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Demachi, Kazue

Kobe University

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Kazue Demachi

Graduate School of International Cooperation Studies, Kobe University

Research Fellow of Japan Society for the Promotion of Science (DC2)

2-1 Rokkodai-cho, Nada, Kobe, Hyogo, 657-8501, Japan.

+81 (0)78-803-7267

k.demachi@stu.kobe-u.ac.jp

Abstract

This study analyses the effects of changes in the international oil price and price volatility on the macro-economy of an African oil exporter, Nigeria. Applying the five-variable Structural Vector Auto Regression (SVAR) model to monthly data series from January 1970 to May 2011, impulse response functions are calculated to see the influences among the crude oil price, Nigeria's exchange rate, money supply (M2), domestic price levels (CPI) and the policy interest rate (Discount Rate). The estimation results suggest that Nigeria's exchange rate is affected not only by the changes in the international oil price but also by its price volatility. M2 increases as a response to an oil price increase, which suggests that as the international oil price rises there is a huge increase in the money supply into the domestic market from the national oil company and international oil companies, which are the largest suppliers of dollars next to the monetary authority itself.

Keywords

African oil exporter, Crude oil price, Volatility

1. Introduction

Many African countries still suffer from poverty and low development. African crude oil producers are coming to the forefront as new suppliers of natural resources and energy resources. Recent economic growth in emerging economies such as China and India puts pressure on energy resources in the international market adding to people's anxiety that the world's oil will soon be depleted. While emerging economies are taking what they can from resource-rich African countries by using various diplomatic tools, industrial countries headed by the United States are also turning to the African oil producers. There has been increased attention on African resources after the 9.11 terror attack in 2001 as alternative energy suppliers other than the Middle East were needed. The increasing demand for African oil has brought a new "resource boom" to resource-rich countries. Money is flowing into African oil-exporting countries regardless of their government's credibility, security, or their situation with respect to the rule of law. The countries receiving investment capital are experiencing rapid economic growth, which, however, can only be regarded as superficial; it is limited as it is to figures in statistical reports. In reality, the majority of the population still live below the poverty line. They suffer from internal and external conflicts, and their economies are shackled by a poor infrastructure except for that which exists in the places where the extractive industries operate.

Problems facing commodity-dependent countries, the negative impact of international commodity price fluctuations and price uncertainty have been debated, in part by dependency theorists such as Prebisch and Singer. The underlying problems of economic stagnation, in spite of the large revenues received from the sale of their resources,

along with conflict, have been called the “resource curse” (Collier and Hoeffler 2004: Deaton and Miller 1995: Gelb 1988: Sachs and Warner 1995). Sachs and Warner argue, from a medium- and long-term analysis using annual data, that resource endowment (dependency on resource exports) is negatively related to economic growth (Sachs and Warner 1995). On the other hand, Deaton and Miller, in comparing Sub-Saharan countries using annual time series data, conclude that there is no statistically significant difference between the economic performance of commodity exporters and non-commodity exporters (Deaton and Miller 1995). The same problem is also analysed in the light of the political economy, and this paradoxical situation is highlighted as the “paradox of plenty” (Karl 1997). The “resource curse” debate contains a broad range of topics, but one of the most discussed by economists is Dutch disease. When the international price of a commodity rises, the exporting country’s currency appreciates, thus the country’s non-booming exports lose their international competitiveness, so the non-booming sector declines. Moreover, domestic labour moves to the booming sector and this also contributes to the decline of the non-booming sector (Corden 1984, Corden and Neary 1982, Cuddington 1989). Another important point regarding the “resource curse” is the fluctuation in government revenues due to the uncertainty of international commodity prices. While the governments of resource-exporting countries usually depend on this resource revenue, the unpredictability of trends in commodity prices impedes governments from investing in mid- or long- term development. Many developing countries’ governments find it difficult to stop or alter development projects once started. The collapse of international commodity prices forces these governments to rely on external

borrowing rather than austerity, which results in increased foreign debt (Budina and Wijnbergen 2008).

There has been radical structural change in the international commodity market and pricing mechanisms in the past. Before the 1970s, the price of crude oil was determined by the cartel of international oil companies, called "The Seven Sisters." Pricing power then shifted to the Organization of Petroleum Exporting Countries (OPEC), but their hegemony was short-lived. With the development of the international market for crude oil, after the oil price crash in 1986, pricing power moved from OPEC to the open market. Recent developments in information technology after the establishment of the international market have extended the power of the financial markets, and commodities in futures markets are increasingly taking on the character of financial products. Movements in the crude oil price today correlate more to other commodity prices such as the price of gold, or even stock prices, than in the past. The international oil price is a reflection of the state of the international economy rather than just being information that reflects the position regarding the balance between supply-and demand in oil. This paper investigates how the price movements of crude oil affect still-struggling African oil exporters' economies.

Extractive industries, and not just those to do with crude oil extraction, are usually operated by international oil companies. In many oil producing countries, these international oil companies form joint ventures with the host governments or with domestic companies. The influence of these corporations on domestic economies is huge, especially in relatively small, developing, commodity-dependent economies. The existing literature mostly focuses on the relationship

between international companies and the host country's exchange rates. They focus on how these companies circumvent and mitigate the currency risk. However, the international companies' activities and influence are sometimes large enough to affect the macro-economy of the host country. This is even more true for a developing, oil dependent country, where the international oil companies' behaviour affects every aspect of the economy.

Based on the questions and motivations above, this paper analyses the influence of the international oil price on the macro-economy of a Sub-Saharan African oil exporting country, Nigeria. The econometric analytical part employs the Structural Vector Auto Regression (SVAR) model, using monthly data on the Nigerian macro-economy from January 1970 to May 2011. This analysis is complementary to the existing literature in that it focuses on shorter term economic responses, by contrast with the data frequency previously employed. The remainder of this paper is organized as follows. The next section briefly reviews prior studies. Section 3 is an overview of Nigeria's economy. Section 4 reports on the data, the SVAR model, the analytical method and the results. The last section concludes.

2. Literature Review

Many economists have investigated crude oil price changes, fluctuation and uncertainty, and their impact on economic activity, especially since the oil crisis in the 1970s. Most of these studies, however, focus either on the price movements themselves, or on the influence of price changes on the industrial countries' economies and industries, such as in the United States or Japan (Apergis and Miller

2009: Hamilton 1983, 1996, 2003, 2008: Kilian 2009: Kim and Roubini 2000). Studies have also focused on other countries, such as Bjørnland (1998, 2009) on Norway, and Ahmed and Wadud (2011) on Malaysia. Norway is an exceptional case in that it is heavily dependent on oil exports but it is also equipped with well-established financial institutions.

