The Macroeconomic Effects of Oil Price Shocks on ASEAN-5 Economies

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Abstract

ASEAN-5's continued economic growth with high oil and trade intensities means it is a fast growing region with a significant presence in the global energy market. This paper identifies three main drivers of oil price shocks - oil-supply, global-activity and oil-specific demand shocks for the period 2000-2013. Subsequently, it assesses the effects of the identified oil shocks on the ASEAN-5's macroeconomic variables and examines the responses of monetary policy. Since the recent shocks are largely demand driven, the impulse responses and historical decomposition for the ASEAN-5 highlight that the effects on inflation are accentuated while the effects on economic growth are less disruptive. The exchange rate responses are mostly positive while the effects on trade are positive for Malaysia, a net oil exporter and are moderately negative for the oil importers. Consequently the ASEAN-5's central banks could tighten their monetary policy in response to higher inflation without fear of weakening their economies. The empirical results highlight that for monetary policy responses to be more supportive of growth, policy makers in these economies should examine the underlying causes of the future oil shocks.

Keywords: Macroeconomics, Oil prices, Emerging Asia, Monetary Policy

JEL: classification numbers: C32, E51, F32, F43, F41, E52

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1. Introduction

Economist generally concur that oil price shocks can push the cost of production up, leading to higher inflation and causing contractionary effects on economic growth and trade balances. Though the oil shocks that occurred between 2003 to 2008 appear to have inflationary effects on the ASEAN-5, namely Indonesia, Malaysia, the Philippines, Singapore and Thailand, but they only caused modest disruptive effects on economic growth. These minimal impacts occurred despite these economies being more trade and oil intensive in their production compared to other countries in the region. The focus of this paper is therefore to examine empirically the effects of oil price shock on ASEAN-5 and to asses why this time it only had minimal effects on these economies.

Hamilton (2013) and Kilian & Hicks (2013) note that oil demand from emerging Asia is an important factor influencing the recent global oil price shocks. Since 2000, the ASEAN-5 oil demand has increased by 45.2 % while in 2012, East Asian account for about 30% of the global energy demand.[2] The oil usage as a proportion of GDP in the ASEAN-5 is about two to three times that of typical OECD countries, theoretically, making these economies more vulnerable to oil shocks (Downes, 2007). Additionally, oil consumption continues to grow while oil production slows making this region one of the largest net importers of oil.

Despite ASEAN-5's increasing importance in the global oil market, the number of empirical studies focussing on the effects of oil price shocks on macroeconomic variables and their relative importance to policy makers in this region are however limited. Some existing studies on the Asian economies such as Abeysinghe (2001), Cunado & Perez de Gracia (2005), Ran & Voon (2012), Cunado et al. (2015) focus on the effects of oil shocks on output and price levels while Le & Chang (2013) assesses the effects on trade balances. To our knowl-

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[2]Source: US Energy Information Administration respectively. The ASEAN-5 is part of the East Asian region.

edge no studies in Asia focussed on the effects of oil shocks on monetary policy and exchange rates, two important variables for small open economies. This paper differs from the existing studies in the following ways. First, drawing on insights from Kilian & Murphy (2014), Kilian (2009) and Hamilton (2009), this paper identifies three main drivers of oil price shocks - an oil-supply disruption shock, a global-activity shock and an oil-specific demand shock for the period between 2000 to 2013. Subsequently, it assesses the effects of each of these oil shocks on the ASEAN-5's macroeconomic variables and examines the corresponding responses of monetary policy.

This paper contributes to and extends the existing literature as follows: (i) it builds a small open economy structural vector autoregressive (SVAR) framework that uses macroeconomic theory and stylized facts to impose appropriate identifying restrictions on the contemporaneous and dynamic relationships among the domestic macroeconomic variables and the oil market variables; (ii) it conducta a country-by-country analysis and examines the differential effects of demand versus supply driven oil shocks on trade, output, inflation, interest rate and exchange rate; and (iii) it uses historical decomposition and variance decomposition techniques, to assess the impact of the recent oil price shocks on these five economies with respect to their level of trade intensity, oil dependency and oil usage. In doing so, it helps us to analyse why the effects of the 2004 and 2006 oil price shocks were relatively modest on trade and economic activities.

Due to its trade intensity and high integration with the global production chain, the ASEAN-5 experience different level of vulnerabilities to various oil price shocks. An oil shock driven by a supply disruption causes a transitory stagflationary pressure for about a year where output in these economies declines while inflation increases irrespective of their level of oil dependency and oil intensity to production. Monetary policy tend to be more accommodative, which helps the ASEAN-5 to recover within a year following an oil-supply disruption shock. The recent oil price shocks however are largely demand driven, either caused by the rise in global activity or due to the rise in oil-specific demand shock driven by expectations about future changes in oil or financial conditions.

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The impulse responses and historical decomposition highlight that the effects on inflation accentuates while the effects on economic growth is positive in the case of the former and negative in the case of the latter. Further, the effects on exchange rates are largely positive, driven by rising domestic price levels, making these economies less competitive in the global market. The effects on trade appear to be positive for Malaysia, the only net oil exporter in the group. For the rest of the economies, who are net oil importers, the effect on trade is moderately negative or insignificant. Consequently, the ASEAN-5's central banks could tightened their monetary policy in response to higher inflation, especially in the high oil importing economies of the Philippines, Singapore and Thailand without fear of weakening these economies.

As small open economies there is little the ASEAN-5 can do to influence future global oil price shocks. However, the monetary policy makers in these economies can pursue more prudent measures when dealing with oil price shocks by carefully considering the underlying causes of the shocks. This is crucial for the operational conduct of monetary policy so that the policy responses are more supportive of growth.

The paper proceeds as follows. Section 2 analyses the causes of recent oil price shocks and empirical evidence assessing the impact of various oil price shocks on macroeconomic variables. Section 3 reviews the oil price and the ASEAN-5 economies. Section 4 describes the SVAR methodology and the identification issues concerning the modelling framework of small open economies. Section 5, discusses the empirical results and Section 6 concludes.

2. The Evolution of Global Oil Price and its Relationship to Macroeconomic Variables

The movement of global oil prices since 2000 could be attributed to the interaction of various factors. Among them, the obvious two factors are global oil production and global activity. Figure 1, highlights the relative importance and timing of the fluctuations in these two variables and their different dynamic

effects on the real price of oil.[3]

Figure 1: Oil Production, Global Activity and Oil Price
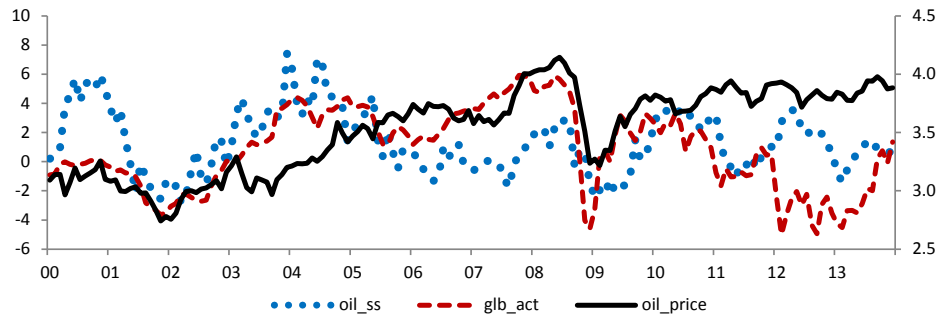
The most noticeable observation in Figure 1 is the rise in the real price of oil since early 2002, which is almost synonymous to the surge in global economic activity that started around 2001. Oil price increases are connected with strong global economic growth until 2008 mostly driven by surge in the demand for oil from emerging economies, particularly China and India (Hamilton, 2009; Kilian & Hicks, 2013). It starts to decline in 2009 following the global financial crisis, in line with the weakening global activity. During these periods, there is no clear evidence to suggest that the increase in oil price was driven by any disruption in oil supply. In fact between the periods 2002 to 2005, the global oil production actually increased. The observation that the oil price movement is driven by business cycle fluctuations, is consistent with that reported in Hamilton (2009), Kilian (2009) and Kilian & Murphy (2014) .

From 2010 onwards, however, the oil price kept rising despite the weakening of global economic activities and with no disruption in global oil production. This raises the question of what is actually driving the oil price after 2010. Kilian (2009) classifies any movements in oil price that are not accounted for by global oil production and economic activity as precautionary demand for oil, driven by

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[3]Source: US Energy Information Administration.

fear of future oil supply shortfalls. Kilian & Murphy (2014) identifies a third factor, speculative demand that could cause a hike in oil prices. This type of demand is typically associated with inventory building with the expectation of selling later at a profit. Ratti & Vespignani (2013) on the other hand highlights that the rise in oil price between 2009-2010 was caused by global liquidity, particulary due to the rise in China's real M2. Hesary & Yoshino (2014) argues that expansionary monetary policy stimulates oil demand through interest rate channels and this combined with a rigid global oil production, creates a surge in oil price. These highlight the distinctive need to decompose oil price into supply disruption, demand driven and oil-specific demand shocks. In this instance, the oil-specific demand can be broadly defined as any movement in the oil price that are not accounted for by the oil supply and oil demand for global economic activity.[4]

Since the seminal paper by Hamilton (1983),the general consensus is that oil price shocks can push cost of production up leading to higher inflation and declining output level. Rising price levels in the economy can erode purchasing power and depress demand, causing further contractionary impact on economic growth, trade balances and real effective exchange rates.[5] Some reason studies however, find that the transmission of oil price shocks appear to be weaker and it no longer affect the economies negatively. For example, Kilian (2007); Hamilton (2009) and Blanchard & Gali (2010), find that after the 1980s, the oil price shock only had a subdued effects on various US macroeconomic variables while Gomez-Loscos et al. (2011, 2012) observe that oil price shocks progressively disappeared since the 1970s in G-7 countries, only to reappear in 2000s especially on inflation.

