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A Vector Autoregressive Analysis of Oil and Exchange Rate in Nigeria: A Case of Dutch Disease

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Abstract

Dutch Disease occurs when a country discovers a substantial natural resource deposit and begins a large-scale exportation of it. As a result, the country's currency appreciates, thereby reducing the competitiveness of the country's traditional export sector. Therefore, this tradable goods sector should contract, leading to structural changes in the economy. This study examines whether Dutch Disease is present in Nigeria in the light of the rejection of the Dutch Disease thesis in other studies on Nigeria. The study assesses the impact of expanding oil revenues on non-oil sectors of the Nigerian economy, taking the agricultural sector as the non-tradable sector. It produces some empirical evidence for the contraction of Nigerian agriculture in the past five decades or more and it demonstrates that the changes in the direction of the Nigerian economy in general was in part a direct consequence of the increase in oil revenue which pushed up the exchange rate and made agricultural product uncompetitive for export. The study uses annual time series data sourced from official sources from 1960 to 2010. The study covers both fixed and post fixed exchange rate system in Nigeria, grouped into three phases. The data are analyzed through the use of vector autoregressive (VAR) modelling consisting of impulse response functions and variance decomposition analyses. The study diagnoses Dutch Disease and concludes that the contraction of the agricultural sector in Nigeria was a result of the sudden windfall from oil. Finally, the paper discusses several policy implications.

Key Words: Exchange rate, Dutch Disease, currency appreciation, traditional export sector, contraction

1. Introduction

The term "Dutch Disease" was first used to depict the fear of death of manufacturing in the Netherland economy when natural gas was discovered in the 1960s. It is generally an upward shift in the resource sector, which may come through an increase in resource prices or through the discovery of a large resource stock available with little cost. Thus, large export potential is possible at low cost for a prolonged period of time, which results in a large increase in resource revenue.

A typical example of DD is an economy whose original exports were tradable agricultural goods, but shift to export of booming sector, which consequently leads to a real exchange rate appreciation and the extinction of the original agricultural exporting sector. The total spending on the non-tradable sector increases if its supply is not perfectly elastic and then there is appreciation in the price of tradables if tradables remain unchanged as a result of this. It can create a serious case of de-industrialization or de-agriculturization. In general, it is a process of re-allocating resources from tradable sectors to non-tradable sectors in the presence of real exchange rate appreciation.

What happened in Nigeria resulted from a combination of economic and non-economic factors. The economic factors relate to the underlying fundamentals, to inappropriate economic policies and planning, while the non-economic factors have more to do with mismanagement of public funds. This study addresses both of these factors from the context of the DD syndrome.

On the economic front, the petroleum export sector led to the creation of a dual economy by giving rise to a new enclave that was only loosely tied into the rest of the economy but created a very large financial surplus. The expansion of Nigeria's petroleum exports also drained resources from other parts of the economy. The oil sector generated an appreciated exchange rate that culminated in a decline in the competitiveness of non-oil exports and of import-competing industries. It also brought about a rise in urbanization to the new oil centres.

Employment increased in non-tradable industries such as construction, internal trade and other private services, and decreased in export industries such as metals, pulp and paper and in import-competing industries such as textiles and clothing. Consumption of domestically produced goods declined, as did agricultural employment and output.

The appreciation in the real exchange rate caused Nigeria to become an ever larger importer of food, where previously it had been largely self-sufficient. It also led to a large increase in imports of industrial goods, thus compounding the negative aspects of the scenario. Nigeria became the "Mecca of the salesmen of the industrial world" (Stevens, 1982). Rice imports rose dramatically from 35 thousand metric tons to 7 million and then 313 million tons in1970, 1975 and 1983 respectively. Wheat, maize and vegetable oil imports also increased dramatically. The dependence of Nigeria on externally produced staples grew markedly after 1972. As Nigerian agriculture stagnated, previous self-sufficiency gave way to ever increasing imports of food, as the payment for imported food was no problem, because of increased oil revenue and a highly valued currency it engendered. The high valued naira was consumer-biased as it apparently became cheaper to import food than to grow it. In any case, cheap imports depressed local food production, and the low prices offered by the marketing Boards had all but quashed export commodity production.

With too many imports and virtually a single export item, petroleum, Nigeria started to develop a current account balance of payments deficit in 1982 (period of recession in the oil market). As imports continued unabated, Nigeria incurred more and more foreign debt. In order to remedy the current account deficit, import controls were instituted which precipitated a black market economy as there was a fixed exchange rate system at the time. One theme of this study is to identify the squeeze on the non-oil tradable sector of the Nigerian economy since the early 1970s, brought about by the combination of real appreciation of naira and

continuous neglect of the rural sector. We call this the "Dutch Disease" syndrome. Our aim is to provide a theoretical and empirical framework for analysing this type of phenomenon.

With exchange rate appreciation, the drive towards industrialization became impossible due to the cheap importation of manufactured products. In addition to this, Nigerian factories could not thrive, owing to inadequate infrastructure facilities such as provision of electricity, which was never there and consequently drove foreign investors away; weak transportation, which continually impeded economic activities even local ones; water supplies that obstructed people's standard of living; telecommunications which was in decline for so many years and human resources development, where free education meant free diversion of funds to private pockets. The national cake was eaten, and many unguided and unhealthy economic policies and social structures were implemented.

A resource boom is not always permanent but may be depletable, thus, if the resource is to be short lived or non-dependable in the long-run, there is a need for diversification into a more broadly based and sustainable economic development. Given the structure of the Nigerian economy, is an opportunity to diversify into the agricultural sector, which can absorb more employment. Therefore, even if the oil export boom is expected to last for a very long time in Nigeria, the government of the day may still need to diversify for employment reason.

This study attempts to translate what happened in the Dutch industrial setting to the Nigerian agricultural setting. Therefore, this study aimed towards the examination of the impact of the crude oil export sector on the traditional agriculture export sector. This is opposed to some earlier studies which used the manufacturing sector to represent the contracting tradable sector, particularly for the period 1960 to 2010. The reason for choosing 1960 is that it will account for the years prior to the oil boom coupled with the fact that it was when Nigeria gained independence. The role of oil, which forms the material base of the export sector, is examined using Nigeria as a contemporary example of a developing country depending on an export resource sector for economic growth.

Some may question why the Dutch situation should be termed a 'disease'. After all, it could be argued that a shift in relative prices or in the 'domestic terms of trade' in most cases favours certain sectors of the economy at the expense of others. If however, such a shift favoured the agriculture sector against the oil sector, as against the case of Nigeria, there is no rationale in calling the phenomenon a disease, rather it is a normal economic mechanism. Our view is that if one sector of the economy squeezes other sectors so much so that the squeeze results in an overall decline in employment, such a phenomenon is a "disease" rather than an adjustment. This is particularly serious if the resource is an exhaustible one.

