PETROLUEM PRODUCTS PRICES AND INFLATION IN NIGERIA (1990 – 2008)

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NOVEMBER, 2012

DECLARATION

I hereby declare that this is a product of my own research. It has not been presented anywhere for the purpose of awarding a higher degree and the sources of information has been dully acknowledged by way of reference.

_____

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CERTIFICATION

This thesis titled "Petroleum Product Prices and Inflation in Nigeria (1990-2008)", meets the requirement governing the award of the degree of Master of Science in Economics, of Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This research work is dedicated to God Almighty for making it possible and giving me the wisdom and strength to complete this course successfully. I also dedicated this thesis to my late parents; Late Mr. Clement Y.N. Bobai and Late Mrs. Janet Y. Clement for being there for me as a growing child. May your gentle souls rest in Peace! Amen

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ABSTRACT

In this work which is titled "Petroleum Product Prices and Inflation in Nigeria", effort was made to see if there was any relationship between petroleum products prices (PPP) and inflation (INF) in the country. The study examines the impact of petroleum products prices increases on the level of inflation in the Nigerian economy. The scope of the study covers a period of eighteen years that is from 1990-2008, time series data on quarterly basis were employed for this work. The methodology employed in this study includes; ADF test, VAR model (Vector Autoregression Model), impulse response function and variance decomposition. A stationary test was carried out using the Augmented Dickey-Fuller (ADF) the variable were found to be stationary at difference order at 5% level of significance. The VAR result indicates an increase in PPP leads to rise in the level of inflation. The impulse response function and the variance decomposition also indicated a positive relation existed between INF and PPP in Nigeria. This suggested that subsidy removal from petroleum products lead to raise their prices and this also increase pressure on domestic inflation in Nigeria. In addition, because of the roles of smuggling, hoarding and other black market activities in raising the effective prices of these products serious penalties should be placed on these activities to avoid shortage of the petroleum products in the country. The major findings from this study is that increase in the prices of petroleum products (PMS, AGO, and DPK) has a positive impact on the general price level of goods and services in the Nigeria economy. Government should make sure that our existing refineries are functioning at full capacity and also build new ones; by so doing the existing refineries can meet Nigerians internal petroleum products needs and some excess for export and strategic reserve of product demand. This can be made possible when the nation refineries Turn-Around-Maintenance are consolidated with transparency and accountability. In conclusion the CBN and policy makers in Nigeria should also pay special attention to the supply management of petroleum products in the country.

CHAPTER ONE

1.1 BACKGROUND TO THE STUDY

Inflation in Nigeria has been considered as a purely monetary phenomenon. Hence inflation targeting has been through the manipulation of monetary variables such as exchange rate, money supply, price index, interest rate etc which are aimed at attaining price stability in the economy (CBN, 2004). However, over the years, Nigeria has experienced unprecedented persistent and appreciable increase in the prices of petroleum products. Petroleum products are major inputs to industrial production, they have a lot of domestic uses, in fact, and they are regarded as the life wire of the nation. Consequently any unprecedented increase in their prices would therefore have a multiplier effect in the economy (Gbadomosi, *et al.,* 2007).

The effect of petroleum products price increase to the growth and development of the Nigerian economy cannot be overemphasized. This is because the price of petroleum products is critical to production cost and the welfare of the people in every economy. Consequently, it has worsened the economic crises in the Nigerian economy. The outrageous price increases has made life unbearable for Nigerians as prices of goods and services have risen and thus causing hardship to most people in the country (Mba-Afolabi, 1999).

This research work is mainly concerned on the relationship between domestic petroleum products prices and inflation in Nigeria. Therefore, the three major petroleum products mostly consumed in Nigeria; Premium Motor Spirit (Petrol), Automotive Gas Oil

(Diesel) and Dual Purpose Kerosene (Kerosene) are the products of interest in this research work. It is to be noted that these products are inadequate in terms of supply most of the time. In this work we would like to ascertain the extent to which petroleum products price have contributed to inflation in Nigeria.

1.2. STATEMENT OF RESEARCH PROBLEM

Observation of the retail prices of petrol (PMS), diesel (AGO) and kerosene (DPK) in Nigeria from 1990-2008 has shown great increase in their prices. In 1990 the prices per liter of PMS, AGO and DPK were 0.60kobo, 0.50kobo and 0.40kobo, but as at the beginning of 2008 the prices of the same product per liter were ₦65.00, ₦60.00 and ₦50.00. Government has often explained these increases as being necessary to reduce or remove the subsidy on petroleum products much of which has to be imported because of the inability to meet products demand domestically. The increases in the prices of these products have a chain effect on the prices of other goods and services in the economy. Transport fares have sky-rocketed and there have been general increase in cost of production of goods and services, and the prices of foodstuff in the economy have always been increasing. (Gbadomosi, *et al*., 2007, p: 156)

Though Nigeria is the 6th oil producer in the world according to OPEC's ranking, It was only 17.0 percent of the total crude oil that she produces that was made available for domestic consumption in 1990, 18.5 percent in 1993. 13.0 percent, 12.4 percent, 11.9 percent, 11.4 percent and 13.8 percent of the total crude oil were also available for domestic consumption in 1995, 1996, 1997, 1998 and 1999 respectively. There was a

major increase to 25.1 percent in 2003, this drastically declined to 7.9 percent in 2005 but in 2006 it increased to 20.2 percent (CBN 2007).

Iwayemi (2000) emphasized the use of pricing instruments for correcting disequilibrium in the energy market. Since the demand for the domestically consumed petroleum products are greater than their supply and the government policies cannot match the market forces, this has always led to shortage in supply of the products. According to World Bank (2002), a sizeable number of firms in Nigeria depend on petroleum powered generating sets for their energy supply as electricity supply is grossly inadequate and/or unreliable. With these and other problems, small and medium scale enterprises in the country are faced with problem of high cost of production which has made the whole business environment to be very unfriendly for most of these companies, thereby leading to their closure. These led to redundancy, high crime rate, social vices etc in the country at the time. Because domestic prices of petroleum products in the country are much lower than what obtains in the neighboring countries. Some percentage of the petroleum products are smuggled to those countries thereby causing shortage of domestic supply. This difference is partly because the crude oil for producing petroleum for domestic consumption is sold to the local refineries at a lower price per barrel. This therefore brings down the cost of production. In 1993 for example the export price of a barrel of crude oil was $15 but the local refineries bought it for $1. In 2002, exported crude oil was sold at $25 per barrel while local refineries bought it at $18 per barrel for local refining. The other reason prices in Nigeria are much lower compared to those in neighboring countries is the subsidization of imports. The end result is that there is an implicit subsidy

on petroleum products which is the difference between border prices and domestic prices. As at 1992, the prices of petroleum products in neighboring countries were at least 700% of those in Nigeria Adenikinju (2000). Hossain (2003) calculated the 2002 implicit subsidy to be ₦94 Billion or 1.8% of GDP. As at 2003, the domestic prices of refined petroleum products in Nigeria were still much lower than obtained in neighboring countries. As at 2003 Fuel, Diesel and Kerosene were being domestically sold at 80% of the importation cost i.e. 'border price'. In June 2003 the government stated that for each liter of petroleum products, ₦12 is spent as subsidy. This implies an explicit subsidy of ₦74 Billion or about 1.42% of GDP. Domestically produced products were also sold at the same price thus giving rise to an explicit subsidy on imported products and implicit subsidy on domestically produced goods. In the year 2003, the explicit subsidy alone amounted to 2% of GDP. Adding implicit subsidy to this would raise the percentage to about 3.5% of GDP.

This research study intends to answer the following questions;

(i) What is the rate of increase of petroleum product prices in Nigeria?

(ii) To what extend is inflation in Nigeria a reflection of petroleum products prices?

1.3 OBJECTIVES OF THE STUDY

The main objective of this research is to examining the relationship between petroleum products prices and inflation in Nigeria. The specific objectives of the study are:

(i) To examine the trend and magnitude of petroleum products prices in Nigeria.

(ii) To examine the impact of petroleum product prices on the level of inflation in the Nigerian economy.

1.4 HYPOTHESIS TESTING

$H_{O:}$ $B = 0$ There is no relationship between petroleum product prices and inflation in Nigeria.

H_1: $B \neq 0$ There is a relationship between petroleum product prices and inflation in Nigeria.

1.5 JUSTIFICATION OF THE STUDY

Most of the debates by scholars regard the causes of inflation in Nigeria are purely monetary in nature. Consequently, the major focus of monetary policy has been predicated on controlling the monetary aggregates, a policy stance which has largely been based on the belief that inflation is essentially a monetary phenomenon. Targeting inflation through monetary variables seems to have yielded protracted results. It becomes expedient to examine the persistent increase in the prices of petroleum products on the level of inflation in Nigeria. One area of value that strengthens justification for this study is its relevance to the Nigerian economy. The study recognizes the significance of the multiplier effect of increase on domestic petroleum product prices have on goods and services in the economy, then management of supply should be an option. This study adds value in both theoretical and empirical result. The innovations introduced are more likely to generate better empirical results. This study would serve as reference for future study. This study will also give insight to Central Bank of Nigeria (CBN) and policy makers that persistent increase in petroleum product prices serves as a major cause of

inflation in Nigeria. Thus the need to carry out such a study on a continuous basis in an economy becomes topical as any other economic issue of national discourse.

1.6. SCOPE AND LIMITATION OF THE STUDY

The scope of this study covers a period of eighteen years that is from 1990 – 2008. This period is chosen because a sample large enough is needed to examine the effect of the petroleum products prices on inflation in the Nigerian economy.

It is acknowledged that inadequate and unreliable data are a major hindrance and limitation for research works in Nigeria. This research is not free from this bug. The data used have conceptual problems and the inconsistent method of compiling such time series data constitute a major constraint.

To lessen the problem, the research resorted to the use of CBN Statistical Bulletin. Unless where the researcher cannot get data on a specific variable in CBN Statistical Bulletin then we shall make a substitute with the NNPC journal and other publications.

1.7 ORGANIZATION OF THE STUDY

This research work is organized into five chapters. Chapter One consist of the general introduction of the study, while chapter two reviewed related theories and literatures, chapter three covered the research methodology and model specification and chapter four concentrated on the presentation and analysis of the findings which was based on the statistical techniques that were adopted in the study. Finally, the summary, conclusion and recommendation base on the finding are all included in chapter five.

CHAPTER TWO

LITERATURE REVIEW

2.1 CONCEPTUAL FRAMEWORK

2.1.1 INFLATION

Inflation is one of the most frequently used terms in economic discussions, yet the concept is variously misconstrued. There are various schools of thought on inflation, but there is a consensus among economists that inflation is a continuous rise in the prices. Abedi, (1997) define inflation as the continuous increase in the prices of all goods and services over a long period of time. Samuelson *et al.,* (2004) says inflation occurs when the general level of prices is rising. The free encyclopedia sees inflation as a decline in the real value of money a loss of purchasing power in the internal medium of exchange which is also the monetary unit of account in an economy. It could be defined as a continuing rise in prices as measured by an index such as the Consumer Price Index (CPI) or by the implicit price deflator for Gross National Product (GNP). Inflation is frequently described as a state where "too much money is chasing too few goods". When there is inflation, the currency loses purchasing power.

In the definition of inflation, two key words must be borne in mind. First, is aggregate or general, which implies that the rise in prices that constitutes inflation must cover the entire basket of goods in the economy as distinct from an isolated rise in the prices of a single commodity or group of commodities. That is, changes in the individual prices or any combination of the prices cannot be considered as the occurrence of inflation. However, a situation may arise such that a change in an individual price could cause the other prices to rise. An example is petroleum product prices in Nigeria. This again does

not signal inflation unless the price adjustment in the basket is such that the aggregate price level is to rise. Second, the rise in the aggregate level prices must be continuous for inflation to be said to have occurred. The aggregate price level must show a tendency of sustained and continuous rise over different time periods.

2.1.2. CAUSES OF INFLATION

While it is acknowledged in literature that some of the socio-political factors that fuel inflation are not easily quantifiable, a number of economic factors responsible for it can be divided into two on the basis of the main traditional theories. These are the demand-pull and cost-push inflation.

Demand-pull cause of inflation is a situation of rapidly rise in the prices that occur due to changes in investment, government expenditure, and net export increase aggregate demand over and above the economy's productive capacity, when the economy is near full employment. The effect of increased demand will be mainly on prices. Cost-push causes of inflation occur from the shifts in the supply curve, such shifts could result from increase in the money rate brought about by union activities or increase in monopoly mark up. Such shifts lead to higher prices and lower output. Abah, (2000)

2.1.3. TYPES OF INFLATION

Broadly, inflation can be grouped into four types, according to its magnitude.

1. **Creeping Inflation:** This occurs when the rise in price is very slow. A sustained annual rise in prices less than 3 percent per annum falls under this category. Such

an increase in prices is regarded safe and essential for economic growth (Friedman 1968).

2. **Walking Inflation:** Walking inflation occurs when prices rise moderately and annual inflation rate is a single digit. This occurs when the rate of rise in prices is in the intermediate range of 3 to less than 10 percent. Inflation of this rate is a warning signal for the government to control it before it turns into running inflation (Friedman, 1968).
3. **Running Inflation:** When prices rise rapidly at the rate of 10 to 20 percent per annum, it is called running inflation. This type of inflation has tremendous adverse effects on the poor and middle class. Its control requires strong monetary and fiscal measures (Friedman, 1968).
4. **Hyper Inflation:** Hyper inflation occurs when prices rise very fast at double or triple digit rates. This could get to a situation where the inflation rate can no longer be measurable and absolutely uncontrollable. Prices could rise many times everyday. Such a situation brings a total collapse of the monetary system because of the continuous fall in the purchasing power of money (Friedman, 1968).

2.2. THEORETICAL LITERATURE

In addition to creating wealth transfers from oil importing to oil exporting economies, oil price changes affect macroeconomic activity in a number of ways. Oil price increases reduce production output and wages. They induce inflationary tendencies and raise interest rates thereby reducing aggregate demand (Awerbuch *et al.,* 2004:8). In most developing countries governments act as guardians of the natural resource wealth hence

serve as a conduit through which the higher oil revenues flow into the economy through higher public spending. This will not be a problem if the increased oil revenues remain stable, but typically they do not, because oil prices are notoriously volatile (Aizenman and Pinto, 2003:20).

The world oil market, as a result of the convergence of a number of factors, has experienced significant tightness since the end of 2003, which cut through 2004 and the first half of 2005 (IEA, 2006). The high prices that result from the tight balance between oil demand and supply do cause increased energy expenditures for consumers, businesses and industries. It is possible then that the economy as a whole might be experiencing macroeconomic effects, not only from the higher oil prices themselves, but as a result of the monetary and fiscal policy responses that may be taken if the high prices persist and are determined to constitute inflation. Different countries respond differently to oil price shocks. There are winners and there are losers. The winners of an oil shock are net exporters while the losers are the net oil importers (Hilde Brand, 2004:3).

2.2.1 THEORETICAL FRAMEWORK

The Cost-Push theory of Inflation is the theoretical framework for this work.

The cost-push inflation is caused by the monopoly power exercised by some monopoly groups of the society like labour unions and firms in monopolistic and oligopolistic market setting. It has been observed that strong labour unions often succeed in forcing money wages to go up causing prices to go up. Thus, the cost-push inflation may be classified on the basis of supply-side factors as follows:

(a) **Wage-Push Inflation:** Is attributed to the exercise of monopoly power by labour unions to get the money wages enhanced above the competitive labour market wage rate. The logic of wage-push inflation is simple labour unions exercise their monopoly power and force firms, the employers to increase their money wages above the competitive level without a matching increase in labour productivity (Dwivedi 2007).

