, in the constrained model, the accumulated response of domestic output growth had a negative effect by 2.5 percent, whereas, in the baseline model the accumulated output declined by 1 percent in responding to a one percent increase in world oil price growth. The effect of the world oil price growth on domestic inflation is also higher without an endogenous response of monetary policy, with the highest effect being recorded at 0.35 percent in 10 months. In comparison, in the baseline model the highest effect of inflation was at 0.25 percent in 7 months. Therefore, we can conclude that monetary policy plays an important role in stabilizing the domestic economy from the adverse supply shocks (an increase in the world oil price growth).

The Malaysian economy is also influenced by the foreign demand shocks, in particular a foreign income shock from a major trading partner (US). A positive innovation in US income will generate an expansion in domestic output growth through an increase in exports, and can accelerate inflation rates. Therefore, monetary policy can be used as a stabilization policy in minimizing the effect of a foreign shock on the domestic inflation rate. In Figure 4, by shutting off monetary policy (constrained IRF), a positive innovation in US income has increased the domestic inflation rate by approximately 0.2 percent within 8 months, while, by implementing monetary policy (baseline IRF), it can minimize an inflation rate at 0.05 percent in 8 months. However, after 18 months by shutting off monetary policy, the positive innovation in foreign income has decreased the inflation rate, with the highest level being recorded at -0.2 percent after 30 months. In contrast, in the baseline model, the inflation rate had decreased after 13 months, with the highest negative effect being recorded at -0.25 percent in 35 months.

A foreign monetary policy shock is also important in influencing the domestic economy. Therefore, monetary policy can be used to mitigate the negative effect of monetary policy tightening from a foreign country to the domestic economy. By

shutting down the monetary policy variables, the accumulated response of domestic output has a negative effect after 5 months in response to the foreign monetary policy tightening. The maximum accumulated response is recorded in period 60 months, when a 100 basis point increase in FFR led to a decline in domestic output of 1.2 percent. In the baseline model, domestic output decreased after 5 months; however the accumulated effect was approximately 1.0 percent in 60 months. This finding shows that monetary policy plays a marginal role in minimizing the negative effect of foreign monetary policy shocks on domestic output growth. The effect of FFR on domestic inflation is negative either by shutting off monetary policy or in baseline model. However, the effect of FFR shocks to domestic inflation is relatively low in the constrained model as compared to the baseline model. Specifically, after 20 months, the inflation rate has declined by 0.075 percent in the constrained model, whereas, in the baseline model, the inflation rate has decreased by more than 0.10 percent.

4.2.3. Robustness Checking[1]

Several alternative procedures have been considered in this study; (i) estimating the recursive SVAR model; (ii) alternative contemporaneous structural identification schemes; (iii) model with money demand; and (iv) model without money. In general, the results are robust with the baseline model. Foreign shock appeared to play a prominent role in influencing the domestic macroeconomics fluctuations, and monetary policy. Monetary policy is also able to minimize the negative effect of foreign shocks on domestic economy, in particular economic growth and inflation.

5. Summary and Conclusion

This study examines the effect of external shocks, namely the world oil price and the US international transmission (US income and US monetary policy) upon domestic monetary policy and macroeconomic fluctuations. The effectiveness of monetary policy in mitigating the negative effect of external shocks to the domestic economy (output and inflation) was also examined by using the shutdown methodology. An open-economy SVAR modelling framework has been used in investigating the propagation of foreign shocks to domestic monetary policy and macroeconomic variables.

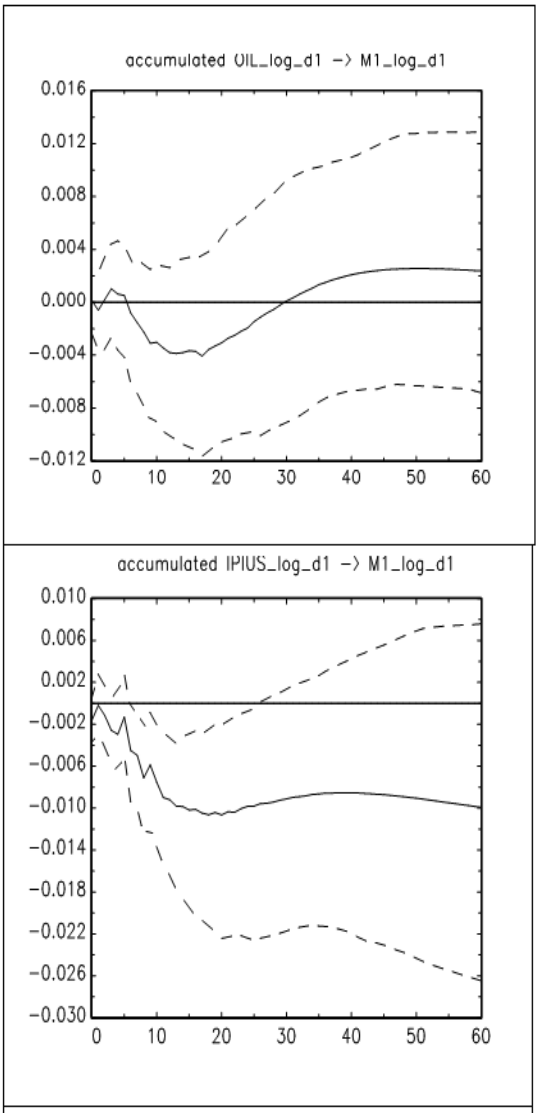
The results of the study revealed that the macroeconomic variables and monetary policy in a small open economy are vulnerable to the exogenous shocks from external environment. The effects of foreign shocks on domestic macroeconomic