A more compelling reason why the lagging agricultural sector must be protected is that since Nigeria is a rural economy and any slowdown in the agricultural sector that creates unemployment faster than people can be absorbed in the non-agriculture sector of the economy is a special problem. Whatever the arguments about making the most of the booming sector and using the income as a transfer payment, most governments see employment as a policy goal. Governments that place a high premium on equity will also find it tempting to protect the lagging sector, which is likely to employ a large share of low-income earners, especially in small-scale farming and labour-intensive manufacturing.

Computationally defined, real exchange rate is:

$$\log RER_t = \log h_t - \log f_t + \log f^*_t$$

Where RER_t is the sum of exchange rate defined in units of home currency per unit of foreign at time t, f_t and f^*_t are the price levels at time t. Meanwhile, if purchasing power parity (PPP) holds, then RER_t is constant (which is not empirically true in the short run but may be true in the long run) or else the real exchange rate varies.

Looking at Nigeria and United State hypothetical example:

Real exchange rate for Nigerian economy = ₦/$ (CPI_{US}/CPI_N)

= US basket in Nigerian currency divided by Nigerian basket in Nigerian currency

Where ₦ is Naira (Nigerian currency)

$ is Dollar (US currency)

CPI_N is the consumer price index for Nigerian economy

CPI_{US} is the consumer price index for US economy

Variations in exchange rate can be due largely to capital flows, external imbalances, output fluctuations, an underdeveloped financial sector, high fiscal deficits, high interest rate differentials and at least double-digit inflation rates which can hamper investment decision making and have terrible effect on the economy's employment, output and growth.

This study employs both descriptive and statistical analysis. The descriptive analysis is used to present economic history of Nigeria and relate it to the Dutch disease theory. A VAR is used to quantify the intersection of the key elements of the Dutch disease. This study employs a Standard VAR model, which captures simultaneous co-movements which may not be identified in univariate or bivariate models. The VAR impulse response model is ideal to simulate hypothetical macroeconomic shocks. We use an unrestricted VAR model that includes cointegrating relationships among variables of the model to capture the long-run characteristics of variables and separately examines an ECM mechanism to track the short run dynamics. Impulse Response was employed to capture the accumulated response of agriculture as a share of GDP to macroeconomic variable shocks in the economy. The framework developed by Bernanke (1986), Bernanke and Blinder (1992) and Mallick (2010) are adopted in formulating the structural VAR model.

2. Theoretical and Empirical Literature Review

The history of Dutch disease dates back to the late 1950s when the Netherlands discovered a large natural gas resource in the north of the country and rapid development of the resource began in 1963. Since then some new finds have been made both onshore and offshore. By the 1970s, what was originally a natural gas importing country started to export gas and by 1976, which represented a peak year for natural gas exports, it exported about 51 billion cubic metres or about 44 million tonnes of oil equivalent (mtoe). In addition, massive long-term export contracts were drawn up, with prices linked to the price of oil. The balance of payments current account benefited accordingly. Apart from natural gas earning foreign exchange to the Netherlands as a result of increased exports, it also made a significant contribution to the national budget (Corden 1984; Kremers 1985).

Dutch Disease implies that the exchange rate has appreciated as a result of a new natural resource which greatly augments the country's foreign exchange earnings. A large inflow of foreign exchange and a large balance of payments surplus in most oil exporting countries causes the domestic currency to appreciate, and the oil-based rate to be higher than desirable for the non-oil sectors, with a harmful impact on the competitiveness of domestic production and the objective of diversification. The first paper credited on the resource boom paradox was that of Meade and Russel (1957) but the core model of the theory of Dutch disease today can be seen in the studies of Corden and Neary (1982).

The Classicalists embrace the theory of Dutch disease, problems of rent-seeking and explanation of political-economy (Corden and Neary 1982; Rodriguez and Sachs (1999); van Wijnbergen 1984). The cause and effect of Dutch disease in resource-rich nations was examined by Rodriguez and Sachs (1999), who noticed that over-shooting of levels of consumption lead to movement towards the stationary state and result in slow growth.

The political economy literature often argues that abundant natural resource nrevenues lead to poor spending policies. The idea is that "easy" revenues corrupt and bring about

conflicts (Ross 1986), and encourage economically inefficient, but politically important projects. To mitigate such problems, Sala-i-Martin and Subramanian (2003) suggest decentralizing revenues for the case of Nigeria, by distributing them directly to the people, so the government is forced to finance public services by taxes. Yet only a limited number of theoretical studies have tried to explain a diverging experience in resource impact on economic performance, an exception being Mehlum et al. (2006).

Stjns (2003), using a dynamic multi-sectoral general equilibrium model, found that a surge of oil revenues leads to a real appreciation. Imimole et al (2011) discovered that a country always witnesses real exchange rate appreciation when its nominal rate is pegged and inflation is high. It is mostly reversed by devaluing the nominal exchange rates. Neary (2003) pointed out that under a fixed exchange rate regime the inflation spiral is the main driver of exchange rate appreciation whereas the catch-up movement in stability is driven by periods of flexible exchange rates.

Ross (1986) examined the Dutch disease symptoms in the case of the United Kingdom. According to him, after the commercial exploitation of crude oil in 1975, the RER appreciated by about 10 percent between 1973 and 1982, and this led to a fall in manufacturing output in the United Kingdom. This was also established by Forysth (1985) who confirms that there is evidence of Dutch disease in the UK. However, he affirms that the specific effect of the booming sector (energy) cannot be measured by structural movements of the economy.