(b) **The Profit-Push Inflation:** When monopolistic and oligopoly firms increase the "administered price" with a view to increasing their profit margin, it leads to rise in prices which takes the form of profit-push inflation (Dwivedi 2007).

(c) **Supply-Shock Inflation:** Supply shock is a sudden unexpected disturbance in the supply position of some major commodities or key industrial inputs. The supply-shock inflation occurs generally due to sudden rise in the prices of major items in the price index number, for instance, food prices due to a crop failure, and prices of some key industrial inputs like coal, steel, cement, oil and basic chemicals. The sudden rise in the OPEC oil price during 1970s due to Arab-Israel war is the famous example of the supply shock. During the mid-and late-1970s, the problem of inflation had become a global phenomenon because the OPEC had more than quadrupled the oil prices between 1972 and 1974 (Dwivedi 2007).

2.2.2 MODERN THEORIES OF INFLATION

The modern approach to inflation follows the theory of price determination. The price theory tells us that, in a competitive market, price of a commodity is determined by the market demand for and the market supply of the commodity and that the variation in the

price of the commodity, if any, is caused by the variation in the demand and supply factors. Likewise, the aggregate price level is determined by the aggregate demand and aggregate supply and variation in the aggregate price level is caused by the variations in the aggregate demand and aggregate supply (Dwivedi 2007).

The modern theory of inflation is, in fact, a synthesis of classical and Keynesian theories of inflation. The modern analysis of inflation shows that inflation is caused by both demand-side and supply-side factors. The demand-side factors are called demand-pull factors and supply-side factors are called cost-push factors. Accordingly there are two kinds of inflation.

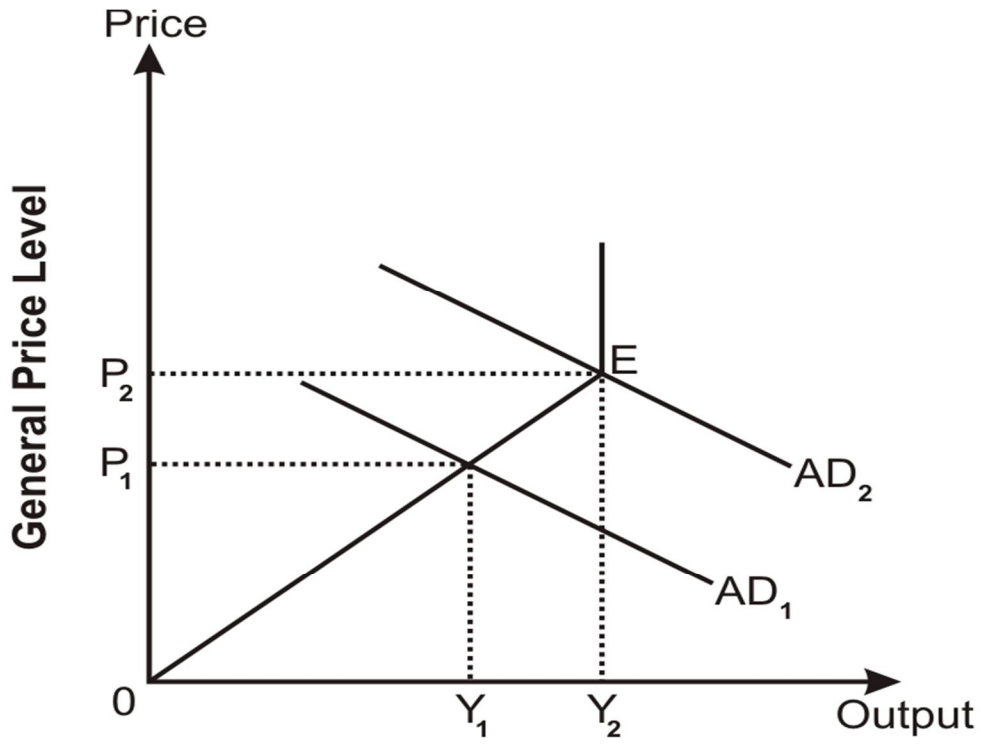
(i) Demand-pull inflation

(ii) Cost-push inflation

2.2.3 DEMAND PULL INFLATION

The demand-pull inflation occurs when the aggregate demand increases much more rapidly than the aggregate supply. The demand-pull inflation occurs, given the aggregate supply (AS), when the aggregate demand (AD) curve shifts upward to right. The rightward shift in the AD curve may be caused by (a) monetary factors i.e. increase in money supply, and (b) real factors i.e. increase in demand for real output (Dwivedi 2007). As shown in the diagram below:

Figure 2.1 Determination of the general price level and output



Determination of the General Price Level and Output

2.2.4 THE STRUCTURALIST'S APPROACH TO INFLATION

According to the structuralist's view inflation is inevitable in the less developed countries embarking on ambitious development programmes and is caused mainly by the characteristic structural imbalance in such countries. Major structural imbalance include: scarcity in the supply of some major goods and services, resource imbalance, foreign exchange bottleneck, infrastructural bottleneck and social and political constraints (Dwivedi, 2007 p. 428). The implication of the scarcity of petroleum products on the growth of output and price level in the economy cannot be overemphasized. However, this has led to imbalance on the demand for and supply of petroleum products due to inelastic products supply in the country, which had often led to rise in the prices of

petroleum products in the country. Some of the reasons for low petroleum product supply are: Technological backwardness, Low level of petroleum infrastructure, Low rate of saving and investment, high rate of mismanagement and corruption in the economy etc which also hold petroleum products supply at low level against the rising demand due to increase in population and urbanization, which bring about a widening gap between demand for and supply of petroleum products in Nigeria. Speculative hoarding of the petroleum products in the country also increase the prices of the products. Since the demand for petroleum products is always greater than supply of the product government has to import the shortage to meet up with the demand. Rise in the prices of petroleum products in Nigeria lies as one of the major price structures in the economy and a cause of inflation in the Nigerian economy.

2.2.5 MEASURES OF INFLATION

There are two common measures of inflation.

1. **Percentage change in Price Index Numbers (PIN)**: The following formula is used for measuring that rate of inflation through the change in the PIN.

$$Rate\ of\ Inflation = \frac{PIN_t - PIN_{t-1}}{PIN_t} \times 100 \quad \ldots \quad \ldots \quad \ldots \quad (2.1)$$

Where PIN_t and PIN_{t-1} are the price index numbers in the year selected for measuring inflation and in the preceding year respectively.

The two widely used PINs are Wholesale Price Index (WPI) also called Producer Price Index (PPI) and Consumer Price Index (CPI). WPI is used to measure the general rate of inflation and CPI is used to measure the rise in the cost of living.

2. **Change in GNP Deflator:** The GNP deflator is the ratio of nominal GNP to the real GNP of the same year. It is also defined as follows:

$$GNP\ Deflator = \frac{No\min al\ GNP}{\mathrm{Re}al\ GNP} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2.2)$$

Where Nominal GNP is GNP at current prices and Real GNP is GNP at constant price. The GNP deflator for any year can be obtained by using the above formula.

2.2.6 MONETARIST APPROACH TO INFLATION

The monetarist approaches to inflation seek to ascribe observed rates of inflation in different countries to the respective growth rates of money supply per unit of the national product. This school of thought believes that inflation is mainly a monetary phenomenon (Friedman 1968). It may not be concluded that Nigeria's inflation palaver is purely monetary issue as it is influenced by other factors apart from changes in money supply, (Abah 2000). Variants of monetary theories are;

a) FISHER'S QUANTITY THEORY OF MONEY

The quantity theory of money states that the quantity of money is the main determinant of the price level or the value of money. In the words of Fisher, "other thing remaining unchanged, as the quantity of money in circulation increases the price level also increases in direct proportion and the value of money decreases and vice versa". If the quantity of money is doubled, the price level will also double and the value of money will be one half. On the other hand, if the quantity of money is reduced by one half, the price level will also reduce by one half and the value of money will be twice (Dwivedi 2007).

Fisher has explained his theory in terms of his equation of exchange:

$$PT = MV + M^1V^1 \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2.3)$$

Where P = price level or $1/P$ = the value of money

M = the total quantity of legal tender money

V = the velocity of money in circulation

M^1 = the total quantity of credit money

V^1 = the velocity of circulation of M^1

T = the total amount of goods and services exchanged for money or transactions performed by money

This equation equates the demand for money (PT) to supply of money ($MV = M^1V^1$). The total volume of transaction multiplied by the price level (PT) represents the demand for money. According to Fisher, PT is ξPQ. In other words, price level (P) multiplied by quantity bought (Q) by the community (ξ) gives the total demand for money. This equals the total supply of money in the community consisting of the quantity of actual money (M) and its velocity of circulation (V) plus the total quantity of actual money (M^1) and its velocity of circulation (V^1). Thus, the total value of purchase (PT) in a year is measured by $MV + M^1V^1$. Thus, the equation of exchange is $PT = MV + M^1V^1$. In order to find out the effect of the quantity of money on the price level or the value of money, the equation will be written as,

$$P = \frac{MV + M^1V^1}{T} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2.4)$$

Fisher points out the price level (P) varies directly as quantity of money ($M + M^1$) provided the volume of trade (T) and velocity of circulation (VV^1) remain unchanged.

The truth of this proposition is evident from the fact that if M and M^1 are doubled, while V, V^1 and T remain constant, P is also doubled, but the value of money ($1/P$) is reduced to half (Jhingan, 2006).

2.2.7 IMPORT APPROACH TO INFLATION

Another theory of inflation is known as imported inflation. For a country that engages in world trade, a number of channels have been identified whereby inflation can be transmitted from one country to another. Given a fixed exchange rate, these include price effects by which inflation is transmitted directly through goods entering international markets, demand effects in which excess demand spills over from one country to another, and liquidity effects where change in foreign reserves if not sterilized may lead to rise in money supply, consequently prices, thereby creating liquidity effects. Nigeria is highly susceptible to this type of inflation because of large volume of imports (Awerbuch and Sauter, 2004).

2.3 THE THEORY OF PRICE DETERMINATION

2.3.1 THE FREE MARKET MECHANISM

The demand and supply of a commodity are both affected by the price of a commodity. But another interesting feature is that the demand and supply of a commodity both also influence the price of a commodity. The buyers of a commodity demand more of it at lower price and less of it at a higher price whereas the sellers of the commodity supply

more of it at higher price and less of it at a lower price (Samuelson et al., 2004). These behaviours of buyer and sellers are explained by the law of demand and the law of supply. There can be a price of commodity at which its quantity demanded and quantity supplied will be equal. This price of the commodity is called the equilibrium price. Thus equilibrium price of a commodity is the price at which its quantity demanded and supplied are equal (Samuelson *et al.*, 2004).

Sellers are unaware of the intentions of the buyers. Similarly the buyers are also unaware of the intentions of the sellers. In other words neither the sellers know the market demand schedule of their commodity nor do the buyers know the market supply schedule. Their decisions about the quantity demanded and supplied at a price are independent decisions. Actually at the price fixed by the sellers, the market supply may be greater or lesser than the market demand at that price. It means that at this price market demand and market supply are not equal. So it is not the equilibrium price. Suppose at the price quoted in the market by the sellers the supply is greater than demand i.e. the buyers are willing to buy less than what the sellers are ready to sell at that price. In this situation not finding enough customers the sellers will reduce the price in order to sell the quantity supplied falls. So as the price is reduced the demand increases and supply falls. This will reduce the original gap between supply and demand. This process of fall in price, rise in demand and fall in supply will continue till a price is reached at the quantity demanded and quantity supplied are equal. Thus the equilibrium price is reached (Samuelson *et al.*, 2004).

The table below contains hypothetical market demand schedule and supply schedule of coco yams in Kg.

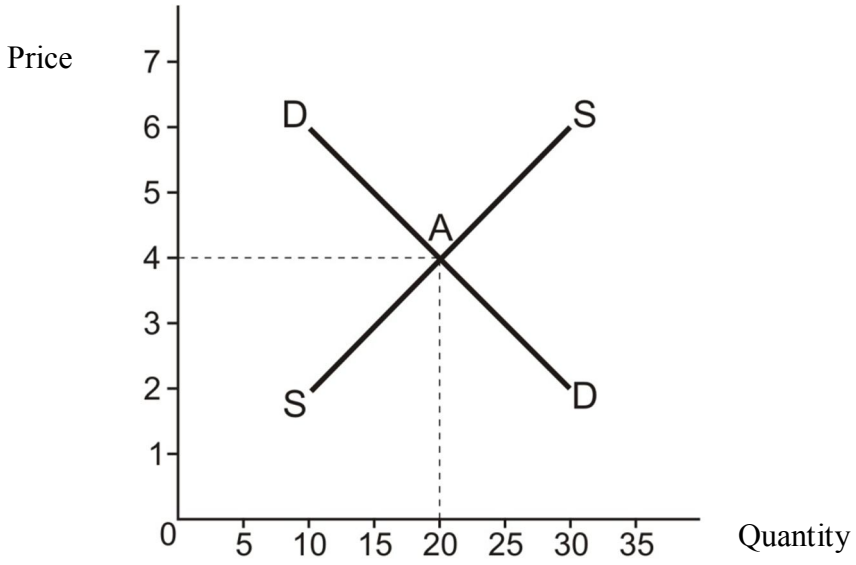
Table 2.1 Demand and supply schedule of coco yams

Price in Naira (₦)	Market demand per day in kg	Market supply per day in kg
6	10	30
5	15	25
4	20	20
3	25	15
2	30	10

Source: Compiled by the author.

Suppose the price of coco yams falls from ₦6 to ₦5. The demand for coco yams rises from 10kg to 15kg and supply falls from 30kg to 25kg. But still supply is greater than demand. So the price will further fall and when it falls to ₦4, we find that demand and supply are both equal. Buyers are willing to buy 20kg of coco yams and sellers are willing to sell 20kg of coco yams at this price. This is the equilibrium price.

Figure 2.2 Quantity demanded and supplied of coco yams



At point A in the diagram above demand curve and supply curve intersect. At the same point the quantity demand is 20kg of coco yams and the price is ₦4:00 so all the quantity supplied is 20kg of coco yams and the price ₦4:00. Thus point A indicates the equilibrium price and equilibrium quantity. We can say that equilibrium price of a commodity is determined by the point of intersection of the demand curve and supply curve of the commodity.

When at a price of the commodity its quantity demanded exceeds its quantity supplied then it is a situation of excess demand.

