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Aims and Scope

The *Economic and Financial Review* is published four times a year in March, June, September and December by the Research Department of the Central Bank of Nigeria. The Review contains articles on research undertaken at the Bank, in particular, and Nigeria, in general, mainly on policy issues both at the macroeconomic and sectoral levels in the hope that the research would improve and enhance policy choices. Its main thrust is to promote studies and disseminate research findings, which could facilitate achievement of these objectives. Comments on or objective critiques of published articles are also featured in the review.

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Notes to Contributors

Information on manuscript submission is provided on the last and inside back cover of the Review.

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External Reserves Accumulation and the Estimation of the Adequacy Level for Nigeria

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Nigeria's foreign exchange reserves, which was US$5.4 billion in 1999, rose to an overwhelming level of US$51.3 billion at end-2007 and further to US$53.0 billion in 2008, but owing to the crash in the international price of crude oil in 2008 and the aftermath of the global financial crisis, the reserve declined to US$42.4 billion in 2009. In trying to determine the optimum level, the paper adopted Shcherbakov (2002) model which estimated the level of international reserves adequacy along the line of the drivers of external reserves. We found that there have been shortfalls in the achieved level of reserves over the year, the actual levels of reserves fell below the estimated trigger levels, except in the period 1992 – 2005. However, from 2006 through 2009 external reserves were in excess of actual reserves, especially in 2006 and 2007. The result reveals that the reserves accumulation in recent years was in line with global trend especially in emerging economies and could not be adjudged to be sufficient or in excess of expectations. Government should sustain reserves accumulation during oil boom to guard against any external shock, especially crude oil price shock.

Keywords: Foreign Exchange Reserves, Reserves Adequacy and Reserves Accumulation.

JEL Classification: F31

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I. Introduction

In the decade 2000-2009**,** the accumulation of foreign exchange reserves by developing economies reached its peak, especially in the oil exporting countries and emerging market economies. In 2005, the European Central Bank (ECB) noted that Emerging Market Economies (EMEs), accumulated reserves at an annual rate of US$250 billion or 3.5 per cent of their annual combined GDP during the period 2000-2005. This was almost five times higher than the levels in the early 1990s and was concentrated in Asia. Countries like China, Korea, India, Malaysia and Taiwan witnessed large surge while Latin America and Central Europe countries recorded modest increase during the period. In the same reasoning, the IMF (2001) noted that the financial crises of the late 1990s and early 2000s have shown that holding and managing adequate external reserves helps a country to prevent and move ahead of external crises especially if propelled by the capital account transactions. Reserves

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accumulation can, therefore, be seen as crisis prevention perception or precautionary motives for holding international reserves, driven by the volatility of capital flows and the vulnerability of global economies to external shocks.

World external reserves rose from US$ 1.2 trillion in January 1995 to above US$3.4 trillion in 2005, surging since 2002. As at end-2007, global reserves stood at US$ 4.1 trillion while Nigeria's stock represented only 1.3 per cent of total stock. Despite this low level, political economist query the need for accumulating foreign reserves in Nigeria amidst decaying infrastructure which brings to the fore the key issue of reserves adequacy, especially in developing economies. In Nigeria, since 1999, foreign exchange reserves have maintained an upward trend, except in 2003. The sharp rise in foreign exchange reserves globally, as well as in Nigeria, was attributable to three main drivers. First, precautionary motive arising from lessons of the financial crisis that occurred in the 1990s which called for huge external reserves to absorb external shocks or attack on the domestic currency. Second, in the Asian economies the surge was boosted by the earnings from the export-led growth, in addition to an increase in crude oil prices for the oil-producing countries. Last, is the macroeconomic development in emerging economies reflected in their excess domestic savings over investment (IMF 2002). Despite this new phenomenon, there have been arguments on why Nigeria should accumulate external reserves.

Reserves accumulation and composition of currency are contemporary issues in reserves management and countries accumulate foreign reserves for different reasons. Prominent among these are, to service foreign liabilities including external debt obligations, finance imports, provide fund for intervention in the foreign exchange market, and cushion the effects of external shocks. Globalization and the continued liberalization of capital account transactions as well as the aftermath of the Asian crisis of the mid-1990s have made most emerging economies to adopt reserve accumulation as a reserve management option. Lessons of experience have shown that recent reserves accumulations are mostly driven by capital account surplus, for example, in China, India, Korea and Taiwan, while in Russia and Nigeria, the build-up reflects the current account surplus. However, the combined estimated current account surplus of oil-producing countries have exceeded that of the Asian economies and have emerged as major net capital exporters in the world economy (ECB, ibid). More importantly, the experience of huge capital reversals in the Asian economies in the 1990s precipitated the accumulation of external reserves in emerging economies.