[1]I do not report the full result of robustness checking to save space. However, the full results are available upon request.

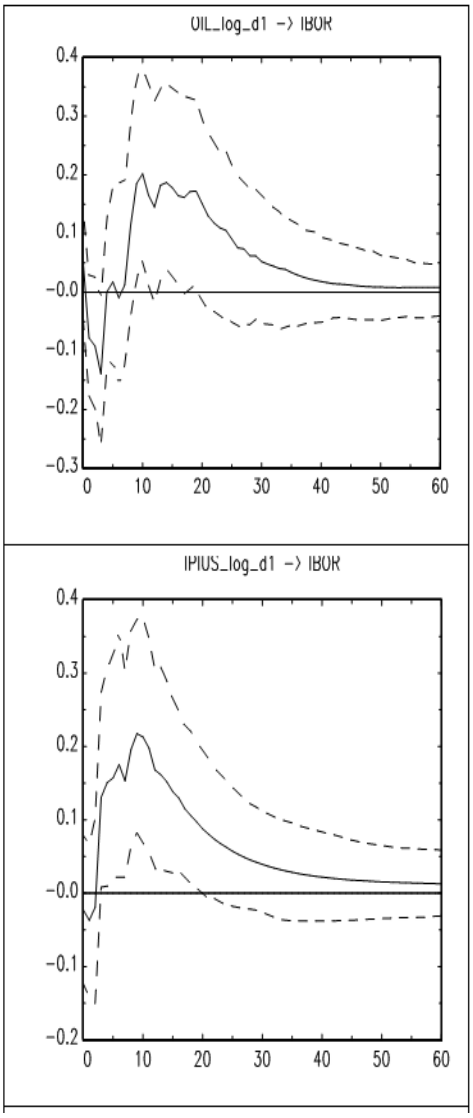
variables are also shown to be consistent with economic theory. Output growth decreases, and the inflation rate rises in response to an adverse supply shock (positive innovation in the world oil price). Monetary policy also plays a vital role in mitigating the negative effects of foreign shocks (adverse supply shocks) on domestic macroeconomic variables (economic growth and inflation). This finding indicates the important role of monetary policy in stabilizing domestic economy following an adverse supply shock (for example, an increase in world oil price).

The policy implications in this study highlight two significant indications for monetary policy implementation in a small open economy. First, the monetary authority has to closely monitor the external environment, such as shocks resulting from the world oil price, and foreign monetary policy and foreign income in formulating their monetary policy. This is because the foreign shocks have a significant effect on domestic macroeconomic variables. Therefore, by considering the external events in the monetary policy strategy, the monetary authority can implement an appropriate policy in achieving their ultimate target in terms of economic growth and price stability. Second, the monetary authority can also use monetary policy as a stabilization policy in mitigating the negative effects of external shocks on the domestic economy.