Effects of excess demand on the price and quantity demanded and supplied

I. Price of the commodity starts rising because of the competition among its buyers.

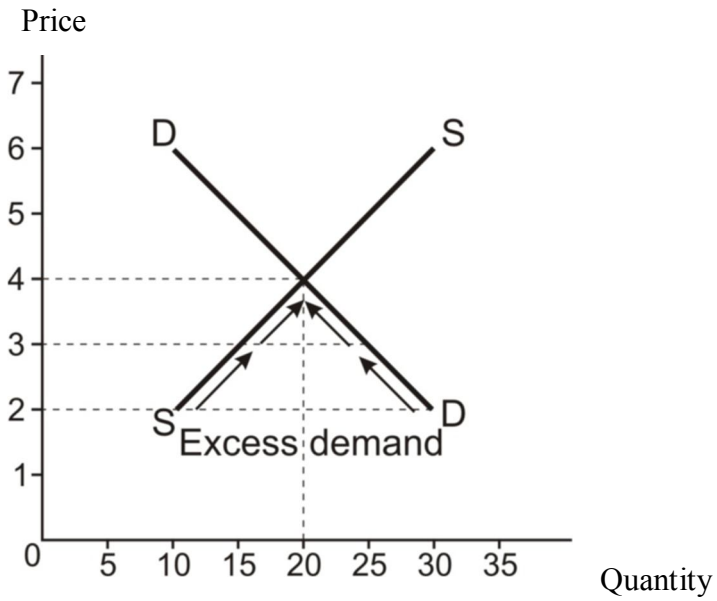
II. As the price starts rising its quantity demanded starts falling as the buyers demand less when prices rises.

III. As the price start rising, its quantity supplied starts rising as the seller sell more when price rises.

IV. The rise in the price of the commodity causes contraction of demand and expansion of supply which continue till price reaches a level at which the quantity demanded and supplied are equal.

V. The equilibrium price which also determines the equilibrium quantity.

Figure 2.3 Excess demand of coco yams



If at a given price the quantity supplied of a commodity exceeds its quantity demanded then it is a situation of excess supply.

Effects of excess supply on the price and quantity demanded and supplied

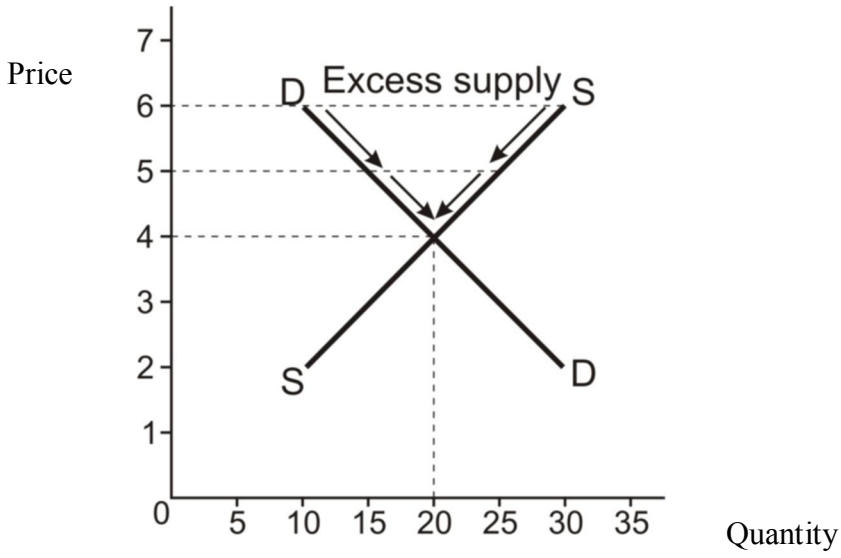
I. As supply exceeds demand, all sellers will not be able to sell the total quantities they want to sell at this price. So there will be competition among sellers. This will reduce the price.

II. As the price starts falling, expansion of demand and contraction of supply will take place. This will reduce the excess supply.

III. Thus changes i.e. fall in price, expansion of demand and contraction of supply will continue till the price reaches that level at which demand and supply are equal.

IV. Thus the excess supply is wiped out and equilibrium price and equilibrium quantity are established.

Figure 2.4 Excess supplies of coco yams



Thus in a situation of excess demand or excess supply, the price starts rising or falling, the demand starts contracting or expanding, the supply start expanding or contracting. Through these changes excess demand or excess supply is wiped out. You should also notice that when there is excess demand, the equilibrium price will be higher than the

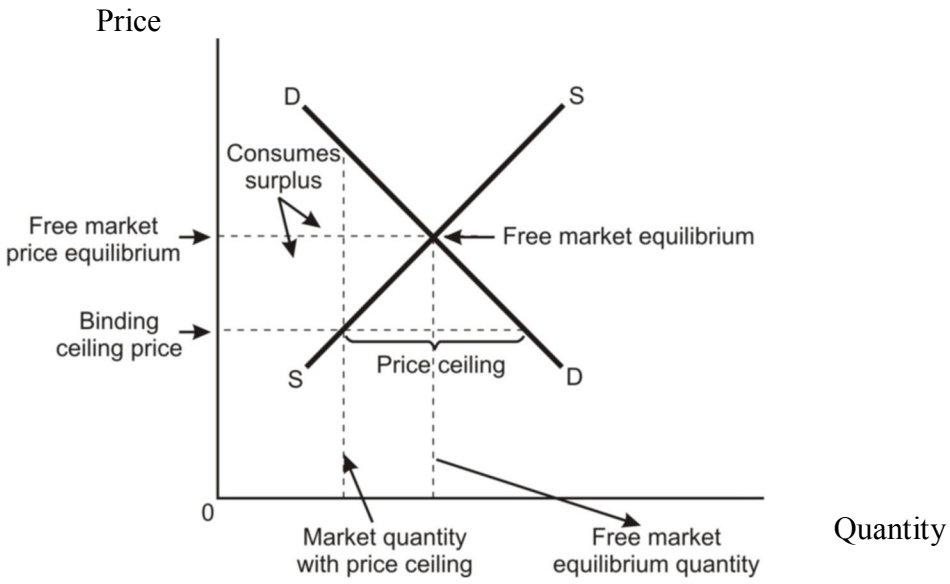
price at which there was excess demand. Similarly the equilibrium price would be lower than price at which there is excess supply.

2.4 PRICE CONTROL MECHANISM: MAXIMUM PRICE THEORY

Price controls are government rules or laws that forbid the adjustment of price to clear markets. Price controls may be floor prices (minimum prices) or ceiling price (maximum prices). A price ceiling is government imposed limit on how high a price can be charged on a product. Price ceilings are often intended to protect consumers from certain conditions that could make necessities unattainable. But they can also cause problems if they are used for a prolonged period of time without controlled rationing (Abedi, 1997). Price ceiling makes it illegal for sellers to charge more then specific maximum price and are typically introduced when a shortage of a commodity threatens to raise its price by a substantial amount.

A price ceiling is set below free market equilibrium price. For a price ceiling to be effective, it must differ from the market price. When a government mandates a maximum price it is set below the free market price, called a binding price ceiling. In this case the price ceiling has a measurable impact on the market (Abedi, 1997).

Figure 2.5 Binding ceiling price



A price ceiling set below the free market price has several effects; suppliers find they can no longer charge what they had been charging for the products. As a result, some suppliers drop out of the market. This represents a reduction in the quantity supplied. Meanwhile, consumers find that they can now buy the same product at lower price. As a result quantity demanded increases. As a result of these two actions, quantity demanded exceeds quantity supplied and shortage emerges, unless rationing or other forms of consumption controls are enforced.

This leads to various form of non-price competition so that supply is able to meet demand.

1. **REDUCTION IN QUALITY:** In order to supply something like the required demand at the legal price, the most obvious thing that a seller is likely to do is lower costs. However, in most cases lower cost will carry with them lower quality products.

2. **BLACK MARKETS:** If somebody cannot obtain a good he/she needs because a price ceiling reduces the quantity supplied, he/she may turn to the black market to obtain the good. Those who by luck or good management obtain goods of which there is a shortage can make a profit by selling it illegally at a price higher than would be obtained on a free market. The black market price is higher than the free market price simply because the quantity supplied is less than would take place on a free market where more sellers could afford to sell the product.

3. Producers or sellers will hoard part of their goods away from the market in order to create an artificial scarcity.

4. Some sellers may smuggle their goods to other countries where they can sell at higher prices.

5. Producers of the commodities whose prices are controlled will have a fall in income. They now receive lower prices for their goods.

Maximum prices can be for both raw materials and finished products. They are fixed in order to protect buyer (consumer) from the exploitative attitude of sellers or producer. Maximum price legislation is used as means of checking inflation. Maximum prices on essential commodities are most often below equilibrium market prices. For instance, when Mr. Yar'Adua was sworn as the then president of Nigeria on May 29, 2007, a liter of PMS (petrol) was then officially sold for ₦75. While it was reported by his officials that the right unsubsidized price should be sold for about ₦95 per liter. But a month later the president reviewed the price down to ₦65 per liter. (SearchWarp.com).

2.5 SUPPLY AND CONSUMPTION OF PETROLEUM PRODUCTS IN NIGERIA

The four refineries in the country produce about 13 million litres of refined petroleum products daily. However, daily domestic consumption is 30 million litres. The government imports the shortfall of 17 million litres so as to meet daily demand. Moreover, the level of investment in the sector is inadequate as the four refineries in the country are over aged and are able to produce only about 50% of their installed capacity and meet only about 40% of the daily 30 million litres domestic demand for refined petroleum products. The government does not sell the imported products at their full landed cost as it subsidies them. Off course changes in the international price of petroleum products and the exchange rate cause the landed cost of the products to fluctuate (Nwafor *et al.,* 2006).

Consumption of petroleum products grew tremendously from the middle of the 1 9 8 0 reflecting the rapid growth in the number of automobiles, industries, households, intensified rural-urban migration, economic and political developments. The bulk of products consumption has been the premium motor spirit (PMS) or petrol, automotive gas oil (AGO) or diesel, dual purpose kerosene (DPK) or kerosene and, bitumen/asphalt. Together, they account for more than 60 per cent of the total consumption of petroleum products. Petrol and diesel are the major fuels utilized in the road transportation sector as well as for small to medium sized electricity generation plants for power supply in homes and locations detached for PHCN, as well as standby power sources in industries. Specifically, petrol is used in vehicles, small electricity generating plants, drives for compressors, etc, while diesel is used largely on heavier engines. Household kerosene is

mostly used in homes and industries to produce insecticides and other pest control products (Onwioduokit *et al.,* 2000).

From the level of 13.9 million tonnes in 1981, consumption of petroleum products rose by 2.0 per cent to 14.2 million tonnes in 1982 but dropped to 7.7 million tonnes in 1990. It subsequently increased to 10.7 million tonnes in 1993, and has since maintained a downward trend to 7.9 and 7.7 million tonnes in 1994 and 1995, respectively. Generally, the demand for petroleum products has continually been on the increase. Most of the demand for the products is usually supplied by the domestic refineries. However, owing to the poor conditions of three of the four refineries, there have been shortages which had to be augmented with importation from time to time. For instance, such importation was put at 3.4 million metric tonnes in 1993, 2.9 million metric tonnes in 1994, 2.2 million metric tonnes in 1995, 3.9 million metric tonnes in 1996 and 2.1 million metric tonnes in 1997, respectively. However, the domestic production of petroleum products for domestic consumption increased to 10.1 million tonnes in 2001, it fell to 5.3 millions tonnes in 2002. There was a sharp increase to 10.2 and 10.4 million tonnes in 2003 and 2004 while it was 12.9 million tonnes in 2005 (CBN, 2007).

2.5.1 THE HISTORICAL PERSPECTIVE OF PETROLEUM SUBSIDY IN NIGERIA

The pressure of international competition, the spread of the capitalist behavioural mode, loss aversion, financial deregulation revolution and the IMF-World Bank-supported Structural Adjustment Programme (SAP), have led to a resurgence in price regulation and hence the substantial reduction or even total withdrawal of government subsidies,

particularly in developing nations experiencing fundamental disequilibrium in their internal and external balances. And Nigeria is not left out of this 'disease' (Anyanwu, 1993)

The concept, 'subsidy', has been defined by various authors and also from various perspectives producers, consumers and government angles. One of such definition is that subsidy is a payment to individuals or businesses by a government for which it receives no products or services in return (The McGraw-Hill Dictionary of Modern Economics, 1973; 496-497).

It is also defined as a payment made by the government (or possibly by private individuals) which forms a wedge between the price consumers pay and the costs incurred by producers, such that prices is less than marginal cost (Pearce, 1983: 373).
In general, a subsidy is a transfer from government to consumers, which makes the price they face at the market place lower than the true market price of the commodity. Subsidies can either be delivered directly to consumers or indirectly through the lowering of costs of production (CBN: contemporary economic policy issues, 2002). From the foregoing, therefore, petroleum subsidy can be rightly seen as the difference between production cost and the domestic price of the product, reflecting an implicit rather than explicit subsidy.

There was no petroleum subsidy on petroleum pricing in Nigeria before 1973 when the oil companies determined retail prices. A subsidy of 33.7 percent was introduced in 1973

when the federal government fixed retail prices of domestic oil consumption at $1.9/Bbl. The subsidy increased to 83 percent by 1974 following the 1973/74 oil price increases at the world market. This was due to the fact that domestic price of oil was not adjusted. In 1978, the subsidy was reduced to only 2 percent following oil price reviews. Then, the price of crude oil to the domestic refinery was increased to $13.80/Bbl. In 1980 subsidy rose to 65.5 percent following the hike in crude oil price to $40/Bbl at the world market, unaccompanied by a review of the domestic prices. In 1982 the then civilian administration increased the retail pump price of PMS from 0.15 kobo to 0.20kobo per litre (Anyanwu, 1993).

2.6 EMPIRICAL LITERATURE

Cebula *et al.,* (1980) in their work, analysis of the effect of oil prices on inflation in a number of industrial countries do not seem to rest on a solid theoretical basis at least not in an explicit way. Rather, reference to other authors is given, who quite generally forward a cost-push explanation of the price determination process. Cebula and Frewer's evaluation of those other authors' work leads them to postulate domestic inflation at time t, P_t to depend linearly on the same period's price of imported oil,PO_t, and on the ratio of imported oil to total oil consumption, IO_t.

$$\boldsymbol{P_t = a_0 + a_1 PO_t + a_2 IO_t} \quad \ldots \quad \ldots \quad \ldots \quad \textbf{(2.5)}$$

Estimates on the basis of equation (2.5) for six industrial countries appear to lend strong statistical support to the hypothesis that domestic inflation is basically determined by oil prices and the dependence on foreign oil.

Over the past decade, a number of studies (Mork 1989, Mory 1993, Mork 1994, Lee *et al*., 1996, Hamilton 1996, Huntington 1998, Davis and Hattiwanger 1998, and Hamilton and Herrera 1999) have investigated and confirmed an asymmetric relationship between oil prices, demand for petroleum and aggregate economic activity. Although asymmetry is not fairly well accepted, few studies have attempted to determined through what channels demand for petroleum products and oil price tend to produce an asymmetric response in aggregate economic activity. Huntington (1998) attributes the asymmetry to the relationship between crude and petroleum product prices. Hamilton (1988) explains that asymmetry could be the result of adjustment costs to changing oil prices. Falling oil prices stimulate economic activity and rising oil prices retard economic activity combining these elements, it could be said that rising oil prices present two negative effects for economic activity. The converse holds true for falling oil prices.

Obaseki (1997) adopting the Bautister's hybrid monetarist model consisting of demand and cost push factors in which the role of variables and price of petroleum product are explicitly recognized at the conclusion that price of petroleum products, money supply and the naira exchange rate primarily influence inflation significantly in Nigeria. This reinforced by adaptive expectations of higher inflation. This he attributes to the persistence of inflation being on the high side for a long time in the recent past.