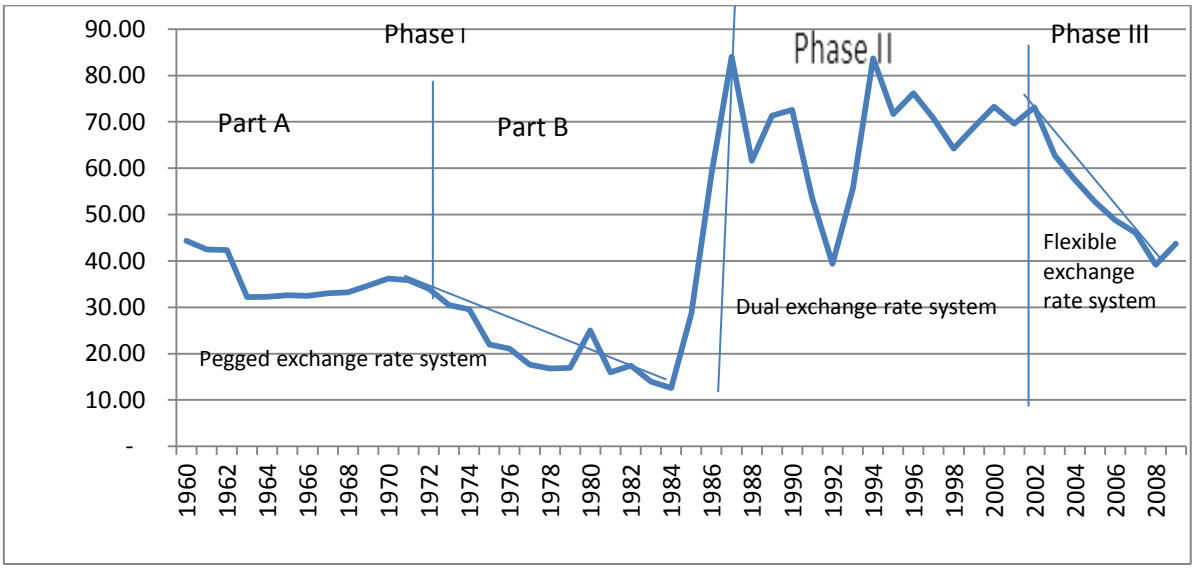
In the case of less developed economies, Warr (1985) thought that the conclusion about the structure of the economy being affected was not clear, but the energy sector boom had unique effects on domestic prices in Indonesia. However, Roemer (1994) confirms that the Indonesian government, through careful exchange rate management, escaped the impacts of the Dutch disease. This shows that the effect of Dutch disease in Indonesia was rendered insignificant through prudent management of exchange.

3. Exchange Rate and Nigeria Economy

3.1 Exchange Rate Regimes

Nigerian economy like some other low income countries of the world from her political independence in 1960 has been using a fixed exchange rate system which entails the pegging of the exchange rate of the Nigerian domestic currency (Naira) to a reference currency (British pound sterling). This was to ensure a low rate of inflation and for proper management of the Nigerian exchange rate but when British pound sterling was floated along the line; the Nigerian Naira became a pegged currency to the American US Dollar. Nigeria shifted from fixed to “controlled/managed” flexible exchange rate system (where there was the official exchange rate and the black market rate) in July, 1986 following the advice of IMF on restructuring the Nigerian economy through Structural Adjustment Programme and economic liberalization due to economic mal-functioning in the early 1980s and not until 1999 a more flexible exchange rate was not introduced to Nigerian economy. The control of the foreign exchange market through visible hand was totally removed in 1999 and the forces of demand and supply determine the exchange rate ever since then (a more pronounced market regulated system). The different phases of exchange rate are demonstrated in figure 1.

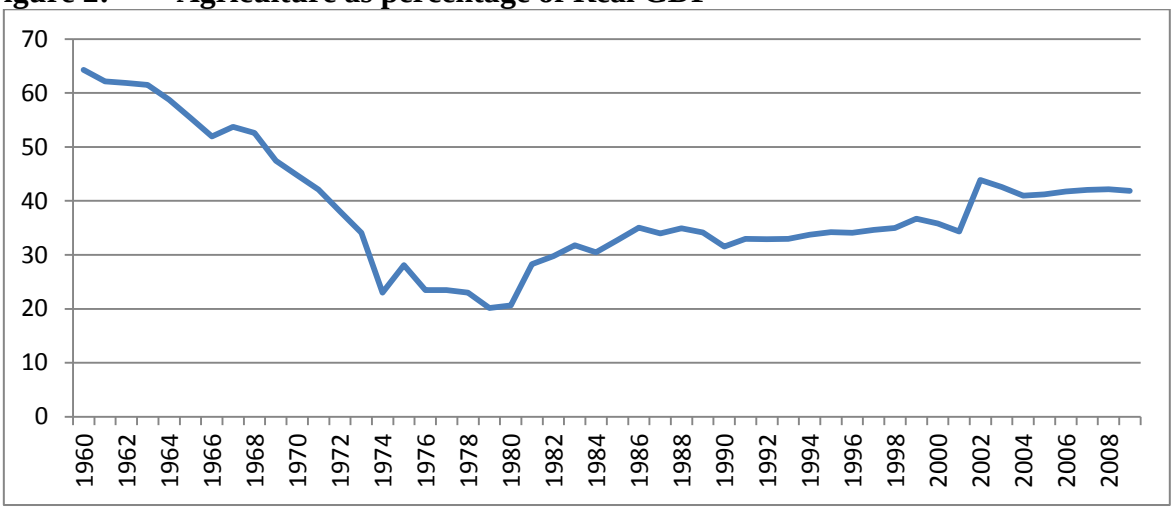
Figure 1: Real Exchange Rate in Nigeria 1960–2010



3.2 Role of Agriculture in Nigeria Economy

Before independence, Nigerian economy was epitome of an agrarian economy that relied on agricultural products for her consumption, employment, domestic savings and foreign exchange earnings. From figure 2, agriculture takes about 65 per cent share of the real GDP signifying the importance of agriculture in the economy at that period.

Figure 2: Agriculture as percentage of Real GDP



Agricultural sector at independence made it possible for the economy to cut down her importations on some major economic activities making the exchange rate stability effective. The contribution of agriculture to GDP was very high from independence till the mid-1970s and agricultural exports remained the backbone of the Nigerian economy and provided a significant proportion of foreign exchange earnings.

> *"In their own contribution, Omowale and Rodrigues (1979) opined that for most developing countries agriculture has been assigned an important role in national development. To them agriculture has been seen as a means of reducing dependence on certain imports, and a way to control food price increases, earning foreign exchange, absorbing many new*

entrants to the labour market and increasing farm incomes at times of severe unemployment and rural poverty" (Anyawu (1997:pp12).)

3.3 Crude-Oil and the Exchange Rate in Nigeria

"There is virtually no exchange rate system that Nigeria has not tried in order to find the 'realistic' exchange value for the Naira" (Adedipe, 2004). The different exchange rate regimes in Nigeria can be classified into different epochs relating to the vagaries of the international oil market.

3.3.1. The Post-Independence Era (1960-1971)

Like some other low income countries of the world, after political independence in 1960, the Nigerian economy used a pegged rate system, where the Nigerian (Pound) was pegged to the British Pound (as can be seen in Figure 1). During this period, the Nigerian Pound was pegged at par to the British Pound Sterling (GBP), using administrative measures to sustain the parity. The devaluation of the GBP in 1967 coupled with its being floated in 1972 forced Nigeria switch to a US Dollar, which was deemed better able to develop Nigeria's import substitution industries. During this period the fiscal balance was in surplus for most of these years, inflation rate averaged about 5 percent and the Current Account Balance was in surplus. This period is captured by Part A Phase I of the exchange rate system (Figure 1).