Panel A



Panel B



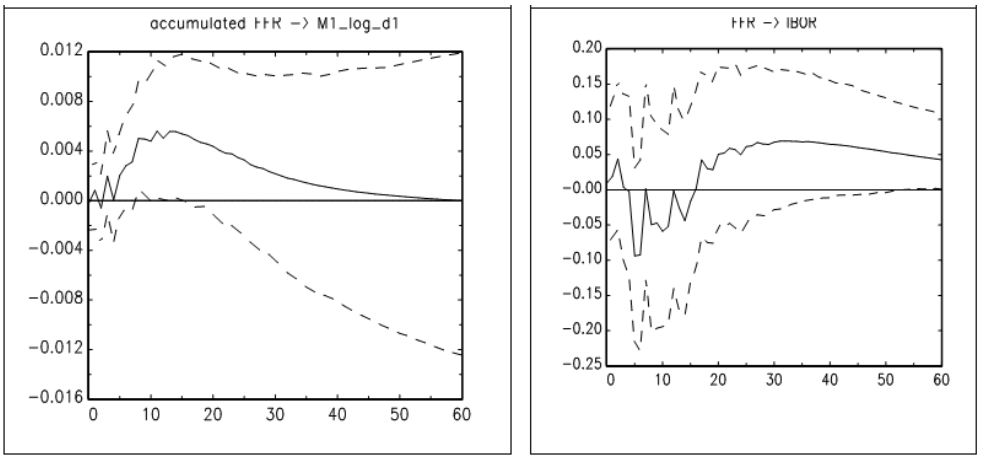
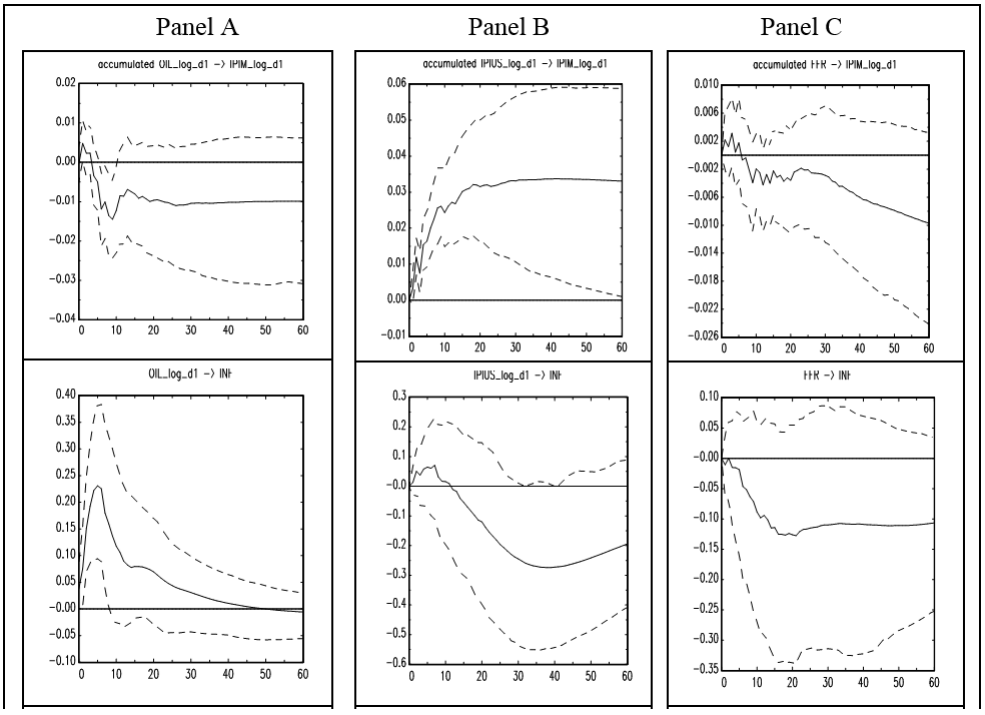


Figure 1. Structural Impulse-Response Function: The Effect of Foreign Shocks on Monetary Policy Variables



