Revisiting the Dynamic Effects of Oil Price Shock on Small Developing Economies*

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Abstract

This paper examines the dynamic effects of oil price shocks in addition to the aggregate supply and demand shocks on macroeconomic fluctuations in four sample economies: Indonesia, Malaysia, Pakistan and Thailand. We aim to discover whether oil price shocks play a crucial role in explaining output and domestic price fluctuation in small emerging economies after 1990s. We are also keen to assess whether oil price shocks have different effects on macroeconomic variations in oil-importing (Pakistan and Thailand) and oil-exporting (Indonesia and Malaysia) countries. A structural *VAR* is applied to identify different structural shocks and further explore the relative contributions of different shocks on macroeconomic fluctuation. Our results show that oil price shocks have negligible positive effects on output in one oil exporting country (Malaysia), but also in two oil importing countries (Pakistan and Thailand). However, it is less likely that oil price shocks have a substantial impact on macroeconomic fluctuation. The aggregate supply and demand shocks are the main sources of fluctuation in output and domestic price respectively in Malaysia, Pakistan and Thailand. In Indonesia, aggregate supply shocks are the key reason for both output fluctuation and inflation.

Key words: Macroeconomic fluctuations, Oil price, Structural *VAR* models, Small Asian developing economies

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1. INTRODUCTION

In the existing literature, the relationship between oil price and macroeconomic fluctuation has been intensively discussed (e.g., Burbridge and Harrison, 1984; Hamilton, 1983, 1996 and 2003; Mork, 1989). Oil prices have always been highly volatile and consequently have a large impact on macroeconomic variables such as inflation and output level. Macroeconomists generally believe that the correlation between oil price shocks and macroeconomic variable fluctuation come from a set of fundamental shocks which hit all sectors of an economy. In the seminal work of Hamilton (1983), oil price shocks were shown to be a contributing factor in some recessions in the US before 1972, though oil price shocks did not necessarily cause economic recession. Dhawan and Jeske (2006) find that nearly all the recessions since 1973 have been preceded by a rise in energy prices. However, in the recent work of Schubert and Turnovsky (2011), the evidence shows that recent oil price shocks have a tempered effect on economic activity compared with those in 1970s and 1980s.[1] One obvious explanation would be the fall in the share of oil in the economy through a more credible policy response and more flexible labour market.

Another explanation is that the nature of shocks in the world oil market has changed over time. The study of Baumeister and Peersman (2012) states that the oil demand curve has become less elastic over time; therefore oil price changes are largely contributed by oil supply. The demand and supply elasticities of oil prices become smaller over time (Baumeister and Peersman, 2011). The recent paper of Millard and Shakir (2012) shows that the impact of oil price shocks on the economy differs with the underlying source of the shock. They find that oil supply shocks make a larger negative impact on output and slightly higher increases in inflation relative to oil shocks stemming from demand in UK.[2]

[1] See also Blanchard and Gali (2008) for a detailed review.
[2] In alignment with these findings, oil price shocks are considered as supply shocks in this paper.

In addition, the variations of oil price are expected to have very different effects on oil-importing and oil-exporting countries. Brown *et al.* (2004) state that increased oil price has a similar effect to a tax, which is collected by oil exporting countries from oil importing countries.[3] Many existing empirical studies show that oil price increase has negative effects on output growth in oil importing countries (e.g., Atukeren, 2003; Awerbuch and Sauter, 2005; Ferderer, 1996; Jimenez-Rodriguez and Sanchez, 2005; Schneider, 2004). Increases in oil price and the resultant instability affect the economy through higher input costs, reallocation of resources, decreases in income and depreciation of currency. As a result, economic growth performance is depressed while inflation and unemployment are raised. A sudden increase in the oil price causes an exogenous inflationary shock because higher oil price puts pressure on the general price level, which results in higher inflation and leads to higher interest rates and could eventually push an economy into recession. Other studies indicate that increased oil price is associated with higher growth in net oil exporting countries through increased state revenue, which leads to higher national income and currency appreciation (e.g., Bjornland, 2000; Jalil *et al.*, 2009). Bjornland (2009) states that higher oil prices also affect oil producing countries through negative trade effects, as oil importing countries suffer from oil induced recession and therefore demand fewer exports from oil exporting countries. For those oil-exporting countries with a large export sector, the negative trade effect may indeed off-set the positive wealth effect, which leave the net effect ambiguous. Bjornland (2000) investigates the dynamic effects of oil price and other shocks on macroeconomic fluctuation in two oil-exporting countries (UK and Norway) and two net oil importers (USA and Germany). The interesting finding is that oil price shocks not only have a significant negative impact on the output of the net oil-importing countries but also on one of the net oil-exporting country (UK).

[3] Similar idea can also be seen in Cologni and Manera (2008).

The recent experience in Asian countries somehow forms the hypothesis of non-eligible effects of oil price shocks on economic fluctuation under some circumstances. Cunado and Gracia (2005) investigate the relationship between oil price and macroeconomic variables for a group of Asian countries and they find their results are sensitive to variable selection on using international or domestic oil price. The short-run effects of oil price on economic growth and inflation are statistically significant. Jalil *et al.* (2009) study the dynamic relationship between oil price and *GDP* in Malaysia using quarterly data from 1991q1 to 2005q4. The co-integration results confirm a positive long-run association between *GDP* and oil price variables. Spikes in oil prices prior to the global crisis led to high inflation rates in most South and South East Asian countries evidenced by double digit inflation rates. The inflationary pressures also caused increased budget deficit and balance of payment concern.

The aim of this paper is to investigate the effects of oil price shocks in addition to aggregate supply and demand shocks on output and domestic aggregate price level in four Asian developing countries: Indonesia, Malaysia, Thailand and Pakistan. Developing economies are generally considered highly vulnerable to external shocks, and prominent among these is volatility in international oil price, because they are more oil-dependent than more developed ones and therefore more adversely affected by oil price increases. We are particularly interested in the nature of oil price shock and how it affects macroeconomic fluctuation in small emerging economies with distinction between oil importing and exporting countries. To identify the various structural shocks and explore their influences on macroeconomic variables over time, a structural *VAR* model is applied imposing both short-run and long-run restrictions. The effects of these structural shocks on economic fluctuation are detailed and compared across 4 sample countries. We contribute to the existing literature by devoting substantial efforts to studying the effects of various shocks on macroeconomic fluctuation in small Asian developing economies. In the past two decades, these countries have experienced higher demand for energy, particularly the dependence on oil following the deepening of economic development. In particular, within the same area, Indonesia and Malaysia are oil exporting countries, while Pakistan and Thailand are oil importing countries. Each of them has experienced world oil price shocks alongside other shocks. Identifying and understanding the effects of various shocks on macroeconomic fluctuation in the sample countries, particularly the effects of oil price shock, could provide some policy recommendations for regional co-operation in the Asian-Pacific area. This could help to minimize negative influences from global economic fluctuations and achieve macroeconomic stability for sustainable growth and development.

The rest of the paper is organised as follows: Section 2 is devoted to a brief review of the economic background and the influence of crisis on economic fluctuation in four sample economies. Section 3 introduces a theoretical model with separated oil price shock in additional to aggregate demand and supply shocks. The empirical methodology and data are explored in Section 4. Section 5 reports econometric results. Finally, concluding remarks are provided in Section 6.