In most cases foreign exchange reserves are held in five currencies namely the US dollar, the euro, the Japanese yen, the British pound, and the Swiss franc. Dollar reserves holdings are by far the largest; accounting for about 70.0 per cent of the total, while euro reserves holdings comes next with a share of 20.0 per cent. The dollar commands a high share in global reserves because of the depth and liquidity in the US market for treasury and agency securities. In Nigeria, over 90.0 per cent of its foreign reserves are denominated in dollar owing mainly to the fact that the country's crude oil receipts and other non-oil exports are invoiced in dollar (Oputa, 2002).

Although Nigeria had sustained the built-up of foreign reserves in recent years, it is pertinent to understand the underlining drivers of current reserves accumulation. The paper will focus on trends in global foreign reserves accumulation and try to estimate the adequacy level for Nigeria using an adjusted form of Shcherbakov (2002) model. The rest of the paper is divided into four parts. Section 2 presents the theoretical framework with the review of literature and empirical measures of reserves adequacy. Section 3 analyzes trends in the recent reserves accumulation in some selected countries and consequences of reserves accumulation. Section 4 presents the estimation and analysis of reserves adequacy in Nigeria. Section 5 concludes the paper.

II. Theoretical Framework

Reserves adequacy is the level of external reserves that ensures sustainable balance of payments and macroeconomic adjustment resulting from external price shocks or reversals in short-term foreign capital flows. The debate on foreign exchange reserves adequacy transcends the use of visible imports or level of import cover in most of the 1950's through the mid-1990's to the recent calls for the incorporation of a broader measure that includes the need to meet major external liabilities such as external indebtedness and other forms of capital flows. A refocus on the issue of reserves adequacy was in the 1990s and early 2000s when depleting foreign exchange reserves associated with the currency crises in some emerging economies became worrisome. The aftermath was the move to accumulate reserves to self-insure against future crises.

II.1 Review of Literature

During the great depression of the 1930's, Keynes advocated the use of external reserves for mitigating external vulnerability or shocks. He called for an international clearing system where the main source of liquidity would be related to the value of trade (import ratio). This was further supported by Triffin (1947) who argued that demand for foreign reserves grew with trade in a linear form and advocated the use of reserves/imports ratio as a measure of reserves adequacy.
The International Monetary Fund (1953) discovered that adequacy of international reserves was related to the international credit system, the existing pattern of exchange rate, the appropriateness of monetary and fiscal policies, policy objectives and the stages of development of countries. The study argued that foreign trade is the largest item in the balance of payments and, therefore, the reserves should be compared with a country's trade figure. A major finding was that globally, most countries' annual reserves/imports ratio ranged between 30 to 50 per cent. This informed the minimum of three months of import cover that has been used internationally. This ratio has continued to serve as a preliminary indicator of reserves adequacy since it has become the most acceptable benchmark widely used until the recent rethink in the wake of the 1990's Asian crisis.

Heller (1966) adopted a radical approach and analyzed the adequate level of reserves in term of rational optimizing decision. He argued that optimum reserves occur where marginal utility of holding reserves equals marginal cost. He identified the precautionary motive of holding reserves as stemming from the ability to smoothen consumption and production in case of balance of payments deficit. This he noted, would lead to a more reliable and consistent index of reserves adequacy than simple reserves/imports ratio. Consequently, Heller supported the provision for other external payments variability.

Heller and Klan (1978) identified the type of exchange rate regime as a critical factor that influences the level of reserves adequacy. In their study, they noted that for industrial countries their reserves requirements trend downwards, while for most developing countries the level seems to be on the increase. Inference from this showed that countries like Nigeria should maintain much higher reserves level than the acceptable level of three month import cover. Lizondo and Mathieson (1987) also found that the debt crisis of the 1980's produced similar structural breaks in the demand for reserves after the collapse of the Bretton Woods System. Their findings showed that major components of external variability serve as critical factors in determining reserves adequacy for developing countries which was in line with Heller's position.

Greenspan (1999) observed that it is necessary to take into account the increased capital inflows for emerging market economies, and to relate the size of reserves to a country's short term external debt. This ratio according to him appears to be the most relevant single indicator of reserve adequacy for countries that borrow in international financial market. Bussiere and Christain (1999) found that higher liquidity could significantly decrease countries' vulnerability to external shocks in the face of weak domestic fundamentals. Their findings suggest full coverage of total short-term external debt as a practical rule for reserves adequacy for individual countries.