Abah (2000) evaluated "The impact of monetary policies on inflation in Nigeria from 1980-1995". He discovered that impact of money supply in fueling inflation was not as great as was perceived. He indeed established that money supply lagged behind inflation,

contrary to the popular belief that growth in money supply adequately explains the phenomenon of inflation in Nigeria. Discovering was made by him that other macro economy factors such as domestic credit, GDP, oil prices and exchange rate of the naira impacted on inflation in Nigeria more than money supply.

Onwioduokit *et al.,* (2000) in their work "empirical analysis of the demand for petroleum products in Nigeria", were able to find that there has been perennial petroleum products scarcity in the country over the past few years; inadequate energy planning had compounded the problem of scarcity. The paper identifies the various variables in the consumption framework for policy simulation purposes regarding energy planning in the country. Elasticities were also estimated for proportions of GDP contributed by agriculture, manufacturing and services. The empirical findings reveal that urbanisation was one of the principal factors that have a positive impact on the consumption of liquified petroleum gas and premium motor spirit. The impact of urbanisation on the consumption of household kerosene is negative, showing that kerosene is not urbanisation elastic. The policy implications of the findings include the need to keep track of the proportion of the population moving into the urban centre, and the relative shift in the importance of the major sectors of the economy. These were significant in the estimation of the demand for petroleum products.

Sanjeev, *et al.,* (2002) examines, issues in domestic petroleum pricing in oil-producing countries. They found that in most major oil-exporting countries, government policies keep domestic prices below free-market levels, resulting in implicit subsidies that equated

3.0 percent of GDP, on average 1999. Moreover, the paper argues, these petroleum subsidies are inefficient and inequitable-entailing substantial opportunity cost in terms of forgone revenue or productive spending and also procyclical complicating macroeconomic management. Nonetheless, the elimination of petroleum subsidies is often politically difficult, although countervailing measures and publicity campaigns can help engender support for reform.

Asaolu (2007) assessed the domestic demand for petroleum products in Nigeria by the used of ordinary least square technique. The main focus of the study was to examine the trends of PMS, AGO and DPK and the factors that influence the domestic demand for petroleum products in Nigeria from 1986-2004. He also carried out an empirical investigation in Zaria from a population of 100 consumers of PMS, AGO and DPK to buttress the regression result as to what factor influences their demand for the products. The overall findings of the regression reveals that price and income have no significant impact on PMS from 1986-2004. Likewise, price have no significant impact on demand for AGO and DKP from 1986-2004, but per capital income has significant impact on the consumption of AGO and DPK from 1986-2004. The primary data result revealed that the uses of PMS, AGO and DPK have a significant impact on domestic demand for petroleum products in Nigeria couple with other composite factors such as price and uses, income and uses, revenue and uses. To enhance effective demand for petroleum products in Nigeria, the study suggested among others appropriate pricing of petroleum products based on market forces, the over hauling of the refineries and more participation of

indigenous markets on the supply and effective distribution of petroleum products in Nigeria.

Gounder *et al.,* (2007) examined oil price shocks and economic growth in Venezuela using the Vector Autoregressive (VAR) methodology based on quarterly data. Three oil price measures were considered, following the various theoretical implications that oil price shocks have on economic growth. The authors analysed the short-run impact of oil price shocks in a multivariate framework which traced the direct economic impact of oil price shocks on economic growth as well as indirect linkages. Furthermore, the models employed the linear oil price and two leading nonlinear oil price transformations to examine various short-run impacts. A Wald and Likelihood Ratio tests of Granger Causality, was utilized and the results indicated that linear price change, the asymmetric price increase and the net oil price variables were significant for the system as a whole, whereas the asymmetric price variables was not. Following the causality analysis of oil price nexus, the generalized impulse responses and error variance decompositions the authors reaffirmed the direct link between the net oil price shock and growth, as well as the indirect linkages. They concluded that since oil consumption continued to increase in New Zealand, there is a need for policy-makers to consider oil price shocks as a major source of volatility for many variables in the economy.

Bassam (2007) in his work 'the drivers of oil prices'; discuss three main approaches for analyzing oil prices: non-structural models, the supply–demand framework and the informal approach. Each of these approaches emphasizes a certain set of drivers of oil

prices. While non-structural models rely on the theory of exhaustible resources as the basis for understanding the oil market, the supply–demand framework uses behavioural equations that link oil demand and supply to its various determinants such as GDP growth, prices and oil reserves. The informal approach, on the other hand, analyses oil price movements within specific contexts and episodes of oil market history. He use the latter approach to identify the main factors that have affected oil price movements in recent years, analyzing whether these drivers reflect structural changes in the oil market. He emphasize that although all the above approaches provide useful insights on how the world oil market functions, they suffer from major limitations especially when used to make long-term projections. Thus, pushing hard for policies based on the projections of such models defeats their purpose and may result in misguided policies.

Odularu (2007) in his work "crude oil and the Nigerian economic performance", found out that for the past three decades, crude oil has been a major source of revenue, energy and foreign exchange for the Nigerian economy. Against this background, his paper analyses the relationship between the crude oil sector and the Nigerian economic performance. Using the Ordinary Least Square regression method, the study reveals that crude oil consumption and export have contributed to the improvement of the Nigerian economy. However, one of the recommendations of the study is that government should implement policies that would encourage the private sector to participate actively in the crude oil sector.

Oludanya *et al.,* (2008) analyses the main sources of fluctuations in inflation in Nigeria. Using the framework of error correction mechanism, it was found that the lagged CPI, expected inflation, petroleum prices and real exchange rate significantly propagate the dynamics of inflationary process in Nigeria. The level of output was found to be insignificant in the parsimonious error correction model. Surprisingly, the coefficient of the lagged value of money supply was found to be negative and significant only at the 10% level. One of the major implications of this result is that efforts of the monetary regulating authorities to stabilize the domestic prices would continuously be disrupted by volatility in the international price of crude oil.

Iwayemi (2009) in his work formulates and estimates petroleum product demand functions in Nigeria at both aggregative and product level for the period 1977 to 2006 using multivariate co-integration approach. The estimated short and long-run and income elasticities confirm conventional wisdom that energy consumption responds positively to changes in GDP and negatively to changes in energy price. However, the price and income elasticities of demand varied according to product type. Kerosene and gasoline have relatively high short-run income and price elasticity compared to diesel. Overall, the result shows petroleum products to be price and income inelastic.

Apkan (2009) analyses the dynamic relationship between oil price shocks and major macroeconomic variables in Nigeria by applying a VAR approach. The study pointed out the asymmetric effects of oil price shocks; for instance, positive as well as negative oil price shocks significantly increase inflation and also directly increases real national

income through higher export earnings, though part of this gain is seen to be offset by losses from lower demand for exports generally due to the economic recession suffered by trading partners. The findings of the study showed a strong positive relationship between positive oil price changes and real government expenditures. Unexpectedly, the result identified a marginal impact of oil price fluctuations on industrial output growth. Furthermore, the "Dutch Disease" syndrome is observed through significant real effective exchange rate appreciation.

Nwosu (2009) in a studies she conducted on "the impact of fuel price on inflation in Nigeria", she examined using the variance Autoregressive analysis model to asses the relative contribution of fuel price on inflation. The study used available quarterly data series spanning 1995 to 2008. The finding of the study revealed that the policy of subsidizing the price of fuel should be continued so as to help cushion the economy from the adverse effects of oil-price shock.

From the foregoing, most of the empirical studies carried out have focused on different monetary policies and inflation, oil price shock and demand for petroleum product in Nigeria. Few studies exist yet on the impact of domestic petroleum products prices and inflation using the VAR model, impulse response function and variance decomposition for an oil consuming and exporting country as Nigeria. This study intends to fill this gap. It would be interesting to empirically verify domestic petroleum products prices and inflation in Nigeria.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 SOURCES OF DATA

This study would simply employ time series data on quarterly basis from 1990-2008. The data for this study depend mainly on secondary sources gotten from Central Bank of Nigeria (CBN) publication of different years such as Statistical Bulletins, Economic and Financial Review, Annual Report Journal gathered from NNPC, text books, and paper presentation on related issue.

3.2 ANALYTICAL TECHNIQUES

Various analytical techniques were employed to test the hypothesis for this study. Simple descriptive statistics such as graph and percentages were used to examine the trend and magnitude of petroleum products prices. In order to analyze the relationship between petroleum products prices and inflation in Nigeria, the VAR model was used. This is because the relationship between the variables is complex and dynamic, and can only be best estimated by the use of a dynamic model. The Vector Autoregressive model is adopted for this work because it is commonly used for forecasting systems of interrelated time series and for analyzing the dynamic impact of random disturbances on the system variance. The VAR model sidesteps the need for structural modeling by treating every endogenous variable in the system as a function of the lagged values of all endogenous variables in the system.

If differenced series happen to be stationary then, it is possible to run regressions in differences. In this case the original time series are integrated of different order. The

problem with regressions in differences is that it is rather difficult to interpret the coefficients on differenced variables. Most economic theory states the long run relationship between variables in level form and not first (or higher order) difference form (Holod, 2000). If series are found to be non-stationary, then there is possibility of co-integration in the data. Finding co-integration in the data would mean that the estimation will have to proceed in level form rather than first or second difference as some information about the long run relationship of the series will be lost. Therefore, if there exist one or more cointegrating equations then, the VAR should take these cointegrating equations into account through an error correction term. The VAR that incorporates cointegration is called the Vector Error Correction (VEC) model.

3.3 MODEL SPECIFICATION

To investigate the relationship between petroleum products prices and inflation in Nigeria the Vector Autoregressive model of Akpan (2009) has been adapted for this study. The reason has been that the VAR model provides a multivariate framework where changes in a particular variable (PPP) are related to change in its own lags and to changes in other variable and the lags of those variables. The VAR treats all variables as endogenous and does not impose a priori restriction on structural relationships. Since the VAR expresses the dependent variables in terms of predetermined lagged variables, it is a reduced-form model. Once the VAR has been estimated, the relative importance of a variable in generating variations in its own value and in the value of other variables can be assessed.

To estimate the VAR, we need to first check the time series properties of the data in order to help us decide whether the VAR will be estimated in levels, first or second difference.

Here we shall use a variant of the unit root tests such as the Augmented Dickey Fuller (ADF) or Phillip Perron (PP). Depending on the nature of the time series, a variant of this test that account for structural changes may be more appropriate.

The VAR model is presented below.

$$PPP_t = f(PPP_{t-1}, GFD_{t-1}, M1_{t-1}, EX_{t-1}, INF_{t-1}, U_{1t}) \quad \ldots \quad \ldots \quad (3.1)$$

$$GFD_t = f(PPP_{t-1}, GFD_{t-1}, M1_{t-1}, EX_{t-1}, INF_{t-1}, U_{2t}) \quad \ldots \quad \ldots \quad (3.2)$$

$$M1_t = f(PPP_{t-1}, GFD_{t-1}, M1_{t-1}, EX_{t-1}, INF_{t-1}, U_{3t}) \quad \ldots \quad \ldots \quad (3.3)$$

$$EX_t = f(PPP_{t-1}, GFD_{t-1}, M1_{t-1}, EX_{t-1}, INF_{t-1}, U_{4t}) \quad \ldots \quad \ldots \quad (3.4)$$

$$INF_t = f(PPP_{t-1}, GFD_{t-1}, M1_{t-1}, EX_{t-1}, INF_{t-1}, U_{5t}) \quad \ldots \quad \ldots \quad (3.4)$$

Where PPP_{t-1} = Domestic prices of petroleum product at time $_{t-1}$

GFD_{t-1} = Government Fiscal Deficit $_{t-1}$

$M1_{t-1}$ = Money Supply $_{t-1}$

EX_{t-1} = Exchange rate at time $_{t-1}$

INF_{t-1} = Inflation rate at time $_{t-1}$

U_t = is the error term

$_{t-1}$ = lag length which be determined by the SC and AK statistics

The study seeks to use the time series values of PPP, GFD, M1, EX, and INF to analyze the effect of PPP on inflation in Nigeria.

Vector Autoregression (VAR) models are useful for policy analysis. Consider the vector autoregressive model— for example, VAR (1) $\mathbf{X}_t = D + A\mathbf{X}_{t-1} + \boldsymbol{\varepsilon}_t$ which describes the dynamics of the vector X_t (a vector of petroleum product prices (PPP), government fiscal deficit (GFD), money supply (M1), exchange rate (EX) and inflation rate (INF)). Each variable is expressed as a linear combination of lagged values of itself and lagged values

of all other variables in the group. In this multivariate setting, the forecast of inflation rate will be a function of a larger information set that combines not only the history of inflation rate but also the histories of many other variables, such as PPP, GFD, M1, and EX.

A VAR is the generalization of the univariate autoregressive model to a vector of economic variables. The pth order vector autoregressive model or VAR model can be written as:

$$X_t = D + A_1 x_{t-1} + A_2 x_{t-2} + \ldots + A_p x_{t-p} + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3.5)$$

Where $\mathbf{X}_t$ is an n x 1 vector of variables at time t, D is vector of intercepts and $\boldsymbol{\varepsilon}_t$ is the vector of stochastic error term called impulses or innovations or shocks in the language of VAR. In 'pure' VAR models no a priori economic restrictions are imposed on coefficient matrix (D). Since every equation in the VAR has the same number of variables on the right-hand side, the coefficients of the overall system are easily estimated by applying Ordinary Least Squares (OLS) to each equation individually. Also, since the OLS estimator has standard asymptotic properties, it is possible to test any linear restriction, either in one equation or across equations, with the standard t and F statistics.

The lag length p is also chosen by statistical testing or by minimizing some information criteria. The VAR model is estimated under the null and under the alternative hypotheses, and testing is carried out by constructing either the F-statistic (based on the comparison of the sum of squared residuals for the restricted and unrestricted specifications) or an asymptotic likelihood test (based on the comparison of the value of the likelihood function for the restricted and unrestricted specifications).

Hence, the general framework of the model to be estimated can be specified as follows:

For simplicity, assume a VAR (1) model of the form:

$$\mathbf{X}_t = D + A_1\mathbf{x}_{t-1} + \boldsymbol{\varepsilon}_t \quad \text{..... (3.6)}$$

where the vector $\mathbf{X}_t$ = (PPP, GFD, M1, EX, INF)

The relationship can be represented as follows:

$$\begin{pmatrix} PPP_t \\ GFD_t \\ M1_t \\ EX_t \\ INF_t \end{pmatrix} = \begin{pmatrix} D_1 \\ D_2 \\ D_3 \\ D_4 \\ D_5 \end{pmatrix} + \begin{pmatrix} \beta_{11} & \beta_{12} & \beta_{13} & \beta_{14} & \beta_{15} \\ \beta_{21} & \beta_{22} & \beta_{23} & \beta_{24} & \beta_{25} \\ \beta_{31} & \beta_{32} & \beta_{33} & \beta_{34} & \beta_{35} \\ \beta_{41} & \beta_{42} & \beta_{43} & \beta_{44} & \beta_{45} \\ \beta_{51} & \beta_{52} & \beta_{53} & \beta_{54} & \beta_{55} \end{pmatrix} \begin{pmatrix} PPP_{t-1} \\ GFD_{t-1} \\ M1_{t-1} \\ EX_{t-1} \\ INF_{t-1} \end{pmatrix} + \begin{pmatrix} \varepsilon_t \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \end{pmatrix} \quad \text{... ... ...} \quad 3.7$$

X_t D A X_{t-1} ε_t

Thus, in all VARS, each variable is expressed as a linear combination of lagged values of itself and lagged values of all other variables in the group.