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[4]Oil-specific demand, therefore could include precautionary demand, speculative demand, global liquidity and monetary policy effects through interest rate channels.

[5]See for example Lee et al. (1995); Hamilton (1996); Jimenez-Rodriguez & Sanchez (2004); Gronwald (2008); Huang (2008) focusing on the recessionary effects of oil price shocks while Bernanke et al. (1997); Barsky & Kilian (2004); Brown et al. (2004); Hamilton & Herrera (2004); Oladosu (2009) focusing on the channels through which oil price shocks affects the economy.

The nature of the apparent changes in the macroeconomic effects of oil price shocks, call into question the relevance of oil price changes as a significant source of economic fluctuations.

Using a vector autoregressive (VAR) framework, Kilian (2009), highlights that the economic consequence of a demand driven oil shock is different from a supply driven shock. He concludes that the effects of oil price surge on the US output for the period between 2003 and 2008 is generally moderate due to the key role played by the demand side factors as opposed to supply side factors.[6] In addition, Kilian (2009); Smith (2009) and Unalmis et al. (2009) find shocks from oil demand to have pronounced effect on inflation but not on output. Cashin et al. (2014) notices oil shocks driven by supply disruption typically cause a fall in economic activity for oil importers while the impact is positive for oil exporters that possess large amount of oil and gas reserves. Bernanke et al. (1997); Leduc & Sill (2004); Blanchard & Gali (2010); Kormilitsina (2011) and Hesary & Yoshino (2014) establish that the way monetary policy is conducted may be responsible for the differential response of the economy to oil shocks.

The various sources of oil price shocks on small open economies such as the ASEAN-5 are bound to affect the macroeconomic variables differently. The transmission of the various oil shocks on macroeconomic variables can be illustrated as in Figure 2. If the oil price shock is caused by increased global demand, the impact will be felt more directly on the ASEAN-5's real and financial variables. If the shock is caused by supply side disruption, it is more likely to lead to slower world growth and a disruption in the world financial markets. The impact on the ASEAN-5 will be felt indirectly through the oil-specific demand shock, driven by expectations about the future changes in oil and or financial conditions. These assessments are important, particularly for monetary policy makers to devise appropriate policy measures that can be supportive of growth.

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[6]Hamilton (2009); Kilian & Hicks (2013) and Kilian & Murphy (2014) also support this argument that the price surge between 2003 and 2008 is caused by strong global demand and stagnating world oil production.

Figure 2: ASEAN5 - Oil Shock Transmission Mechanism
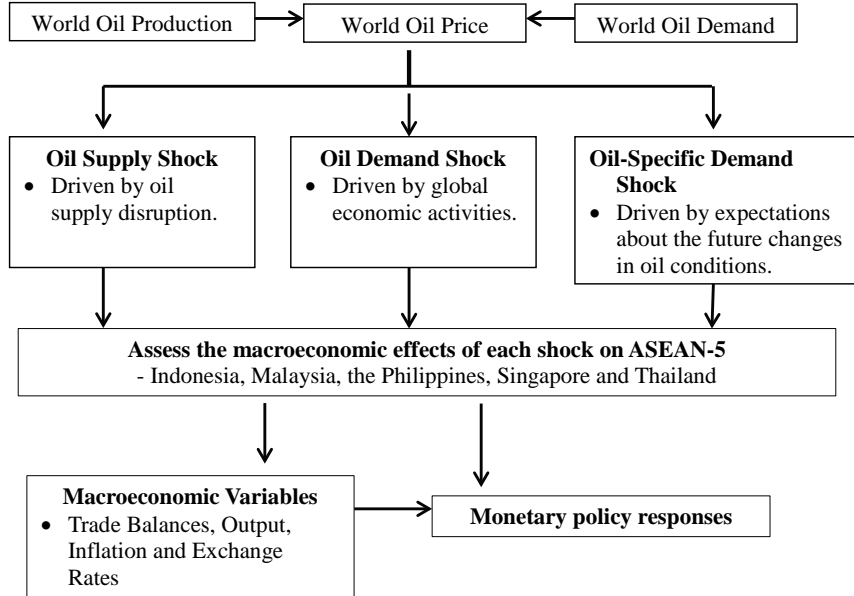

3. Oil Price Shocks and the ASEAN-5

Southeast Asia's continued strong economic growth and high energy and oil usage means it is a fast growing region with a significant presence in the global energy market. Expanding economies coupled with demographic growth are expected to increase energy demand in these region by about by 4.4% per annum. Out of this, the industrial sector consumption is expected to grow at an annual rate of 5.2%, rendering that a stable oil supply is crucial for economic growth (ESSPA, 2011). Oil production in these region peaked in 2010 while oil consumption continued to grow causing the difference between consumption and production to rise from 31.5% in 2000 to about 59.8% in 2012, making this region one of the largest net importer of oil.[7].

How oil price shocks are transmitted into the individual ASEAN-5 economies depends on the structure of these economies, particularly their level of trade in-

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[7]Source: US Energy Information Administration respectively

tensity, oil dependency and oil ussage in production. These features will also have a large bearing on the way these economies respond to various oil price shocks. As shown in Figure 3, the ASEAN-5 are trade intensive economies, where the trade intensity is measured as sum of imports and exports as a percentage of GDP for each economy.[8] Singapore, Malaysia and Thailand meet the criterion for being super trading nations with trade shares over 100% of GDP. This reflects the high integration of this region into global production chains and it can be heavily influenced by developments in global activities (see, for example, Abeysinghe, 2001; Le & Chang, 2013).

Figure 3: ASEAN-5 - Trade Intensity and Oil Self-sufficiency
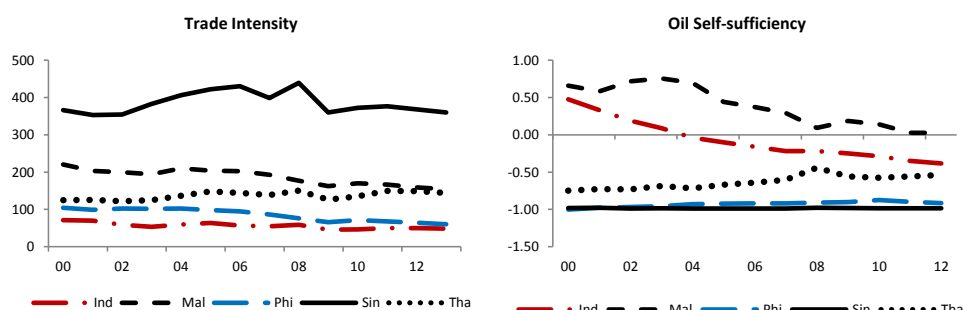
The right panel of Figure 3 shows the level of oil self-sufficiency, measured as oil production less consumption over oil consumption.[9] The ASEAN-5 differ widely in terms of their oil dependency, from net oil exporter such as Malaysia, to economies that are totally dependent on imports, such as Singapore and the Philippines. Prior to 2004, Indonesia was a net oil exporter, after which it is a net oil importer. This means that the impacts of higher oil prices on terms of

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[8]Source: Trade variables are obtained from Datastream.

[9]A negative value, highlights the country is dependent on imported oil while a positive value indicates it is a net exporter of oil. Data source: US Energy Information Administration.

trade, output and exchange rate adjustments will be felt asymmetrically across the region, thus requiring different monetary policy responses (see, for example, Cunado & Perez de Gracia, 2005; Cashin et al., 2014; Cunado et al., 2015) .

As can be seen in Figure 4, oil consumption is rising in the ASEAN-5, highlighting the importance of oil in these economies.[10] Oil intensity on the other hand is marginally declining, due largely to a rapid rise in GDP compared to the rise in oil consumption. As oil intensity declines, oil price shocks are expected to have a declining effects on these economies (Chang & Wong, 2003; Blanchard & Gali, 2010). Generally, the ASEAN-5 are relatively more oil intensive in their production compared to OECD economies, which means that domestic consumer prices will be far more sensitive to changes in oil prices than the OECD. The primary impacts on domestic prices, particularly for the oil dependent economies of Indonesia, the Philippines, Singapore and Thailand will be felt more deeply.