The IMF (2002) deriving from the currency crisis of the late 1990's argued that three months of imports of goods and services as an indicator of reserves adequacy was inadequate. The study in addition to recognizing the size and structure of external debt and export bills, positioned the ratio of reserves to base money or other monetary aggregates as major indicator of reserves adequacy. The Fund noted that lower levels of reserves have the potential of creating the risk of capital flight and lower investors' confidence on the economy. Similarly, Aizenman and Marion (2004) focused on the magnitude and speed of the reversal of capital flows throughout the 1997–98 crisis and observed that accumulating international reserves could be viewed as a precautionary adjustment process, reflecting the desire for self-insurance against exposure to future shocks.

Aizenman and Lee (2005) tested empirically the significance of precautionary and mercantilist motives in accounting for the hoarding of international reserves by developing countries. The empirical results were in line with the precautionary demand nexus. They found that the effects of financial crisis were localized, and had increased reserves hoarding in most countries. However, to obtain an optimum level of external reserves will require a detailed model and more information that include an assessment of the probability and output costs of shocks, as well as the opportunity cost of holding external reserves. In their view, exposure of developing countries to external shocks and reversals of hot money as well as growing trade openness are accountable for the observed increase in international reserves/GDP ratios by developing markets.

In the literature, we found no specific empirical work that focused on optimal reserves for Nigeria, except for the analytical usage of the months of import cover in various publications of the Central Bank of Nigeria. The most current and related work by the Drummond and Dhasmana (2008), considered the 'foreign reserves adequacy in sub-Saharan Africa' where it also mentioned that the

'literature on optimal reserves so far has not paid attention to the particular shocks facing low-income countries'. The authors used a 'two-good endowment economy model' for countries facing terms-of-trade and aid shocks to derive the optimal level of reserves. There result confirmed that optimal level of reserves in these countries depended on the size of trade and aid shocks, their probability and output cost.

II.2 Analytical Methodology

There are various approaches in the estimation of reserves benchmark level as noted in Triffin (1947), IMF (1953 and 2002), Heller (1966) among others. These models assume that optimal reserves should be that which could finance the gap between demand and supply of foreign currency, smoothening external payments imbalances and prevent exchange rate crisis. The basic models of external reserves adequacy are discussed in this section.

II.2.1 The Traditional Model

This consists of three variants designated along the line of thoughts of the proponents namely Kaminsky (1999), Pablo (1999) and Greenspan (1999) which are mix of both the balance of payments and monetary (balance sheet) approaches.

Basically this model relates reserves to the total months of import cover of any country. Consequently, the IMF (1953) and Triffin (1947) suggest that reserves adequacy required a minimum average yearly reserves to import ratio of 30-35 per cent. This has remained the benchmark ratio and it represented the trade-related approach to balance of payments and reserves needs

$$RA = Rs/M \quad (1)$$

where
RA=Reserves adequacy
Rs=Reserve stock
M= Imports

The limitation of this measure was proved by the Asian experience which was characterized by capital reversal that could not be backed by the available reserve, resulting in a bail-out by the IMF to avert the contagion effects which moved towards a total destabilization of the international financial system. Empirically, massive capital outflows have been associated with short-term debt outstanding rather than trade financing. Therefore, it has been suggested that

the size of the reserves of emerging market economies should be related to their short-term external debt outstanding.

Pablo (1999) and Greenspan (1999) advocated for a new minimum reserves stock benchmark using short-term emerging market debts as well as the current account deficit as measure of reserves adequacy. The short-term debt outstanding should be of maturity less than one year.

$$RA = Rs/M + Dt \quad (2)$$

where Dt =short term debt

Kaminsky (1999) employed the monetary aggregates and measured reserves adequacy as the ratio of broad money (M2) to the stock of reserves. They considered this as an accurate predictor of crises. De Beaufort Wijnholds and Kapteyn (2001) also revealed the monetarist approach to reserves adequacy by linking reserves to broad money. Increased money stock was expected in an import-dependent economy to translate to increased imports which would drain the reserves. For them the ratio of the money stock to reserves could be a guide to the measurement of reserves adequacy in any country. Unlike the traditional model, adequate threshold was not established in this model.

$$RA= Rs/M2 \quad (3)$$

where M2 =aggregate money stock

II.2.2 The Buffer Stock Model

The buffer stock model posits that the authorities select the stock of reserves by establishing the trade-off between the macroeconomic costs of future depletion of reserves and the current accumulation. This precautionary optimal reserves management is based on the minimization of the total cost of financing and adjusting to external shocks. The proponents included Heller (1966), Hamada and Ueda (1977) and Frenkel and Jovanovic (1981).