3.3.1 IMPULSE-RESPONSE FUNCTION AND VARIANCE DECOMPOSITION

An important use of VAR is to quantify the effects over time of economic policy. Suppose that the Federal government increases domestic prices of petroleum products. The questions become: When, for how long and by how much does price shocks impact on inflation rate? Impulse-response functions are designed to answer these questions. An impulse-response function describes the response over time of each variable in the VAR to a one-time shock in any given variable while keeping all others constant.

Closely associated with the impulse-response function is the variance decomposition. This decomposition refers to the contribution of each innovation to the variance of the forecast error associated with the forecast of each variable in the VAR. It can be used, therefore, to determine how much variations in a given variable can be attributed to each variable over the sample period. This will therefore enable us to determine, for instance, whether it is petroleum product prices changes that have the most impact on inflation historically.

3.4 A- PRIORI- EXPECTATION

It is expected from equation 3.7 above as the prices of petroleum product increases, inflation rate will also increase. That is positive relationships exist between petroleum prices and inflation in Nigeria. The inclusion of the error term is to capture the effects of other variables that affect inflation but are not included in the model.

CHAPTER FOUR

EMPIRICAL RESULTS AND ANALYSIS

4.0 INTRODUCTION

This section presents the empirical results and analysis of the study. Graphs and percentages were used to analyze the trend of petroleum product prices in Nigeria. The unit root tests result was also reported. This is followed consequently the VAR analysis.

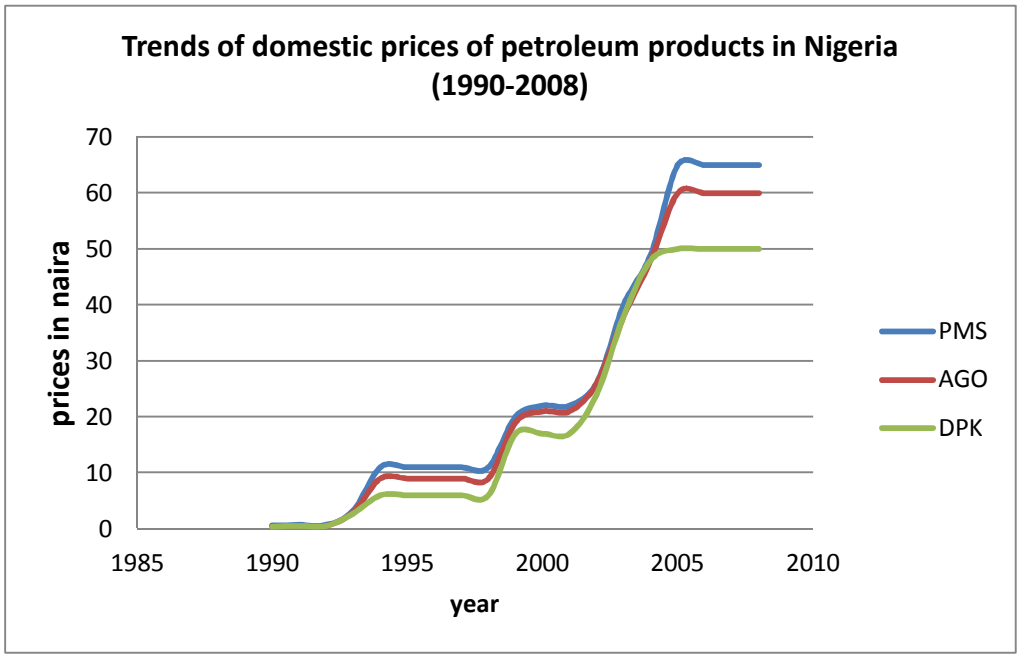
4.1 ANALYSIS OF THE TRENDS IN THE PETROLEUM PRODUCTS PRICES IN NIGERIA

Appendix (2) shows the domestic prices of petroleum product in Nigeria from 1990-2008 in naira and kobo. The price of petroleum product has been on the increase in the Nigeria economy. The domestic prices of PMS, AGO and DPK in 1990 rose from 0.60 kobo, 0.50 kobo and 0.40 kobo respectively per litre to ₦3.25, ₦3.00 and ₦2.75 per litre respectively in 1993. Looking at the prices of the same products from 1994-1998 indicated a significant increase because the prices rose to ₦11.00, ₦9.00 and ₦6.00 respectively. There was a significant increase in the prices of AGO and DPK to ₦48.00 each per litre while the price of PMS was ₦49.00 per litre in 2004. However, from 2005 to 2008 the prices of PMS, AGO and DPK stood at ₦65.00, ₦60.00 and ₦50.00 respectively.

Increase in the prices of petroleum products in Nigeria has been attributed to increase in the demand for the products in the country, while formally the products demand were met by the domestic refineries. However, owing to the poor conditions of three of the four refineries, increase in population and urbanization which has led to serious shortages in the supply of the products in the country. Government has often explained that increase in the prices of petroleum product is necessary as to reduce or remove the subsidy on

petroleum products much of which has to be imported because of her in ability to meet products demand domestically.

Fig 4.1 Trends in the domestic prices of petroleum products in Nigeria (1990-2008)



From the above diagram, it has been observed that there has been a significant increase in the prices of the entire petroleum product in the Nigerian economy. However, the prices of PMS, AGO and DPK per litre for each product in 1990 were 0.60 kobo, 0.50 kobo and 0.40 kobo, as at 2008 the prices of the same products per litre were ₦65:00, ₦60:00 and ₦50:00. indicating that there has been 10,733.3% change in prices of petrol, 11,900% change in the prices of diesel and 12,400% changes in the prices of kerosene per litre for each product from 1990-2008.

Table 4.1 Growth rate in the prices of Petroleum Products in Nigeria (1990-2008)

YEAR	PMS %	AGO %	DPK %
1990	16.7	0.0	25.0
1991	0.0	10.0	0.0
1992	364.3	445.5	450.0
1993	238.5	200.0	118.2
1994	0.0	0.0	0.0
1995	0.0	0.0	0.0
1996	0.0	0.0	0.0
1997	0.0	0.0	0.0
1998	81.8	111.1	183.3
1999	10.0	10.5	0.0
2000	0.0	0.0	0.0
2001	18.2	23.8	41.2
2002	53.8	46.2	58.3
2003	22.5	26.3	26.3
2004	32.7	25.0	4.2
2005	0.0	0.0	0.0
2006	0.0	0.0	0.0
2007	0.0	0.0	0.0
2008	0.0	0.0	0.0

Source: Author's Estimation using Excel

An examination of table 4.1 shows generally an appreciable increase in the prices of the petroleum products. However, some years such as 1991 and 1992 show spike in the prices while, from 2005 to 2008 shows relative stability in the prices.

Table 4.2 Index Values of Petroleum Products Prices in Nigeria; 2002 as the base year

YEAR	PMS	AGO	DPK
1990	2.3	1.9	1.7
1991	2.7	1.9	2.1
1992	2.7	2.1	2.1
1993	12.5	11.5	11.5
1994	42.3	34.6	25.0
1995	42.3	34.6	25.0
1996	42.3	34.6	25.0
1997	42.3	34.6	25.0
1998	42.3	34.6	25.0
1999	76.9	73.1	70.8
2000	84.6	80.8	70.8
2001	84.6	80.8	70.8
2002	100.0	100.0	100.0
2003	153.8	146.1	158.3
2004	188.5	184.6	200.0
2005	250.0	230.8	208.3
2006	250.0	230.8	208.3
2007	250.0	230.8	208.3
2008	250.0	230.8	208.3

Source: Author's Estimation using Excel

Table 4.2 above shows the index value for the prices of the commodities. The index values show an appreciable trend with stability for some of the years. The behaviour of the series in table 4.2 is similar to that of table 4.1.

4.2 RELATIONSHIP BETWEEN PETROLEUM PRODUCT PRICES AND INFLATION IN NIGERIA

The relationship between petroleum product prices and inflation is complex and dynamic and this can best be estimated only by the used of a dynamic model such as the VAR, VEC models etc. These models are commonly used for forecasting system of interrelated time series and have the ability to deal with several endogenous variables. Furthermore, it is a theory free model that can be used in estimating economic relationship among various variables.

First is to test if the relevant variables in equation (3.7) are stationary and to determine their orders of integration. The exercise was carried out using Augmented Dickey-Fuller (ADF) test as articulated in Engle and Granger (1987). The Augmented Dickey Fuller (ADF) test was used to find the existence of unit root in each of the time series. The

Augmented Dickey-Fuller unit root tests are applied to determine whether the series are stationary. The unit root test makes the series stationary and enables correction for any spurious result which may occur in the dynamic specification of the model. The table below summarizes the unit root results for all the variables.

Table 4:3 Augmented Dickey Fuller (ADF) Unit Root Test Result
Trend & Intercept

Variables	Lag	Level 1st & 2nd difference	Calculated tau	5 %	Stationary
PPP	2	Level	-5.78	-3.4724	Stationary
GFD	2 2	Level 1st difference	-2.495269 -5.015894	-3.4721 -3.4730	Non stationary Stationary
M1	2 2	Level 1st difference	-2.882581 -4.841698	-3.4713 -3.4721	Non stationary Stationary
EX	2 2	Level 2nd difference	-0.812967 -4.321302	-3.4721 -3.4739	Non stationary Stationary
INF	2	Level	-3.595093	-3.4721	Stationary

Notes:
• Optimal lag for conducting the ADF tests was selected based on the Schwartz and Akaike Information Criteria and also the auto-correlation function of the series. The optimal lag length in all cases was 2. Mackinnon(1991) critical value for rejection of hypothesis of unit root applied.
Source: Author's Estimation using Eviews 4.0.

The results in the table 4.3 show that two of the variables were stationary at levels which are PPP and INF while GFD and M1 are not stationary in level but they were stationary at first difference. However, EX rate was stationary at secondary difference. Hence the variables are stationary at different order. This can be seen by comparing the observed values (in absolute terms) of both the ADF test statistics with the critical values (also in absolute terms) of the test statistics at the 5% level of significance. The table reveals that all the variables are stationary but at different level on the basis of this, the null hypothesis of non-stationarity was rejected and it is safe to conclude that the variables are stationary. This implies that the variables are integrated of different order. Tom and Johansen (1997) assume that if the cumulated process satisfies an I(2) model, then the results about this model can be phrased in terms of multicointegration. This was proven by Engle and Yoo (1991). From this work it shows that the results are not cointegrating. Therefore, the most suitable model that can be used to analysis the relationship between petroleum products prices and inflation in Nigeria is the VAR model.

4.2.1. OPTIMAL LAG LENGTH IN THE VAR

A major requirement in conducting Johansen (1992, 1995) cointegration tests and estimation of a VAR system, either in its unrestricted or restricted Vector Error Correction (VEC) forms, is the choice of an optimal lag length. In this study, this choice was made by examining the lag structure in an unrestricted VAR originally specified with two lags, using a combination of VAR lag order selection criteria and examination of the roots of the characteristic polynomial to verify if the VAR is stable. Table 4.4 presents the evidence based on the VAR Lag Order Selection Criteria, while Appendix (14) shows

that the VAR satisfies the stability condition, and appendix (15) presents the inverse roots of the AR characteristic polynomial associated with the different lag orders specified by the selection criteria. As shown in Table 4.4, while the LR: Likelihood Ratio sequential modified LR test statistic, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion, FPE: Final prediction error and the AIC: Akaike information criterion suggests that two lags should be accommodated in the VAR. Examination of the inverse roots of the AR characteristic within the unit circle for the VAR specification involving two lags. This shows that the VAR in Equation 3.7 will be unstable if only one lag is accommodated. Thus, subsequent analyses were based on VAR with two lags. We find the optimal lag length that makes the residuals free from autocorrelations to be two.

Table: 4.4 OPTIMUM LAG ORDER SELECTION CRITERIA

Lag	LogL	LR	FPE	AIC	SC	HQ
0	40.24900	NA	2.58E-07	-0.979139	-0.821037	-0.916198
1	332.7583	536.2670	1.53E-10	-8.409952	-7.461341	-8.032307
2	527.3294	329.6900*	1.40E-12*	-13.12026*	-11.38114*	-12.42791*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

4.3 THE VECTOR AUTOREGRESSION MODEL

The vector autoregression (VAR) is commonly used for forecasting systems of interrelated time series and for analyzing the dynamic impact of random disturbances on the system of variables. The VAR approach sidesteps the need for structural modeling by

treating every endogenous variable in the system as a function of the lagged values of all of the endogenous variables in the system. Since only lagged values of the endogenous variables appear on the right-hand side of the equations, simultaneity is not an issue and OLS yields consistent estimates. Moreover, even though the innovations ε_t may be contemporaneously correlated, OLS is efficient and equivalent to GLS since all equations have identical regressors. Having concluded that variables in the VAR model appeared not to be cointegrated, we proceed to estimate VAR result. The table 4.5 below shows that the variables PPP, GFD, M1, and EX all depend on INF.

Table 4.5 VECTOR AUTOREGRESSION MODEL RESULT

Vector Autoregressive Result of ΔINF

Regressor	Coefficient	T-value
Intercept	0.203557	3.62205
D(PPP(-1))	0.418467	2.27761
D(PPP(-2))	-0.119698	-1.07177
D(GFD(-1))	0.118426	3.65894
D(GFD(-2))	-0.092723	-2.84762
D(M1(-1))	0.276980	1.56548
D(M1(-2))	0.147303	0.80445

D(EX(-1))	0.258227	1.19753
D(EX(-2))	-0.640478	-3.09303
INF(-1)	1.676764	23.8878
INF(-2)	-0.761518	-10.9129

R-squared	0.987
Adjusted R-squared	0.985
S.E equation	0.099
F-statistic	479.58

The results of the VAR produced some salient features that are worth explaining. The VAR result in the table 4.5 above was extracted from column six in appendix (11). The result shows that positive relationship existed between PPP and INF at lagged one and it is statistically significant, while at lagged two it showed a negative relationship and insignificant which make no economic sense. A one naira increase in the price of petroleum product brought about 42 percent increase in the inflation rate in Nigeria economy. However, rise in PPP has a multiplier effect on the cost of production of goods and services as well as the welfare of people in the whole economy. It was found that the demands for the domestically consumed petroleum products are greater than their supply and government policies unable to meet up with the supply in the country. Petroleum products serve as the major input to most firms, since electricity supply is unreliable in Nigeria. Whenever there is a rise in prices of petroleum product, scarcity in petroleum products or problem with the supply of petroleum products in the country etc, these seriously affected all economic activities in Nigeria by causing hardship to most people, making life to become unbearable for Nigerian, this has contributed in worsen the economic crises where the transportation fare has skyrocketed. However, this alone is not