Figure 4: ASEAN-5 - Oil Consumption and Oil Intensity
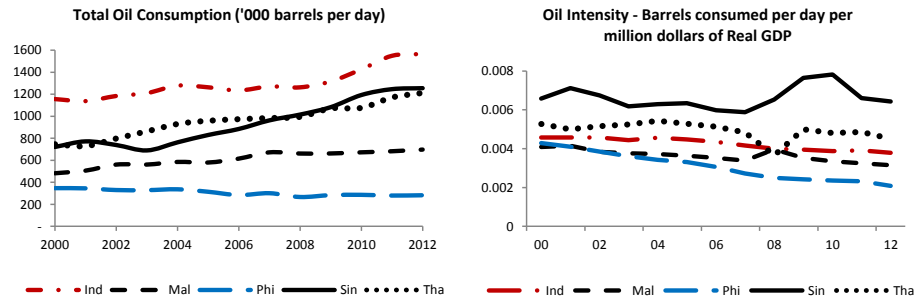
ASEAN-5 differs in terms of the regulation and taxation imposed on gasoline and diesel prices. In the past, Malaysia and Indonesia regulated and subsidised

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[10]Source: Oil consumption data is obtained from the US Energy Information Administration while real GDP series is obtained from Datastream.

retail prices for oil products. These two economies could afford to do so due to their oil exporting status and the involvement of government in oil production. The other three oil dependent economies allowed the market to determine the price of oil. The existence of price regulation could affect the normal transmission of higher global oil prices to domestic economies due to their dependence on political and administrative decisions (Downes, 2007). The above discussions present some key indicators, particularly with respect to ASEAN-5's exposure to developments in world economic activity and with respect to its exposure to the direct effects of oil price increases.

4. Modeling Framework

The interactions between oil and macroeconomic variables can be described using an SVAR model

$$\mathbf{A}_0\mathbf{X}_t = \mathbf{A}_1\mathbf{X}_{t-1} + \mathbf{A}_2\mathbf{X}_{t-2} + \ldots + \mathbf{A}_p\mathbf{X}_{t-p} + \boldsymbol{\varepsilon}_t, \tag{1}$$

where $\mathbf{X}_t$ is a $(n \times 1)$ vector of variables and $\mathbf{A}_i$ is a $(n \times n)$ coefficient matrix for $i = 0, 1, \ldots p$. $\boldsymbol{\varepsilon}_t$ is $(n \times 1)$ vector of serially uncorrelated structural shocks with properties, $E(\boldsymbol{\varepsilon}_t) = 0$ and $E(\boldsymbol{\varepsilon}_t\boldsymbol{\varepsilon}_t') = \boldsymbol{\Sigma}$, where $\boldsymbol{\Sigma}$ is a diagonal matrix containing the variances of the structural disturbances. The SVAR in (1) can be written as

$$\mathbf{A}(L)\mathbf{X}_t = \boldsymbol{\varepsilon}_t, \tag{2}$$

where $\mathbf{A}(L)$ is a matrix polynomial in lag operator L and $\mathbf{A}(L) = \mathbf{A}_0 - \mathbf{A}_1L - \mathbf{A}_2L^2 - \ldots - \mathbf{A}_pL^p$. The reduced form VAR representation of (2) is

$$\mathbf{B}(L)\mathbf{X}_t = \mathbf{e}_t, \tag{3}$$

where $\mathbf{B}(L) = \mathbf{A}_0^{-1}\mathbf{A}(L)$ and the reduced form errors are related to the structural disturbances by $\mathbf{e}_t = \mathbf{A}_0^{-1}\boldsymbol{\varepsilon}_t$ and (3) can now be represented as

$$\mathbf{B}(L)\mathbf{X}_t = \mathbf{A}_0^{-1}\boldsymbol{\varepsilon}_t. \tag{4}$$

The impulse response functions of the SVAR model can be derived from the Vector Moving Average (VMA) representation,

$$\mathbf{X}_t = \mathbf{\Phi}(L)\boldsymbol{\varepsilon}_t. \tag{5}$$

where $\mathbf{\Phi}(L) = (\mathbf{B}(L))^{-1}\mathbf{A}_0^{-1}$. Since the structural shocks $\boldsymbol{\varepsilon}_t$ are obtained by imposing appropriate restrictions based on economic theory and stylized facts on the contemporaneous matrix $\mathbf{A}_0$ and on the lag matrixes $\mathbf{B}(L)$, the effects of these shocks on domestic variables can be captured more effectively through the impulse response function given in (5).

4.1. Data and Time Series Properties

To construct SVAR models with small open economy properties, $\mathbf{X}_t$ for each of the ASEAN-5 economies contains monthly observations of eight variables. These variables are grouped into two blocks, the oil block ($\mathbf{X}_{1,t}$) and the domestic block ($\mathbf{X}_{2,t}$). In the oil block, there are three variables that broadly captures conditions in the global oil market. These three variables are similar to those identified by Kilian (2009), where changes in global crude oil production (os_t), obtained from the US Energy Information Administration, represents the global oil supply. The global real activity (ga_t) is the dry cargo shipping rate index developed by Kilian (2009) to capture the fluctuations of the global demand for industrial commodities.[11] and the global real oil price (op_t), is the crude oil prices obtained from the West Texas Intermediate (WTI) and deflated by the US producer price index to proxy the real price of oil in the global market. ASEAN-5 are small open economies, so $\mathbf{X}_{1,t} = [os_t, ga_t, op_t]$ are exogenous to these economies where fluctuations in the oil block will affect the ASEAN-5 but not vice-versa.

To capture each of the ASEAN-5's domestic economic conditions, the following five variables are included in the domestic block - trade balance (tb_t) ,

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[11] For a detailed explanation on the construction and the interpretation of this index, please refer to Kilian (2009)

output (y_t), inflation (π_t), interest rate (r_t) and exchange rate (q_t). ASEAN-5 are trade intensive and highly integrated into global production chains and any changes in the oil block are expected to have large effects on the import and export sectors of these economies. The real trade balance measured in US dollar is included to capture the indirect effects of oil price shocks on the domestic economic growth. The log of industrial production index is chosen as the output variable to capture the economic activity while the log difference of consumer price index is used to represent the inflation rate. Both output and inflation also represent as the target variables of monetary policy while the short term interbank rates are used as the interest rate variable to capture the movement in the monetary policy instrument.[12] The log of real effective exchange rate is represented as the information market variable to capture the open nature of the ASEAN-5 and the importance of international trade to these economies. The output, inflation, interest rates and exchange rates are also the standard set of variables used in the monetary literature to represent open economy monetary business cycle models (see for example Sims, 1992). This second block of variables $\mathbf{X}_{2,t} = [tb_t, y_t, \pi_t, r_t, q_t]$ are specific to each of the ASEAN-5.

The model is estimated using monthly data from January 2000 to December 2013. The period of study covers the post-1997 East Asian financial crisis, which includes the 2008 global financial crisis (GFC) but excludes the 2014 oil crisis. Detailed data descriptions and sources are provided in Table (3), in Appendix A. Augmented Dickey-Fuller and Phillips-Perron tests indicate that each of the trade balance, production index, interest rate and real exchange rate are I(1) series while domestic inflation show evidence of being stationary in all economies. The three variables in the oil block by construction are stationary series. Trace

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[12]Unlike Indonesia, Malaysia, Thailand and the Philippines, Singapore's monetary policy is centred on the foreign exchange rate rather than the interest rate. Since the exchange rate is found to be an ideal intermediate target with stable and predictable relationship with price stability and economic conditions, it will be treated as a monetary policy instrument for Singapore.

tests and Maximum Eigenvalue test failed to clearly indicate whether cointegration relationship exist amongst the I(1) variables. Since the objective of this study is to assess the interrelationships among the variables and to correctly identify the effects of various oil price shocks, the non-stationary variables are all linearly de-trended instead of first differencing.[13]

4.2. Model Specification

To capture the oil block exogeneity phenomenon described in (4.1), $\mathbf{X}_t$ is divided as follows:

$$\mathbf{X}_t = \left(\begin{array}{cc} \mathbf{X}_{1,t} & \mathbf{X}_{2,t} \end{array} \right).$$

where $\mathbf{X}_{1,t} = [os_t, ga_t, op_t]$ and $\mathbf{X}_{2,t} = [tb_t, y_t, \pi_t, r_t, q_t]$ representing the oil and domestic block respectively and equation (4) can now be represented as

$$\left(\begin{array}{cc} \mathbf{B}_{11}(L) & 0 \\ \mathbf{B}_{21}(L) & \mathbf{B}_{22}(L) \end{array} \right) \left(\begin{array}{c} \mathbf{X}_{1,t} \\ \mathbf{X}_{2,t} \end{array} \right) = \left(\begin{array}{cc} \mathbf{A}_{11}^{(0)} & 0 \\ \mathbf{A}_{21}^{(0)} & \mathbf{A}_{22}^{(0)} \end{array} \right)^{-1} \left(\begin{array}{c} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{array} \right) \quad (6)$$

In line with the small open economy assumption, oil block exogeneity restrictions are imposed, by assuming that neither contemporaneous nor lagged values of ASEAN-5 variables affect the oil block. To identify the structural shocks (ε_t), further restrictions are also imposed on the contemporaneous and