3.3.2 The 'Oil Boom' Era (1972-1986)

The oil boom is Part B of the Phase I of the exchange rate system (Figure 1 above). During this period, the exchange rate mirrored movements in oil prices and the naira remained strong as a result of the huge increase in foreign exchange earnings. The currency was pegged to US Dollar in 1972. This was abandoned between 1974 and 1976, when an independent exchange rate management policy that pegged the naira to either the US dollar or the British pound sterling was put in place and a policy of gradual appreciation of the naira was pursued. The huge earnings from crude petroleum export over this period allowed Nigeria to run persistent external surpluses in the balance of payments, which supported the appreciation of the naira.

This period was the beginning of Dutch Disease in Nigeria. The strong exchange rate that followed helped to cheapen imports of competing food items as well as agro-based and industrial raw materials, which led to rapid expansion in the importation of these goods to the detriment of local production of similar goods. Aggregate import demand later outstripped total foreign exchange available for import and trade restrictions though an import licensing scheme was introduced. A policy reversal was effected in the management of the naira exchange rate towards the latter part of 1976: this was a deliberate policy to depreciate the naira, although it was not systematic. However, in 1978, the naira was anchored on a basket of 12 currencies of Nigeria's major trading partners. This was jettisoned in 1985 and the naira reverted to anchored against the US dollar.

3.3.3 The Post-Sap Era (1986 till 2010)

The last exchange rate period in Nigeria began in 1986 (see figure 1). A major policy reversal was effected in September 1986 when the fixed exchange rate regime had to be discarded and a flexible exchange rate regime was put in place following the advice of the IMF on restructuring the Nigerian economy through the Structural Adjustment Programme (SAP).

With the adoption of SAP, foreign exchange allocation and import licensing procedures were abolished and transactions in foreign exchange were subjected to market forces under an auction system. The naira was subjected to a managed float in a continuing

effort to restructure the economy away from oil dependency. The policy of deregulation of the foreign exchange market in 1986 was aimed at establishing the market exchange value of the naira. The hope was to boost non-oil exports and reduce the dependence on crude petroleum exports.

As noted by Honohan and Lane (2003), exchange rate depreciation had resulted in the dramatic increase in the naira price of imports, which should have discouraged imports. However, it was not until 1999 that a more flexible exchange rate was again introduced to the Nigerian economy. The visible control of the foreign exchange market was totally removed in 1999 and a more pronounced market regulated system was introduced.

4 Methodology

4.1 Model Description

The model tests if Dutch Disease measured by AGRICGDP is a function of the relative price variable, demand variable, oil effect and the policy stance. The empirical model is given by:

$$AGRICGDP = \beta_0 + \beta_1 PON_t + \beta_2 VON_t + \beta_3 RER_t + \beta_4 MS_t + \beta_5 PC_t + \mu_i \ldots\ldots\ldots\ldots\ldots [4.1.1]$$

Where

AGRICGDP = share of agriculture to GDP

PON = Price of oil

VOL = VOL

RER = real exchange rate

MS = money supply as share of GDP

PC = per capita income

t is the time trend and μ_i is the error term which is assumed according to OLS assumption to be distributed in zero mean and constant variance $\mu_i \sim N(0,\delta^2)$ where $i \neq j$.

From the theory it is hypothesized that the Dutch Disease variables will account for a substantial part of the tradable goods sector contraction.

The model focuses on the agricultural output percentage of GDP as the dependent variable and presents explanatory variables that attempt to capture the impact of the essential theoretical elements detailed in the preceding section.

4.1.1 Types and Sources of Data

Annual time series data were used for the study and they are purely secondary data. The data collected for this study were from official sources including the IMF International Financial Statistics and the World Bank. This study covers both fixed and post fixed exchange systems in Nigeria as discussed in previous chapters, for the period 1960 to 2010.

4.1.2 Identification of Variables

The variables identified for utilization in the study is:

The dependent variable (share of agriculture to GDP) and the independent variables (price of oil, quantity of oil, real exchange rate, money supply and per capita income).

4.1.2.1 Relative Price Effect Variable

The relative price effect is brought about due to an increase in expenditures in the domestic economy as the oil windfall flows into the country. Most of the increased spending

arises from the government sector as it is the substantial recipient of the oil revenues (through direct ownership or levying taxes on domestic oil producers). Therefore, a variable of government expenditures would capture most of the aspects of the relative price effect. However, when national incomes rise, there is an excess demand for products which is mitigated only by an increase in the price level. The increase in the domestic price level affects the real exchange rate, causing the country's agriculture to become less competitive. Then, production of those goods should decrease as the real exchange rate appreciates. If this is so, then perhaps the real effective exchange rate is a suitable proxy for the relative price effect.

However, it is expected from the Dutch Disease theory that the government expenditures variable and the real exchange rate variable should be highly correlated (Rudd, 1996). Correlation coefficients are presented below.

Table 4.1: Correlation between Government Expenditures and Real Exchange Rate in Nigeria

	GGS	RER
GGS	1	-0.1192
RER	-0.1192	1

Source: Author's computation (2012)

The two variables are correlated and from the econometric perspective it is confusing to include both in the model. This confusion results from a fundamental principle of regression analysis (that all other variables are held constant when examining the effects of anyone variable). For example, when examining the effects of the government expenditures variable, it is necessary to hold constant the real exchange rate if it is included in the model. However, in theory the government expenditures variable works through the changing real exchange rate. But if both are included in the regression, then this econometrics principle prevents them from functioning according to theory (Rudd, 1996).

Therefore, it is necessary to decide which one to include: in this study the real exchange rate variable is chosen as the proxy for the relative price effect in Nigeria. This is because many LDCs like Nigeria finance government expenditures through the printing of money, the government expenditures variable therefore takes into account much more than just the increase in oil revenue. In fact, the increase in revenue from oil may be totally lost, or at least distorted, if the government does indeed print a large amount of money to finance its expenditures. Data for this are found in the International Financial Statistics. It is predicted that as RER decreases (representing an appreciation of the country's currency), the country's agricultural output should contract. According to the Dutch Disease theory, the nation's currency should appreciate as the government spends more, which will eventually cause its traditional export sector, agriculture, to contract. This real exchange rate employed in this is computed as the ratio of domestic prices to foreign prices.