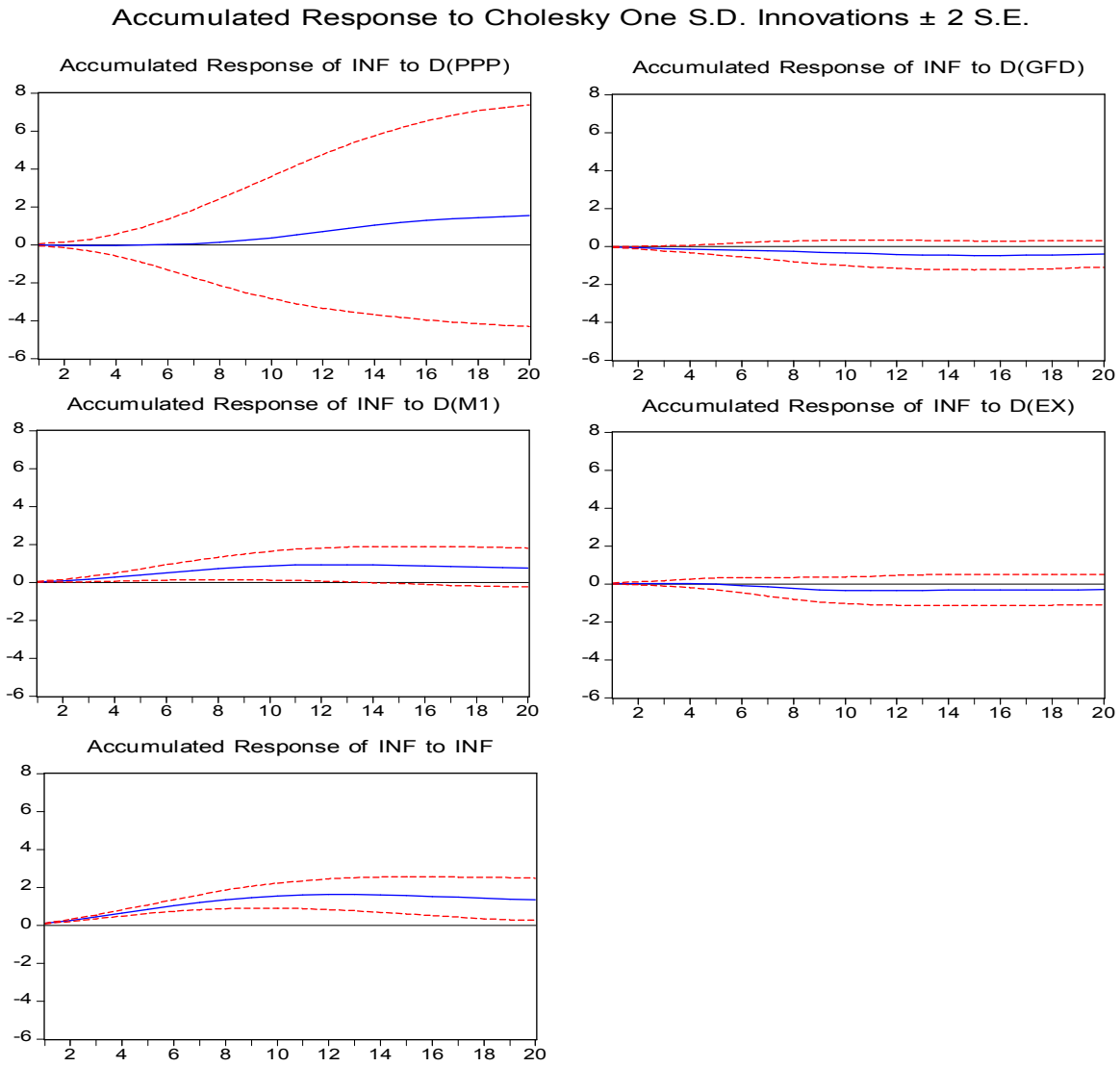
good enough to proof the positive relationship between PPP and INF in the Nigerian economy. The impulse response function and the variance decomposition were used to confirm the above results.

4.3.1 IMPULSE RESPONSE FUNCTION OF PPP, GFD, M1, EX AND INF

Impulse responses trace out the response of current and future values of each of the variables to a one unit increase in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. The implied thought experiment of changing one error while holding the others constant makes most sense when the errors are uncorrelated across equations, so impulse responses are typically calculated for recursive and structural VARs.

The extent to which shock in different variables influence PPP, GFD, M1, EX and INF can be assessed through impulse response function. The simulation horizon covers 20 quarters. The solid lines are impulse response. In this study impulse response function is depicted for a horizon of 20 quarters in the table below which enables us to trace out the response of PPP, GFD, M1, EX and INF to a shock in policy variables. The impulse response function depicts the growth rate relative to the base period when the shocks occurred.

Fig 4.2: Accumulated Response of INF to PPP, GFD, M1, and EX.



Source: Author's Estimation using Eviews 4.0.

The response of INF to PPP from the above graph has shown that from the 1st to the 7th quarter inflation does not response to any change in the prices of petroleum product. However, response of INF to PPP began to show positive impact from the 8th quarter and this persisted into the long-run that is the 20th quarter. This indicated that increases in the prices of petroleum product have a positive impact on inflation in Nigeria from the 8th - 20th quarter and remained positive. The positive impact was being noted in the 8th quarter

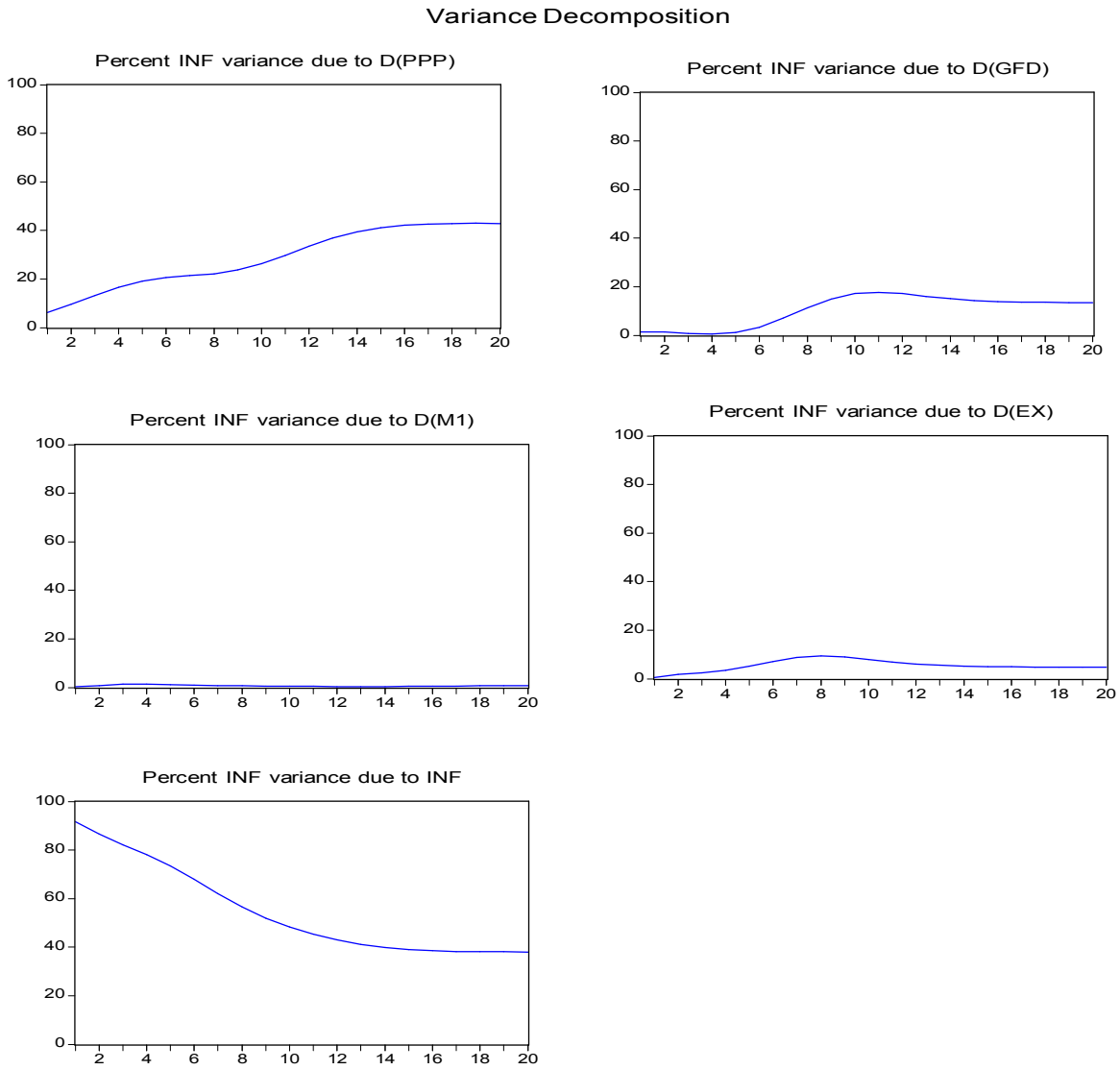
because whenever the prices of petroleum products are increased in Nigeria, people always believe that these prices will be reduced to their previous prices but after sometime they realize that this has come to stay. This is in line with our a-priori expectation that positive relationship exist between PPP in INF in Nigeria. The accumulated response of INF to GFD show that a slight negative relationship between the two variables from the 3rd quarter to the 20th quarter. So with the response of INF to EX this implies that negative relationship exit between inflation rate and exchange rate in Nigeria. An increase in exchange rates lead to a decrease inflation rate in Nigeria and vice verse. Furthermore, inflation rate response positively to change in money supply in the country.

4.3.2 VARIANCE DECOMPOSITION OF PPP, GFD, M1, EX, INF

We now proceed to examine the relative strength of various processes through which petroleum product prices impulses are transmitted to inflation. This is accomplished by carrying out a decomposition of PPP, GFD, M1 EX and INF with a view to determining the size of the fluctuation in a given variable that are caused by different shocks. In this particular study, we calculated variance decomposition at forecast horizons of four through 20 quarters. One quarter ahead is the short-run and four, eight and ten quarters represent the medium term, while 15 quarters ahead is the long-run. VAR for each variable was estimated which included 2 lags. The results are reported in the table below, indicating the percentages of variance of the variable forecast as attributed to each variable at a 20 quarter horizon. The first column list the periods, whereas the second column refers to standards error (SE), which is the forecast error of the variable at

different periods. The third column refers to PPP, the fourth GFD, the fifth M1, sixth EX and INF is the seventh.

Fig 4.3 Percent INF variance due to PPP



Source: Author's Estimation using Eviews 4.0.

The percent INF variance due to PPP graph shows that a positive relationship existed between INF and PPP in the study. About 41 percent of the inflation rates in the long-run

are influence by increase in petroleum prices in Nigerian economy as can seen in variance decomposition graph above. Therefore, since the impulse response function and the variance decomposition have both shown that there is a positive relationship between PPP and inflation in Nigeria. These are in accords with the supply shock inflation and structuralist view of inflation in the less developed countries like Nigeria, indicating how rise in the prices of petroleum products in Nigeria lies as one of the major price structures in the economy and a cause of inflation in the Nigerian economy. The major findings from this study is that whenever, there is an increase in the prices of petroleum products (PMS, AGO and DPK) in Nigeria, this has a positive impact on the general price level of goods and services in the economy and also has direct negative implication on the standard of living of the populace.

4.4 IMPLICATIONS OF THE FINDINGS

In Nigeria, inflation targeting has mainly been through manipulation of monetary variables. However, over the years the country has experienced appreciable increase in the prices of petroleum products, this study has shown that the persistent increase in the prices of petroleum products in the economy has a significant inflationary effect on the general prices levels of goods and services in the economy. This is because petroleum product has a lot of domestic uses, and serves as a major input to industrial production. Hence, this price increase of petroleum products has a multiplier effect on the whole Nigerian economy. Government should as matter of urgency pay attention to the activity and management of the petroleum industries and the supply of petroleum products. Because the findings in this study have revealed that increase in the domestic prices of

petroleum products in Nigeria are inflationary. This increase in the domestic prices of petroleum product in Nigeria is truly a reflection of the inflation on the economy as a whole.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 SUMMARY

Looking at the trends of petroleum products prices in Nigeria, graph and percentage were used to analysis the prices of PMS, AGO and DPK. This has shown a significant increase in the prices of these products in Nigeria from 1990-2008. The data used to analysis the relationship between petroleum product prices and inflation in the study proved to be stationary after differencing twice. The cointegration result showed the presence of cointegration, indicating the existence of a long-run relationship between PPP, INF and the other variables.

In terms of the VAR result revealed that increase in domestic petroleum product prices has a positive effect on inflation. This indicated that as the prices of petroleum product increase, it has led to increase in inflation in Nigeria from 1990-2008. This was further supported by the graph of impulse response function which indicated a positive relationship from PPP to INF in both short and long-run.

The study also revealed that inflation in Nigeria is not only a purely monetary phenomenon, but also a result of increase in the domestic prices of petroleum product in the Nigerian economy.

5.2 CONCLUSION

The conclusion reached from this study is that increases in prices of petroleum products have a positive effect on the level of inflation in the Nigerian economy. The consumption of petroleum products has increased tremendously from 1990-2008. This has led to

serious increase in the domestic consumption of petroleum product which is now far greater than the supply. The four local refineries are not operational at full capacity, smuggling of the products to other neighboring countries, intentional hoarding etc. has help in increasing the prices of the products which has a multiplier effect on the prices of other goods and services, even though government subsidies the prices of this products in the economy.

The Central Bank of Nigeria as well as the policy maker in the country should as a matter of urgency have a second thought, by not perceiving inflation in Nigeria as purely a monetary phenomenon rather begin to pay special attention to the supply management of petroleum products in the country. In this research work, it was revealed that domestic increase in the price of petroleum products is another serious cause of inflation in Nigeria from the VAR result and this was further proven by the impulse response function and variance decomposition graphs'.

5.3 RECOMMENDATIONS

The following recommendations are made with the hope that they could proffer solution to the effect of petroleum product prices and inflation in Nigeria.

1. Since the prices of petroleum product has chain effect on the prices of other goods and services in the country. Government should continue to subsidies their prices by so doing it will stabilizes prices of other goods and services and this will go a long way in reducing the rate of inflation in Nigeria.
2. Government should make sure that our existing refineries are functioning at full capacity and also build new ones; by so doing the existing refineries can meet Nigerians

internal petroleum products needs and some excess for export and strategic reserve of product demand. This can be made possible when the nation refineries Turn-Around-Maintenance are consolidated with transparency and accountability.

3. Government should introduce a very strong and strict policy that will severely deal with citizens who smuggle, hoard, and create artificial scarcity and black marketers of petroleum products so as to make abnormal profit to the detriment of the whole country.

4. Government should always carry along Labour Union, Trade Union and Private sector before it increase the prices of petroleum product because of it critical nature to cost of production and the welfare of people in the country so as to avoid unnecessary crises.