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[13]In this regard, the use of unrestricted VAR allows the data series to decide whether the effects of the various oil shocks are permanent or temporary.

the lagged matrix of (6) where

$$
\mathbf{A}_0 = \begin{bmatrix}
1 & 0 & 0 & | & 0 & 0 & 0 & 0 & 0 \\
a_{21}^{(0)} & 1 & 0 & | & 0 & 0 & 0 & 0 & 0 \\
a_{31}^{(0)} & a_{32}^{(0)} & 1 & | & 0 & 0 & 0 & 0 & 0 \\
-- & -- & -- & & -- & -- & -- & -- & -- \\
a_{41}^{(0)} & a_{42}^{(0)} & a_{43}^{(0)} & | & 1 & 0 & 0 & 0 & 0 \\
a_{51}^{(0)} & a_{52}^{(0)} & a_{53}^{(0)} & | & a_{54}^{(0)} & 1 & 0 & 0 & 0 \\
0 & 0 & a_{63}^{(0)} & | & a_{64}^{(0)} & a_{65}^{(0)} & 1 & 0 & 0 \\
0 & 0 & a_{73}^{(0)} & | & 0 & a_{75}^{(0)} & a_{76}^{(0)} & 1 & 0 \\
a_{81}^{(0)} & a_{82}^{(0)} & a_{83}^{(0)} & | & a_{84}^{(0)} & a_{85}^{(0)} & a_{86}^{(0)} & a_{87}^{(0)} & 1
\end{bmatrix}
\tag{7}
$$

and

$$
\mathbf{B}_i = \begin{bmatrix}
b_{11}^{(i)} & b_{12}^{(i)} & b_{13}^{(i)} & | & 0 & 0 & 0 & 0 & 0 \\
b_{21}^{(i)} & b_{22}^{(i)} & b_{23}^{(i)} & | & 0 & 0 & 0 & 0 & 0 \\
b_{31}^{(i)} & b_{32}^{(i)} & b_{33}^{(i)} & | & 0 & 0 & 0 & 0 & 0 \\
-- & -- & -- & & -- & -- & -- & -- & -- \\
b_{41}^{(i)} & b_{42}^{(i)} & b_{43}^{(i)} & | & b_{44}^{(i)} & b_{45}^{(i)} & b_{46}^{(i)} & b_{47}^{(i)} & b_{48}^{(i)} \\
b_{51}^{(i)} & b_{52}^{(i)} & b_{53}^{(i)} & | & b_{54}^{(i)} & b_{55}^{(i)} & b_{56}^{(i)} & b_{57}^{(i)} & b_{58}^{(i)} \\
0 & 0 & b_{63}^{(i)} & | & b_{64}^{(i)} & b_{65}^{(i)} & b_{66}^{(i)} & b_{67}^{(i)} & b_{68}^{(i)} \\
0 & 0 & b_{73}^{(i)} & | & 0 & b_{75}^{(i)} & b_{76}^{(i)} & b_{77}^{(i)} & b_{78}^{(i)} \\
b_{81}^{(i)} & b_{82}^{(i)} & b_{83}^{(i)} & | & b_{84}^{(i)} & b_{85}^{(i)} & b_{86}^{(i)} & b_{87}^{(i)} & b_{88}^{(i)}
\end{bmatrix} .
\tag{8}
$$

The restrictions imposed on the oil block in (7)and (8) are similar to those imposed by Kilian (2009). The global oil supply is assumed not to respond to global real economic activity and global real oil price within the same month but do respond with a lag. These restrictions are realistic considering that the oil-producing countries will be slow to respond to any changes in oil price or global demand due to uncertainty associated with the state of the crude oil market and the time and costs needed for adjusting the oil production. The global real economic activity is assumed to be contemporaneously affected by the global oil supply but not immediately by the oil price. This restriction is in line with

the sluggish behavior of global real economic activity after each of the major oil price (see Kilian, 2009). The oil price on the other hand is assumed to respond immediately to changes in oil supply and global real economic activity. Apart from the oil block exogeneity restrictions no other restrictions are imposed on the lag structure.

The identified, three structural shocks in the oil block, $\boldsymbol{\varepsilon}_{1,t} = [\varepsilon_t^{os}, \varepsilon_t^{ga}, \varepsilon_t^{op}]$ are oil-supply shock, global-activity shock and oil-specific shock respectively. As in Kilian (2009), oil-supply shock is defined as unpredictable innovations to global oil production, while global-activity shock is defined as shocks to the global demand for industrial commodities and oil-specific shock is defined as the demand for oil driven by uncertainty about future oil market and or financial conditions. This could include precautionary demand, speculative demand, global liquidity and or the effects of monetary policy.

In the domestic components of the model, a number of restrictions are drawn from the existing literature. Since oil is a crucial input for ASEAN-5, the price of oil is assumed to affect the real sector and inflation immediately (see Kim & Roubini, 2000; Raghavan & Dungey, 2015). In addition, the trade balance, output and real exchange rates are assumed to be affected by changes in oil-supply and global economic activity within a month. Among the domestic variables, the trade balance is assumed to be the most exogenous variable and thus is not contemporaneously affected by the domestic variables. Output is influenced contemporaneously by trade balance, while inflation is affected by both trade balance and output. These three variables are influenced by all five domestic variables in the lag structure.

Real exchange rate is seen as an information market variable that reacts quickly to all relevant economic disturbances and hence is affected by all the variables in the systems both contemporaneously and in the lag structure. The interest rate equation is assumed to be the reaction function of the ASEAN-5 Central banks which set the interest rate after observing the current oil price, output and inflation. We include these variables and the lagged real exchange rate in the monetary policy reaction function to control for current system-

atic responses of monetary policy to the state of the economy like inflationary pressure, demand disturbances and or external shocks; thus reflecting the open economy Taylor rule.

Five additional restrictions were imposed on the contemporaneous structure described in 7 for each economy.[14] The over-identifying restrictions are not rejected at the 1% significance level, thus suggesting that the identified model specifications are appropriate.

5. Empirical Results

To obtain the orthogonal oil-supply, global-activity and oil-specific demand shocks, the identification structure described in Section 4.2 is applied. The sizes of the shocks are measured by one-standard deviation of the orthogonal errors derived from the SVAR model. The impulse responses of each ASEAN-5's macroeconomic variables are normalized by dividing them with the standard deviation $[\varepsilon_t^{os} = 0.991, \varepsilon_t^{ga} = 0.792$ and $\varepsilon_t^{op} = 065]$ of the respective three shocks. 68% confidence bands for the impulse functions are computed via bootstrapping 10000 samples, using the bootstrap-after-bootstrap method of Kilian (1998). Historical decomposition is generated to asses the evolution of each economy's macroeconomic variables following major exogenous events in oil markets. Variance decomposition is provided to show the proportion of the variance in trade balances and real exchange rates that are attributable to each shocks identified in Equation 6.

5.1. What drives the global real price of oil between 2000 to 2013?

The impulse response functions of the real price of oil to the three identified shocks in the oil block are derived and revealed in Figure 5. A disruption in the oil-supply, defined as an unanticipated decline in the oil production, triggers a delayed temporary rise in oil price after six months, peaking around 1% above

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[14]The contemporaneous matrix $\mathbf{B}_0$ requires $((8^2 - 8)/2 = 28)$ restrictions for exact identification while in (7) there are 33 restrictions imposed, leading to over-identification.

the baseline fifteen months later, before adjusting downwards.[15] The effect of an unanticipated expansion in global activity on the other hand led to an immediate jump in oil price which peaked around 5% above the baseline six months after the shock. The oil-supply shock tend to have a smaller positive effect on oil price compared to the global activity shock. According to Kilian (2009), the oil supply contractions in one region could trigger production in other parts of the world, thus causing only a transitory inflationary effects on the global economy. Since shifts in the oil-specific demand are generally driven by expectations about future changes in oil and or financial conditions, they tend to trigger an immediate and sharp changes in real price of oil.[16] This can be observed in Figure 5, a positive oil-specific demand shock on impact leads to a significant rise in oil price around 6%.

Figure 5: Impulse Responses of Oil Price to Oil-Supply, Global-Activity and Oil-Specific Shocks
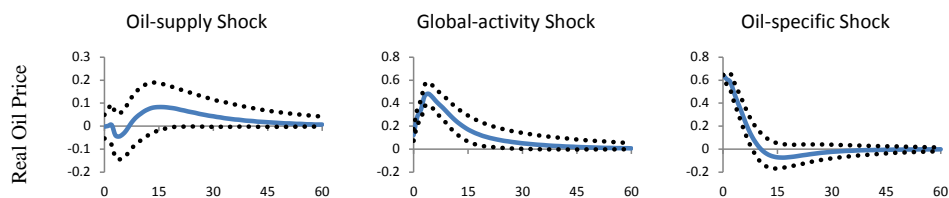
The historical decomposition of the real price of oil are shown in Figure 6. Since 2000, the oil-supply shocks have made comparatively small contributions to the oil price. The biggest contributions are from the oil-specific demand shock and the global activity shock. The important channel though which exogenous events such as wars or financial market conditions affect the real price

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[15]Each shock has been scaled up by 10; for example a response of 0.5 means 5%; this applies to all impulse response functions reported in the following subsections.