2. ECONOMIC BACKGROUND AND IMPACT OF CRISIS

In Southeast Asia, Malaysia has the third highest oil reserves but its net oil exports are very tight due to the small gap between domestic production and demand. Indonesia is the largest oil producer in Southeast Asia and was also a significant exporter.[4] Thailand is a significant net oil importing country with two-third reliance on imports, thus spending a significant amount of its *GDP* on oil imports. Similarly, Pakistan is an oil importing country but one of the lower users of oil. It has limited domestic oil reserves and relies heavily on

[4] Indonesia faced stagnant oil production due to the aged oil fields and inadequate investment for exploring new oil fields, which transferred its status from oil exporter to oil importer in 2004 (Bradsher, 2008). However, Indonesia was net oil exporter during most of the period examined in this study.

imports. For all these countries, governments provide subsidies on oil price in order to reduce the adverse effect of oil price shocks on real activities.

In the past 17 years (1994-2010), the four sample economies experienced two major crises: the Asian financial crisis during 1997-1998 and the recent global economic crisis accompanying high oil prices in 2008. Figure 1 exhibits the annual real *GDP* growth and inflation for the four countries.

[FIGURE 1]

In general, three Southeast Asian countries experienced a serious recession during 1997-1998 indicated by negative *GDP* growth rate accompanied by hyperinflation. In 1998, the real *GDP* growth rate was -14.1%, -7.6% and -11.1% for Indonesia, Malaysia and Thailand respectively. The inflation was about 58% in Indonesia, while Malaysia, Thailand and Pakistan were also suffering from high inflation. The poor economic performance in 1998 was clearly induced by the Asian financial crisis. The high oil price in 2008 seems to affect inflation more than growth performance. Inflation in Indonesia and Pakistan reached double figures in 2008, while those were slightly above 5% in Malaysia and Thailand. Meanwhile, four countries still managed moderate *GDP* growth. The effects of recent global recession on four sample countries were ambiguous. Except for Pakistan, high inflation was not observed in the remaining three countries in 2009. Indonesia and Pakistan coped well in terms of growth performance, while Malaysia and Thailand experienced negative growth rate but with tempered magnitude compared with the 1997-1998 recession. The influence of crisis on economic performance in four sample countries is country-specific. The context-specific explanations are given below.

a. Indonesia

Indonesia has a large rural economy with a flexible agriculture sector and significant oil reserves. It was the only Southeast Asian country that was a member of OPEC and also was among the top twenty oil producing countries in the world. Before the Asian financial crisis in 1997, Indonesia was one of the most fast growing economies with annual growth rates varying between 5.5% and 7.5% during 1986-1996. The Asian financial crisis was mainly from unexpected large capital outflow from Indonesia, as a direct consequence there was huge exchange rate depreciation against the US dollar. The economy was deeply depressed with annual GDP growth rate -14.1% in 1998 accompanying extremely high inflation (58.4%). Thereafter, the economy gradually recovered and inflation slowly moved back to the par level but the economy was hit again by the recent global economic crisis. During the global economic crisis of 2008-2009, a sizeable proportion of Indonesian workers went abroad. The economy was increasingly dependent on remittances from abroad especially for those living in villages. The study by Tambunan (2010) shows the global financial crisis affected the country's exports, investment and also remittance. Indonesia still managed to maintain positive economic growth, though real *GDP* growth rate declined during the crisis from 6.2% in 2007 to 4.5% in 2009. In 2010, the growth rate moved back to 5.9%.

b. Malaysia

Malaysia is a small open economy with a few significant economic achievements: fast economic growth, low inflation and smaller foreign debt. In the past two decades, Malaysia has faced two economic crises. The Asian financial crisis in 1997 was due to the internal sources which started with a rapid short-run capital outflow from the country as a result of floating of Thailand's baht in 1997 (Cheng, 2003). This crisis caused an extraordinary reduction of *GDP* in 1998 (-7.6%) and doubled inflation. However, Malaysia managed to recover quickly, as is evidenced by 6% *GDP* growth rate in 1999. After some years of good economic performance, at the end of 2008, the country was affected by the global economic recession. The demand for Malaysian products in advanced economies (such as the US and Japan) fell significantly during the crisis in 2008-2009. The high oil price in 2008 seems not to have affected Malaysia. One possible explanation for this is that Malaysia is a net oil exporting country. In addition, Malaysia is deeply involved in big subsidies to all sectors of the economy.

c. Pakistan

Pakistan is an agricultural economy with 65% of the population living in rural areas. Pakistan's major exports are rice, leather goods and sports goods, while imports are mainly machinery, petroleum and steel products. The Pakistan economy achieved impressive performance in 1980s with average annual growth rate of around 7%. During 1992-1993, Pakistan was affected by devastating floods and political instability (Khan, 2009), hence economy performance was below its potential. Pakistan's economy was seriously affected by political instability from late 1996 to the end of 1997. Performance hit the bottom in 1997 (-0.1%). In 1996-97, Pakistan faced renewed political instability that damaged private sector confidence and led to a sharp decline in GDP growth. According to Khan (2009), the fiscal year 1996-97 was stained by political and constitutional disasters and the effect of the Asian financial crisis in Pakistan. This crisis further extended into economic sanctions imposed by *IMF* and other developed countries prompted by the nuclear test in 1998. Consequently, the Pakistan economy faced declining foreign loans, trade and aid. This led to capital flight from the economy and decreased growth. The global economic crisis of 2008 affected the Pakistan economy through trade, investment, aid and remittance channels. Pakistan faced the high prices of international food and energy in 2007-2008. As a result, the country faced scarce infrastructure, security concern and power shortage which led to economic instability. The crisis reduced real *GDP* growth from 5.5% in 2007 to 1.6% in 2008 with 20.3% inflation.

d. Thailand

Thailand is a small industrialized economy heavily dependent on exports. The share of exports is more than two thirds of *GDP*. The exports consist mainly of machinery, electronic products, agricultural goods and jewellery. The economy developed quickly from the middle of 1970s to 1996. The average annual real *GDP* growth rate was 9% during 1990-1996. Thailand was one of the most affected countries during the Asian financial crisis in 1997-1998. The real *GDP* growth rate decreased dramatically from 5.7% in 1996 to -1.4% and -11.1% in 1997 and 1998 respectively. After the crisis, the economy started to recover with an average annual real *GDP* growth rate of 4% before the global financial crisis in 2008-2009. The global crisis hit the Thai economy through the export, stock market, tourism industry and private investment. The crisis reduced exports by 23.4% in 2009 (Government of Western Australia, 2011), which lead to a negative real GDP growth rate of -2.3% in 2009.[5] In 2010, Thailand achieved rapid growth (7.5%) owing to a gain in net exports.

3. THEORETICAL MODEL

The theoretical framework of this paper is a modified textbook aggregate demand and supply model (e.g., Romer, 2006).

Lucas supply curve (Lucas, 1972 and 1973) with rational expectations:

$$y_t^s = \overline{y}_t + \alpha[p_t - E_{t-1}(p_t \mid \Omega_{t-1})] \qquad (1)$$

where aggregate supply y_t^s is a function of natural rate of output $\overline{y}_t$ and the difference between actual domestic price level p_t and its expectation given all available past information Ω_{t-1}. Taking expectations conditional on time *t*-1 and rearranging equation (1) gives[6]:

[5] The economic disaster of 2009 was also caused by political instability and a collapsing in tourist industry.
[6] Detailed derivation is up on request.

$$y_t^s = E_{t-1}(y_t \mid \Omega_{t-1}) + \alpha[p_t - E_{t-1}(p_t \mid \Omega_{t-1})] + \eta_t \quad (2)$$

where η_t represents productivity shock, which is further decomposed into supply shock and oil price shock (see Bjornland, 2000).

$$y_t^s = E_{t-1}(y_t \mid \Omega_{t-1}) + \alpha[p_t - E_{t-1}(p_t \mid \Omega_{t-1})] + \varepsilon_t^s + \beta\varepsilon_t^{op} \quad (3)$$

High oil price affect the economy of oil importing countries through increased marginal costs and inflation. It is therefore expected that $\beta < 0$ for oil importing countries. In contrast, oil exporting countries will respond the same shock positively ($\beta > 0$) due to an increase in national income through greater oil export revenue, which is particularly the case for those oil exporting countries where the oil sector is large compared with the rest of the economy.