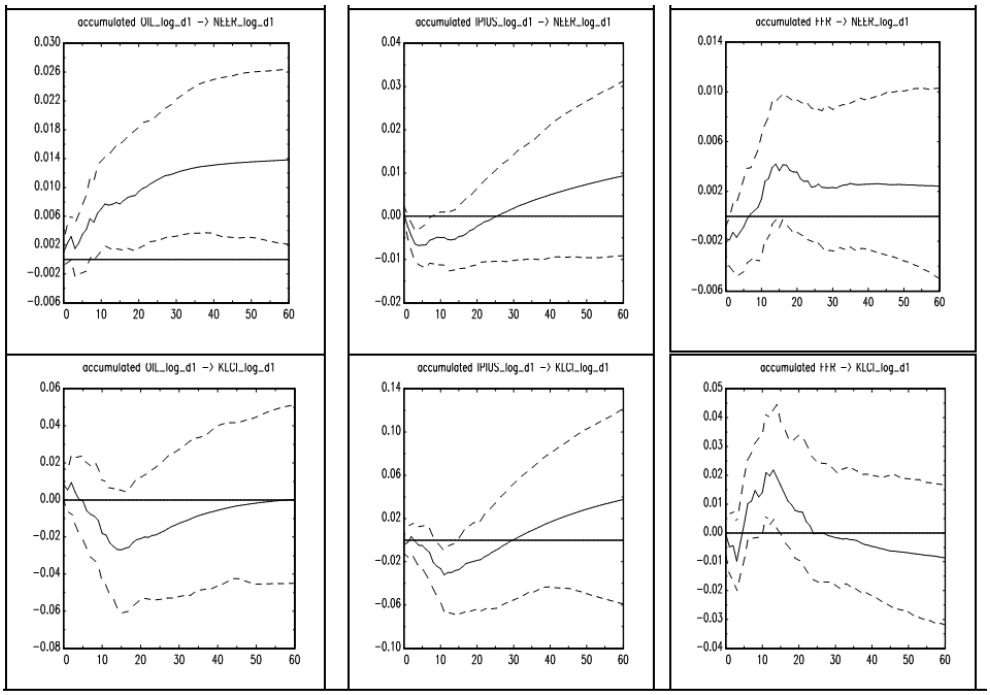


Figure 2. Structural Impulse-Response Function: The Effect of Foreign Shocks on Macroeconomic Variables

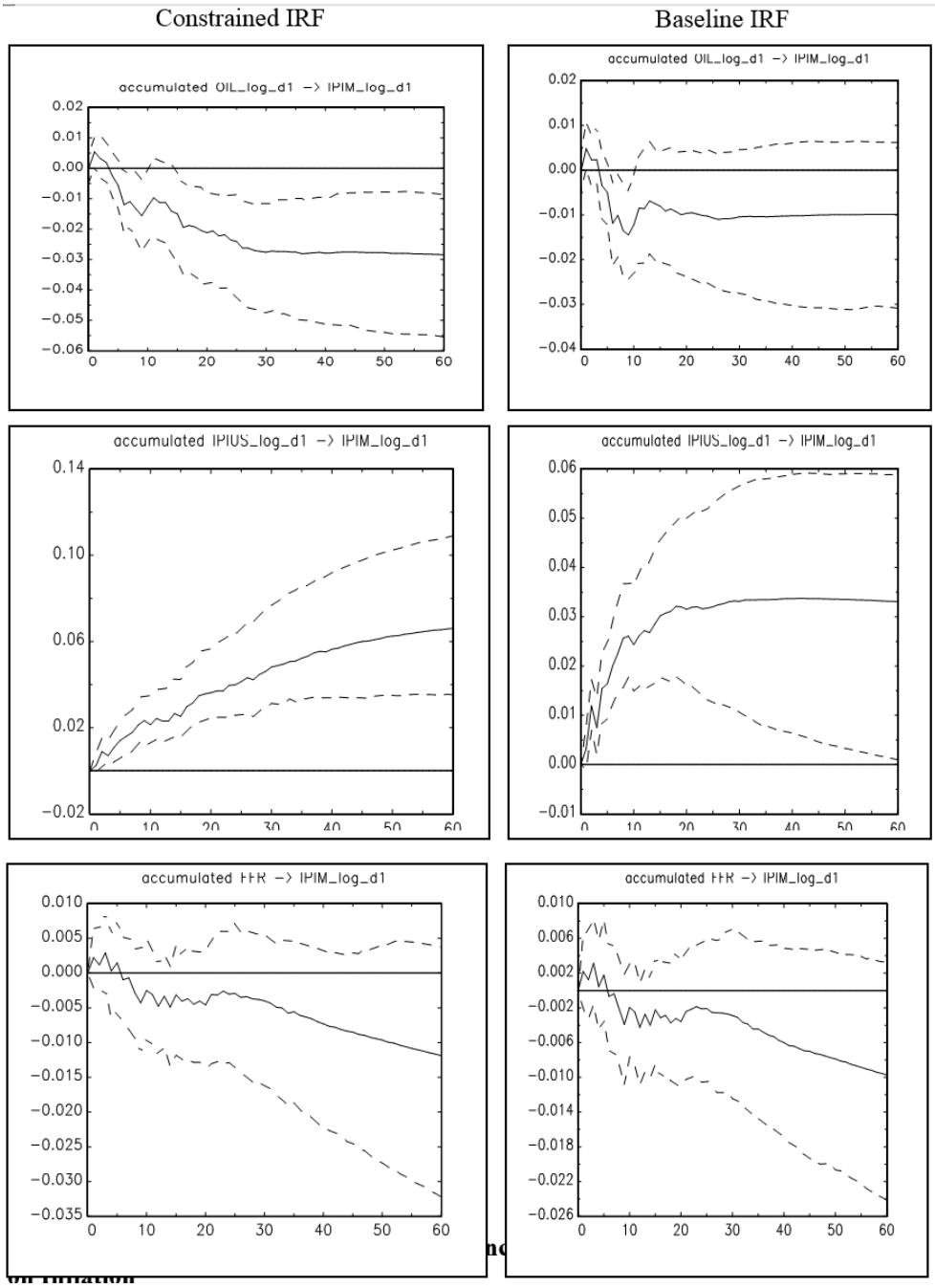


Figure 3. Structural Impulse-Response Function: The Effect of Foreign Shocks on Domestic Output