Some studies distinguish price uncertainty from mere price change, assuming that price uncertainty has specific effects on the economy. Ferderer (1996) calculates monthly oil price volatility as a standard deviation of daily price changes and argues that volatility has an explanatory power that can estimate fluctuations in U.S. economic output. Ahmed and Wadud (2011), on the other hand, employ an Exponential General Auto Regression Conditional Heteroscadasticity (EGARCH) model to estimate monthly oil price volatility, apply the SVAR model to 1986 to 2009 monthly data, and thus analyze the effects of the oil price shock on Malaysia's industry. They suggest that oil price volatility negatively affects Malaysian industrial production. Notably, they point out that oil price volatility lowers price levels over the long term, and the Malaysian authorities respond to this with an expansionary monetary policy to stimulate the economy. The Malaysian case is an example of how a government responds to the effects of an international oil price shock. In general, developing countries like Nigeria, as opposed to industrialized countries, have only limited financial tools to implement financial policy, so it is worth looking at how the monetary authority of such a resource rich country responds to an international oil price shock.

3. Economic overview of Nigeria

Nigeria is an oil producing country which depends on its oil income for most of its federal revenue. The share reached 80% in 2008 (Central Bank of Nigeria 2011, Table B.1.1). The *Foreign Trade Statistics* issued by the Nigerian National Bureau of Statistics suggest that more than 90% of Nigerian exports are crude oil and natural gas (National Bureau of Statistics 2011). Moreover, about 97% of foreign revenues is from oil and gas (Technical Committee on the Niger Delta 2008:102). Nigeria began its oil production with Shell-BP in 1957, just before independence from the United Kingdom. Oil production at that time was only around 20,000 barrels/day, but it increased steadily to reach 540,000 barrels/day in 1969. Nigeria established the Nigerian National Oil Corporation in 1971 and joined OPEC the same year (Frynas 1993:16). In 1977, the company was amalgamated with the Ministry of Petroleum, and changed its name to the Nigerian National Petroleum Corporation (Oyrwole and Lucas 2000: 374).

The major exports of Nigeria had been palm oil, cacao and ground nuts in the 1950s until the agricultural sector started to plummet as the oil sector developed in the 1960s (Helleiner 1964). The economy experienced a typical Dutch-disease-type structural shift and now heavily depends on oil exports. The oil industry is generally capital intensive, thus the oil sector is not generating much domestic employment. Domestic infrastructure outside the oil sector has yet to be developed. A detailed industrial analysis is still lacking, but the share of labourers working in the industrial sector is estimated to be around 10% and in services 20%. The remainder work in agriculture ("Nigeria," The World Factbook). In 2007, the poverty ratio was estimated to be over 70%, indicating that the income generated from oil, the national wealth, has not been spread throughout the population

(ibid).

Nigeria's exchange rate regime was opportunistic from independence in 1960, when it was pegged to the UK pound or the US dollar, whichever was stronger and more favourable for imports, until the implementation of the Structural Adjustment Programme (SAP) in 1986 (Egwaikhide et al. 1994, Onafowora and Owoye 2008). In 1986, Nigeria shifted to a managed float regime, but this was a *de facto* dual market system, consisting of an official rate and a market rate while pursuing integration. The black market flourished in this era, and the gap between the official rate and the market rate widened. Suffering from radical economic adjustment and economic stagnation as a result of cuts in public expenditure, domestic criticism of the SAP peaked, forcing the government to retreat from the SAP and re-introduce a fixed exchange rate regime in 1994. The next year, Nigeria again shifted to a managed float regime and established an Autonomous Foreign Exchange Market to boost the integration of exchange rates. In 2002, it introduced a Dutch Auction System, and since then the auction system has been modified and extended several times in response to economic conditions.

Nigeria benefited from the two oil price hikes in the 1970s, receiving windfall profits like the Middle Eastern oil producers did. The huge oil revenues notwithstanding, Nigeria has accumulated foreign debt like other non-oil exporters, and it suffered prolonged economic stagnation in the 1980s. Literature on the Nigerian experience with the SAP points out problems such as poor foreign exchange management, that is, the maintenance of a fixed and overvalued exchange rate which led to the expansion of the black market, high inflation, ailing agricultural exports, a flourishing domestic service sector (Dutch

disease), and a chronic budget deficit (Budina et al. 2007: Chibber 1991: Pinto 1987,1990). Of these, the budget deficit of the federal government is still a serious problem; it exceeded 10% of GDP during the stagnant 1980s, a decade in which Nigeria experienced negative GDP growth for several years. However, the GDP growth ratio has been boosted since 2000, hitting 7% in 2009, and 7.8% in 2010 (World Development Indicators). Nigeria's balance of payments shows a clear change before and after 2000. Especially after 2003, the international balance went into surplus as it benefited from rapid growth in exports due to an increase in the international oil price.

Like other developing countries, one of the main tasks of the Central Bank of Nigeria (CBN) has been to control inflation. Prices rise quite rapidly even at present, recording an inflation rate in the double-digits. The official interest rate (annual discount rate) peaked around 1993 at 26%. It has been fluctuating since then and has gone down substantially since 2001. It stayed around 6 to 8% in 2011. Katz and his colleagues point out that the CBN has been under demand pressure from the market despite its efforts to lower the inflation rate through its monetary policy (Katz et al. 2004:44). Today, the CBN declares that it uses Open Market Operations through bill issuance as its main tool to control the money supply, but the movement of the Nigerian Treasury Bill rate was closely tied to that of the policy interest rate until January 2005. It is thus safe to think that until recently, the policy interest rate has been one of the monetary authorities' most important policy tools.

One of the major reasons for the increase in the money supply in Nigeria is the federal government's borrowing from the CBN. In 1980, domestic financing by the Nigerian government resulted in high

inflation. In general, another reason for the surge in the money supply is the inflow of oil revenues into the domestic currency market, especially when the government's sterilization policy has not been effective enough. This has a particular effect in Nigeria, where the Nigerian National Petroleum Corporation (NNPC) and the international oil companies supply US dollars to the domestic market as the crude oil price increases and oil revenues soar. The NNPC and the international oil companies can be regarded as the second largest foreign currency suppliers after the CBN.

Information on the capital flow of oil revenues in Nigeria has not been disclosed and is out of reach for most citizens. A small amount of information, however, has become available since Nigeria joined the Extractive Industry Transparency Initiative, which was started in 2002 on the initiative of the former UK Prime Minister, Tony Blair. The Nigerian EITI (NEITI) has already published two reports on audits of financial flows within the oil and gas industry since the launch of NEITI in 2004. According to its second report published in 2011, one part of several kinds of revenue from taxes on the oil companies for their oil sales is paid to local governments in the local currency, the naira, and the rest is deposited with JP Morgan Chase in New York in US dollars (Hart Nurse Limited 2011). Thus a price hike in international crude oil and an increase in oil revenues may indeed lead to more money being supplied to the domestic market, but the amount of money flowing into the domestic economy in the local currency and its size relative to the revenue deposited in the external account is still unknown.

It is noteworthy that the recent foreign exchange market in Nigeria has been active. A press release by the CBN in April 2010

reveals that domestic demand for foreign currency increased after the financial crisis in 2008; this was especially because foreign investors wanted to move funds to their home countries. Moreover, the press release points out, the expectation that the naira would depreciate along with the decline in the international oil price stimulated speculators' demand for the dollar (Central Bank of Nigeria 2010). On the other hand, the NNPC and other major oil companies, such as Shell, are reported to have been selling large amounts of dollars into the domestic inter-bank market. This supply of foreign currency by institutions other than the CBN seems to affect Nigeria's exchange rate.