The aggregate demand:

$$y_t^d = m_t - p_t + \gamma op_t^w \quad (4)$$

where aggregate demand y_t^d is a function of literal money m_t, domestic price level p_t and world oil price op_t^w. Similarly as for the supply side, taking expectations conditional on time $t-1$ and rearrange equation (4) gives,

$$y_t^d = E_{t-1}(y_t \mid \Omega_{t-1}) - [p_t - E_{t-1}(p_t \mid \Omega_{t-1})] + \varepsilon_t^d + \gamma\varepsilon_t^{op} \quad (5)$$

If $\gamma < 0$, high oil price may subsequently lead to lower level of demand by rational consumers. If $\gamma > 0$ for oil exporting countries which implies that high oil price increases the level of demand from energy producers.

The economy is in equilibrium when,

$$y_t^s = y_t^d = y_t \quad (6)$$

Hence we have,

$$p_t = E_{t-1}(p_t \mid \Omega_{t-1}) - \left(\frac{1}{1+\alpha}\right)\varepsilon_t^s + \left(\frac{1}{1+\alpha}\right)\varepsilon_t^d + \left(\frac{\gamma-\beta}{1+\alpha}\right)\varepsilon_t^{op} \tag{7}$$

$$y_t = E_{t-1}(y_t \mid \Omega_{t-1}) + \left(\frac{1}{1+\alpha}\right)\varepsilon_t^s + \left(\frac{\alpha}{1+\alpha}\right)\varepsilon_t^d + \left(\frac{\alpha\gamma+\beta}{1+\alpha}\right)\varepsilon_t^{op} \tag{8}$$

Following Bjornland (2000), we assume that world oil price can only be affected by the shocks of oil demand and oil supply, while other factors (such as political events) are considered as exogenous to the oil price.[7] Hence,

$$op_t^w = op_{t-1}^w + \varepsilon_t^{op} \tag{9}$$

Equations (7) - (9) give us the structural form model in the paper. Each structural shock (oil price shock, ε_t^{op}, demand shock, ε_t^d and supply shock, ε_t^s) is a white noise and they are assumed to be uncorrelated with each other. In the short run, oil price, aggregate supply and aggregate demand shocks affect the output level due to nominal and real inflexibilities as exhibited in equation (8). In alignment with Blanchard and Quah (1989), we assume aggregate supply shocks have permanent effect on output level, while aggregate demand shocks only affect output level in the short run.

4. EMPIRICAL METHODOLOGY AND DATA

In this paper, we use a structural *VAR* model with the combination of both short-run and long-run restrictions following Blanchard and Quah (1989) to identify the effects of the different shocks on macroeconomic fluctuation.

We use quarterly time series data: log of real world oil price, log of real *GDP* and log of consumer price index (*CPI*) for 4 sample economies: Indonesia, Malaysia, Pakistan[8] and

[7] In particularly, our sample countries are small economies. Hence, this is a reasonable assumption.

Thailand.[9] All the series in use are seasonal adjusted. The time-spans differ across countries depending on the availability of data: Indonesia (1990q1 to 2010q4), Malaysia (1991q1-2010q4), Pakistan (1981q1-2010q4) and Thailand (1993q1-2010q4).

Before proceeding further, a few pre-estimation tests are conducted. As exhibited in Table 1, the unit root tests (both Augmented Dickey Fuller and Phillips Perron tests) indicate that none of these three series are stationary at level for any country. The first order differences series are proved to be stationary, i.e., all of the series are *I(1)*. The Johansen test of cointegration is performed next to the level series with appropriate assumptions on trends and lags to check whether the variables are cointegrated in each country (see Table 2). Generally speaking, there is no cointegration evidence among three series in any country.[10]

The reduced form model is constructed by the following variables: the first order difference of log real world oil price $\left(\Delta op_t^w\right)$, the first order different of real log *GDP* $\left(\Delta y_t\right)$ and inflation $\left(\Delta p_t\right)$. The change of world oil price is assumed to be exogenous, which is not affected by other variables in the system but only its past histories. A 3-dimensional multivariate *VAR(k)* model is given in equation (10), where $k = 5$ for Indonesia and Pakistan and $k = 2$ for Malaysia and Thailand.[11]

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[8] Due to the limit observations in quarterly *GDP* series, data used for Pakistan are interpolated from the annual series by using Simpson's rule in numerical integration (see Al-Turki, 1995). The annual series is downloaded from *IMF*, *IFS*, 2011.

[9] Data are downloaded from the International Monetary Fund (*IMF*), International Financial Statistics (*IFS*), Edition: April 2011. The real *GDP* series are based on authors' calculation from the GROSS DOMESTIC PRODUCT (GDP) (Units: National Currency; Scale: Billions) and GDP DEFLATOR (2005=100) for four countries. The real world oil price series is calculated from PETROLEUM AVERAGE CRUDE PRICE (Units: US Dollars per Barrel) and CPI ALL ITEMS CITY AVERAGE (United States). The CPI series are given as follows: CPI:17 CAPITAL CITIES (Indonesia), CPI PENINSULAR MALAYSIA (Malaysia), CPI:12MAJOR CITIES ALL INC. (Pakistan), CPI: URBAN (Thailand).

[10] Both the trace and maximum eigenvalues test statistics indicate no cointegration at the 0.05 level for Indonesia, Pakistan and Thailand, while at the 0.01 level for Malaysia.

[11] The number of lags for each country is selected through Akaike (AIC), Schwarz (BIC) and Hannan-Quinn (HQ) information criteria. Results are up on request.

$$\Delta op_t^w = a_{10} + \sum_{j=1}^{k} a_{11,j} \Delta op_{t-j}^w + e_t^{op}$$

$$\Delta y_t = a_{20} + \sum_{j=1}^{k} a_{21,j} \Delta op_{t-j}^w + \sum_{j=1}^{k} a_{22,j} \Delta y_{t-j} + \sum_{j=1}^{k} a_{23,j} \Delta p_{t-j} + e_t^s \quad (10)$$

$$\Delta p_t = a_{30} + \sum_{j=1}^{k} a_{31,j} \Delta op_{t-j}^w + \sum_{j=1}^{k} a_{32,j} \Delta y_{t-j} + \sum_{j=1}^{k} a_{33,j} \Delta p_{t-j} + e_t^d$$

The matrix form of equation (10) is,

$$z_t = K + A_1 z_{t-1} + ... + A_p z_{t-k} + e_t$$
$$A(L) z_t = K + e_t \quad (11)$$

where $A(L)$ is the matrix polynomials lag operator. z_t is vector of stationary variables, where $z_t = \left(\Delta op_t^w, \Delta y_t, \Delta p_t\right)'$. $\varepsilon_t = \left(\varepsilon_t^{op}, \varepsilon_t^s, \varepsilon_t^d\right)'$ is a vector of reduced form residuals with covariance matrix Ω, and $K = \left(k_1, k_2, k_3\right)'$ is the vector of intercepts. As z_t is covariance stationary, equation (11) can be rewritten to an infinite moving average process:

$$z_t = C_0 + C_1 e_{t-1} + C_2 e_{t-2} + ... = C(L) e_t \quad (12)$$

where $C(L) = A(L)^{-1}$ and C_0 is an identity matrix.