[16]For example, a precautionary demand and or a speculative demand for oil could be driven by expectations about future changes in oil supply or oil demand.

of oil is through the oil-specific demand. Thus this channel causes sharply defined increases and decreases in the price of oil. The sharp increase in the oil price in 2004-2006 and in 2007-2008 can be attributed to precautionary and or speculative demand, either in anticipation of stronger economic growth or in anticipation of declining oil supplies (see Kilian, 2009; Kilian & Murphy, 2014, for details). The rise in oil price between 2010-2011 can be attributed to global liquidity conditions, particulary caused by the rise in China's real M2 (see Ratti & Vespignani, 2013, for details) or could be attributed to quantitative easing measures undertaken by the majors advanced economies. This is consistent with the view that oil-specific shocks may reflect rapid shifts in the markets assessment of the uncertainty surrounding future oil supply and demand. The global activity shock on the other hand causes prolonged and persistent swings in the real price of oil and was obvious especially between the periods 2003 to 2008. According to Kilian (2009); Kilian & Hicks (2013) and Kilian & Murphy (2014), the surge in the real price of oil between 2003-2008 is mainly caused by shifts in the demand for crude oil driven by the global business cycle. Overall, there are important differences in the relative contribution of the three structural shocks to the real price of oil for the past 13 years.

Figure 6: Historical Decomposition of Oil Price to Oil-Supply, Global-Activity and Oil-Specific Shocks

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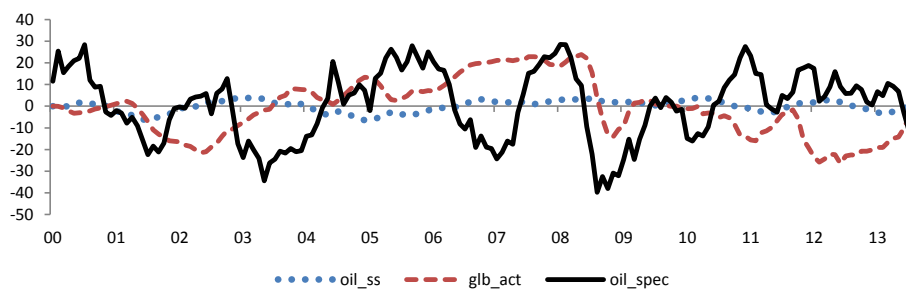
5.2. Macroeconomic Responses of the ASEAN-5 to Oil Shocks

The "oil-macroeconomic" relationship of the ASEAN-5 are examined by generating impulse responses of trade, output, inflation, monetary policy and real exchange rate, to the three specified shocks in the oil block. The response functions for each shocks are revealed in Figures 7 to 9. These results illustrate the important differences in how the oil demand and oil supply shocks underlying the real price of oil affect ASEAN-5's macroeconomic variables.

5.2.1. Oil-Supply Disruption Shock

A supply disruption shock is expected to trigger a rise in production costs and a decline in global aggregate demand. This would induce inflationary pressure, often placing downward pressure on economic growth, consistent with stagflationary effects of oil price shocks.[17] In Figure 7, the unanticipated oil-supply disruptions lower the production level on impact on all the economies except for the Philippines. Singapore felt the largest negative output response around 1% below the baseline and it takes around thirty six months for the economy to revert back to the baseline. This outcome is not surprising as almost one-fifth of the worlds oil production is transported via the Malacca Straits and the related transport and processing industries account for around 5% of Singapore's GDP. So any disruption in oil supply is expected to have larger effect on Singapore, given the importance of oil refining and distribution to it's economy. In comparison, output fell around 0.5% in Indonesia, Malaysia and Thailand and these economies only took around twelve to fifteen months to adjust back. The Philippines's delayed negative response after one year could be attributed to its lower level trade and oil intensity compared to the other four economies.[18]

The inflationary response is positive in the four oil importing economies and insignificant for Malaysia, the only net oil exporter in the group. The inflationary effect however varies in length among the four economies, with the

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[17]Stagflation is defined as a condition of slow economic growth accompanied by a rise in prices.

[18]Refer to Figures 3 and 4.

peak rate ranging between 0.5% to 2% depending on their oil self-sufficiency. Given their relatively low level of oil self-sufficiency, the inflationary effects on Singapore and the Philippines are higher compared to Thailand. However, it is not clear as to why Indonesia's inflationary effect is persistent, given it's low trade and oil intensity compared to Thailand. One possible explanation could be that Indonesia's total primary energy consumption grew by 43% between 2003 and 2013, and oil continues to account for the highest portion of Indonesia's energy mix at 38% in 2013 (EIA, 2015).

To alleviate the stagflationary effects caused by the oil-supply disruption shock, monetary policy tend to be more accommodative in the ASEAN-5 where the policy rates declined. In practice, the recession may be deepened in these economies if monetary policy makers raise interest rates to combat the inflationary pressures. Further, as observed in Figure 7, the oil-supply disruption shock is not as inflationary as they used to be, thus allowing for a accommodative monetary policy responses. The easing of monetary policy is larger in Indonesia and the Philippines compared to the measures undertaken in Malaysia and Singapore.[19] On the other hand, Thailand with an inflation targeting central bank, did not respond to the oil-supply shock.

The effects on trade is as expected, positive for Malaysia while it is significantly negative for the Philippines for about six months. As for the other oil importers it is generally moderate and insignificant. The real exchange rate responses is positive for Indonesia, the Philippines and Thailand making these economies less competitive in the global market. The effects however varies in length among the three economies, depending on their responses to inflation.[20] The decline in Malaysia's real exchange rate could be attributed to higher foreign prices relative to the domestic price, as its retail prices for oil products are

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[19]In Indonesia, Malaysia, the Philippines and Thailand the monetary policy variable is represented by the interest variable while in Singapore the policy variable is represented by exchange rate.

[20]Real exchange rate is measured as nominal effective exchange multiplied by domestic price level divided by foreign price level.

subsidised. As for Singapore, the exchange rate is Singapore Monetary Authority's policy instrument and thus is kept low to stimulate the economy.

5.2.2. Oil demand shock driven by global economic activity

In response to an oil demand shock driven by global activity, all five economies irrespective of trade intensity, oil self-sufficiency and oil intensity, experience an increase in production, inflationary pressures, rise in interest rate and appreciation of the real exchange rate . Consistent with Cashin et al. (2014) and as expected, in response to a demand-driven oil price shock, output and inflation move in the same direction, largely influenced by the global activity. In Figure 8, an unanticipated aggregate demand expansion causes a statistically significant increase in output in the first year, particularly for the trade intensive economies of Malaysia, Singapore and Thailand. It peaks around six months before reverting back to the baseline after a year, except for Thailand where the positive effect lasts for about two years. This finding suggests that the primary effect of higher global activity in these economies dominates the contractionary effect of rising oil prices.

The corresponding inflationary effect shows a sustained increase that reaches its maximum in the range between 2% to 4% in the first year and is statistically significant. The inflationary effect appear to be larger compared to that caused by an oil-supply disruption. Higher domestic activity accompanied by inflationary pressure on consumer prices, led to a rise in policy rate in all five economies. The central banks of the ASEAN-5 could tightened their monetary policy in response to higher oil price caused by global activity shock without fear of weakening their economies. The policy response appear to be larger particularly in Thailand, Indonesia and the Philippines, the three economies with their respective central bank committed to inflation targeting.

The effects on trade varies among the five economies. Malaysia as oil exporter experiences positive effect which peaks around 2% after six months and reverts back to its baseline after two years. Indonesia and Philippines, the two less trade intensive economies had minimal effect on trade. As for Singapore and