4. Econometric Analysis

Based on the economic background reviewed above, this section investigates the impact of the international oil price on the oil-dependent Nigerian economy. To analyze the effects of the oil price on economic activity, Ahmed and Wadud used variables such as the industrial production index (Ahmed and Wadud 2011). However, available statistics on Nigeria only offer a crude oil production index. CBN's major objective has been to control the inflation rate, and the rate of change in prices can be regarded as important information that illustrates the economic state of Nigeria. Therefore the consumer price index (CPI) has been employed as a variable.

The international oil price is denominated in US dollars, thus an oil price increase will lead to an appreciation in the naira through the payment for crude oil in US dollars. In addition, the appreciation of the currency along with the increase in the oil price improves Nigeria's terms of trade, which stimulates demand for imports, thus pushing up

domestic demand for foreign currency. In this analysis, the CBN is assumed to have decided to control the interest rate after it observes a change in the inflation rate or in the money supply, thus the policy interest rate (Discount Rate) and Money Supply (M2) are included as variables. Moreover, the exchange rate is an important indicator of the economy for an oil exporter, so it is also included.

In this analysis, not only is international crude oil price volatility distinguished from percentage changes in the oil price (OP), but also sharp rises and falls are extracted and separated to make alternative variables, a Hamilton Index (HI) and an Inverse Hamilton Index (Inverse HI). This enables the analysis on the monetary authority's responses to each price increase and decrease, if any. The calculation of volatility, HI and Inverse HI, is explained below.

All of the data used in this analysis are taken from International Financial Statistics (IFS). For the crude oil price, nominal price data for Brent oil are used, as Nigerian oil is closely related to the Brent oil market. It should be noted that M2 in the Nigerian definition seems not to include net foreign assets (M2 minus net foreign assets turns negative after 2000). Thus, M2 can be understood as a proxy for money within the domestic market.

4-1. Estimation of Crude Oil Price Volatility

Changes in the international oil price and price uncertainty, namely volatility, show different trends, so it is worth creating variables for each. Ahmed and Wadud (2011) employ the EGARCH model proposed by Nelson (1991) to calculate crude oil price volatility. In the EGARCH model, a negative price shock is evaluated to have a larger impact on the conditional variance than a positive shock. As

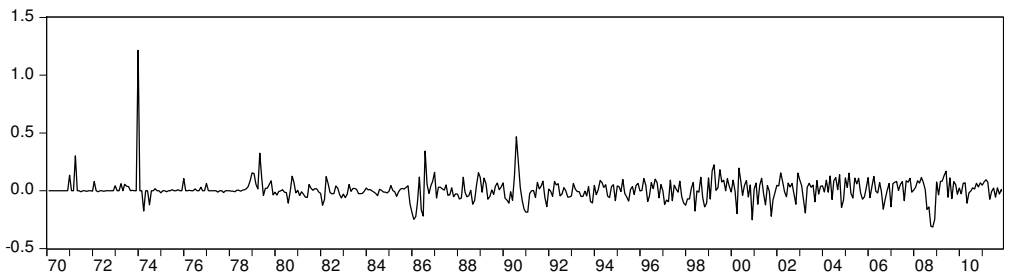
Ahmed and Wadud point out, this model allows an oil price shock to have an asymmetric impact on the uncertainty. Moreover, by using an exponential form, this model does not require a non-negative restriction on the variable. Thus, this analysis also employs the EGARCH model to estimate crude oil price volatility. The Brent oil price from January 1970 to May 2011 is modelled through AR(1) as in equation (1) below, then EGARCH(1,1) is applied in equation (2).

$$OPBrent = c + OPBrent_{t-1} + u_t \qquad (1)$$

$$ln\sigma^2 = \omega + \beta \ln {\sigma_{t-1}}^2 + \alpha \left|\frac{u_{t-1}}{\sigma_{t-1}}\right| + \gamma \frac{u_{t-1}}{\sigma_{t-1}} \qquad (2)$$

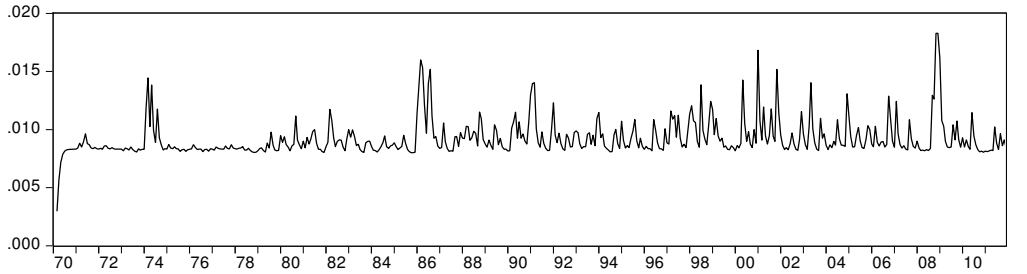
In the equation above, u is residual, and σ denotes the conditional variance obtained from equation (1). Here, if $\gamma < 0$, it indicates the asymmetric character of oil price movements on volatility. This means that a negative price shock has a larger influence than a positive price shock. In the SVAR analysis below, this estimate of the conditional variance is used for crude oil price volatility. The oil price data series and estimated volatility series are shown in Figures 1 and 2.

Figure 1. Nominal Oil Price, monthly % change



Note: Original data is Brent spot oil price, monthly average. Sample period is January 1970 to May 2011.

Figure 2. Oil price volatility, estimated with EGARCH model.



Note: Original data is Brent spot oil price, monthly average. Sample period used for EGARCH estimation is January 1970 to May 2011.

4-2. The Hamilton Index and the Inverse Hamilton Index

Some of the previous literature focused on the asymmetric character of an oil price shock on industrial activity. For an oil exporter, especially for a country like Nigeria, whose economy is heavily dependent on oil revenues, sharp jumps and drops in the international oil price may have special effects on the macro-economy and these should be linked to special actions by the authorities. Thus, this analysis employs a Hamilton Index, introduced by Hamilton (1996) and applied by Ahmed and Wadud (2011). The HI extracts the net increase in the oil price as below.

$$HI_t = \{(oilprice_t - maxop) > 0,0 \; for \; (oilprice_t - maxop) \leq 0\} \quad (3)$$

(maxop: maximum oil price in the past one year)

In the same manner, but in the opposite way, this analysis sets up the Inverse HI, which is generated as in equation (4).