In order to fully identify parameters in the structural form model, a set of restrictions are needed in equation (12). Following Bjornland (2000), e_t can be written as a linear combination of $\varepsilon_t = \left(\varepsilon_t^{op}, \varepsilon_t^s, \varepsilon_t^d\right)'$, which is a vector of the orthogonal structural disturbances.

$$e_t = D_0 \varepsilon_t = \begin{bmatrix} d_{11} & d_{12} & d_{13} \\ d_{21} & d_{22} & d_{23} \\ d_{31} & d_{32} & d_{33} \end{bmatrix} \begin{bmatrix} \varepsilon_t^{op} \\ \varepsilon_t^s \\ \varepsilon_t^d \end{bmatrix} \quad (13)$$

Equation (12) can be rewritten as,

$$z_t = C_0 D_0 \varepsilon_t + C_1 D_0 \varepsilon_{t-1} + C_2 D_0 \varepsilon_{t-1} + ... = D(L) \varepsilon_t = C(L) D_0 \varepsilon_t \quad (14)$$

In the long run, we have

$$z_t = \sum_{j=0}^{\infty} C_j D_0 \varepsilon_t = D(1)\varepsilon_t = \begin{bmatrix} d_{11}(1) & d_{12}(1) & d_{13}(1) \\ d_{21}(1) & d_{22}(1) & d_{23}(1) \\ d_{31}(1) & d_{32}(1) & d_{33}(1) \end{bmatrix} \begin{bmatrix} \varepsilon_t^{op} \\ \varepsilon_t^{s} \\ \varepsilon_t^{d} \end{bmatrix}.$$

If D_0 is identified, which is a 3×3 matrix containing 9 elements, all the parameters in equation (14) are identified.[12] For simplicity, the structural disturbances are normalized to have unit variance. Hence, $\text{var}(\varepsilon_t) = \Omega = D_0 D_0'$. The symmetry in Ω imposes 6 restrictions on the elements in D_0. 3 more restrictions are needed for identifying D_0. According to the theoretical model in equation (9), real world oil price are free from supply and demand shocks, i.e., the contemporaneous effects of supply and demand shocks on oil price are zero. Therefore we have 2 more restrictions: zero short-run restrictions on oil price, $d_{12} = d_{13} = 0$. Finally, we impose a long-run restriction (Blanchard and Quah, 1989), where demand shocks have no long-run effects on the level of output, $d_{23}(1) = 0$.

5. EMPIRICAL RESULTS

a. Impulse Response Functions

In order to explore the effect of structural shock on endogenous variables (output and aggregate price level), we first assess the impulse response functions using structural decomposition. The impulse response functions are estimated to expose the response of the model to one standard deviation shock to the structural disturbances.[13] We are using cumulated impulse response function in this paper, which is the cumulative sum of the impulse response function. The cumulative impulse responses of output to oil price (*OP*),

[12] See Bjornland (2000) for detailed derivation.
[13] It is a widely used tool to track the impact of any variable on others in the system. See Hamilton (1994) for a detailed review.

aggregate supply (*AS*) and demand (*AD*) shocks are exhibited in Figure 2. In addition, the dynamic reaction of output to oil price shocks with one standard deviation (*S.D.)* band around the point estimates are reported in Figure 3. The one *S.D.* is computed by Monte Carlo simulation with 10,000 replications by using simulation from the distribution of the reduced form VAR coefficients.[14]

[FIGURE 2-3]

Generally speaking, oil price shocks seems have some long-run effects on the output levels in four sample economies, but the magnitudes are not comparable with the aggregate supply shocks. The oil price shocks have a negative and permanent effect on the level of output in Indonesia, though the effect is very small as output level reduced by only 0.3% after the shock. This may be because Indonesia recently experienced increased production dependency on oil and a high share of oil in consumption bundles, which transformed it into a net oil importer. Hence, increasing world oil prices has a negative effect on its output level. As an oil-exporting country, oil price shocks have positive and permanent effects on the output level in Malaysia, where output level increased by 1.5% after the shock. This positive output response is consistent with the conventional wisdom that increase in world oil prices leads to a rise in revenue and income of oil-exporting country. As indicated in Figure 3(a) and 3(b), the *S.D.* confidence band shows that oil price shocks have a very small effect on output in all horizons.

The interesting finding is that, for oil-importing countries like Pakistan and Thailand, oil price shocks also have a positive and permanent effect on the level of output, while the degree of output response in Thailand is much larger than that in Pakistan. The world oil price shocks have a very small positive impact (0.15%) on output in Pakistan. Although 80%

[14] This is computed by authors in Gauss.

of Pakistan's domestic oil demand is supplied by importing, it is considered a low oil using country. Thus oil demand accounts for a small share of its consumption basket. This may explain why Pakistan suffers less from oil price shocks. Another possible explanation is that Pakistan's government started to subsidize oil prices in 1970 in order to stabilize the domestic oil price during the bad period. So oil price shock may not affect Pakistan's economy, or may even slightly help because the government handled it well due to past experience. The response in one S.D. error band is negligible and close to zero as exhibited in Figure 3(c), which verifies that the effect on output of oil price shocks is eligible in Pakistan. For Thailand, the positive response of output to oil price shocks is about 1.8%. Thailand produces a sizeable amount of oil, which meets some part of domestic demand even though it is a net oil importing country. Furthermore, Thai government not only subsidizes oil price but also promotes exports, which brings a massive amount of trade surplus. During the bad period, a part of trade surplus can be used to overcome the increased world oil price. The crucial domestic demand could be autarkic. It should also be noted that if data from longer periods are available, the long run output response may well be revealed as negative in alignment with the expectations for oil importing countries in theory.

As expected, the reaction of output to aggregate supply shocks is positive and permanent in all countries. In Indonesia, Malaysia and Thailand, the output responses to the supply shock are much larger than in Pakistan. The impacts of supply shock vary from 2.2% to 3.3%. However, the immediate reactions to supply shock fluctuate from period to period for each economy. The positive effects become stable after 8 quarters except in Pakistan. It seems that the supply shock is likely to have a longer positive effect for Pakistan. This maybe because Pakistan is less developed compared with the rest and hence technological progress could benefit its economy more.

Aggregate demand shocks have a very small impact on output movements in all countries in the short run. It is less likely to have any permanent effect on output. In Indonesia, aggregate demand shocks have a negative effect across the time horizon, but the effect is very small. The cumulative negative effects reach a trough 3 quarters after the oil shock, which is just about -0.3%. 5 quarters later, the responses to the shock disappear. In Malaysia, aggregate demand shocks have positive effect on the output. 2 quarters later, the cumulative positive effects reach a peak, which is about 0.6%. However, the positive influences gradually diminish and eventually disappear after 7 quarters. In Pakistan, this positive response peaks after 4 quarters though the magnitude is only about 0.2%. Eventually, aggregate demand shocks have no permanent effect on output. The positive response in Thailand is the most significant, which is up to 0.8% after 2 or 3 quarters. 6 quarters later, the positive response has completely gone. Therefore, aggregate demand shock has no permanent effect on output in Thailand either. In the long run, the response of *GDP* to demand disturbances disappears in all countries, which is consistent with the theoretical expectations and restrictions (e.g., Blanchard and Quah, 1989).