4.1.2.2 Control Variables

4.1.2.2.1 Demand Variable

The paper has hypothesized that Nigeria's agricultural output has declined due to the presence of Dutch Disease. However, it is possible that much of these declines are due, in part, to the natural tendency for the agriculture sector to contract as LDCs begin to develop. It is perhaps worthwhile mentioning that in 1820, the US agriculture sector employed 79 percent of the labour force and accounted for over 60 percent of GDP (Johnston and Kilby

1975:196). However, today, the agriculture sector accounts for just 2 percent of GDP and employs a mere 3 percent of the total number of workers. This dramatic redistribution of the economy was merely a result of the country's development process. As such, the US changed from a predominantly agrarian society to an industrialized nation, not due to Dutch Disease, but because that transition was part of its development process. Consequently, it is necessary to account for this in Nigeria. We therefore employ per capita income as an appropriate control variable for this development tendency. Per capita income is used by economists as the most common measure of a country's level of development. As the country develops and devotes more attention to manufactures, per capita incomes should increase. As such, PC is used as a control variable controlling for demand in the economy. This is not to say that the changes in per capita income cause agriculture to expand or contract, but merely that PC accounts for the demand process. A positive relationship is expected to exist between PC and the growth of the tradable sector.

4.1.2.2.2. Oil Effect

It is necessary to include the effect of trade with the rest of the world. However, the major dominant variable of export in Nigeria's current account balance has been oil. Therefore, the price and the quantity of oil produced are used as proxy in this study to capture the trade effect. Another argument in the Dutch disease studies is that the oil fortune led to the neglect of the tradable sector in Nigeria through exchange rate appreciation, that is, due to the oil windfall factors of production have moved from tradables to non-tradables, leading to expansion in non-tradables and shocking up of the tradable agriculture. Negative relationships are expected between the price of oil (PON) and quantity of oil produced (VOL) and the growth of the tradable sector.

4.1.2.2.3 Policy Stance

Several other control variables are needed to account for possible other explanations of the decline in the agricultural sector in Nigeria. The most obvious of these would be a money supply variable. In an article titled "Dutch Disease or Monetarist Medicine?: The British Economy under Mrs. Thatcher," Chrystal (1984) posits that contractionary monetary policy, rather than Dutch Disease, caused the decline in the UK's manufacturing sector. Using descriptive statistics and convincing argument, the researcher refutes Dutch Disease as an important underlying factor in the contraction of Britain's manufacturing sector. Another study, by Hutchison (1994), decomposes the variance of manufacturing output fluctuations into that part attributable to energy booms and disturbances in monetary conditions, using the Johansen method of co-integration analysis and the vector error correction modelling (VECM) approach. Using his empirical model, he concludes that monetary factors played a large role in the UK, helping to explain slightly over 15 percent of unanticipated manufacturing output restrictions. Thus it is expected from the Dutch Disease theory that an expansionary monetary policy would lead to expansion in the tradable sector while a tight monetary policy would shrink the tradable sector. The money supply share of GDP is represented by the variable MS. A positive relationship is expected to exist between MS and the growth of the tradable sector.

Table 2: Variables and their Expected Signs

Variable	Type	Explanation	Expected Sign
AGRICGDP	Dependent	Percentage share of agriculture to GDP	
RER	Dutch Disease: Relative Price Effect	Real Exchange Rate (₦/$)	Positive
PC	Control: Demand variable	Per Capita Income(GDP/Population)	Positive
MS	Control: Policy Stance	Money supply as percentage of GDP	Positive
PON	Control: Oil Effect	Price of oil (Naira)	Negative
VOL	Control: Oil Effect	Quantity of Oil Produced (barrels)	Negative

Source: Authors' computation (2012)

4.2 Model Specification and Methodology

Based on the literature reviewed and condition of the country, this study has adopted the works of Bernanke (1986), and Jimenez-Rodriguez and Sanchez (2003), we represent the reduced form of a standard open economy macroeconomic model as a multivariate dynamic system. We thus specify the following vector autoregression (VAR) model as:

$$\beta_0 \square_t = A + \sum_{i=1}^{P} \beta_i \square_{t-1} + \xi_t \qquad ---------- (4.2.1)$$

where Υ_t is a (6 X 1) vector of endogenous variables being considered as price of oil, quantity of oil produced, percentage of agricultural output to GDP, money supply share of GDP, per capita income and real exchange rate; β_0 and β_i are 6X6 matrices of coefficients; A is a vector of constants; P is the number of lags and ξ_t is a 6 X 1 vector of uncorrelated white noise disturbances. The matrix β_0 is assumed to be lower triangular with 1s along its main diagonal thus guaranteeing that the model is just identified.

The framework developed by Bernanke (1986), Bernanke and Blinder (1992) and Mallick (2010) are adopted in formulating the structural VAR model.

Therefore, the structural unrestricted VAR model for this study is specified as:

$$A_t = \square_i + \sum_{i=1}^{a} \Psi_{1i} A_{t-1} + \sum_{i=1}^{b} \theta_{11i} P_{t-1} + \sum_{i=1}^{c} \theta_{12i} V_{t-1} + \sum_{i=1}^{d} \theta_{13i} R_{t-1} + \sum_{i=1}^{e} \theta_{14i} M_{t-1} + \sum_{i=1}^{f} \theta_{15i} G_{t-1} + \mu_{1t} ----$$
$$- (4.2.2)$$

$$\chi_t = \square_i + \sum_{i=1}^{a} \theta_{j1i} P_{t-1} + \sum_{i=1}^{b} \theta_{j2i} V_{t-1} + \sum_{i=1}^{c} \theta_{j3i} R_{t-1} + \sum_{i=1}^{d} \theta_{j4i} M_{t-1} + \sum_{i=1}^{e} \theta_{j5i} G_{t-i} + \mu_{jt} ------$$
$$- (4.2.3)$$

Where x_t is a vector (5 x 1) matrix of other endogenous variables excluding agriculture share of

GDP A_t ie

$$\chi_t = \begin{pmatrix} p_t \\ v_t \\ r_t \\ m_t \\ g_t \end{pmatrix} \qquad (4.2.4)$$

where:

A_t is the agriculture product as share of GDP;

$P_t$is the domestic price of oil;

V_t is the quantity of oil produced in barrels;

R_t is the real exchange rate of naira vis-à-vis US dollar;

M_t is the domestic monetary aggregate measured by the broad money supply (M2) as share of GDP;

G_t is the per capita income growth;

χ_t is the extension of other macroeconomic variables excluding A_t incorporated in the VAR model above;

Ψ_{ij} and θ_{ij} are parameters to be estimated in each system of equations;

Υ_i is the intercept;

u_{it} is the innovation term that propels shocks in the interdependence equation system (4.2.2) to (4.2.3);

t is time; and

i is the lag length to be determined by the Akaike and Schwarz information criteria.