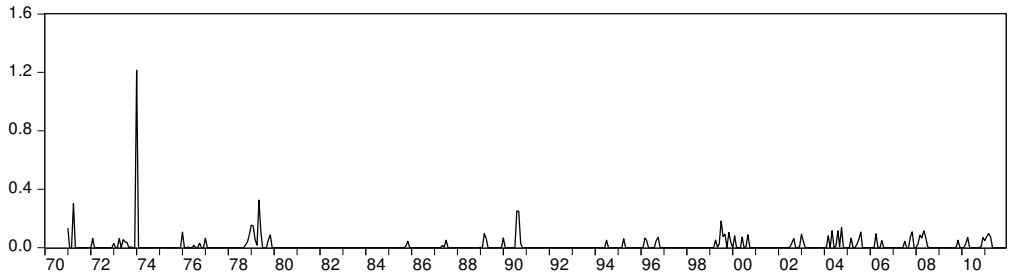
$$InverseHI_t = \{(oilprice_t - minop) < 0,0 \; for \; (oilprice_t - minop) \geq 0\} \quad (4)$$

(minop: minimum oil price in the past one year)

To calculate HI and Inverse HI, the Brent oil price in a natural logarithm is used. Both series are shown in Figures 3 and 4. Comparing

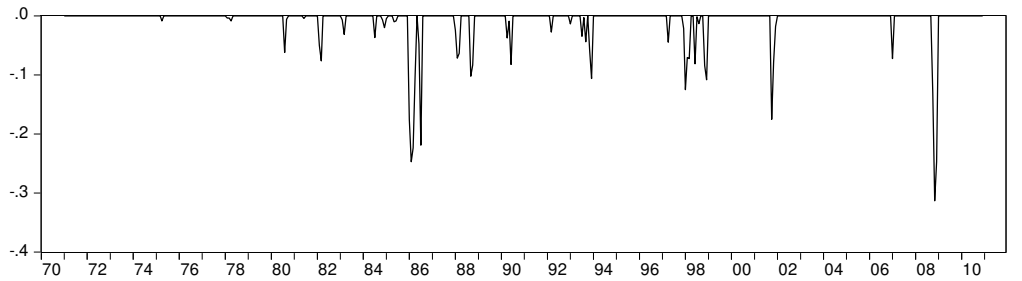
with oil price and volatility data, every series shows a different movement. This supports the need for different variables.

Figure 3. Hamilton Index (1971M01-2011M05)



Note: Original data is Brent spot oil price, monthly average. Sample period used for calculation is January 1970 to May 2011.

Figure 4. Inverse Hamilton Index (1971M01-2011M05)



Note: Original data is Brent spot oil price, monthly average. Sample period used for calculation is January 1970 to May 2011. In SVAR estimation the sign is converted.

4-3. The SVAR model estimation

For an econometric analysis of the impact of the international oil price on Nigeria's economy, the existing literature suggests using a sample data range from 1986 when the oil price fell precipitously. 1986 was also the year when Nigeria accepted the SAP and Nigeria's economic behaviour may have changed after 1986. In the meantime,

Nigeria introduced the Autonomous Foreign Exchange Market in 1995. Since then, the exchange regime has shifted to a managed float regime, which possibly affected the exchange rate reaction to a macro-economic shock. Moreover, Nigerian government shifted to a civilian regime under President Obasanjo in 2000. This may have influenced government behaviour by making economic policies more stable and responsive than before. The year 2000 can also be regarded as the start of a new global resource boom which brought new capital flows into Nigeria as well. Based on these considerations, this analysis takes the sample time series from January 1970 to May 2011 as a "base period," and three alternative data ranges (before and after 1986, 1995 and 2000) are applied to compare results and check the robustness of the estimation.

The estimation of the SVAR below adopts five variables: four macro-economic indicators and one variable for the international oil price (either percentage changes, a HI, an Inverse HI or Volatility). The four indices for the oil price are regarded as exogenous to other macro-economic variables. Every variable is tested for the existence of a unit root before the SVAR estimation using the Augmented Dickey Fuller (ADF) test applying Schwartz Information Criteria. All the variables, except for the HI, the Inverse HI and Volatility become stable after taking first order difference, so these variables are used in first order log difference form. Volatility, HI, and Inverse HI are diagnosed as having no unit root, and the last two variables are taken in log form, while Volatility data are used as they are estimated in the EGARCH model.

To analyse the impact of the international oil price on Nigeria's

economy, a SVAR model is constructed as in equation (5).

$$A_0 X_t = A_1(L) X_t + B\varepsilon_t \qquad (5)$$

L is a lag operator. Here, $X_t = [CPI, M2, Oil\ Price, Discountrate, Exrate]'$, and $Oil\ Price = [OP, HI, InverseHI, Volatility]$. A_0, A_1, and B are 5×5 coefficient vectors. Equation (5) is rewritten in a reduced form as below.

$$X_t = \alpha + \sum_{i=1}^{p} \beta_i X_{t-i} + e_t \qquad (6)$$

In equation (6), p denotes lag order, and e_t is the 5×5 error vector.

Regarding the identification restriction, based on Amisano and Giannini (1997), consider the model in equation (7).

$$Ae_t = Bv_t \qquad (7)$$

Here, e_t is the residual obtained from equation (6), and v_t is an unobserved innovation. Both A and B are 5×5 vectors. To estimate A and B, zero restrictions on the vectors are set as identification restrictions, based on Kim and Roubini (2000) and Ahmed and Wadud (2011).

$$\begin{bmatrix} 1 & a_{12} & a_{13} & a_{14} & a_{15} \\ 0 & 1 & a_{23} & a_{24} & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & a_{43} & 1 & 0 \\ 0 & a_{52} & a_{53} & a_{54} & 1 \end{bmatrix} \begin{bmatrix} e_{CPI} \\ e_{M2} \\ e_{oilprice} \\ e_{drate} \\ e_{exrate} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 \\ 0 & 0 & 0 & 0 & b_{55} \end{bmatrix} \begin{bmatrix} u_{CPI} \\ u_{M2} \\ u_{oilprice} \\ u_{drate} \\ u_{exrate} \end{bmatrix} \qquad (8)$$

In equation (8), the subscript *oilprice* denotes either oil price percentage change (OP), HI, Inverse HI, or Volatility. This restriction can be interpreted as assuming that CPI responds to shocks in M2, Oil Price, Discount Rate and Exchange Rate instantaneously, i.e. in this analysis, within a month. In the same way, M2 is affected by and responds to Oil Price and Discount Rate within the same period, but responds to CPI and Exchange Rate with a time lag of at least one period. In this model,

the international oil price is regarded as exogenous to the Nigerian economy, thus Oil Price is not affected by any other variables, at least within the month. Nigeria is the major oil producer in the African continent together with Libya. Indeed, attacks on the oil refineries and the kidnapping of foreign engineers by the Movement for the Emancipation of the Niger Delta in the Niger Delta region was reported to have been one cause of the international oil price increase from 2006 to 2007. This notwithstanding, in general, Nigeria's production can be considered to be not large enough to affect the international oil price, thus this assumption is appropriate.