[FIGURE 4-5]

Figure 4 provides the cumulative impulse responses of price level to oil price (*OP*), aggregate supply (*AS*) and demand (*AD*) shocks, while the dynamic reaction of price level to oil price shocks with one standard deviation (*S.D.)* band are reported in Figure 5. Oil price shocks have negative effects on domestic price level, which cause deflation in all sample countries. However, in Indonesia and Pakistan, increasing real world oil price reduces domestic price level in the first two quarters but, increases domestic price level thereafter and eventually the effect disappears after four quarters. In Malaysia and Thailand, oil price shocks have permanent negative effect on domestic price level. However, as indicated in Figure 5(a)-5(d) the response of domestic price level to oil price shocks is negligibly different from zero for this group of countries, which can be attributed to directly government-subsidised oil price to protect citizens and domestic industry from international oil price shocks. The subsidised oil price benefits many economic sectors and therefore effectively controls inflation in sample countries.

As expected, the aggregate supply shocks have a relatively stable negative impact on price level in all countries except for Malaysia. The positive impact of supply shocks on price level in Malaysia holds for only 4 quarters and the magnitude is negligible. In Indonesia, the cumulated negative response of domestic price level reaches a trough after 5 quarters (around 6%) and becomes stable after 12 quarters at 5%. In Pakistan, the domestic price level is reduced by 0.9%, while it is about 0.15% in Thailand.

The aggregate demand shocks have a permanent and positive effect on inflation in all countries, which is consistent with the economic theory. The response is highest in Indonesia and Pakistan, where a single unit shock corresponds to about 2.1% and 2.7% rise in price level respectively. In comparison, the demand shocks caused only 0.8% increase in price level in Malaysia. Thailand is in between, with around 1.2%.

b. Variance Decomposition

In this subsection, we apply variance decomposition, which allow us to verify how much of the forecast error variance is explained by shocks to each explanatory variable in a system over a time period. Variance decomposition is based on structural decomposition (orthogonalization) estimated in the factorization matrices for an identified *VAR* model. For each country in this study, variance decomposition is used to measure the proportion of fluctuations in output and domestic price level caused by oil price, aggregate demand and aggregate supply shocks respectively.

[TABLE 3]

The forecast-error variance decompositions for Indonesia are reported in Table 3(a). These results show that real oil price shocks cause 3.5% of short-run and 4.9% of long-run variations in output. Aggregate supply shocks contribute 88% of the changes in output in Indonesia in the short run, while it is a bit lower about 85% in the long run. Aggregate demand shocks explain about 10% of fluctuations in output level. Oil price shocks explain 4.5% of the variations of inflation in the long run in Indonesia, while aggregate supply shocks explain 73% of the forecast-error variance. In the short run, aggregate demand shocks contribute 44% of the variations in price level, though it gradually diminishes over time and eventually become stable around 23%. It is obvious that aggregate demand shocks only explain 22.7% of long-run variations of price level in the 30^{th} quarter. Unlike the findings of Cover *et al.* (2006), who find that the major source of long-run inflation is aggregate demand shock, the current results indicate that aggregate supply shocks contribute the most to inflation in Indonesia.

In Malaysia, oil price shocks account for 19% to 22% of the forecast-error variance in output as indicated in Table 3(b), which also becomes stable in a longer term. The contribution of aggregate supply shocks to output varies within the range of 68%-76%. Regarding long-run inflation in Malaysia, about 18% of this is explained by oil price shocks. Aggregate demand shocks are the single most significant source of inflation, accounting for 74%. Aggregate supply shocks only explain 8% of the fluctuations in the long run.

In Pakistan, oil price shocks have a relatively small effect on output as exhibited in Table 3(c), which contribute only 1.3% of long-run variations in output. With regard to the variance of output in Pakistan, the aggregate supply shocks are the important causal factors contributing 95% of the variance over the time period under investigation. Aggregate demand shocks explain only 4% of output fluctuation and oil price shocks contribute 3% to the variations in price level in the long run. In the short run, aggregate demand shocks explain 91% of the variations in price level though it gradually decline as time passes. Aggregate supply shocks are less important in explaining inflation in Pakistan, contributing 3% in the short run and 6% in the long run.

The forecast-error variance decomposition for output and price level in Thailand is reported in Table 3(d). In terms of variance decomposition of output, aggregate supply shocks contribute the biggest proportion in Thailand. The short run effect is 80% which gradually decreases with the forecast horizon to 68%. In the long run, oil price and aggregate demand shocks account for 15% and 17% of the variation of output respectively. Aggregate demand shocks contribute the most to inflation in Thailand, around 73% in the long run. Oil price shocks explain 12% of the variation in price level, while supply shocks account for 15%.

To summarise, our results show that aggregate supply shocks are the most important factor behind output fluctuation in both the short-run and long-run in 4 countries. Aggregate demand shock is the main source of variation in domestic price level in Malaysia, Pakistan and Thailand. While in Indonesia, aggregate supply shocks are more crucial than demand shocks for explaining fluctuation in price level. In all countries, aggregate supply and demand shocks are main sources of macroeconomic fluctuation, while oil price shocks are less important.

6. CONCLUSION

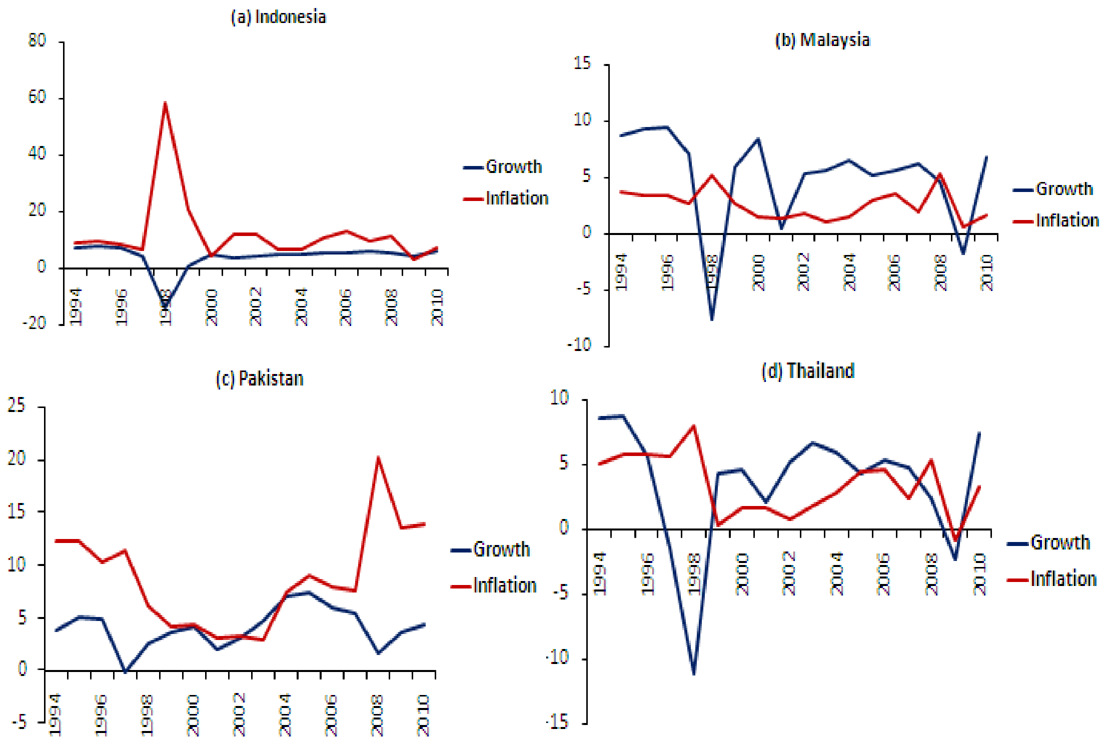
This paper examines the dynamic effect of oil price, aggregate supply and aggregate demand shocks on both output and domestic aggregate price level in Indonesia, Malaysia, Pakistan and Thailand using structural *VAR* model with a mixture of short-run and long-run restrictions. The cumulative impulse responses and variance decomposition functions are computed for each country.