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APPENDIX1: Quarterly prices of PPP, GFD, M1, EX, INF

obs	PPP	EX	GFD	INF	M1
1990:1	-2.662121269	2.361259579	-1.1853	3.15628953	3.308562952
1990:2	-0.935983365	2.15665718	-6.3813	2.435821442	3.373291612
1990:3	-0.549739717	2.03612947	-9.7372	1.576294694	3.430672038
1990:4	-0.424495034	2.01743315	-11.5618	1.056678565	3.542120968
1991:1	-0.42617815	2.08881002	-12.1638	1.54817934	3.698421286
1991:2	-0.504843552	2.217930936	-11.8521	2.248498427	3.798507103
1991:3	-0.624554389	2.371821935	-10.9353	2.794038277	3.85312614
1991:4	-0.736890104	2.527295416	-9.7223	3.197909561	3.885835075
1992:1	-0.771108722	2.671047293	-8.5218	3.497564578	4.01382299
1992:2	-0.659712404	2.79619538	-7.6426	3.717612673	4.1867095
1992:3	-0.396158549	2.89928745	-7.381	3.872175536	4.288104616
1992:4	-0.01349059	2.980248009	-7.7452	3.973565794	4.372902637
1993:1	0.431652538	3.040562225	-8.4554	4.031887429	4.464268845
1993:2	0.881864905	3.080822222	-9.2193	4.051118639	4.563167286
1993:3	1.305246982	3.100880267	-9.7491	4.031273408	4.656309969
1993:4	1.660073991	3.104174037	-9.8616	3.985305065	4.823679014
1994:1	1.924788652	3.097855555	-9.478	3.944224914	4.859122244
1994:2	2.102706306	3.088990349	-8.5241	3.944395322	4.972213195
1994:3	2.196246321	3.084548687	-6.9348	4.01693422	5.035718074
1994:4	2.222101455	3.085915698	-4.8595	4.136086134	5.18425241
1995:1	2.207724812	3.088771695	-2.6615	4.24207755	5.10510876
1995:2	2.175535505	3.088548437	-0.7137	4.29367618	5.212187419
1995:3	2.148034333	3.080964569	0.6235	4.255055108	5.238089541
1995:4	2.136459668	3.068796844	1.2693	4.11341326	5.335174712
1996:1	2.138570929	3.062198623	1.4224	3.877791744	5.357844916
1996:2	2.150959556	3.071827199	1.2939	3.557625466	5.406983413
1996:3	2.169819122	3.106436984	1.0888	3.198232204	5.387325915
1996:4	2.187824984	3.151239176	0.8744	2.869091373	5.462037824
1997:1	2.194543208	3.172555408	0.5798	2.608553939	5.527371416
1997:2	2.179366059	3.137496558	0.1285	2.432121014	5.526209625
1997:3	2.131215346	3.004285589	-0.5545	2.309511053	5.535190238
1997:4	2.065241192	2.793652808	-1.4999	2.210338216	5.617127398
1998:1	2.031996098	2.671973873	-2.6943	2.134521408	5.636655718
1998:2	2.087409711	2.865105231	-4.1228	2.081102661	5.652106651
1998:3	2.259938518	3.347314773	-5.762	2.046388768	5.733551611
1998:4	2.491758125	3.835645074	-7.4042	2.020752545	5.790877182
1999:1	2.705934632	4.202620324	-8.657	1.988997005	5.936023188
1999:2	2.869182169	4.448543276	-9.1199	1.933519414	5.931183616
1999:3	2.967708243	4.583546061	-8.4151	1.833477063	5.887791496
1999:4	3.009970428	4.635244389	-6.6843	1.712102798	5.993527418

2000:1	3.016911404	4.641475114	-4.5892	1.66540228	6.190204744
2000:2	3.004543342	4.630479194	-2.8139	1.796680674	6.25321901
2000:3	2.987448054	4.62837584	-2.0183	2.112078127	6.32146769
2000:4	2.975315258	4.644865786	-2.303	2.461859766	6.476486091
2001:1	2.972719499	4.672542812	-3.2097	2.732905402	6.64991417
2001:2	2.983862101	4.703520286	-4.2556	2.898587913	6.621594715
2001:3	3.012196	4.730870244	-4.9711	2.945133475	6.651211343
2001:4	3.058073069	4.752518928	-5.1835	2.886213123	6.705281626
2002:1	3.118967088	4.770590552	-5.0175	2.761249678	6.728536504
2002:2	3.191919753	4.787185029	-4.6107	2.615430399	6.770897216
2002:3	3.273924459	4.804193981	-4.0985	2.520314012	6.838997737
2002:4	3.360937729	4.821955164	-3.5671	2.512846018	6.852509975
2003:1	3.448551595	4.839383441	-3.053	2.559789917	7.022466936
2003:2	3.533540569	4.85540581	-2.5908	2.618774444	7.185182449
2003:3	3.613649314	4.869034095	-2.214	2.654733809	7.142060309
2003:4	3.687621163	4.879794374	-1.9303	2.663722067	7.111153161
2004:1	3.754861464	4.887682418	-1.722	2.667200428	7.091359346
2004:2	3.8149657	4.892689995	-1.5704	2.686697173	7.102359428
2004:3	3.867648876	4.894796367	-1.4567	2.740459306	7.141173861
2004:4	3.913154365	4.89421458	-1.3633	2.815738007	7.193430339
2005:1	3.952108729	4.891388438	-1.2735	2.877477877	7.292731925
2005:2	3.985005773	4.886763761	-1.1711	2.896988706	7.28223183
2005:3	4.012212173	4.880784738	-1.0404	2.845734625	7.350522594
2005:4	4.034015834	4.873962974	-0.8855	2.713104075	7.34060855
2006:1	4.05063298	4.8668827	-0.7301	2.508907967	7.389069699
2006:2	4.062203529	4.860150332	-0.5989	2.248329521	7.531895302
2006:3	4.068813056	4.854354904	-0.5155	1.976037444	7.514598105
2006:4	4.071116876	4.849383013	-0.4827	1.755147351	7.567867773
2007:1	4.070350664	4.844398875	-0.4821	1.63284189	7.614992724
2007:2	4.067735322	4.83851671	-0.4948	1.636624972	7.5743942
2007:3	4.064495134	4.830828971	-0.5013	1.751631678	7.735756727
2007:4	4.061864414	4.820393656	-0.4827	1.934198983	7.84851616
2008:1	4.061091076	4.806208814	-0.4197	2.142721459	8.186720521
2008:2	4.063412734	4.787183362	-0.2931	2.351165711	8.372978651
2008:3	4.070043331	4.762084187	-0.0838	2.546754053	8.416663212
2008:4					8.450664424

Sources: Gbadamosi, R. Kupolokun, F. and Oluleye, O. (2007) A Story of The Deregulation of the Nigerian Downstream Oil Sector (PPPRA) No. 1/3 Sankuru Close off Rima/Gurara Street Maitama, Abuja.

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APPENDIX 2: Prices of Petroleum Product in Nigeria

YEAR	PMS	AGO	DPK
1990	0.6	0.5	0.4
1991	0.7	0.5	0.5
1992	0.7	0.55	0.5
1993	3.25	3	2.75
1994	11	9	6
1995	11	9	6
1996	11	9	6
1997	11	9	6
1998	11	9	6
1999	20	19	17
2000	22	21	17
2001	22	21	17
2002	26	26	24
2003	40	38	38
2004	49	48	48
2005	65	60	50
2006	65	60	50
2007	65	60	50
2008	65	60	50

Sources: Evans J and Todd J… Nigeria: Draft Public Sector Pricing Study world Bank Mission.

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APPENDIX 3: ADF TEST OF PPP at level

ADF Test Statistic	-5.789699	1% Critical Value*	-4.0890
		5% Critical Value	-3.4721
		10% Critical Value	-3.1629

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PPP)
Method: Least Squares
Date: 11/02/12 Time: 18:57
Sample(adjusted): 1990:4 2008:3
Included observations: 72 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP(-1)	-0.039470	0.006817	-5.789699	0.0000
D(PPP(-1))	1.184764	0.041718	28.39928	0.0000
D(PPP(-2))	-0.257215	0.022877	-11.24314	0.0000
C	0.016028	0.009001	1.780752	0.0795
@TREND(1990:1)	0.002260	0.000485	4.663124	0.0000

R-squared	0.939027	Mean dependent var	0.064164
Adjusted R-squared	0.935387	S.D. dependent var	0.121711
S.E. of regression	0.030938	Akaike info criterion	-4.046764
Sum squared resid	0.064129	Schwarz criterion	-3.888662
Log likelihood	150.6835	F-statistic	257.9638
Durbin-Watson stat	0.699111	Prob(F-statistic)	0.000000

APPENDIX4: ADF TEST Gfd at level

ADF Test Statistic	-2.495269	1% Critical Value*	-4.0890
		5% Critical Value	-3.4721
		10% Critical Value	-3.1629

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GFD)
Method: Least Squares
Date: 11/02/12 Time: 18:58
Sample(adjusted): 1990:4 2008:3

Included observations: 72 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GFD(-1)	-0.020192	0.008092	-2.495269	0.0151
D(GFD(-1))	1.557896	0.052180	29.85599	0.0000
D(GFD(-2))	-0.706473	0.047664	-14.82200	0.0000
C	-0.184588	0.073555	-2.509516	0.0145
@TREND(1990:1)	0.002958	0.001225	2.414272	0.0185

R-squared	0.968959	Mean dependent var	0.134075
Adjusted R-squared	0.967105	S.D. dependent var	0.885380
S.E. of regression	0.160580	Akaike info criterion	-0.753132
Sum squared resid	1.727660	Schwarz criterion	-0.595030
Log likelihood	32.11276	F-statistic	522.8525
Durbin-Watson stat	0.483649	Prob(F-statistic)	0.000000

APPENDIX 5: ADF TEST of GFD at first difference

ADF Test Statistic	-5.015894	1% Critical Value*	-4.0909
		5% Critical Value	-3.4730
		10% Critical Value	-3.1635

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GFD,2)
Method: Least Squares
Date: 11/02/12 Time: 19:00
Sample(adjusted): 1991:1 2008:3
Included observations: 71 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GFD(-1))	-0.078679	0.015686	-5.015894	0.0000
D(GFD(-1),2)	1.415475	0.059315	23.86364	0.0000
D(GFD(-2),2)	-0.637899	0.058007	-10.99700	0.0000
C	0.041526	0.025271	1.643251	0.1051
@TREND(1990:1)	-0.000631	0.000569	-1.108557	0.2716

R-squared	0.955775	Mean dependent var	0.028646
Adjusted R-squared	0.953095	S.D. dependent var	0.436250
S.E. of regression	0.094481	Akaike info criterion	-1.813011
Sum squared resid	0.589163	Schwarz criterion	-1.653667
Log likelihood	69.36187	F-statistic	356.5933
Durbin-Watson stat	1.153197	Prob(F-statistic)	0.000000

APPENDIX 6: ADF TEST of M1 at level

ADF Test Statistic	-2.882581	1% Critical Value*	-4.0871
		5% Critical Value	-3.4713
		10% Critical Value	-3.1624

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(M1)
Method: Least Squares
Date: 11/02/12 Time: 19:01
Sample(adjusted): 1990:4 2008:4
Included observations: 73 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
M1(-1)	-0.141790	0.049188	-2.882581	0.0053
D(M1(-1))	0.186114	0.115226	1.615205	0.1109
D(M1(-2))	0.054639	0.116775	0.467900	0.6414
C	0.581956	0.179237	3.246861	0.0018
@TREND(1990:1)	0.008326	0.002997	2.778598	0.0071

R-squared	0.133965	Mean dependent var	0.068767
Adjusted R-squared	0.083022	S.D. dependent var	0.071528
S.E. of regression	0.068495	Akaike info criterion	-2.458087
Sum squared resid	0.319023	Schwarz criterion	-2.301206
Log likelihood	94.72017	F-statistic	2.629700
Durbin-Watson stat	2.007412	Prob(F-statistic)	0.041770

APPENDIX 7 ADF TEST OF M1 at1st difference

ADF Test Statistic	-4.841698	1% Critical Value*	-4.0890
		5% Critical Value	-3.4721
		10% Critical Value	-3.1629

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(M1,2)
Method: Least Squares
Date: 11/02/12 Time: 19:03
Sample(adjusted): 1991:1 2008:4
Included observations: 72 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(M1(-1))	-0.924805	0.191008	-4.841698	0.0000
D(M1(-1),2)	0.075333	0.161037	0.467800	0.6414
D(M1(-2),2)	0.076944	0.124617	0.617446	0.5390
C	0.071615	0.023822	3.006276	0.0037
@TREND(1990:1)	-0.000222	0.000416	-0.533639	0.5954

R-squared	0.429018	Mean dependent var	-0.001076
Adjusted R-squared	0.394930	S.D. dependent var	0.093531
S.E. of regression	0.072754	Akaike info criterion	-2.336550
Sum squared resid	0.354641	Schwarz criterion	-2.178448
Log likelihood	89.11579	F-statistic	12.58543
Durbin-Watson stat	1.991069	Prob(F-statistic)	0.000000

APPENDIX 8: ADF TEST OF EX at level

ADF Test Statistic	-0.812967	1% Critical Value*	-4.0890
		5% Critical Value	-3.4721
		10% Critical Value	-3.1629

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EX)
Method: Least Squares
Date: 11/02/12 Time: 19:04

Sample(adjusted): 1990:4 2008:3
Included observations: 72 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EX(-1)	-0.010417	0.012814	-0.812967	0.4191
D(EX(-1))	1.464559	0.074377	19.69105	0.0000
D(EX(-2))	-0.750396	0.077775	-9.648246	0.0000
C	0.043318	0.029678	1.459590	0.1491
@TREND(1990:1)	0.000183	0.000589	0.311262	0.7566

R-squared	0.898905	Mean dependent var	0.037860
Adjusted R-squared	0.892869	S.D. dependent var	0.108758
S.E. of regression	0.035597	Akaike info criterion	-3.766179
Sum squared resid	0.084900	Schwarz criterion	-3.608077
Log likelihood	140.5824	F-statistic	148.9358
Durbin-Watson stat	1.057651	Prob(F-statistic)	0.000000

APPENDIX 9: ADF TEST OF EX at 2nd difference

ADF Test Statistic	-4.321302	1% Critical Value*	-4.0928
		5% Critical Value	-3.4739
		10% Critical Value	-3.1640

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EX,3)
Method: Least Squares
Date: 11/02/12 Time: 19:07
Sample(adjusted): 1991:2 2008:3
Included observations: 70 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EX(-1),2)	-0.388614	0.089930	-4.321302	0.0001
D(EX(-1),3)	0.806740	0.077347	10.43011	0.0000
D(EX(-2),3)	-0.347132	0.113261	-3.064892	0.0032
C	-6.56E-05	0.007858	-0.008354	0.9934
@TREND(1990:1)	-1.31E-05	0.000177	-0.073786	0.9414

R-squared	0.695030	Mean dependent var	-0.001374
Adjusted R-squared	0.676263	S.D. dependent var	0.052149
S.E. of regression	0.029671	Akaike info criterion	-4.128516
Sum squared resid	0.057226	Schwarz criterion	-3.967909
Log likelihood	149.4981	F-statistic	37.03396
Durbin-Watson stat	1.656990	Prob(F-statistic)	0.000000

APPENDIX 10: ADF TEST OF INF at level

ADF Test Statistic	-3.595093	1% Critical Value*	-4.0890
		5% Critical Value	-3.4721
		10% Critical Value	-3.1629

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INF)
Method: Least Squares
Date: 11/02/12 Time: 19:08

Sample(adjusted): 1990:4 2008:3
Included observations: 72 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF(-1)	-0.060566	0.016847	-3.595093	0.0006
D(INF(-1))	1.100219	0.084841	12.96800	0.0000
D(INF(-2))	-0.435795	0.087170	-4.999398	0.0000
C	0.247591	0.063037	3.927700	0.0002
@TREND(1990:1)	-0.001882	0.000593	-3.175523	0.0023

R-squared	0.832154	Mean dependent var	0.013479
Adjusted R-squared	0.822133	S.D. dependent var	0.208855
S.E. of regression	0.088083	Akaike info criterion	-1.954157
Sum squared resid	0.519828	Schwarz criterion	-1.796055
Log likelihood	75.34964	F-statistic	83.04376
Durbin-Watson stat	1.721404	Prob(F-statistic)	0.000000