Specifically, the Frenkel and Jovanovic (1981) stochastic model adopted a rigorous quantitative approach in deriving the optimal reserves based on the outcomes of restocking financial transactions. Their optimizing equation was presented as:

$$Rt = -\mu dt + \sigma dWt \quad (4)$$

where Rt represents external reserves, Wt is a Wiener process with a mean of zero and variance t. At any given time the distribution of the reserves holdings is expected to be.

$$Rt = Ro - \mu + \sigma W \quad (5)$$

where R0 is the optimal initial stock of reserves, μ is a drift parameter and σ is the standard deviation of the Wiener reserves increment.

In their exposition, optimal reserves management like the management of most financial assets involves the selection of the cost minimizing stocks with a lower band, set here at zero. Since reserves holdings follow a stochastic process, the authorities are assumed to select the initial level of reserves R0 that minimizes total expected costs. Costs here have two interrelated dimension which are influenced by opportunity cost of reserves holdings and the adjustment cost of reserve restocking within the lower band. Thus, optimal reserves level will drift between μ and zero.

As a product of a stochastic process, this model is faced with the problem of exact predictability because the random factors could be unforeseen macroeconomic shocks and financial assets volatility, which are difficult to estimate. The technicality of the model poses a major limitation to its wide usage.

II.2.3 Integrated Model (Reserves Drainer Approach)

A more adaptable model by Shcherbakov (2002) based on the Russian experience examined the totality of foreign exchange outflows as major "drainers" of external reserves. He identified three basic variables that should be considered in measuring reserves adequacy namely import bills, short-term debt payments and money base. Shcherbakov opined that once these variables are matched by available external reserves, then external shocks would be cushioned in any economy. The equation for optimal reserves level was given as.

$$RA = I + D + M \quad (6)$$

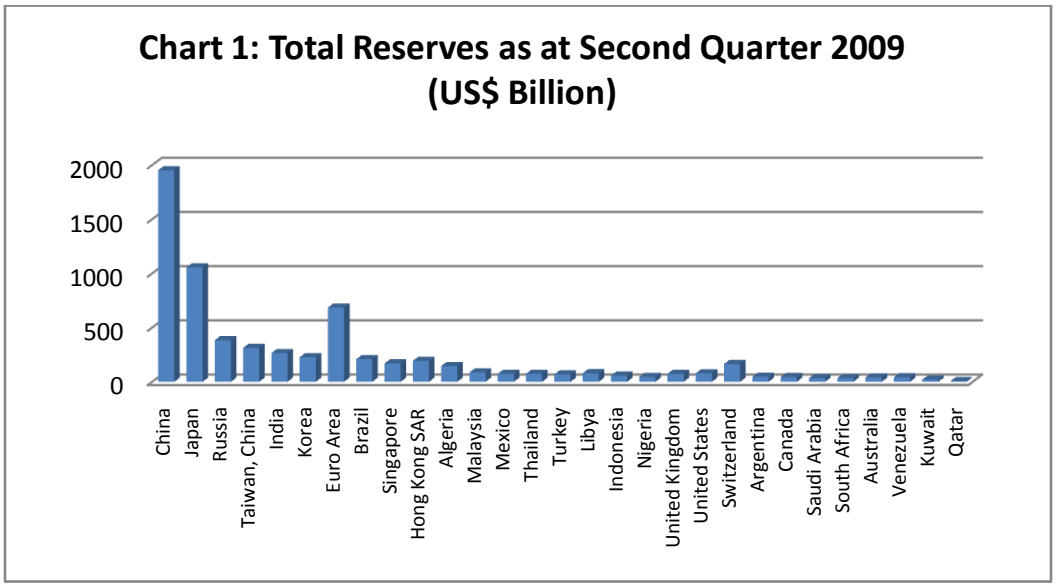
where:
RA = Reserves adequacy in year t
I = Value of imports in year t
D = Debt service payments in year t
M= Base money in year t

The advantages of this model over the previous ones included its simplistic nature and, therefore, ease of adoptability, and its comprehensiveness, as it did not only measure trade financing but combined short-term debts and the monetary base. After a review of the various models for estimating reserves adequacy, Shcherbakov's simplistic procedure was adopted in estimating Nigeria's data because of its broad base and the recognition of shocks.