In re-specifying the VAR system model 4.2.2 to 4.2.3 in matrix form, the matrix (6 x 6) is expressed as:

$$\begin{pmatrix} a_t \\ p_t \\ v_t \\ r_t \\ m_t \\ g_t \end{pmatrix} \begin{pmatrix} \Psi_1 & \theta_{11} & \theta_{12} & \theta_{13} & \theta_{14} & \theta_{15} \\ \Psi_2 & \theta_{21} & \theta_{22} & \theta_{23} & \theta_{24} & \theta_{25} \\ \Psi_3 & \theta_{31} & \theta_{32} & \theta_{33} & \theta_{34} & \theta_{35} \\ \Psi_4 & \theta_{41} & \theta_{42} & \theta_{43} & \theta_{44} & \theta_{45} \\ \Psi_5 & \theta_{51} & \theta_{52} & \theta_{53} & \theta_{54} & \theta_{55} \\ \Psi_6 & \theta_{61} & \theta_{62} & \theta_{63} & \theta_{64} & \theta_{65} \end{pmatrix} \begin{pmatrix} \mu_a \\ \mu_p \\ \mu_v \\ \mu_r \\ \mu_m \\ \mu_g \end{pmatrix} \quad (4.2.5)$$

We therefore proceed with the endogenous variables n=6 and we assume that the structure of the model is consistent with the class of dynamic linear stochastic models. The matrix form of the VAR model is presented in 4.2.5.

The effect of the structural breaks in the exchange rate regime in Nigeria is captured by different phases as discussed in Chapters 3. Thus, the VAR was conducted using dummy in capturing phase 1 and phase 3.

5 Empirical Results and Analysis

5.1 Unit Root Tests

To test the variables for stationarity and determine the order of integration of the individual data series, Augmented Dickey and Fuller (1979) and the Phillips and Perron (1988) tests for unit roots were conducted. The variables were tested with intercept and intercept plus trend. The results are reported in Table 5.1.

Table 5.1: Unit Root Tests Result

Table 5.1.1: Unit root tests at Levels

	Type of Tests			
	ADF		PPT	
Variables	Intercept	Intercept & Trend	Intercept	Intercept & Trend
LNAGRICGDP	-1.989774	-1.557825	-2.012952	-1.520100
LNPON	-3.444091**	-3.353217*	-3.444091**	-3.353217*
LNVOL	-2.503881	-6.376241***	-2.965170**	-2.349896
LNRER[1]			-1.596798	-1.995326
LNMS	-1.484841	-1.970408	-1.292309	-1.753882
PC	1.998864	-2.705055	1.998864	-2.184420

Source: Author's computation (2012)

Table 5.1.2: Unit root tests at First Differences

	Type of Tests			
	ADF		PPT	
Variables	Intercept	Intercept & Trend	Intercept	Intercept & Trend
LNAGRICGDP	-7.334347***	-7.766072***	-7.330206***	-7.725640***
LNPON	-10.31391***	-10.33207***	-13.28866***	-32.74700***
LNVOL	-6.372755***	-	-6.359255***	-6.583409***
LNRER	-5.585149***	-5.527662***	-5.462629***	-5.396046***
LNMS	-5.040604***	-4.988070***	-5.039060***	-4.986193***
PC	-4.686384***	-4.865722***	-4.566899***	-4.727239***

Source: Author's computation (2012)

***Notes**: (i) Critical Values for **ADF (Intercept)** are **(10** percent**)** -2.59, **(5** percent**)** -2.92 and **(1** percent**)** -3.57 (ii) Critical Values for **ADF (Intercept & trend)** are **(10** percent**)**-3.18, **(5** percent**)**-3.50, **(1** percent**)**-4.16 (iii) Critical Values for **PPT (Intercept)** are **(10** percent**)**-2.59, **(5** percent**)** -2.92, **(1** percent**)** -3.57 (iv) Critical Values for **PPT (Intercept & trend)** are **(10** percent**)**-3.18, **(5** percent**)**-3.50, **(1** percent**)**-4.16*

Table 5.1.2 reveals that all variables are integrated of order 1 except PON. VOL may be stationary at level as shown in Tables 5.1.1 and 5.1.2. As a result, the variables are integrated of order one i.e. I (1) in levels. The Engle-Granger (1987) co-integration representation theorem is then applied which states that, if a group of time series data is integrated of the same order, then there could be a possible cointegration (long run) relationship among them. The next stage involves the tests and a result of co-integration.

5.2 Cointegration Tests

The cointegration tests results on the variables {price of oil (PON), quantity of oil (VOL), real exchange rate (RER), money supply as share of GDP (MS), per capita income (PC) and the share of agriculture to GDP (AGRICGDP)} are presented below.

Table 5.2.1 reveals that the Trace Test rejects the null hypothesis of zero cointegrating vectors at 1 percent level of significance but could not identify more than 1 cointegrating vector.

Table 5.2: Johansen's Cointegration Tests Results

[1]*We did not use ADF for **LNRER** due to the structural break. According to Enders (2010) **w**hen there are structural breaks, the various Dickey Fuller test [1]statistics are biased towards non rejection of a unit root', Enders (2010)*

Table 5.2.1: Trace Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value (0.05)	Prob.**
None *	0.592768	105.8437	95.75366	0.0084
At most 1	0.357523	63.62020	69.81889	0.1413
At most 2	0.349036	42.82626	47.85613	0.1368
At most 3	0.246156	22.64912	29.79707	0.2637
At most 4	0.180703	9.368360	15.49471	0.3324
At most 5	1.77E-05	0.000831	3.841466	0.9780

Trace test indicates 1 contegrating eqn(s) at the 0.05 level

Table 5.2.2: Max-eigenvalue test

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	Critical Value (0.05)	Prob.**
None *	0.592768	42.22345	40.07757	0.0282
At most 1	0.357523	20.79394	33.87687	0.6995
At most 2	0.349036	20.17714	27.58434	0.3290
At most 3	0.246156	13.28076	21.13162	0.4267
At most 4	0.180703	9.367529	14.26460	0.2568
At most 5	1.77E-05	0.000831	3.841466	0.9780

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Source: Author's computation (2012)

However, to pin down the exact number of cointegrating vectors, we conducted a Maximum Eigenvalue Test as shown in Table 5.2.2. The results of this test confirm that there is at least one cointegration vector as the hypothesis of zero cointegration vectors is rejected at 5 percent level of significance. The hypothesis of at most 1 cointegrating equation cannot be rejected. This means that variables in the system move together towards a stationary long-run equilibrium state defined by the cointegrating vector.

The implication is that even though the series are not individually stationary, a linear combination was found to be stationary. This means that there is a stable long-run relationship between them and so we can avoid both the spurious and inconsistent regression problems which otherwise would occur with regression of non-stationary data. Since we have 1 co-integrating equation from two tests, we can conclude that there is a long-run equilibrium relationship in the system of variables that comprise one Dutch Disease equation in Nigeria.