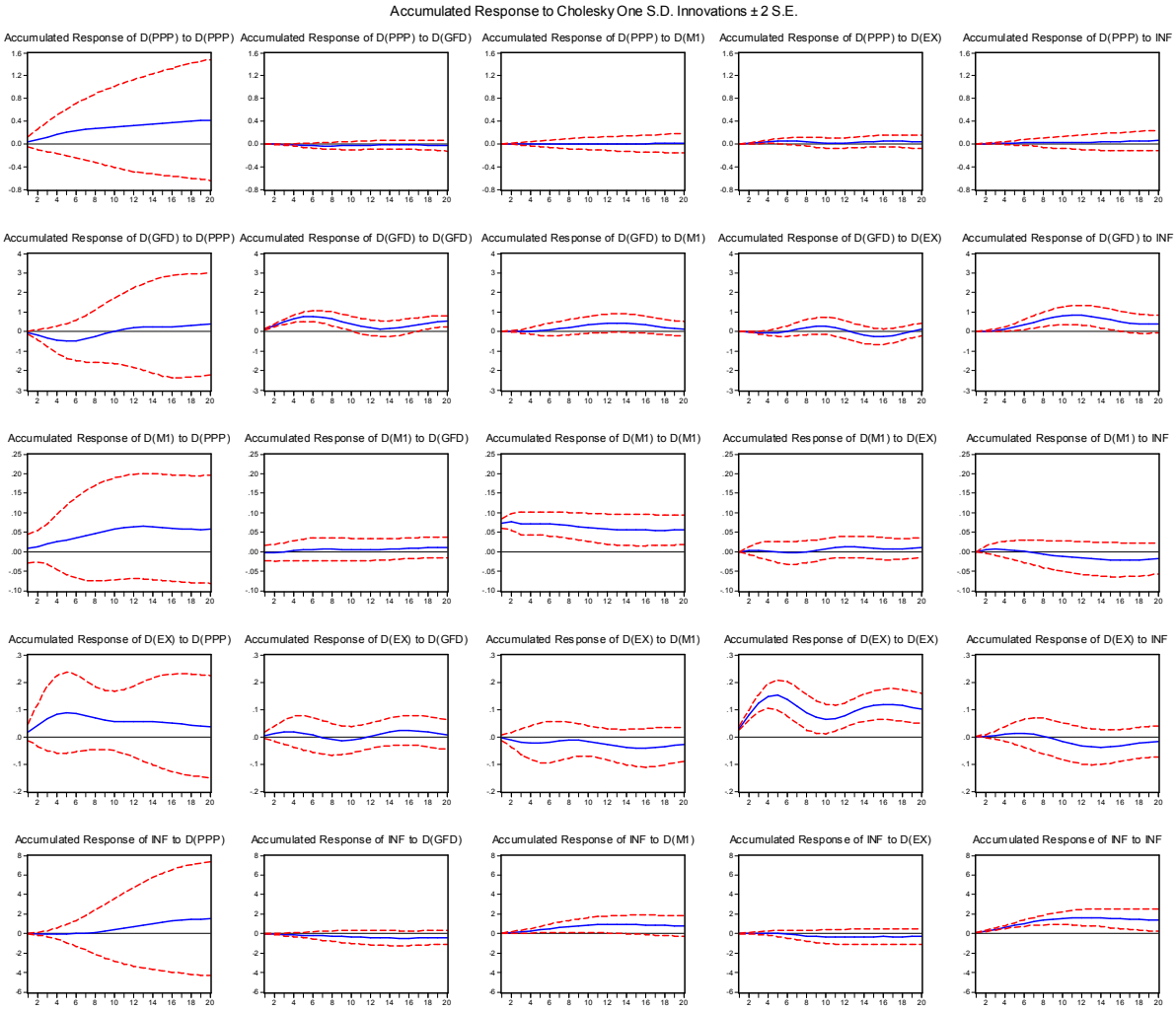
APPENDIX 11: VECTOR AUTOREGRESSION RESULT

Date: 11/02/12 Time: 09:41
Sample(adjusted): 1990:4 2008:3
Included observations: 72 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

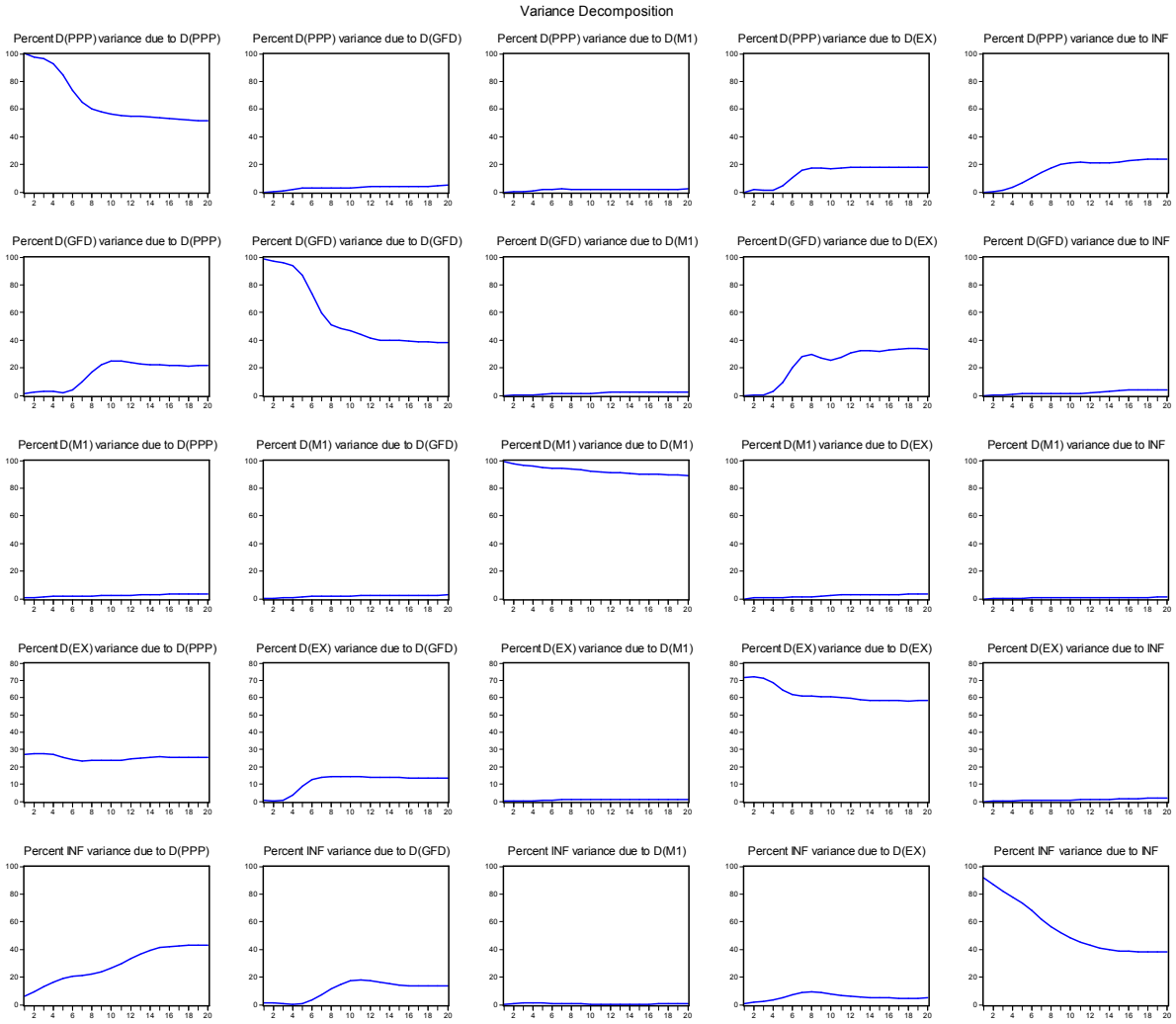
	D(PPP)	D(GFD)	D(M1)	D(EX)	INF
D(PPP(-1))	1.072718	0.319666	0.148443	0.051230	0.418467
	(0.06310)	(0.25023)	(0.13452)	(0.06816)	(0.18373)
	[17.0004]	[1.27747]	[1.10347]	[0.75158]	[2.27761]
D(PPP(-2))	-0.158075	-0.308851	0.052267	-0.044226	-0.119698
	(0.03836)	(0.15211)	(0.08177)	(0.04143)	(0.11168)
	[-4.12126]	[-2.03048]	[0.63917]	[-1.06740]	[-1.07177]
D(GFD(-1))	-0.038979	1.640054	0.009507	0.003864	0.118426
	(0.01112)	(0.04408)	(0.02370)	(0.01201)	(0.03237)
	[-3.50660]	[37.2050]	[0.40116]	[0.32181]	[3.65894]
D(GFD(-2))	0.036974	-0.856577	0.008081	-0.010796	-0.092723
	(0.01118)	(0.04435)	(0.02384)	(0.01208)	(0.03256)
	[3.30629]	[-19.3151]	[0.33895]	[-0.89369]	[-2.84762]
D(M1(-1))	0.010107	-0.172117	0.047475	-0.032168	0.276980
	(0.06076)	(0.24097)	(0.12954)	(0.06564)	(0.17693)
	[0.16633]	[-0.71426]	[0.36647]	[-0.49008]	[1.56548]
D(M1(-2))	-0.026236	0.098448	-0.082357	0.004398	0.147303
	(0.06289)	(0.24939)	(0.13407)	(0.06793)	(0.18311)
	[-0.41720]	[0.39475]	[-0.61428]	[0.06475]	[0.80445]
D(EX(-1))	0.192695	-0.743591	0.079073	1.443695	0.258227
	(0.07406)	(0.29368)	(0.15788)	(0.08000)	(0.21563)
	[2.60202]	[-2.53195]	[0.50084]	[18.0467]	[1.19753]
D(EX(-2))	-0.145853	1.031332	-0.133684	-0.776283	-0.640478
	(0.07112)	(0.28202)	(0.15161)	(0.07682)	(0.20707)
	[-2.05092]	[3.65691]	[-0.88174]	[-10.1050]	[-3.09303]

INF(-1)	0.022327	0.149378	0.053969	0.019867	1.676764
	(0.02411)	(0.09560)	(0.05139)	(0.02604)	(0.07019)
	[0.92615]	[1.56252]	[1.05010]	[0.76291]	[23.8878]
INF(-2)	-0.017508	-0.064965	-0.079320	-0.022985	-0.761518
	(0.02397)	(0.09504)	(0.05109)	(0.02589)	(0.06978)
	[-0.73053]	[-0.68356]	[-1.55247]	[-0.88785]	[-10.9129]
C	-0.006897	-0.223400	0.126888	0.022370	0.203557
	(0.01930)	(0.07654)	(0.04115)	(0.02085)	(0.05620)
	[-0.35734]	[-2.91869]	[3.08369]	[1.07294]	[3.62205]
R-squared	0.932511	0.979943	0.121263	0.901370	0.987440
Adj. R-squared	0.921447	0.976655	-0.022792	0.885201	0.985381
Sum sq. resids	0.070983	1.116317	0.322626	0.082830	0.601811
S.E. equation	0.034112	0.135279	0.072725	0.036849	0.099327
F-statistic	84.28481	298.0304	0.841781	55.74739	479.5856
Log likelihood	147.0279	47.83516	92.52185	141.4711	70.07762
Akaike AIC	-3.778553	-1.023199	-2.264496	-3.624198	-1.641045
Schwarz SC	-3.430729	-0.675375	-1.916672	-3.276374	-1.293221
Mean dependent	0.064164	0.134075	0.069250	0.037860	2.762490
S.D. dependent	0.121711	0.885380	0.071910	0.108758	0.821512
Determinant Residual Covariance		6.86E-13			
Log Likelihood (d.f. adjusted)		497.4868			
Akaike Information Criteria		-12.29130			
Schwarz Criteria		-10.55218			

APPENDIX 12: Accumulated impulse responses



APPENDIX 13: Variance decomposition



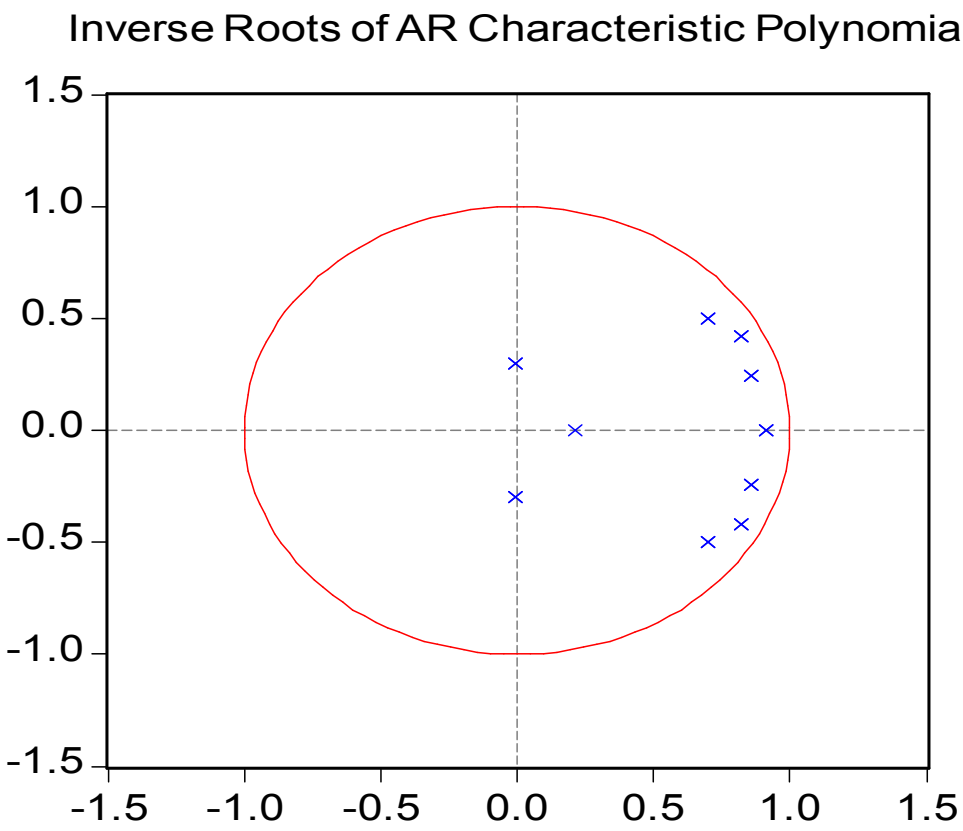
APPENDIX 14: Roots of Characteristic Polynomial

Roots of Characteristic Polynomial
Endogenous variables: D(PPP) D(GFD) D(M1) D(EX) INF
Exogenous variables: C
Lag specification: 1 2
Date: 11/02/12 Time: 22:35

Root	Modulus
0.823125 - 0.419210i	0.923727
0.823125 + 0.419210i	0.923727
0.915259	0.915259
0.856023 - 0.246222i	0.890731
0.856023 + 0.246222i	0.890731
0.701963 - 0.496042i	0.859540
0.701963 + 0.496042i	0.859540
-0.004548 - 0.297690i	0.297725
-0.004548 + 0.297690i	0.297725
0.212320	0.212320

No root lies outside the unit circle.
VAR satisfies the stability condition.

APPENDIX 15: Inverse Roots of AR Characteristic Polynomial


Inverse Roots of AR Characteristic Polynomial
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5