Our results show that the effect of oil price shocks on output is positive but statistically negligible in Malaysia, Pakistan and Thailand, while the effect is negative in Indonesia. Initially, increasing oil prices reduce domestic aggregate price level in all countries, while 2 or 3 quarters later, the responses of the price level become positive in Indonesia and Pakistan, though the magnitude of responses are very small. These findings suggest that oil price shocks are less likely to cause substantial fluctuation in macroeconomic variables in 4 sample economies. It is also evident that oil price shocks have a negligible effect on economic fluctuation. The relatively small or negligible effect could be attributed by government direct control and subsidised oil prices which help to minimize the adverse effect of oil price on real activities to avoid sharp decline in *GDP* and high inflation during the bad period. In addition, the economic structure of a country plays a crucial role, which may affect the influence of oil price shocks on macroeconomic fluctuation. Countries with a low production reliance on oil, a low share of oil in the consumption bundle and relatively low labour intensities in production are suspected to suffer less from oil price shocks.

In alignment with conventional wisdom, aggregate supply shocks are the key reason for fluctuation in output and aggregate demand shocks are the main factor inducing fluctuation in aggregate price level in Malaysia, Pakistan and Thailand. However, aggregate supply shocks are the main reason for fluctuation in both output and aggregate price level in Indonesia. These findings further highlight the importance of correctly identifying the supply and demand shocks as this, could help to provide effective monetary and fiscal policies to cope with crises and minimize loss.

FIGURE 1

The Patterns of Annual Real GDP Growth and Inflation 1994-2010

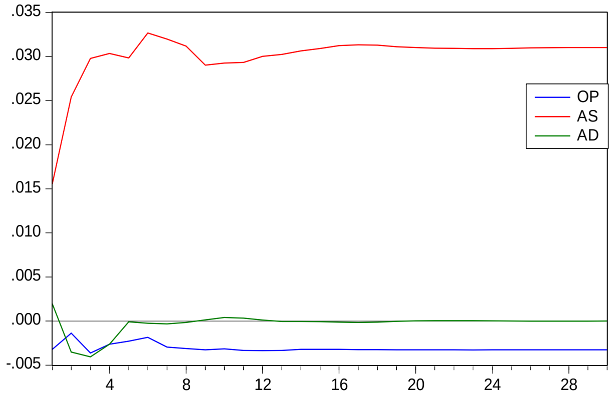


Source: data are downloaded from *IMF*, *IFS* (Edition: June 2011).

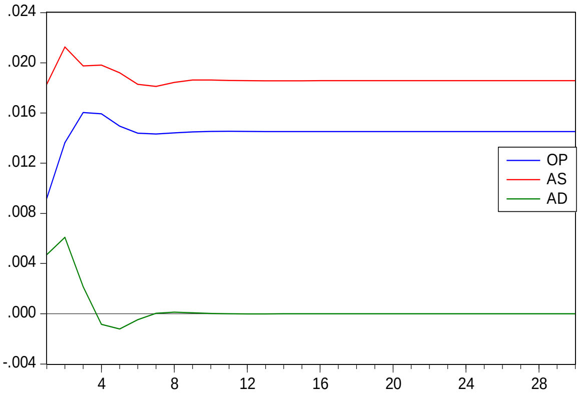
FIGURE 2

The Dynamic Effects of Oil Price, Supply and Demand Shocks on Output

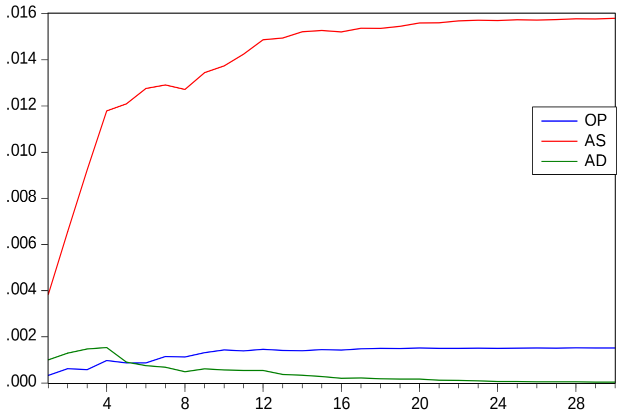
(a) Indonesia



(b) Malaysia



(c) Pakistan



(d) Thailand

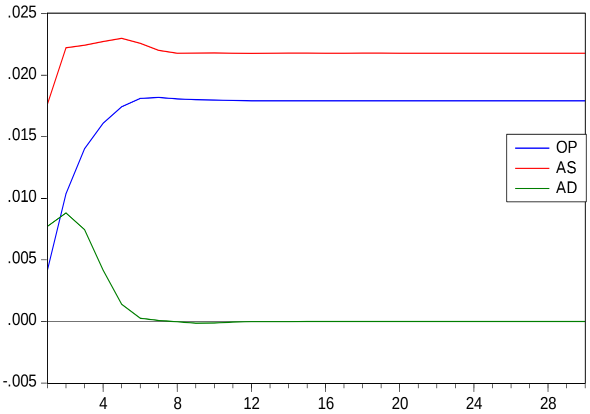
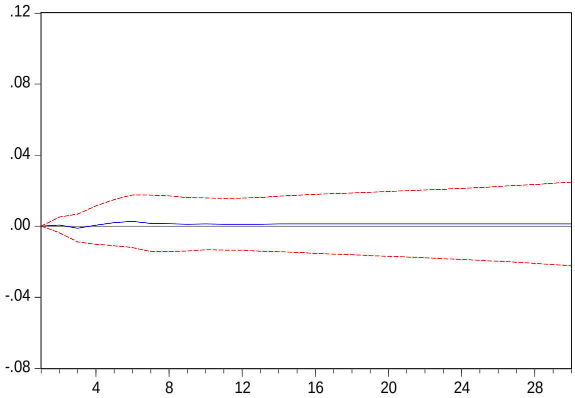