III. Trends in External Reserves Accumulation

III.1 Global Perspective

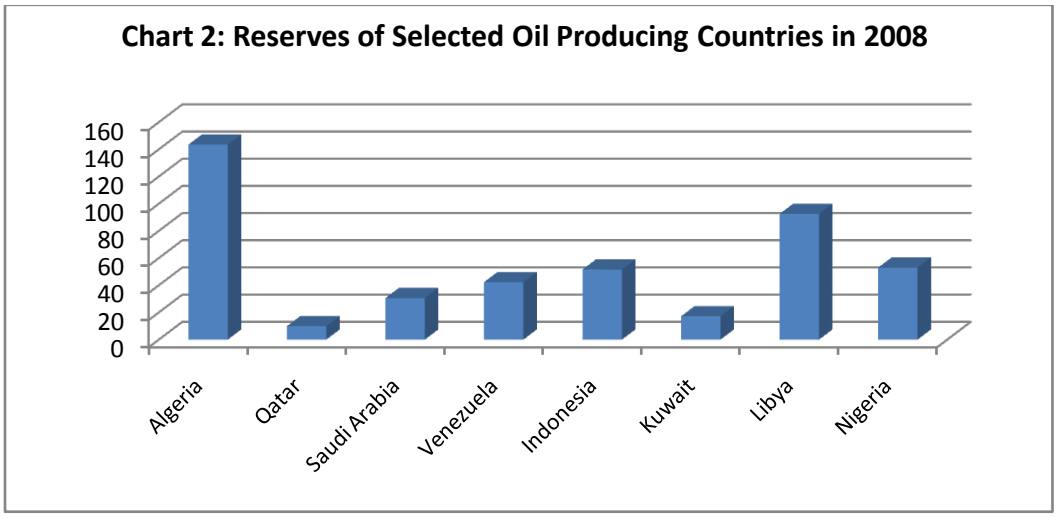
Global external reserves have increased significantly since the 1990s with most emerging market economies accumulating external assets as a precautionary measure against the increased capital flows into their economies. China, Japan and Euro area ranked first, second and third, respectively, in the stock of reserves as at end-June 2009 (Table 4). The accumulation of reserves was clearly visible from 2000. For instance, the stock of China's external reserves was US$28.6 billion in 1990, it increased to US$154.7 billion in 1999 and skyrocketed to US$1.95 trillion by June 2009. Similar trend was experienced for Japan and Russia with the stock of external reserves growing from US$277.7 billion in 1999 to US$1.06 trillion in 2009, while for the Euro area, the stock grew from US$203.2 million in 2007 to US$685.4 million by end-June 2009. Analysis for selected emerging market economies and the oil producing countries revealed that growth in reserves in 2007 were above a 100 per cent for all the countries, ranging from 106.8 per cent for Venezuela to 2404.6 per cent for Algeria (Table 5 and Chart1).



Source: *Authors, based on analysis of data from IMF*

III.2 Oil Producing Countries

An analysis of reserves accumulation by some selected countries revealed an upward trend for most oil-producing countries for the period 1999 through 2002, except for Venezuela, which recorded a decline in the stock of foreign exchange reserves. The increase in foreign reserves ranged from 4.1 per cent for Brazil to a high of 450.0 and 423.8 per cent for Algeria and Russia, respectively. The stock of foreign exchange reserves in Nigeria for 1999-2002 increased by 42.6 per cent. In the period 2002 through 2007 when oil prices soared, the upward trend in reserves accumulation was sustained with Nigeria's reserves growing by 267.5 per cent while Kuwait, an oil-producing country, recorded a negative growth of 3.3 per cent. In this period other oil producing countries such as Russia, Qatar, Venezuela, Libya and Algeria recorded increases of 253.9, 181.3, 181.2, 176.2 and 123.8 per cent, respectively (Table 6). Consequently, the reserves accumulation is not peculiar to Nigeria but has become a global phenomenon.



Source: *Authors, based on analysis of data from IMF*

III.3.1 ASEAN Plus Three

The experience of the 1997-98 Asian financial crisis provided a driving force for the ten Association of South East Asian Nations (ASEAN) countries together with China, Japan and Korea known collectively as ASEAN Plus Three (APT) to engage in regional cooperation. They agreed to pool currency reserves via a network of bilateral currency swaps and repurchase agreements to provide liquidity support to assist currency crisis and avert future financial crises. They were of the opinion that the arrangement would strengthen financial integration without sacrificing monetary independence in the respective member countries. A member country

in crisis can draw on "tiers of liquidity" as defense lines, utilizing owned reserves placed with the regional pool and other members' reserves with the pool.