Figure 7: Impulse Responses of Macroeconomic variables to an Oil-Supply Disruption Shock
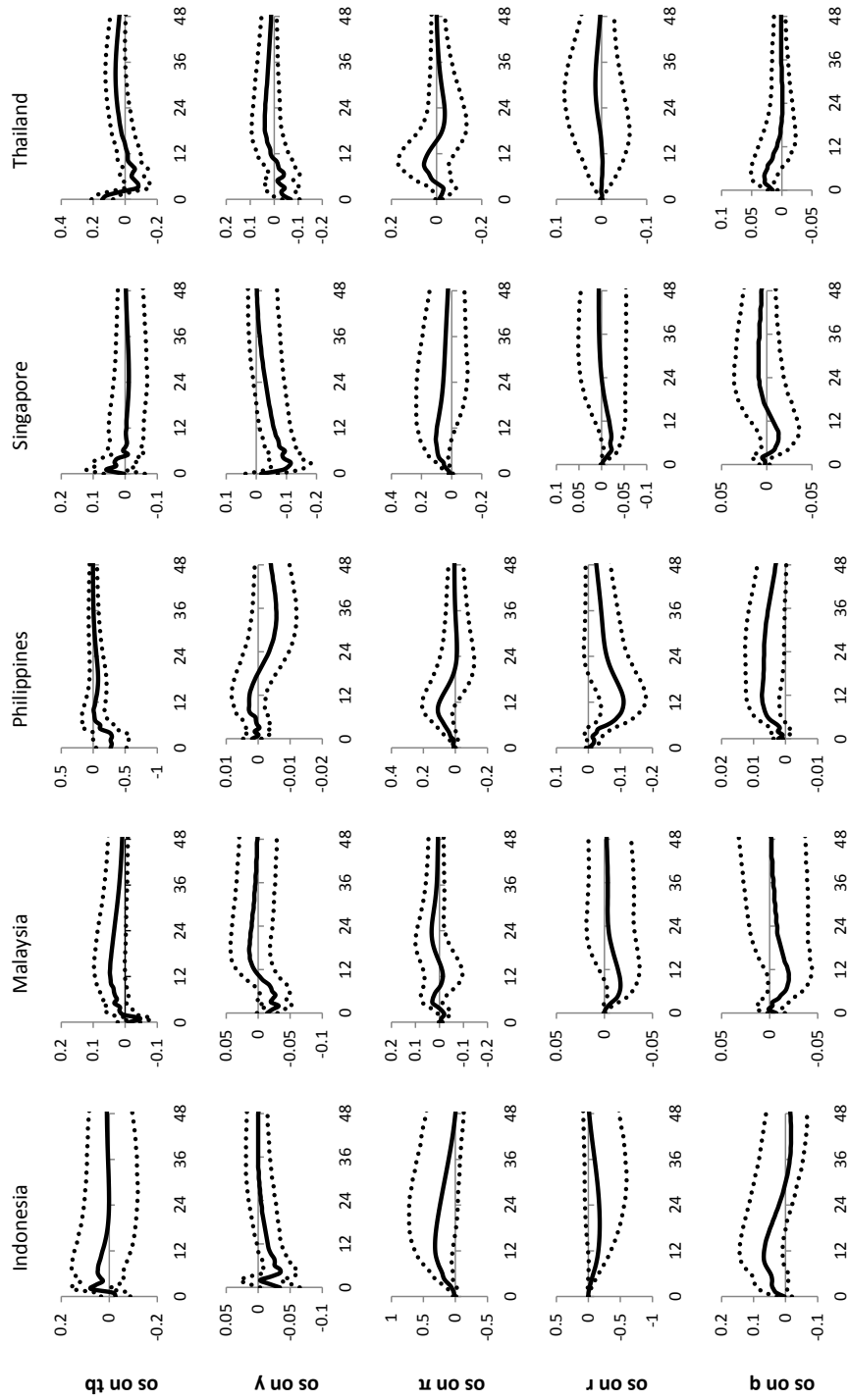
Thailand, though they are trade intensive but they are also highly dependent on imported oil. The positive effect of trade is felt immediately but eventually it becomes negative due to the rising oil price. In addition, it could also partly be explained by the rise in real exchange rate responses, making these economies less competitive in the global market.

5.2.3. Oil-Specific Demand Shock

Oil-specific shocks are often associated with inflationary and foreign exchange pressures, which prompt central banks to raise the short-term interest rates. In Figure 9, the responses of macroeconomics variables to an unanticipated oil-specific demand shock are reported. The effects on inflation, interest rate and exchange rate are quite similar as to that observed for the demand shock caused by global activity. The oil-specific demand shock as expected causes a sustained and highly significant increase in inflation rate, compared to the global activity or supply disruption shocks. The largest increase around 5% is observed in Indonesia, the Philippines and Thailand. Consequently, the ASEAN-5 encounter a positive cost-push shock and face increasing risk or uncertainty caused by oil price volatility. This is followed by tightening of monetary policy where all five central banks increase their policy rate between 0.5% to 2%.

The real exchange rate appreciates making these economies less competitive in the global market. This consequently reflects a negative trade balance effects on all the economies except Malaysia. This negative effect is also felt in the production, where the initial increase result in a gradual reduction in output that reaches its minimum after a year. These results indicate the production structures of these economies, which rely heavily upon trade. A rise in global oil prices without a clear boost in global demand can easily lead to a slump, since it will only raise the cost of production.

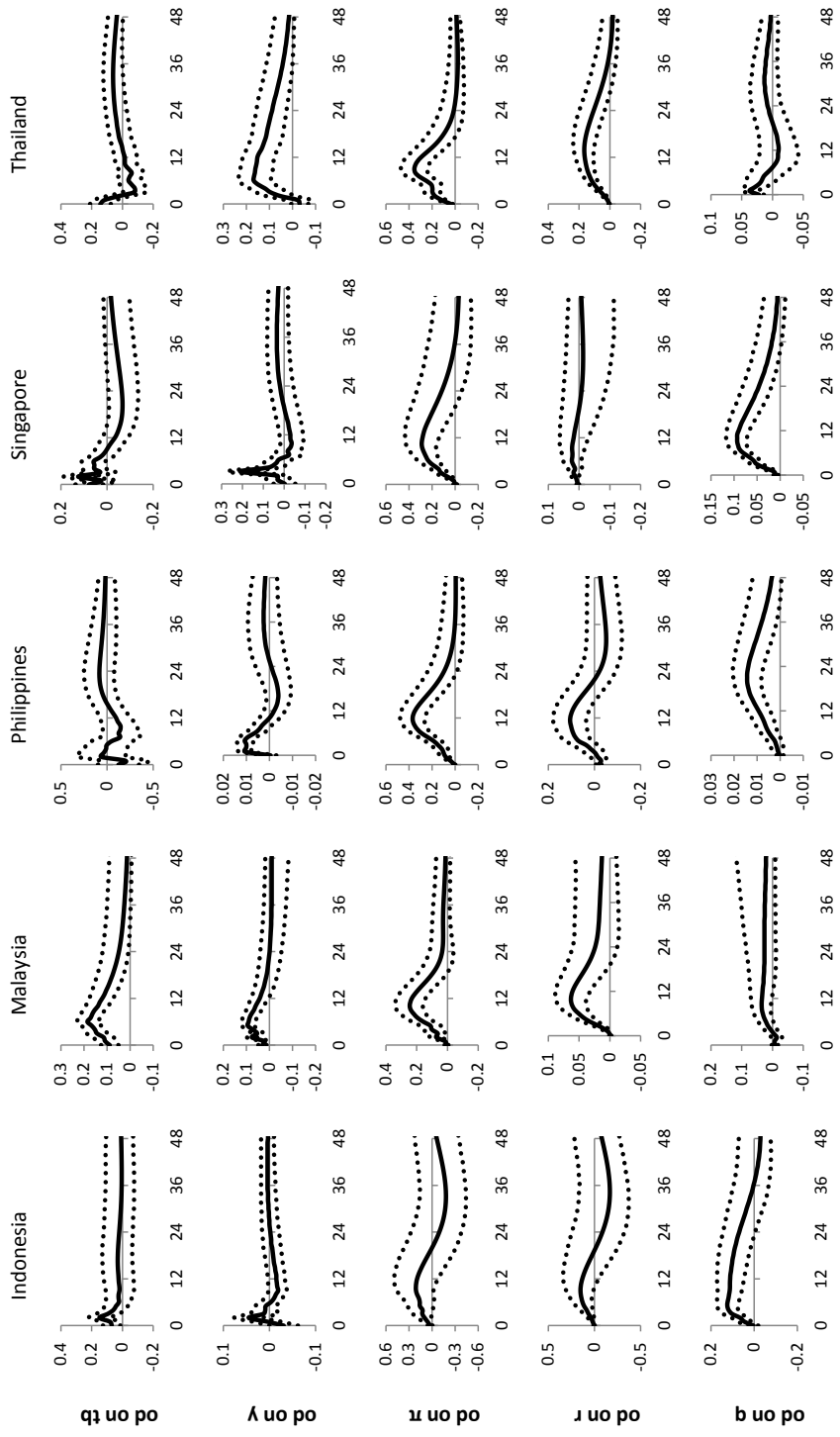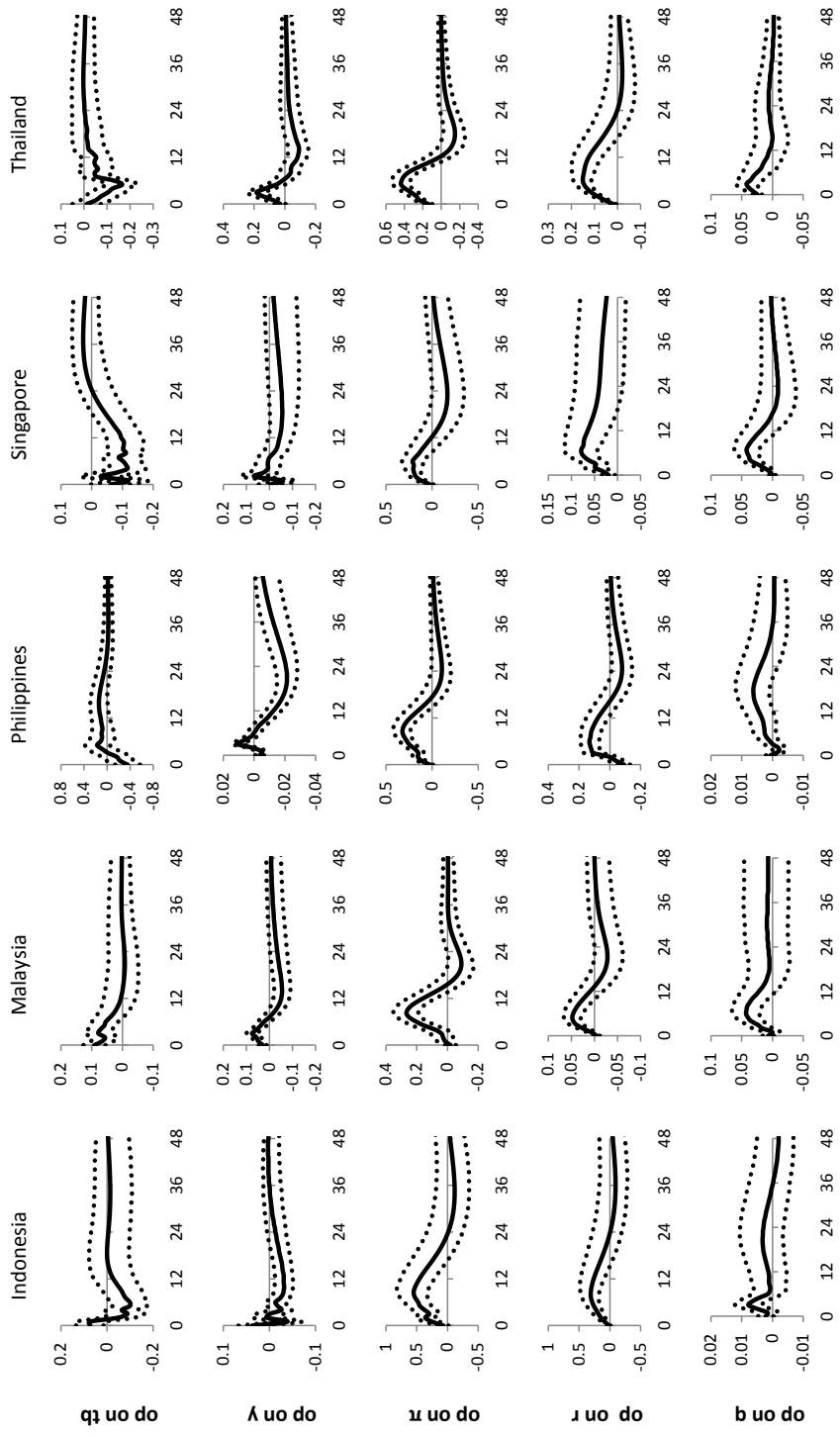Figure 8: Impulse Responses of Macroeconomic variables to a Global Activity Shock