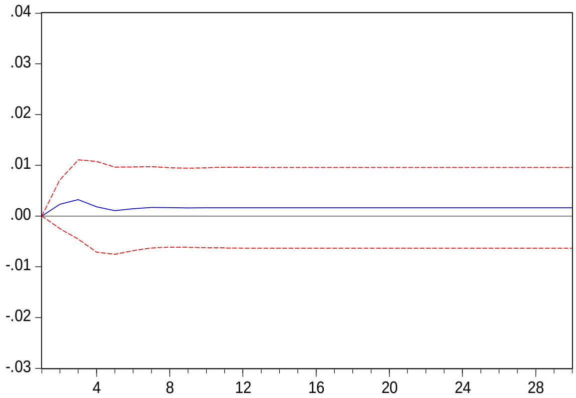
FIGURE 3

Cumulative Impulse Response One S.D. Error Band of Output to Oil Price Shocks

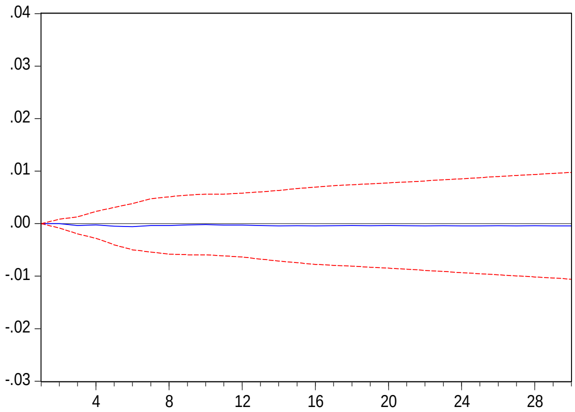
(a) Indonesia



(b) Malaysia



(c) Pakistan



(d) Thailand

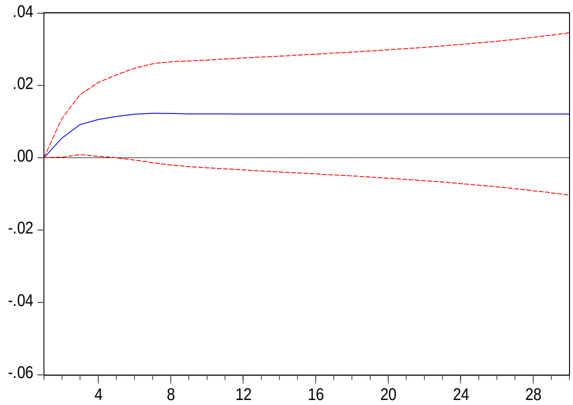
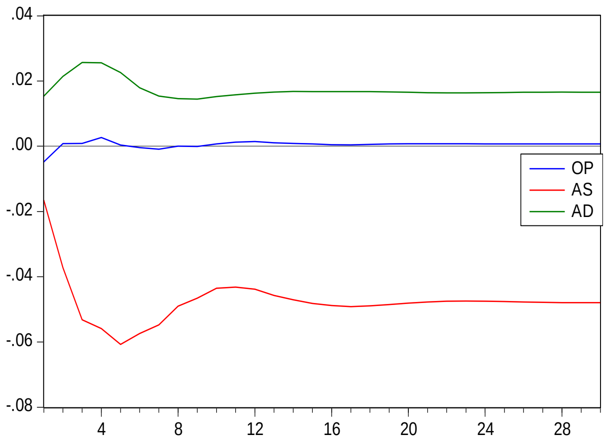


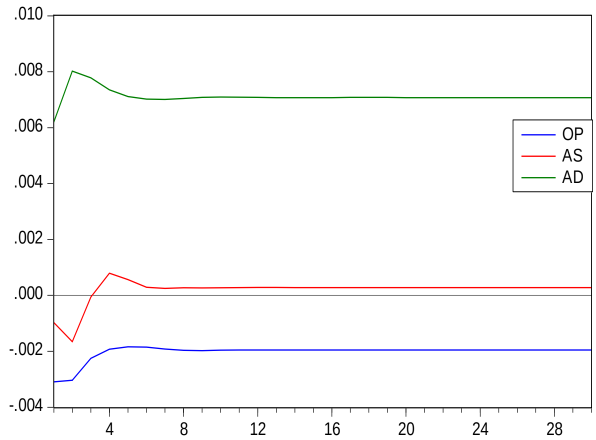
FIGURE 4

The Dynamic Effects of Oil Price, Supply and Demand Shocks on Price Level

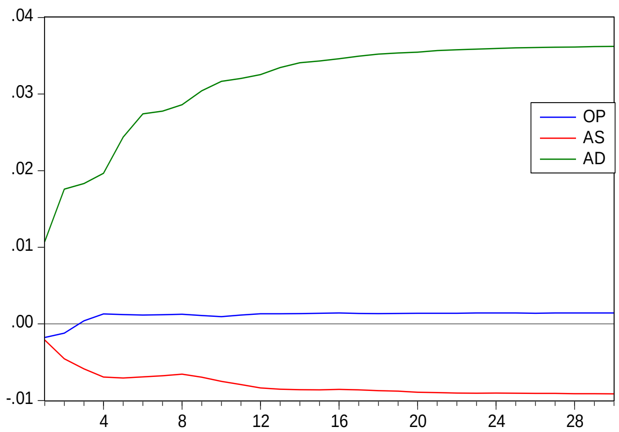
(a) Indonesia



(b) Malaysia



(c) Pakistan



(d) Thailand

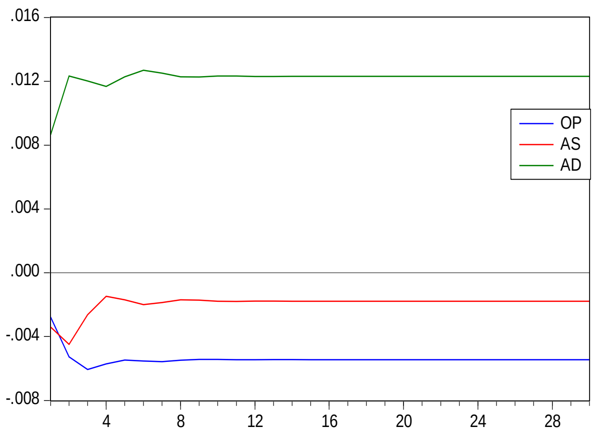
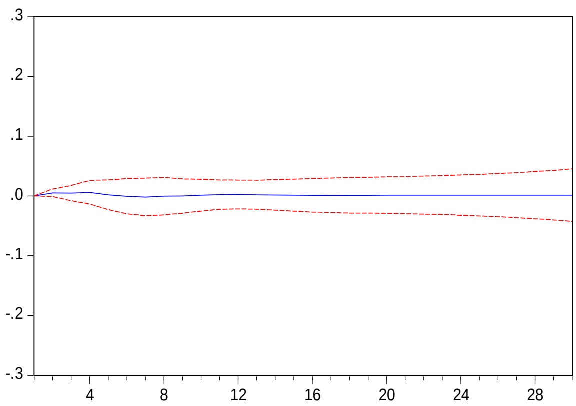


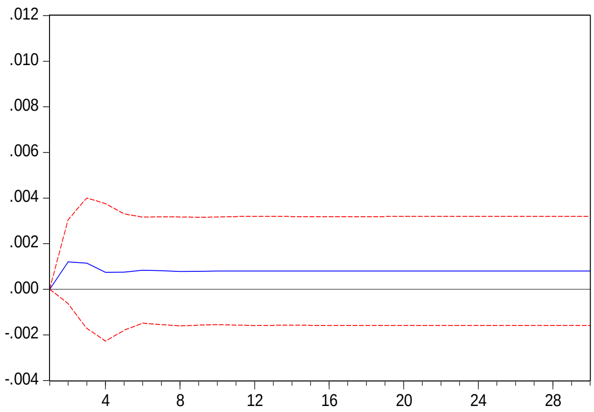
FIGURE 5

Cumulative Impulse Response One S.D. Error Band of Price Level to Oil Price Shocks