III.3.2 India

In 1993 India adopted the market-based system of exchange rates when the current account recorded a surplus. As a result of measures initiated to liberalize capital inflows, India's foreign exchange reserves increased from US$6 billion at end-March 1991 to over US$155 billon by mid-2006 to US$276 billion at end-December 2008. India's foreign exchange reserves were among the highest in the world after China and Japan. The accumulation of foreign exchange reserves could be explained mainly by three factors: the size of the economy, its vulnerability to the current and capital accounts shocks and exchange rate flexibility. The increasing financial integration in global markets and the pace of movement of capital were considerations for reserves accumulation in defense of any financial crisis caused by reversals in capital flows. These have become important factors for accumulating foreign exchange reserves in most emerging economies.

III.4 Consequences of Reserves Accumulation

Reserves accumulation like most economic policy measures has its costs and risks as well as benefits. The benefits and reasons for reserves accumulation have been treated, but the adverse consequences include market risks, the cost for monetary stability and financial risk.

III.4.1 Market risk

High reserves holdings might increase market risk notably currency and interest rate risks, resulting in potential capital losses on the balance sheet of the monetary authority. When a particular foreign currency dominates reserves holdings of a country, a depreciation of such currency could lead to sizable capital losses. A good example is Nigeria's reserves holdings; with substantial portion denominated in the US dollar, persistent depreciation of the US dollar would have a serious implication on the value of the stock of Nigeria's reserves holdings. Also a low or zero interest rate on investment as adopted in the wake of the global financial melt-down of 2008 will surely affect the rate of returns on investment on reserve assets of countries currently accumulating external reserves. This will certainly lower the income profile of most independent central banks which could affect the operations of these banks. For instance, income earned by Nigeria on external reserves declined by 8.3 per cent from US$ 2.04 billion in 2007 to US$1.87 billion at end-2008.

III.4.2 Monetary Stability

Reserves accumulation could result in a delicate balancing between exchange rate stability and further accumulation when the huge reserves are used to defend the currency as well as the continued pressure to ease monetary conditions. If inappropriate easing of monetary conditions is adopted, the resultant effect will be inflation and other macroeconomic bubbles, which will make it difficult for central banks to manage the money market. These would impinge on macroeconomic stability and on the achievement of set targets in the monetary programmes.

III.4.3 Financial Markets Risk

The sterilization of accumulated external reserves in most developing countries with less developed market-based policy instruments is injurious to internal financial stability especially to the financial market. When central banks, in order to control credit expansion, issue huge bills for sterilization, they often resort to increasing reserve requirements and use of non-market instruments like credit rationing. These have their costs and may lead to inefficient capital allocations especially if non-market instruments are deployed. Credit and interest rates become administered and the credit crunches have fiscal costs which are transferred to the banking sector and eventually to the bank customers' stockholders.

Despite the downside risks of holding external reserves the associated benefits include the ability of offering the central bank's enough intervention funds for the foreign exchange market as well as serving as security against external shocks. It could also be used as collateral for external borrowing.

IV. Estimation and Analysis of Reserves Adequacy for Nigeria

Estimating optimum level of reserves adequacy has undergone different approaches since the aftermath of the Asian financial crisis. Some of the earlier approaches adopted to measure reserves adequacy by most developing countries include reserves to imports, to measures of external debt and to money aggregates, but most countries seem to favour reserves to imports ratio which make three months of import cover deemed appropriate (Triffin 1947; Kaminsky 1999). However, frequent and unpredictable macroeconomic adjustments induced by external shocks and short-term capital reversal have rendered individual use of these measurements less appropriate (Shcherbakov, 2002).

A more versatile approach of reserve adequacy was proposed by Greespan (1999); he used stochastic tests to identify the vulnerability of balance of

payments, nevertheless, the approach suffer a major set-back because it is difficult to apply to the existing data. Shcherbakov (2002) observes that appropriate level of reserves must cover balance of payments vulnerability, i.e. current account transactions (imports), external debt structure and the risks of residents' capital flight in a less developed financial market and uncertain macroeconomic environment.

We estimated optimum level of reserves adequacy for Nigeria using a combination of reserves adequacy measurements identified by Shcherbakov (2002) which estimated the level of international reserves adequacy using the major outflows which he termed the "drainers" of reserves. However, minor adjustments were made to make the model adoptable in the Nigerian context. The approach enjoy major advantages over the previous ones for two main compelling reasons, its simplistic nature thus the ease of adaptability for Nigeria and the model is very comprehensive as it did not only measure trade financing but combined short-term debt and the money base reserves adequacy.