Figure 9: Impulse Responses of Macroeconomic variables to Oil-Specific Shock

A useful contribution of an estimated SVAR is the historical decomposition, which exposes the contribution of the oil shocks to the observed outcome at each point in time. Figure 10 presents the historical decomposition of ASEAN-5 output, inflation and monetary policy variables, for the period 2000-2013. The variations in these variables over the sample period are primarily explained by two drivers of oil shocks - global activity shocks and oil-specific shocks, while oil disruption shocks played lesser role.

The analysis provides evidence that global activity shock is dominant in explaining the variations in ASEAN-5 output, but the source of this shock has fluctuated considerably over the sample. Sometimes dominant and positive, but at other times acting as a damper to the dominant oil-specific demand shock, especially following the GFC in 2008.

The contributions of differently sourced oil shocks to the variation in ASEAN-5 inflation are shown in the middle panel of Figure 10. It is clear that during 2003-2008, global activity shock had strong positive contribution, while at other times the contributions were negative. This reflects the strong role of trade in these economies, influencing the domestic price movements. There is some evidence that the oil-specific demand shock is responsible for instigating the inflationary pressure. The positive movement during 2003-2008, can be attributed to precautionary and or speculative demand, in anticipation of stronger economic growth. The positive movement after 2010 can be attributed to global liquidity conditions. During this time, the negative global activity shock act as damper to the dominant positive oil-specific shock.

The variations in the ASEAN-5's monetary policy variables to the three oil shocks over the sample period are primarily in line with the movement in inflation. This shows that the ASEAN-5's central banks are focussed in maintaining price stability. The global activity shock causes prolonged and persistent swings in the policy variables and was obvious especially during 2003-2008 for Malaysia, Singapore and Thailand, the three trade intensive economies. It is clear that

at various times, the transmission of the oil-specific shock is anticipated in the domestic policy response. The source of this shock has fluctuated over the sample, at times positive, reinforcing the effect of global activity shock and other times, acting as a damper.

5.4. Variance Decomposition of the ASEAN-5's Trade and Exchange Rate

Tables 1 and 2, reports the proportion of the variance of the trade balance and the real exchange rate respectively that are attributable to shocks to each of the variables in the model. Results are reported for forecast horizons 1, 12, 36 and 60 months ahead. Focussing first on the trade balance, the decompositions show that over the longer horizons, a substantial part of the variance in trade in each economy is explained by shocks in oil market variables. At 60 months, 62.43% of the variance in Malaysian trade is attributed to oil market variables. As a net exporter of oil, large part of these variation is influenced by the global activity shock (50.63%) while contributions from domestic variables are minimal. For Indonesia, 42% of the variance is attributed to oil-supply shock while 13% is due to interest rate and 18% is due to real exchange rate respectively. Around 54% of the variance in trade for Singapore and Philippines are actually attributed to their own shock. For the Philippines, global activity shock contributes 28% of the variance to trade while for Singapore both demand driven shocks contribute around 25% of the variance to trade. In Thailand, the oil market variables contributed only around 24.42% of the variance in trade, lowest among the five economies while domestic production contributed around 16%.

Focusing on the real exchange rate, the decomposition highlights that with exception of Thailand, in all the other economies, the global activity shock plays an important role in driving the movement in the real exchange rate. For Thailand, the trade shock appear to be contributing more then the the oil market variables. Another interesting observation is that for Malaysia, around 62% of the variation in the exchange rate is attributed to its own shock. This could be due the fact that the ringgit was pegged till 2005 and thus it contains

Figure 10: Historical Decomposition of Output, Inflation, Policy variable to Oil-Supply, Global-Activity and Oil-Specific Shocks
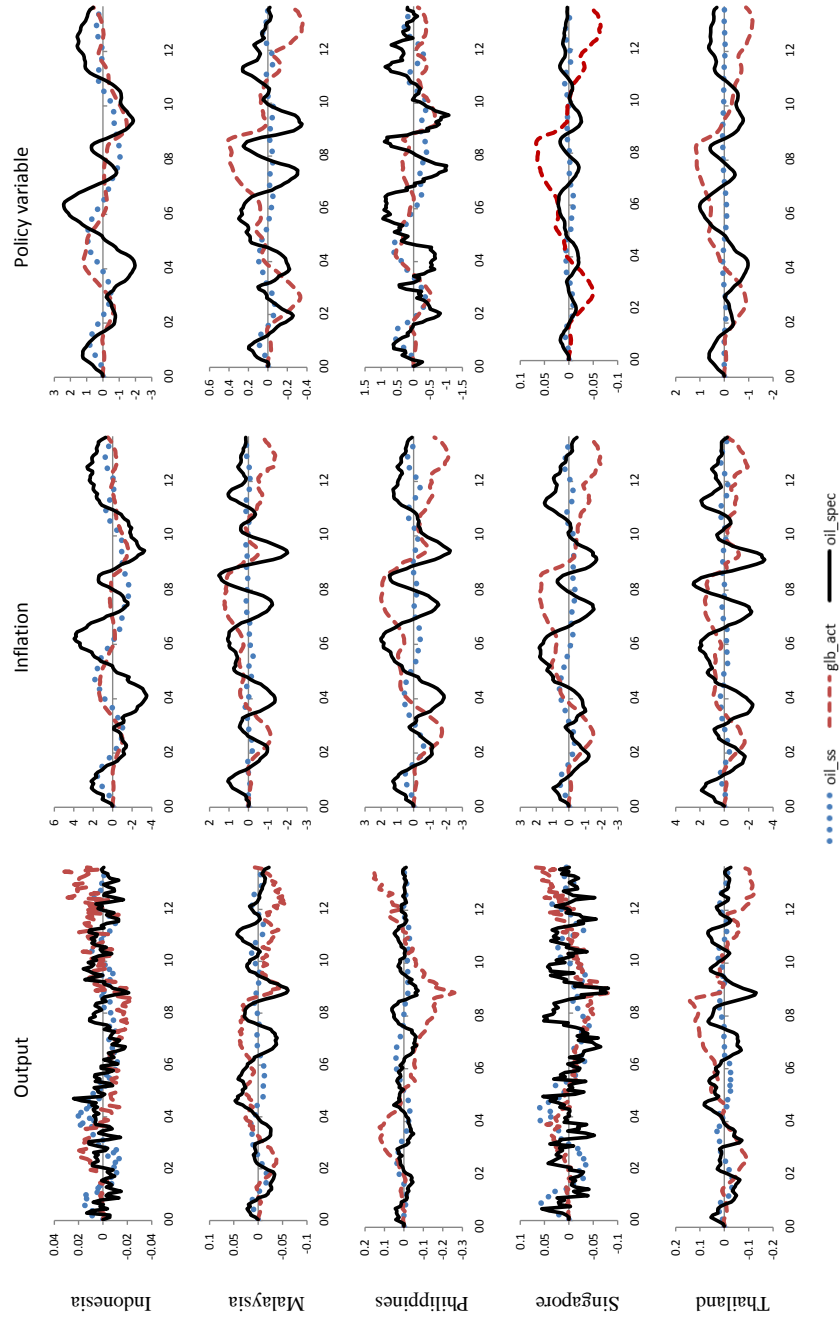
Table 1: Forecast Error Variance Decomposition of the Trade Balance