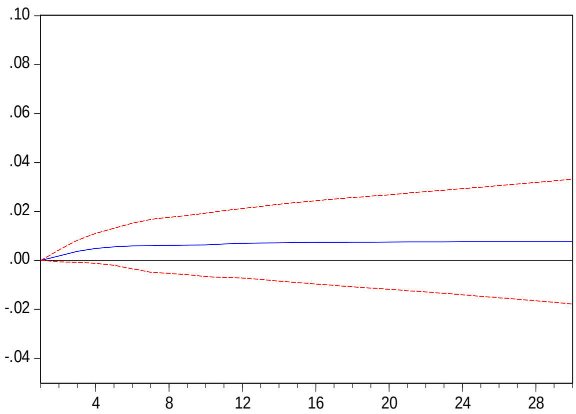
(a) Indonesia



(b) Malaysia



(c) Pakistan



(d) Thailand

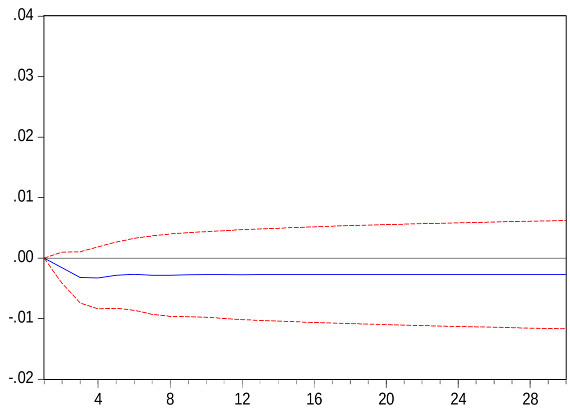


TABLE 1

Unit Root Test

	Augmented Dickey-Fuller (ADF) Test				*Phillips-Perron (PP) Test*			
Variables	*Indonesia*	*Malaysia*	*Pakistan*	*Thailand*	*Indonesia*	*Malaysia*	*Pakistan*	*Thailand*
Real world oil price (op_t^w)	-1.478	-1.478	-1.478	-1.478	-1.135	-1.135	-1.135	-1.135
1st order difference of real world oil price (Δop_t^w)	-9.286+++	-9.286+++	-9.286+++	-9.286+++	-7.679+++	-7.679+++	-7.679+++	-7.679+++
Real *GDP* (y_t)	-1.926	-3.106	-2.343	-2.220	-1.523	-2.402	-2.165	-1.934
1st order difference of real *GDP* (Δy_t)	-7.142+++	-7.293+++	-5.320+++	-5.802+++	-7.131+++	-7.194+++	-4.852+++	-5.749+++
Domestic aggregate price level (p_t)	-0.854	-2.121	1.253	-1.940	-0.824	-2.250	1.230	-2.036
Inflation (Δp_t)	-4.399+++	-7.164+++	-3.586+++	-5.899+++	-4.511+++	-7.038+++	-6.446+++	-5.419+++

Note: +++, ++ and + indicate the level of significance at the 1%, 5% and 10% respectively. Constant and time trend are used for the variables at level, while only constant is included for variables at the first order difference.

TABLE 2

Cointegration Test Results with Trace and Maximum Eigenvalues Statistics

(a) Indonesia

Hypothesised No. of CE(s)	*Trace Test*			*Maximum Eigenvalues*		
	Statistics	*Critical Values 5%*	*Critical Values 1%*	*Statistics*	*Critical Values 5%*	*Critical Values 1%*
None	20.359	29.797	35.458	13.362	21.132	25.861
At most 1	6.997	15.495	19.937	6.382	14.265	18.520
At most 2	0.615	3.841	6.635	0.615	3.841	6.635

(b) Malaysia

Hypothesised No. of CE(s)	*Trace Test*			*Maximum Eigenvalues*		
	Statistics	*Critical Values 5%*	*Critical Values 1%*	*Statistics*	*Critical Values 5%*	*Critical Values 1%*
None	35.035	29.797	35.458	25.086	21.132	25.861
At most 1	10.749	15.495	19.937	8.097	14.265	18.520
At most 2	2.652	3.841	6.635	2.652	3.841	6.635

(c) Pakistan

Hypothesised No. of CE(s)	*Trace Test*			*Maximum Eigenvalues*		
	Statistics	*Critical Values 5%*	*Critical Values 1%*	*Statistics*	*Critical Values 5%*	*Critical Values 1%*
None	28.418	29.797	35.458	17.811	21.132	25.861
At most 1	10.607	15.495	19.937	10.567	14.265	18.520
At most 2	0.040	3.841	6.635	0.040	3.841	6.635

(d) Thailand

Hypothesised No. of CE(s)	*Trace Test*			*Maximum Eigenvalues*		
	Statistics	*Critical Values 5%*	*Critical Values 1%*	*Statistics*	*Critical Values 5%*	*Critical Values 1%*
None	27.939	29.797	35.458	14.491	21.132	25.861
At most 1	13.449	15.495	19.937	13.174	14.265	18.520
At most 2	0.274	3.841	6.635	0.274	3.841	6.635

TABLE 3

Forecast-Error Variance Decompositions of Output and Price Level

(a) Indonesia

Horizon (quarters)	*Output*			*Price Level*		
	OP shock	*AS shock*	*AD shock*	*OP shock*	*AS shock*	*AD shock*
1	3.995	94.545	1.459	4.239	51.434	44.327
2	3.510	87.855	8.636	5.230	68.111	26.659
4	4.739	86.629	8.632	4.339	73.427	22.234
6	4.648	85.514	9.839	4.531	72.158	23.310
8	4.917	85.292	9.791	4.457	72.535	23.007
10	4.869	85.414	9.717	4.447	72.767	22.786
14	4.873	85.410	9.717	4.463	72.813	22.723
18	4.871	85.415	9.714	4.465	72.841	22.694
24	4.870	85.414	9.715	4.464	72.848	22.688
30	4.870	85.414	9.715	4.464	72.848	22.687

(b) Malaysia

Horizon (quarters)	*Output*			*Price Level*		
	OP shock	*AS shock*	*AD shock*	*OP shock*	*AS shock*	*AD shock*
1	19.173	75.777	5.050	19.501	1.933	78.565
2	22.119	72.765	5.116	18.117	2.686	79.196
4	21.828	68.554	9.618	18.038	8.252	73.710
6	21.948	68.363	9.689	17.989	8.448	73.563
8	21.932	68.333	9.735	17.997	8.450	73.553
10	21.931	68.334	9.735	17.997	8.450	73.554
14	21.931	68.334	9.735	17.997	8.450	73.554
18	21.931	68.334	9.735	17.997	8.450	73.554
24	21.931	68.334	9.735	17.997	8.450	73.554
30	21.931	68.334	9.735	17.997	8.450	73.554

(c) Pakistan

Horizon (quarters)	*Output*			*Price Level*		
	OP shock	*AS shock*	*AD shock*	*OP shock*	*AS shock*	*AD shock*
1	0.669	92.961	6.370	2.568	3.614	93.817
2	0.825	94.520	4.655	1.979	5.963	92.058
4	0.929	96.052	3.019	3.714	7.221	89.066
6	0.929	95.039	4.031	3.177	6.184	90.639
8	1.124	94.755	4.122	3.166	6.192	90.642
10	1.227	94.680	4.093	3.113	6.259	90.627
14	1.230	94.680	4.090	3.118	6.374	90.508
18	1.245	94.642	4.113	3.115	6.373	90.512
24	1.247	94.635	4.118	3.114	6.382	90.504
30	1.248	94.633	4.119	3.114	6.383	90.503

(d) Thailand

Horizon (quarters)	*Output*			*Price Level*		
	OP shock	*AS shock*	*AD shock*	*OP shock*	*AS shock*	*AD shock*
1	4.537	80.180	15.282	8.216	12.245	79.539
2	12.388	74.101	13.510	12.084	11.040	76.875
4	15.270	69.439	15.292	12.138	14.448	73.414
6	15.371	67.865	16.764	12.117	14.472	73.412
8	15.362	67.880	16.758	12.120	14.492	73.399
10	15.362	67.878	16.760	12.112	14.495	73.394
14	15.362	67.877	16.761	12.112	14.495	73.393
18	15.362	67.877	16.761	12.112	14.495	73.393
24	15.362	67.877	16.761	12.112	14.495	73.393
30	15.362	67.877	16.761	12.112	14.495	73.393

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