Discount Rate is affected instantaneously by Oil Price, but it responds to CPI, M2 and Exchange Rate after a time lag of at least one period. This is based on the assumption that it takes at least one month for policy makers to observe a price increase and to react to set a new exchange rate, as was pointed out by Kim and Roubini (2000). Finally, Exchange Rate instantaneously responds to M2, Oil Price and Discount Rate, but it responds to CPI after a lag of one period. Regarding the assumption on the identification restriction above, both Kim and Roubini (2000) and Ahmed and Wadud (2011) assume that Exchange Rate is affected by all the other variables within a month. However, the assumption that the effects pass through from innovation in CPI to Exchange Rate within the same period is rather strong, thus a_{51} is given a zero restriction in this analysis. To check the robustness of this restriction, an alternative restriction is also applied, where Exchange Rate is assumed to be affected by all the other variables within a period, and the instantaneous Discount Rate shock on CPI is set to zero (a_{14} in equation 8). This does not significantly change the estimation results.

Applying Akaike Information Criteria, the tests for lag length

indicated that no lag is appropriate. However, the purpose of this model is to see the influence over time, and the variables are expected to affect each other in the course of time. Thus, after testing several lag lengths on the basis of the literature, 10 term lags are included.

4-4. Estimation Results

4-4-1. Volatility

The result of the EGARCH model estimation is as below (numbers in parenthesis are standard deviations, ** and * denote 5% and 10% significance, respectively).

$$ln\sigma^2 = \underset{(1.484)}{-2.934^{**}} + \underset{(0.074)}{0.138^{*}}\, ln\sigma_{t-1}{}^2 \underset{(0.057)}{-0.109^{*}} \left|\frac{u_{t-1}}{\sigma_{t-1}}\right| + \underset{(0.308)}{0.393}\frac{u_{t-1}}{\sigma_{t-1}} \qquad (9)$$

As mentioned in 4-1, if the last coefficient is negative, this indicates a larger influence from a negative price shock than from a positive price shock. In this estimation, however, the last coefficient is neither negative nor statistically significant, and it fails to show the asymmetry of oil price shocks on volatility. Alternatively, volatility is estimated for the period from January 1986 to May 2011. In this case, γ is positive and statistically significant at the 1% level, but again fails to show any stronger influence from a negative price change.

4-4-2. The SVAR

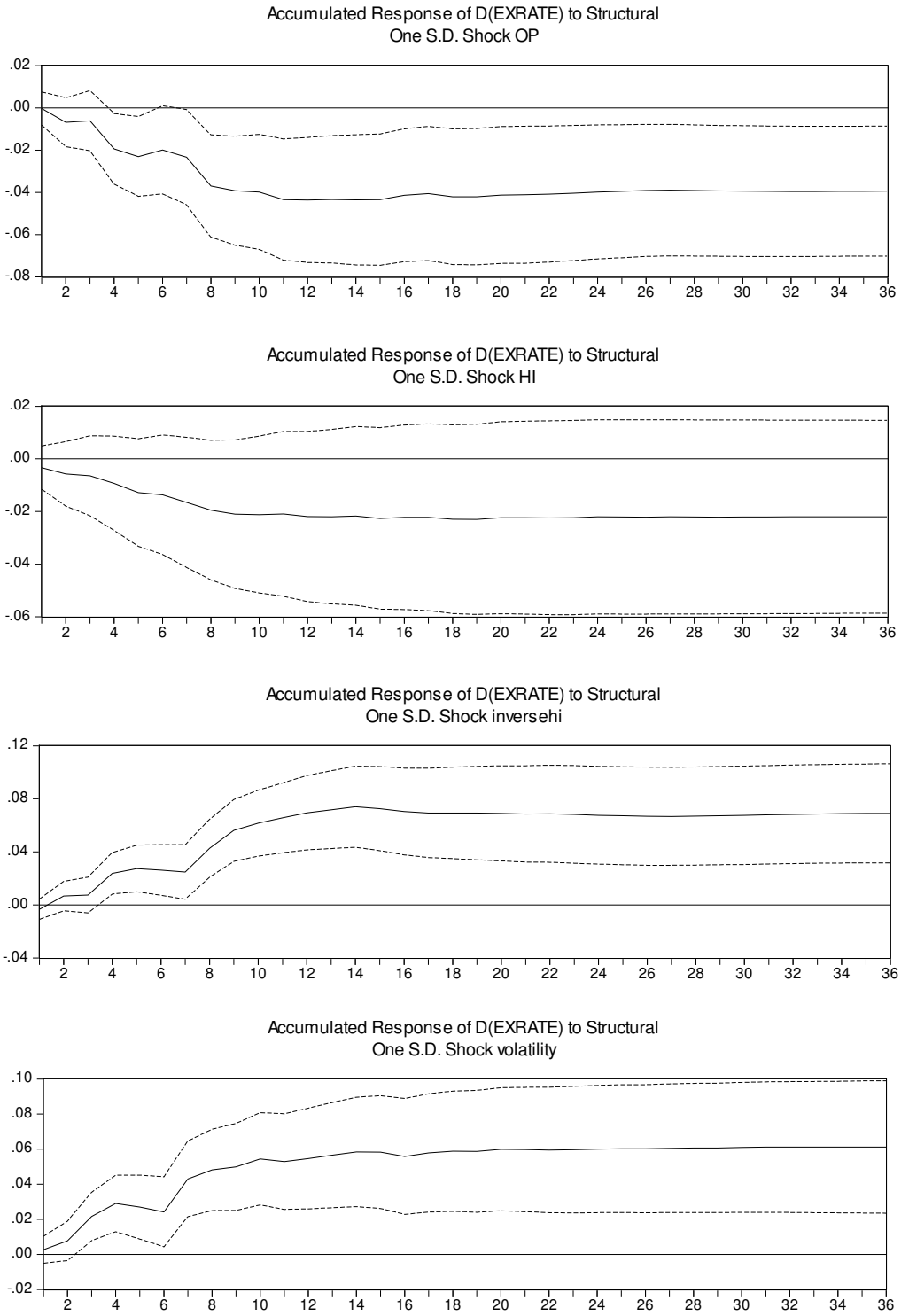
[Exchange Rate]

Figure 5 shows the impulse response of Exchange Rate to an innovation in Oil Price. This shows a response with three to four month lags. The response of Exchange Rate to HI (that is, a price hike) is not statistically significant (for all the other alternative sample periods), but it does respond to the other three oil price indices, and these

responses are statistically significant. Exchange Rate (here denoted as naira per US dollar) appreciates against an innovation in OP. In contrast, Exchange Rate depreciates against an innovation either in Inverse HI (i.e. an acute price drop) or Volatility. These results are robust for almost all the other alternative sample periods, except for the response to the change in OP and Inverse HI for the sample period from January 1995 to May 2011, which were not statistically significant.