IV.1 The Adjusted Model for Nigeria

IV.1.1 Determinants of Reserve Accumulation in Nigeria

External reserves are foreign currency assets that are available to the monetary authority for intervention purposes in order to stabilize the value of the domestic currency. Trends in external reserves accumulation in Nigeria have been influenced by a number of factors which include the movement in crude oil prices, import bills and debt service payments. During the period 1992-2003, reserves accumulation averaged US$6.12 billion and was driven by the relatively lower crude oil prices at the international market, huge debt servicing profile and high import bills. All these, drastically reduced the ability of the monetary authority to build-up external reserves. For instance, the average price of crude oil for this period was US$18.48 per barrel, import bills averaged US$9.87 billion while debt service payments averaged US$1.75 billion (Table 1).

Table 1: Nigerian Debt Service Payments, Imports and Crude oil Prices

Years	Crude Oil Price (US$ Billion)	Debt Service (US$ Billion)	Imports (US$ Billion)
1992	19.04	2.39	7.2
1993	16.79	1.77	7.51
1994	15.95	1.84	7.44
1995	17.2	1.62	9.32
1996	20.37	1.88	6.92
1997	19.27	1.64	10.36
1998	13.07	1.27	9.99
1999	17.98	1.72	9.31
2000	28.23	1.72	9.65
2001	24.33	2.13	12.13
2002	24.95	1.17	12.5
2003	28.89	1.81	16.08
2004	37.76	1.75	14.88
2005	53.35	7.57	21.19
2006	64.27	6.73	22.63
2007	71.13	1.02	30.44
2008	97.04	0.44	36.89
2009	61.78	0.43	28.76

Source: **Authors, based on analysis of data from Central Bank of Nigeria**

Table 2: Nigerian Foreign Exchange Flows and Reserves Level

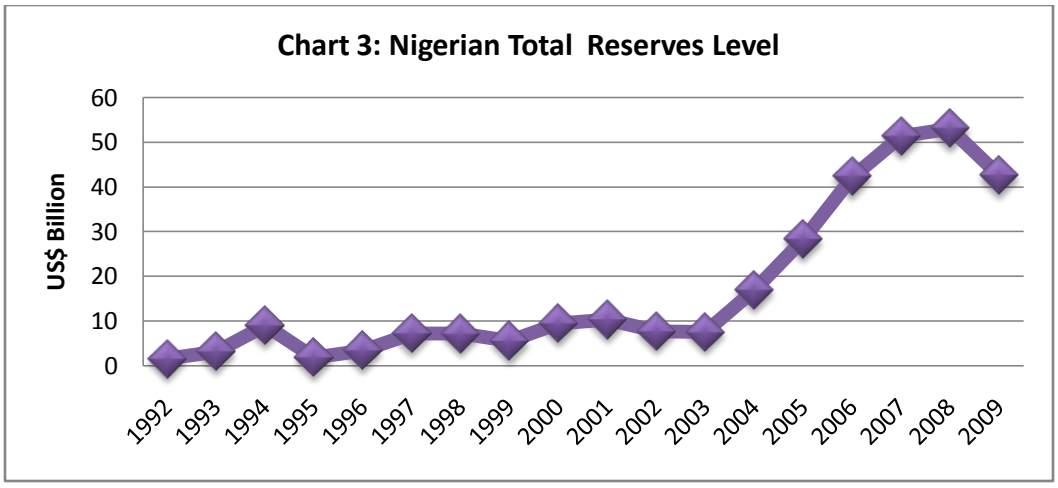
Years	Inflow (US$ Billion)	Outflow (US$ Billion)	Net flow (US$ Billion)	Actual Reserves (US$ Billion)
1992	8.45	10.19	-3.35	1.55
1993	7.51	7.42	0.33	3.05
1994	6.07	6.34	0.21	9.01
1995	9.52	21.36	-11.99	1.84
1996	13.05	18.37	5.42	3.4
1997	14.98	11.23	3.48	7.22
1998	10.16	11.6	-2.19	7.11
1999	10	10.88	1.51	5.44
2000	18.07	12.9	3.93	9.39
2001	19.34	15.69	0.98	10.27
2002	15.01	13.76	3.35	7.68
2003	23.38	17.9	0.73	7.47
2004	35.4	15.85	9.63	16.96
2005	51.24	24.84	10.77	28.28
2006	58.72	24.72	12.41	42.3
2007	74.05	26.04	11.2	51.33
2008	106.8	47.17	2.28	53
2009	67.26	36.51	-10.75	42.38