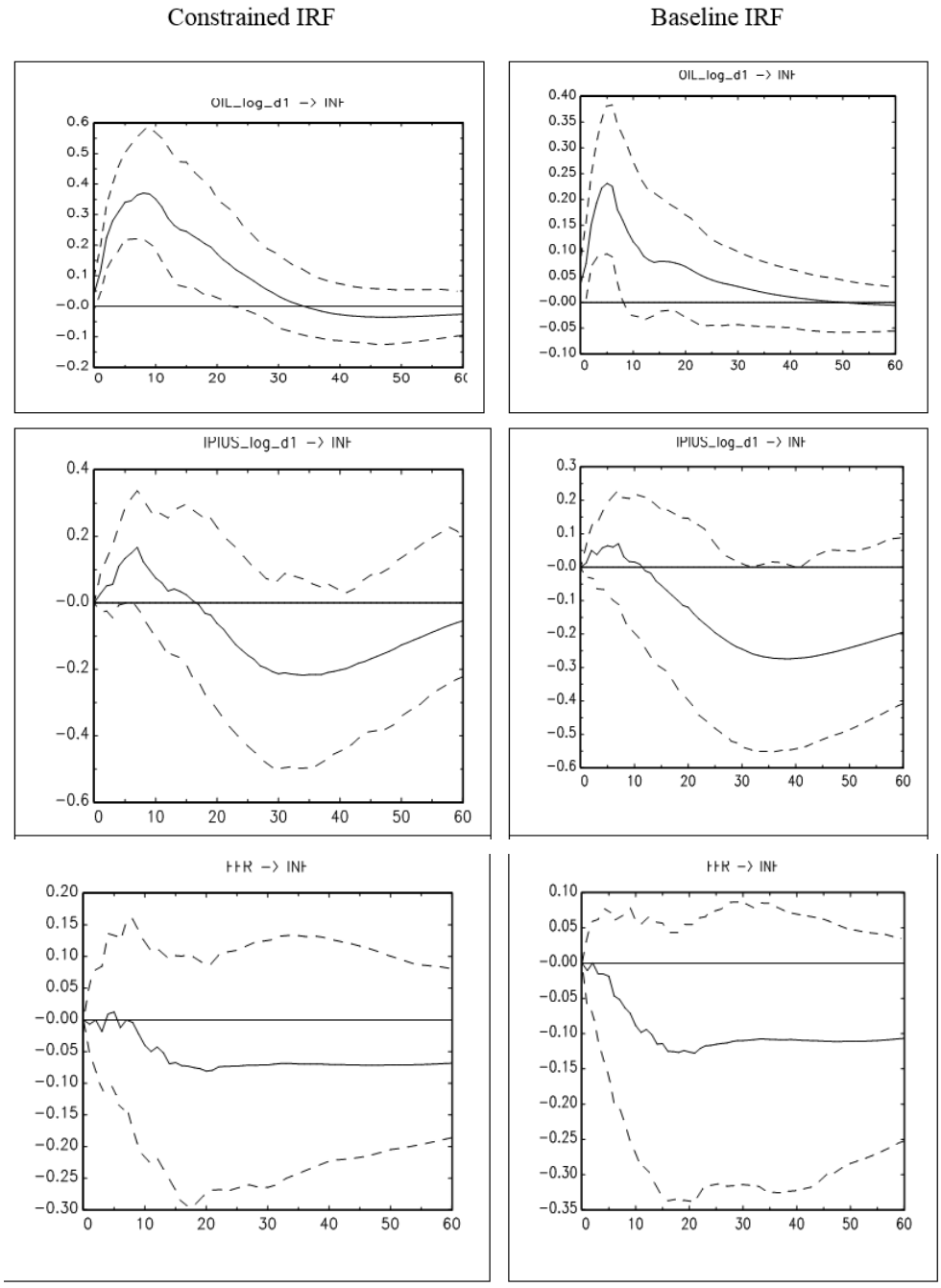


Figure 4. Structural Impulse-Response Function: The Effect of Foreign Shocks on Inflation

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