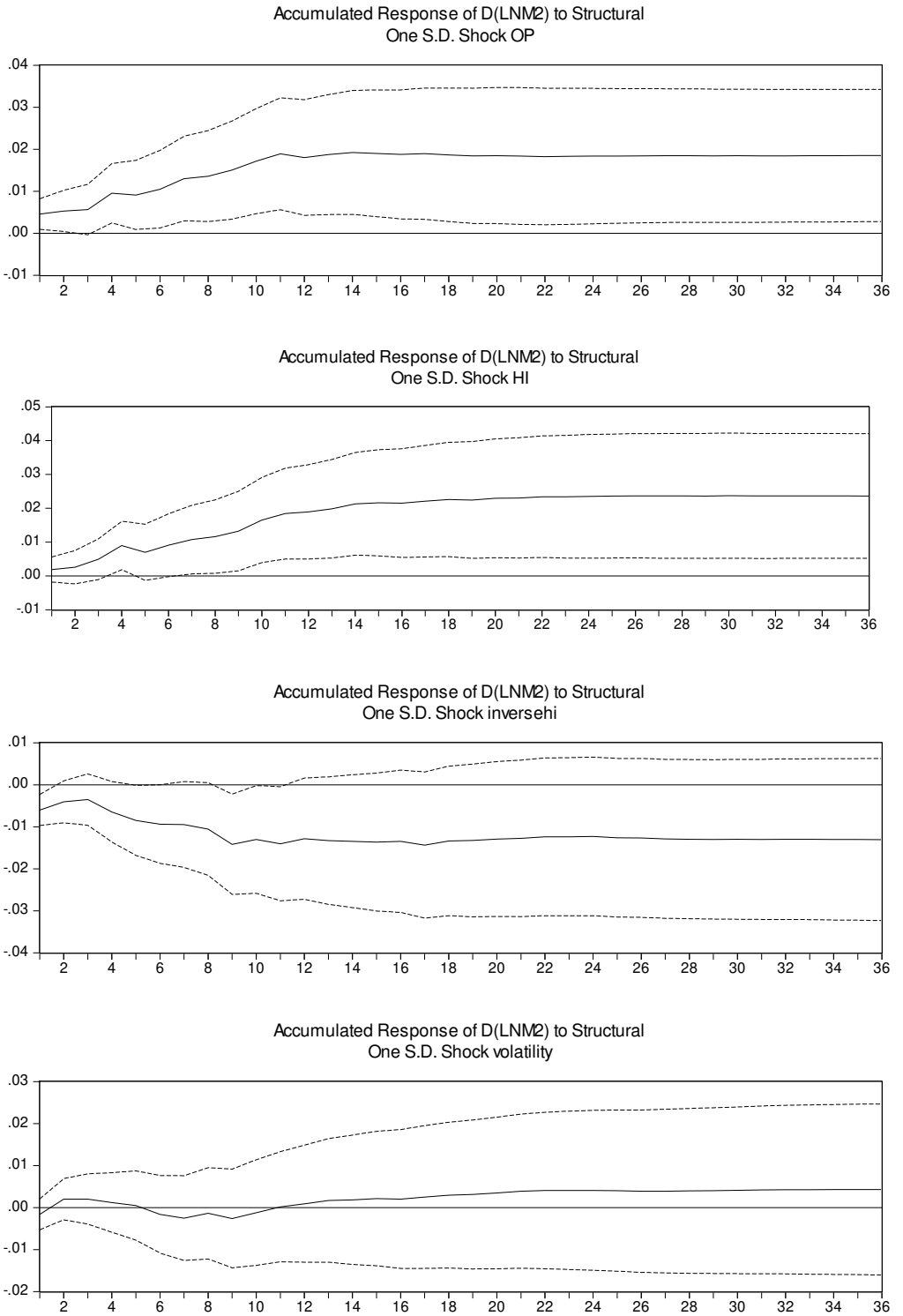
Nigeria's exchange rates were fixed until 1995, so it is possible that the exchange rate did not respond to the oil price change before 1995. However, the estimation result does not change when the sample period is limited to the period from January 1970 to December 1994. This implies that the influence of the international oil price has been quite strong, and that Nigeria's exchange rate has been responding relatively flexibly to price shocks regardless of the exchange regime.

Figure 5. Accumulated Impulse Response of Exchange Rate to an innovation in Oil Price



Note: Doted lines indicate the confidence interval, ± 2 standard deviations. Sample period: January 1970-May 2011

Figure 6. Accumulated Impulse Response of M2 to an innovation in Oil Price



Note: Doted lines indicate the confidence interval, ± 2 standard deviations. Sample period: January 1970-May 2011

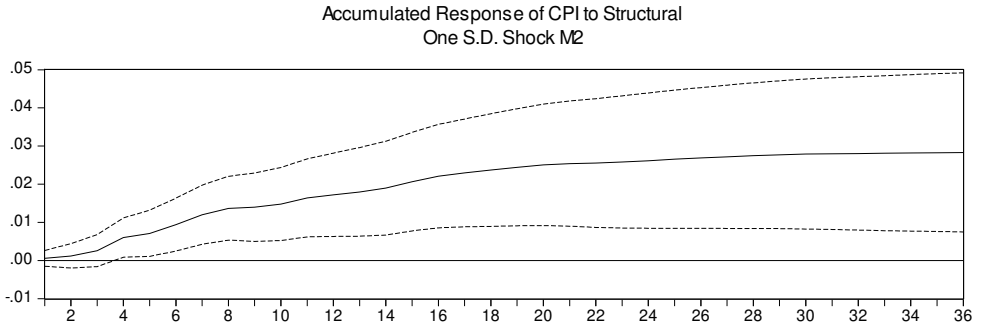
[M2]

Figure 6 shows the response of M2 to an innovation in Oil Price. M2 responds positively and statistically significantly to OP and HI, indicating increases in the money supply after an oil price increase. In the meantime, M2 shows a negative and statistically significant response to Inverse HI for the first 12 months. This remains unchanged for the sample period January 1986, but when the period is limited to after January 1995 and after January 2000, this response ceased to appear. M2 does not show any significant response to Volatility at any sample period.

One possible reason for the increase in the money supply is the surge in the government's liabilities to domestic private banks as well as to the central bank. In Nigeria's recent past, government expenditure increased as the international oil price rose and revenues increased. The expanded budget during the oil boom was maintained even after the oil price fell and revenues decreased (Budina et al. 2007). First, the budget deficit was financed by borrowing from foreign financial institutions, but then it shifted to borrowing from domestic banks. In such a case, however, the increase in the money supply as a response to the oil price shock will be associated with longer time lags. Another reason for an increase in the money supply, which seems more pertinent here, is the supply of oil revenues to the domestic market by the NNPC and the international oil companies. The NNPC, in fact, deposits a fraction of crude oil sales revenues in local currency in the CBN, and this will affect domestic money supply. The central bank is supposed to intervene to neutralise this, but the estimation results suggest that the intervention is insufficient, or that the influence of the NNPC and the international oil companies is far stronger than any