Months	Shock os_t	ga_t	op_t	tb_t	y_t	π_t	r_t	q_t
	Indonesia							
1	1.47	0.42	0.51	97.60	0.00	0.00	0.00	0.00
12	11.68	0.63	5.08	48.61	2.39	1.60	20.72	9.29
36	39.69	2.31	1.76	14.94	2.13	1.44	13.95	23.78
60	42.40	6.97	3.52	11.95	1.71	2.43	12.99	18.03
	Malaysia							
1	0.08	4.43	4.80	90.7	0.00	0.00	0.00	0.00
12	2.26	46.52	6.74	33.85	5.83	0.30	3.65	0.83
36	6.21	50.55	5.31	26.69	5.47	0.29	4.33	1.54
60	6.55	50.63	5.25	25.91	5.45	0.29	4.31	1.61
	the Philippines							
1	0.00	1.28	0.76	97.96	0.00	0.00	0.00	0.00
12	2.00	8.00	0.81	74.21	1.62	0.89	10.03	2.43
36	3.50	26.06	0.87	56.78	1.41	0.76	7.72	2.90
60	4.70	28.17	0.90	54.04	1.34	0.73	7.34	2.77
	Singapore							
1	0.00	1.09	0.69	98.22	0.00	0.00	0.00	0.00
12	0.68	3.75	12.49	71.49	2.86	2.39	3.45	2.88
36	0.70	9.52	13.73	56.18	2.48	5.80	7.52	4.08
60	0.71	10.20	14.27	54.73	2.55	5.94	7.52	4.06
	Thailand							
1	0.92	3.86	0.03	95.20	0.00	0.00	0.00	0.00
12	4.28	5.29	8.10	55.24	15.42	7.27	2.06	2.34
36	6.24	8.17	7.47	50.24	16.36	7.12	2.31	2.10
60	6.47	10.70	7.25	48.54	15.80	6.90	2.30	2.04

much of the movement in the exchange rate. On the other hand, Singapore's real exchange rate movement is largely influenced by global activity shock, around 66%. Among the five economies, Singapore is the most trade intensive economy and the exchange rate is the monetary policy instrument. So global activity will have substantial effects on Singapore and its Monetary authority would want to contain that effects through exchange rate variation. As for Indonesia, global activity shock contributes 22% while domestic interest rate contributes 30% of the variation in the exchange rate.

6. Conclusion

Oil is a critical source of energy and thus any abrupt and or sharp increases in oil prices can have detrimental effects on the macroeconomic variables such as economic growth, inflation and trade balances. The general consensus is that oil price shocks can push cost of production up leading to higher inflation and declining output level. Following these, there is clear evidence that policymakers care about oil shocks and are concern about managing inflation expectations when hit with an oil shock. Since the late 1990s, the global economy has experienced two oil shocks, one in 2004 and the other in 2006, largely driven by increasing global demand for oil. As highlighted in Kilian (2009) and Kilian & Murphy (2014), the economic consequences of a supply-driven oil-price shock are very different from those of an oil-demand shock driven by global economic activity.

This paper contributes to and extends the existing literature in two main areas. First, using an SVAR models with small open economy properties, it divides the variables into two blocks - oil block and the domestic block. The oil block captures the conditions in the global oil market and as in Kilian (2009) it decomposes the oil price shocks into oil-supply, oil-demand and oil-specific shocks. Second, using developing economy application, it analyses the interaction between domestic and oil block variables. It emphasizes the transmission of the three identified shocks in the oil block to the ASEAN-5 economies and

Table 2: Forecast Error Variance Decomposition of the Exchange Rate

Months	Shock							
	os_t	ga_t	op_t	tb_t	y_t	π_t	r_t	q_t
	Indonesia							
1	0.00	0.00	0.74	4.75	0.32	7.56	1.24	85.39
12	4.84	25.51	2.51	3.42	0.35	7.32	13.96	42.09
36	4.34	23.71	2.82	3.07	0.21	11.00	28.81	26.05
60	4.88	22.01	2.70	3.43	0.29	10.75	30.31	25.63
	Malaysia							
1	0.43	0.58	0.40	0.69	0.45	0.49	2.65	94.30
12	2.56	6.69	12.77	0.14	1.11	4.54	3.03	69.17
36	2.72	13.48	7.82	0.48	4.55	5.56	1.72	63.67
60	2.28	15.83	6.94	0.54	5.68	5.47	1.61	61.66
	the Philippines							
1	2.12	0.03	0.27	0.12	4.22	2.80	1.13	89.30
12	16.89	9.04	2.22	3.59	1.70	2.70	1.54	62.32
36	23.71	10.00	5.90	1.76	0.68	1.58	0.62	25.75
60	25.00	41.86	5.41	1.61	0.62	1.45	0.57	23.49
	Singapore							
1	0.15	1.97	0.00	0.72	1.61	0.02	0.86	94.66
12	0.98	55.11	10.33	0.16	3.45	0.10	0.98	28.90
36	1.21	66.67	6.48	0.18	2.64	0.82	4.94	16.53
60	1.58	65.78	6.33	0.19	2.57	1.41	5.99	16.16
	Thailand							
1	2.64	5.91	7.04	4.12	0.74	2.94	0.52	76.08
12	5.94	4.02	8.79	15.19	3.15	6.14	4.30	52.47
36	5.58	5.63	8.43	15.07	3.93	5.77	7.15	48.45
60	5.56	6.19	8.40	15.04	3.97	5.73	7.10	48.02

the responses of monetary policy to the various oil shocks. The econometric framework uses exogeneity restrictions for the oil block in relation to ASEAN-5 economies.

The analysis provides us with some useful insights as to the nature of the effects of various oil shocks on ASEAN-5. The underlying source of the oil-price shock is crucial in determining its macroeconomic consequence for an oil importer as opposed to an oil exporter. It suggest that oil disruption shocks are relatively unimportant during 2000-2013 on ASEAN-5's macroeconomic variables. A global activity shock, which stimulates major economies' output, raises ASEAN-5's output, inflation increases and this is followed by a contractionary monetary policy responses. On the other hand, the oil-specific shock triggers a substantial rise in inflation, followed by a rise in policy rate which triggers a fall in output. A global activity shock makes a notable contribution to Malaysia's trade balance and to Singapore and the Philippines real exchange rate. An oil supply shock causes large movements in Indonesia's trade balance. Apart from the oil market variables, interest rate plays an important role for Indonesia's trade and real exchange rate movements while output plays an important role for Thailand's trade balance. This illustrates the potential complexity of the transmission mechanisms of the various oil shocks on the ASEAN-5's macroeconomic variables.

Whether monetary policy is tightened in ASEAN-5 in response to higher oil price depends on the impact of each sources of oil shock on output relative to inflation. As the recent oil price shocks are demand driven, the impulse responses and historical decomposition highlights that the effects on inflation are accentuated while the effects on economic growth are less disruptive. Consequently, the central banks of these economies could tighten their monetary policy in response to higher inflation, especially in the oil importing economies without fear of weakening their economies. Though as small open economies there is little the ASEAN-5 can do to influence future oil price shocks, these economies may need to pursue prudent monetary policy measures that are more supportive of growth. This is crucial for the operational conduct of monetary

policy for achieving price stability and sustainable economic growth.

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Appendix

Appendix A

Table 3: Data Descriptions and Sources

Variable	Description	Source
Oil Block		
os_t	Global Oil Production	US Energy Information Website
	(Percentage change per annum)	
ga_t	Global Real Activity	Kilian - UM Personal Website
	(Deviation from trend)	
op_t	World Oil Price Index,	Spot Oil Price: West Texas
	(Percentage change per annum)	Intermediate, FRED Database
Domestic Block		
tb_t	Real Trade Balance	Datastream
	(SA and detrended),	
y_t	Industrial/Manufacturing Production	Datastream
	(Logs, SA and detrended)	
π_t	Consumer Price Index	Datastream
	(Percentage change per annum)	
r_t	Inter-Bank Rate/	Datastream
	Treasury Bills Rate (Percentage)	
q_t	Real Effective Exchange Rate, Logs	Datastream
	(Logs, SA and detrended)	

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