5.3 Impulse Response Functions

The Impulse Response Functions (IRFs) are used in this study because many of the variables have linkages to each other: the problem of the non-exogeneity of some of the variables can be taken care of using the IRFs, which capture the endogeneity of the variables. Using Cholesky Ordering, (Appendix 1) shows that all the interrelationships in the model are captured by VAR. The IRFs show the response of a particular variable to one standard deviation shock on each of the variables in the system. The interpretation of the IRFs takes into consideration the use of first differencing of the variables since a one-time shock to the first difference in a variable is a permanent shock to the level of that variable. The following conclusions could be drawn from the IRFs results in Appendix 1.

The response of the real exchange rate to innovations in the quantity of oil produced in Nigeria is negative throughout the accumulated period except the first two periods. This shows that an increase in quantity of oil produced for the eight periods led to appreciation of real exchange rate in Nigeria. This tends to suggest that Nigeria is plagued with Dutch disease.

The effect of the price of oil on the contraction of the agricultural sector is also established from the result throughout the observed periods. The signs are negative throughout the accumulated period and the coefficients are strong, which also tends to suggest that Nigeria is plagued with Dutch disease.

The contractionary impact of the real exchange rate for the accumulated periods on agricultural output is established. This is seen from the response of agricultural output to innovations in the real exchange rate. Using the 10-period accumulation, from the second to the tenth period the signs are positive and the coefficients are strong. This tends to suggest that exchange rate appreciation has a contractionary impact on the agricultural output in Nigeria, which further suggests that Nigeria is plagued with Dutch disease.

Also, the contractionary impact of the quantity of crude oil produced and the price of oil on agricultural output is established. This is seen from the response of agricultural output to their innovations. Using the 10-period accumulation, from the first to the tenth period the signs are negative and the coefficients are strong for the price of oil but weak for the quantity of oil. This tends to suggest that Nigeria is plagued with Dutch disease. This is contrary to the finding of Roemer (1985), whose study was based on Nigeria, Mexico and Venezuela and Jazayeri (1986) who studied Iran and Nigeria among other studies on the LDCs which made similar findings. The problem with these studies, which did not find evidence of the Dutch disease in the LDCs, was that they assumed manufacturing was the sector that suffered whereas agriculture is the traditional export sector of most of the LDCs, especially Nigeria.

5.4 Variance Decomposition

After discussing the findings for the impulse response functions in the previous subsections, we now turn to the results for the variance decomposition, which shows the share of the forecast error attributable to each variable. Appendix 2 displays the forecast error variance decomposition results for all the variables involved in the SVAR model. From the table, it appears that both the quantity of oil produced and the real exchange rate spread dominate the system to some extent as their forecast errors are largely attributable to their own innovations: about 85 percent and 67 percent respectively of the forecast error variance are explained by their own innovations at the end of the 10-year period considered in the variance decomposition.

Forecast errors of price of oil in the first two months are purely explained by its own shock (100 percent), which reflects the contemporaneous identification scheme. Among all the variables, changes in the agriculture share of GDP are not fully explained by its own innovation (80 percent) in the first period but by the end of 10-year horizon, less than 44 percent of its movement are due to its own shocks while the remaining percentage are mainly due to real exchange rate spread and the quantity of oil produced.

The forecast errors of the exchange rate spread is relatively largely determined by the change in the price of oil — at least for longer term forecasts. This is consistent with the findings for the impulse responses of the previous subsections.

The major finding here is that variations in agricultural output are explained predominantly by own shock followed by the quantity of oil in the short run (two periods) while the real exchange rate explained more than own shock in the long run. Thus, in the long run, the real exchange rate is the most important variable that explains variations in agricultural output as share of GDP if own innovation is assumed away. These further confirm that real exchange rate and the quantity of oil are an important source of variation in agricultural production in Nigeria. Likewise, over the medium to longer term (4–10 years), changes in the real exchange rate (aside from the effects of its own shock) are only explained

by shocks to the price of oil spread. These are akin to the response found in the impulse response functions.

6. Conclusion and Policy Recommendation

The results above offer support for the hypothesis that agriculture as a share of GDP responds to movements in real exchange rates and price and quantity of oil produced and that most of the dynamic interaction takes place in the long run. These results are consistent with Olusi and Olagunju's (2005) model of speculation and theoretical groundwork of Dutch disease. Rising oil prices can breed appreciation of real exchange rate which will lead to contraction of the traditional tradable sector (agriculture).

This study has shown that, contrary to earlier findings that Nigeria is not suffering from the Dutch disease, the disease is present in Nigeria, although in the long run. A possible explanation for earlier findings could be because the authors assumed that oil would impact manufacturing rather than agriculture. But it is a known fact that agriculture and not manufacturing has been the traditional leading foreign exchange earner and therefore the traditional tradable sector of most less developed economies including Nigeria. Likewise, it is also a known fact that manufacturing sectors in the less developed economies are still not developed to the stage where their products will enjoy large foreign patronage and become tradables as in the developed economies.

The contraction of the agricultural sector in resource boom countries, especially Nigeria, was a result of the sudden windfall from oil. It is therefore inescapable that government should focus more on the traditional tradable sector and put more money into agriculture, the sector with long-term potential for sufficiency in food and economic development. It is clear that things changed domestically in this regard in recent years in Nigeria as evidenced in our quantitative analysis although at an insignificant rate. The recent rise in the local contribution of non-oil to GDP (as seen in the third phase of the economy) is a welcome development for the agricultural sector and sectors other than oil in the Nigerian economy.

The results in this study have a number of policy implications. As expected, real exchange rates respond to the price of oil and the quantity of oil produced in Nigeria. Also, the agriculture share of GDP responds to both the exchange rate and the price and quantity of oil produced in Nigeria to confirm that Dutch disease is real in a significant way in the economy. Thus, increased oil revenues could hurt the whole economy if not properly managed. In Nigeria, the effects of oil revenues spent on unproductive activities are visible. We find that the real exchange rate appreciation led to a significant contraction of the agricultural sectorial productivity. Such a scenario could be reversed if the revenues of oil were used on productive activities.

Provision of extension services and new technology by the government to the agricultural sector could enhance increase productivity in the sector. In addition, spending a significant proportion of the oil revenues on infrastructural facilities would greatly enhance workers' productivity which would result in both short- and long-term growth. It is important that the government of Nigeria prioritize agricultural sector again with more sense of responsibility and strong effort in reducing the impact of corruption on the implementation of policies.

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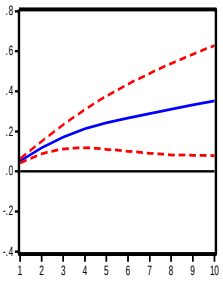
Appendix 1

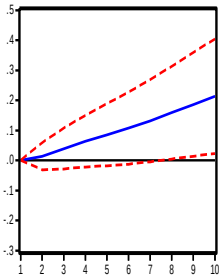
Impulse Response Functions

Accumulated Response to Cholesky One S.D. Innovations ± 2 S.E.