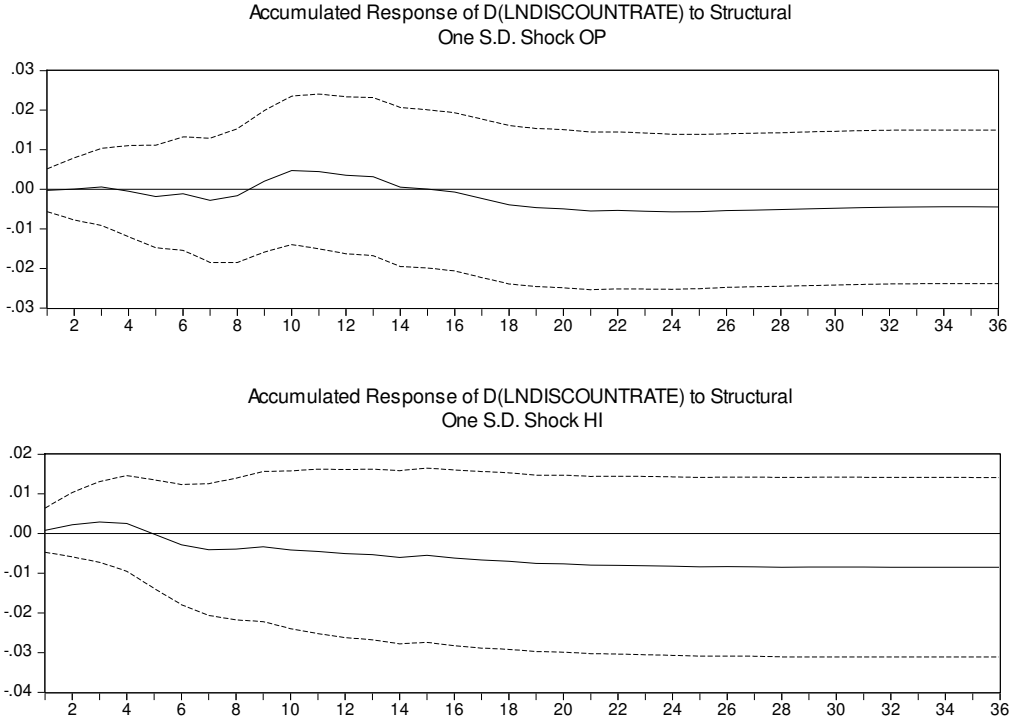
financial measure by the CBN.

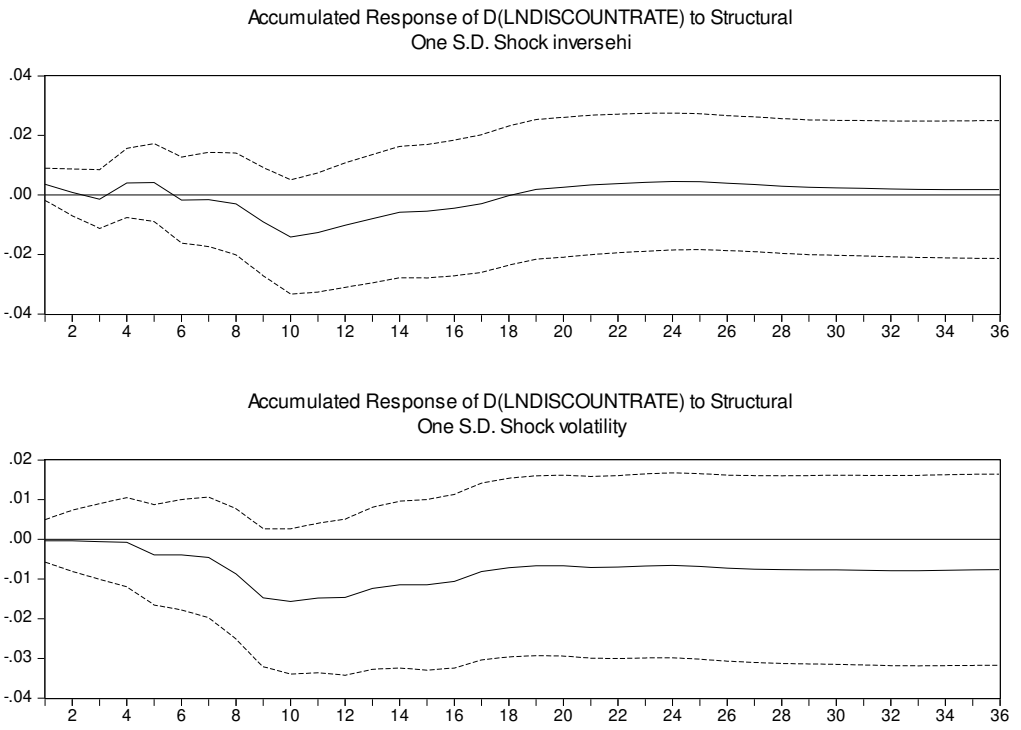
Figure 7. Accumulated Impulse Response of CPI to an innovation in M2



Note: Doted lines indicate the confidence interval, ± 2 standard deviations. The variable for the oil price change in the estimated model is OP. Sample period: January 1970-May 2011

Figure 8. Accumulated Impulse Response of Discountr Rate to an innovation in Oil Price





Note: Doted lines indicate the confidence interval, ± 2 standard deviations. Sample period: January 1970-May 2011

[CPI]

Nigeria's domestic price levels show no direct response to any innovation in any of the four oil price indices. According to economic theory, it is expected that domestic prices in an oil exporting country will fall due to an improvement in the terms of trade after an oil price increase, especially in an economy like Nigeria, which is very dependent on imported goods and foods. CPI, however, shows no statistically significant response to Exchange Rate. On the other hand, CPI responds positively and statistically significantly to a shock in M2 (Figure 7). Because an oil price increase leads to an increase in M2 as shown above, this indicates that price levels are indirectly affected by the international oil price. In other words, the influence from an oil price shock through its effect on the money supply is larger than any

effects that might come from any improvement in the terms of trade.

One more possible reason for the lack of any response by Nigeria's CPI to an oil price shock can be explained by Nigeria's industrial structure. In their analysis of Malaysia, Ahmed and Wadud (2011) suggested that, given that the Malaysian government possesses large stakes in the oil industry, an oil price increase results in a rise in government revenues in the short term that stimulates industrial activity. However, in the longer term, the oil price increase also means higher costs for industrial inputs, so it leads to economic stagnation and inflation. In Nigeria's case, in contrast, while the government also holds huge stakes in the oil industry, the industrial sector is relatively quiescent, and the impact of an oil price shock as an input cost is small.
[Discount Rate]

Figure 8 shows the response of Discount Rate to an innovation in Oil Price. Discount Rate does not show statistically significant responses to any of the four Oil Price indices. As mentioned above, Exchange Rate responds to an Oil Price shock, as does M2. However, Discount Rate shows no response to M2. This result is robust when other alternative sample periods are applied, indicating that there has been no effective reaction to the shock in the economy by the CBN, either to an acute oil price increase (HI) or to a sharp drop (Inverse HI).

Regarding the results above, the impact of oil price volatility is noteworthy. Ahmed and Wadud suggest that oil price volatility has a negative influence on demand in a developing economy such as Malaysia through its influence on price levels like it does in an industrialized country. This result, however, was not proved in the case of the African oil exporter, Nigeria. On the other hand, Nigeria's

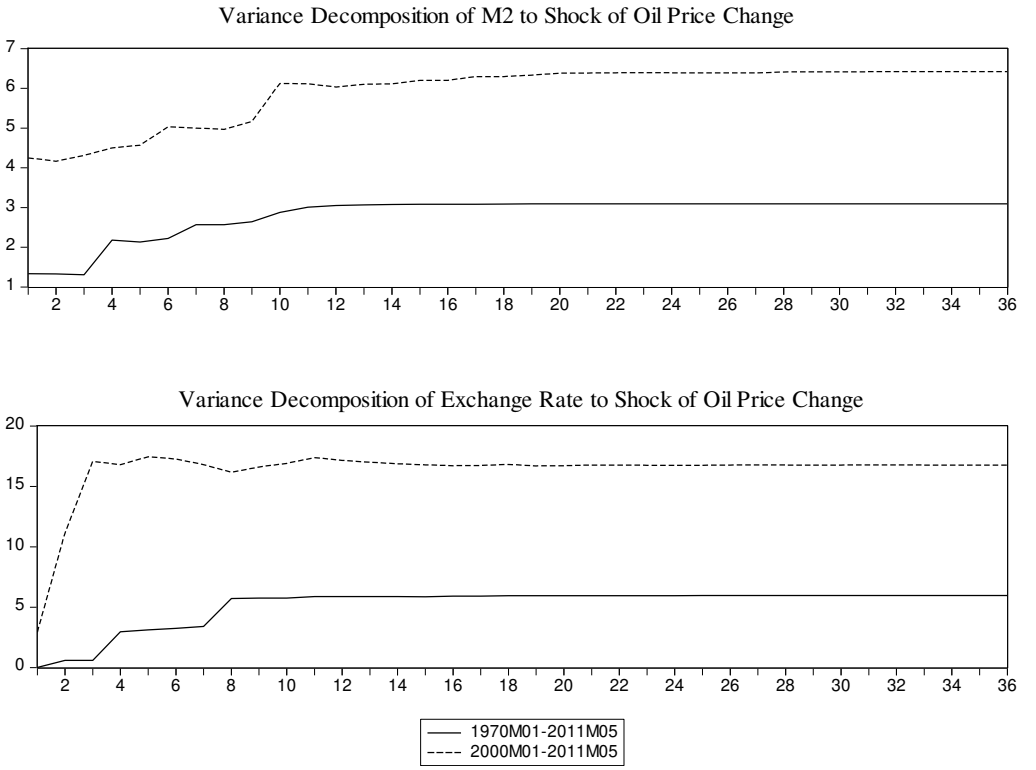
exchange rate significantly depreciates when there is an increase in volatility of the international oil price, and this is robust for alternative sample periods. This point has not been made in the existing literature. Moreover, the correlation coefficient of Volatility and Inverse HI is 0.501, suggesting that Volatility is not necessarily too strongly correlated to a fall in the oil price. Thus it can be understood that Volatility has its own influence on the exchange rate, apart from oil price hike or drop. This result, that oil price volatility influences the exchange rate, indicates that the major money suppliers, namely the NNPC and the international oil companies, refrain from releasing foreign currency onto the domestic market (in other words, they avoid holding local currency) when the oil price is unstable, while demand for foreign currency rises when the oil price fluctuates. The latter leads to a depreciation of the naira.

4-4-3. Variance Decomposition

The major results for the impulse response functions explained above are robust for alternative sample periods. This section looks into whether the power of the influences among the variables changes depending on the sample period. When the results of the variance decomposition in the different sample periods are compared, a variable's contribution ratio to explain other variables' variance is relatively low, staying at 6 to 7% for the highest variable for the period from January 1970 to May 2011, but when the sample is limited to the period from January 2000 to May 2011, the contribution ratio rises. For instance, a percentage change in the oil price explains 18% of the variation in the Exchange Rate for the sample period January 2000 to May 2011 (Figure 9). This implies that the economic liberalization in

Nigeria's economy after 2000 relaxed the restraints on economic factors, which had been fixed or tightly controlled before, so that the economy could react relatively flexibly to exogenous economic shocks. In other words, a shock in the international oil price now passes through macro-economic factors more smoothly than before.

Figure 9. Variance Decompositions



Note: Calculated from the SVAR model.

5. Conclusion

This analysis examined the impact of the international oil price on the economy of an African oil exporter, Nigeria. It has shown that a change in the oil price and price uncertainty has a strong influence on Nigeria's exchange rate, while the direct impact of the international oil price on Nigeria's domestic price levels has not been confirmed. The results also indicate that the money supply is influenced by increases in

the oil price. Moreover, the results indicate that the monetary authority does not react to exogenous shocks by controlling the policy interest rate.

Returning to the context of the "resource curse" literature, the conclusions of preceding studies on the economic performance of resource rich developing countries are mixed. Some argue that resource endowment is negatively correlated to economic performance in the medium- to long-term, thus a "resource curse" exists, while others suggest that there is no difference between the economic performance of resource rich and resource poor developing countries, which implies that there is no such a thing as a "resource curse." This analysis investigated the macro-economic behaviour of a resource rich country, taking an external shock, a change in the international oil price, as a key to explain the mechanism of the resource curse. It is beyond the scope of this paper to offer support for either side of this debate. However, based on a time series analysis using monthly data, it has been shown that Nigeria's economy is indeed affected by the international oil price, not only with respect to any change in the crude oil price but also with regard to oil price volatility. The bottom line is that a heavy dependence on crude oil exports exposes the economy to international price shocks that disturb the domestic macro-economy, mainly because of the strong influence of the change in the price of oil price on the exchange rate.

This amounts to saying that the economy suffers from pro-cyclicality and is thus vulnerable to external negative shocks. For an oil exporting country, a drop in the international crude oil price results in a decrease in government revenues as well as in a depreciation of the local currency. Moreover, as the oil price drops, the

cost of the country's imports rise and the country's purchasing power weakens. According to Nigeria's recent history, economic problems, such as government budget deficits and high inflation, become especially prominent after a drop in the international oil price. These problems are closely related, thus Nigeria's economy is pro-cyclical with regard to any shock in the international oil price. Today, Nigeria's economy heavily and increasingly depends on imports of intermediary inputs, petroleum products such as gasoline (because there is a lack of domestic refining capacity), and food, due to a deteriorating agricultural sector, which has been further aggravated by high population growth. These imports are essential to the economy and price elasticity of demand is low. This indicates that a reduction in purchasing power for imported goods places a large burden on Nigeria's economy. As Nissanke points out, in general, the government in a pro-cyclical economy faces tough and strict austerity adjustments during an economic downturn (Nissanke 2010:83). To avoid repeating the economic stagnation of the 1980s, the government needs to establish a policy which can be implemented in times of unfavourable oil prices.

Lastly, this analysis has suggested the possibility of a strong influence of the national oil company and international oil companies on the domestic economy, especially through their behaviour in the foreign exchange market. In other words, international oil price movements affect the oil exporter's economy through the existence of these large oil companies, which are the main suppliers of foreign currency and operate under only limited control from the monetary authority. As the economy becomes more closely connected to the international financial market, which is associated with increasingly

active movements in the domestic currency market, the influence on Nigeria's economy of these oil companies is expected to become stronger. Further study in this area is a task for the future.

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