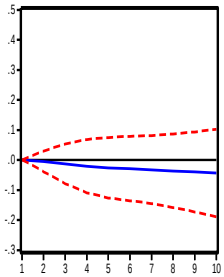
Accumulated Response of PON to PON



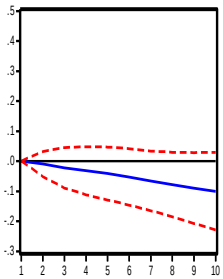
Accumulated Response of PON to VOL



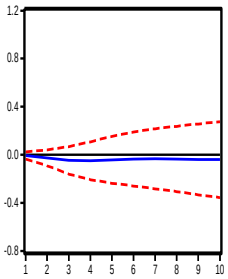
Accumulated Response of PON to RER



Accumulated Response of PON to AGRICGDP



Accumulated Response of VOL to PON



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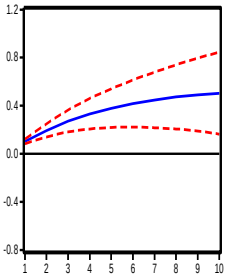

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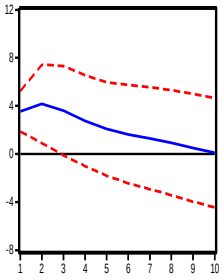

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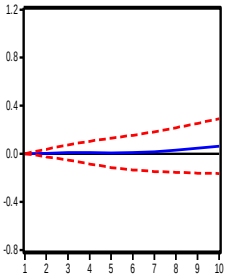

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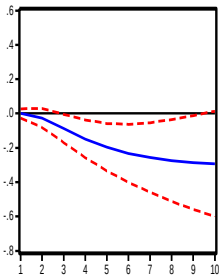

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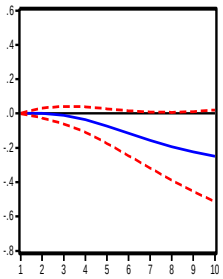

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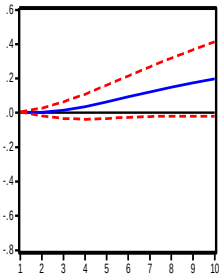
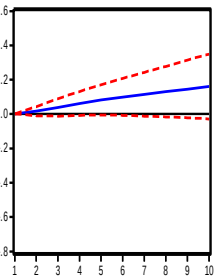
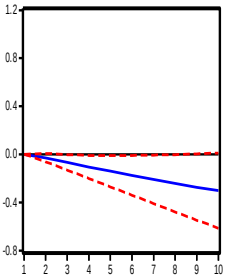


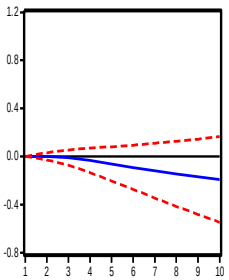
Accumulated Response of RER to AGRICGDP



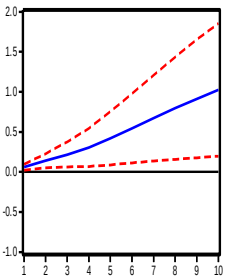
Accumulated Response of AGRICGDP to PON



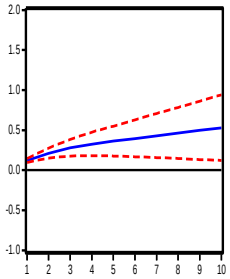
Accumulated Response of AGRICGDP to VOL



Accumulated Response of AGRICGDP to RER



Accumulated Response of AGRICGDP to AGRICGDP



Appendix 2

Variance Decomposition

Variance Decomposition of PON:

Period	S.E.	PON	VOL	RER	AGRICGDP
1	0.148791	100.0000	0.000000	0.000000	0.000000
2	0.148791	100.0000	0.000000	0.000000	0.000000
3	0.166140	85.29807	3.191673	1.918701	3.795494
4	0.166140	85.29807	3.191673	1.918701	3.795494
5	0.180524	73.12045	7.840269	2.256569	8.392046
6	0.180524	73.12045	7.840269	2.256569	8.392046
7	0.193898	63.71882	12.66387	2.291123	12.41911
8	0.193898	63.71882	12.66387	2.291123	12.41911
9	0.206355	56.40861	16.54105	2.592185	15.62313
10	0.206355	56.40861	16.54105	2.592185	15.62313

Variance Decomposition of VOL:

Period	S.E.	PON	VOL	RER	AGRICGDP
1	0.155647	0.145266	99.85473	0.000000	0.000000
2	0.155647	0.145266	99.85473	0.000000	0.000000
3	0.207108	0.864151	93.82301	1.536809	0.319764
4	0.207108	0.864151	93.82301	1.536809	0.319764
5	0.226099	1.432135	89.21597	3.248403	0.885063
6	0.226099	1.432135	89.21597	3.248403	0.885063
7	0.234269	1.482352	86.73692	4.082343	1.486942
8	0.234269	1.482352	86.73692	4.082343	1.486942
9	0.238603	1.438616	85.28234	4.442483	2.111120
10	0.238603	1.438616	85.28234	4.442483	2.111120

Variance Decomposition of RER:

Period	S.E.	PON	VOL	RER	AGRICGDP
1	0.136786	4.448336	0.323808	95.22508	0.002780
2	0.136786	10.61204	0.668052	86.54524	1.617723
3	0.191691	16.49295	2.676379	77.95388	1.313843
4	0.191691	20.20940	3.260517	72.73374	1.226388
5	0.218984	21.87513	3.185913	70.38246	1.322447
6	0.218984	22.64796	3.020884	69.22653	1.487629
7	0.229285	23.15072	2.924610	68.44955	1.617506
8	0.229285	23.56640	2.883581	67.81495	1.700210
9	0.232557	23.90853	2.860818	67.29852	1.755965
10	0.232557	24.17731	2.839872	66.89343	1.799609

Variance Decomposition of AGRICGDP:

Period	S.E.	PON	VOL	RER	AGRICGDP
1	0.218629	7.088022	9.904618	0.578046	80.09326

2	0.218629	7.088022	9.904618	0.578046	80.09326
3	0.311863	4.415281	8.283552	15.13465	70.05614
4	0.311863	4.415281	8.283552	15.13465	70.05614
5	0.395174	3.060884	6.071267	29.57408	57.83942
6	0.395174	3.060884	6.071267	29.57408	57.83942
7	0.468475	2.362407	4.341705	38.86050	48.79659
8	0.468475	2.362407	4.341705	38.86050	48.79659
9	0.526753	2.072694	3.514375	43.51742	43.25309
10	0.526753	2.072694	3.514375	43.51742	43.25309

Cholesky Ordering:
PON VOL PC MS RER AGRICGDP