Source: **Authors, based on analysis of data from Central Bank of Nigeria**

Table 3: Nigerian Actual Reserves, Reserves Adequacy and Reserves Gaps

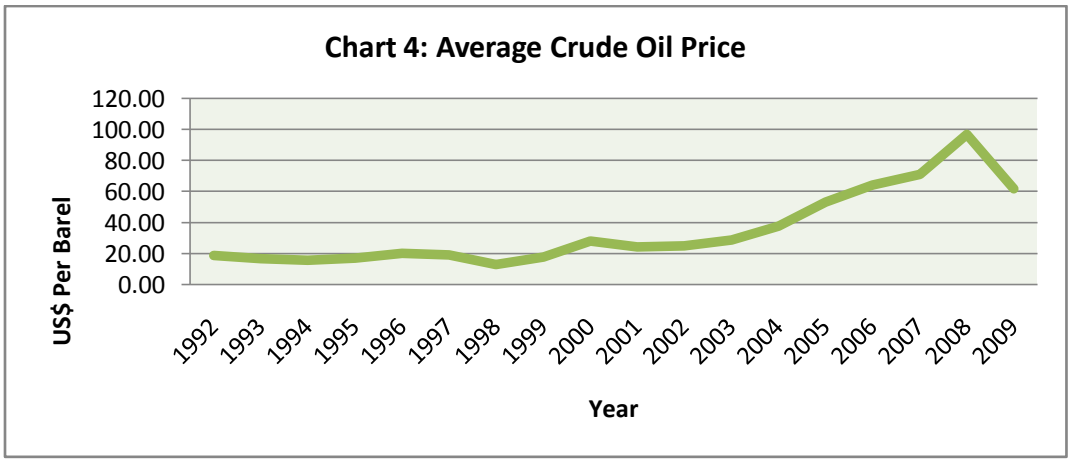
Years	Actual Reserves (US$ Billion)	Estimated Reserves (US$ Billion)	Reserves Gaps (US$ Billion)
1992	1.55	9.6	-8.04
1993	3.05	19.74	-18.31
1994	9.01	22.01	-13
1995	1.84	23.65	-22.04
1996	3.4	9.7	-6.3
1997	7.22	12.16	-4.94
1998	7.11	36.43	-29.33
1999	5.44	11.03	-5.59
2000	9.39	18.42	-9.04
2001	10.27	19.74	-9.47
2002	7.68	19.08	-11.4
2003	7.47	18.84	-11.37
2004	16.96	25.99	-9.03
2005	28.28	28.76	-0.48
2006	42.3	33.25	9.05
2007	51.33	35.95	15.37
2008	53	50.38	2.62
2009	42.5	41.78	0.69

Source: **Authors, based on analysis of data from Central Bank of Nigeria**



Source: *Authors, based on analysis of data from Central Bank of Nigeria*

In 2004 through mid-2008, reserves accumulation rose consistently from US$16.96 billion in 2004 to US$28.28 billion, US42.30 billion, US$51.33 billion, and US$53.00 billion in 2005, 2006, 2007 and 2008, respectively. The significant accretion to reserves during these periods was mainly driven by high crude oil prices that reached the peak of US$147.1 per barrel in July 2008. Other complementary factors include decrease in the foreign debt stock due to debt forgiveness and prudent macroeconomic management that moderated import bills and reduced capital outflows during the periods (Table 2 & 3).



Source: *Authors, based on analysis of data from World Bank*

The upward tempo in reserves accumulation was not sustained in the later part of 2008, due to the second-round effects of the global financial and economic

crises. External reserves trended downward from US$53.00 billion in 2008 to US$42.38 billion in 2009. The reversal was also due to the drastic fall in crude oil prices at the international market and huge capital outflows from the domestic stock market by foreign portfolio investors.

In Nigeria, the appropriate level of reserves requires identification of major drainers of reserves or most vulnerable items in the balance of payments. The Nigerian economy is susceptible to high variations of exports prices due to the frequent changes in crude oil prices at the international market. Also, debt service repayments constituted significant portion of reserves drainer prior to the debt forgiveness of 2007. Annual debt servicing varied from US$1.5 billion to US$ 2.0 billion which constituted below 70.0 per cent of the scheduled debt servicing profile with the reminder capitalized annually.In addition, debt servicing constituted 10.5 per cent of total outflows during 2000 – 2009. Imports, through the funding at the foreign exchange market, have remained a major source of outflows or 'drainer' of reserves. Funding of imports through the CBN constituted 87.2 per cent of foreign exchange outflows in 2000 – 2009. With these considerations, we deem it appropriate to include imports bills and short-term debt repayments in modeling reserves adequacy in Nigeria.

The economy is also exposed to unpredictable capital flows, high volatility of the domestic currency and frequent macroeconomic adjustments which often cause some level of uncertainty in domestic economy and external imbalance. This condition may exacerbate capital flight. Shcherbakov (2002, pp.3) noted that '*additional uncertainty induced by any balance of payments problem may trigger off another balance of payments problems*'. In Nigeria a sudden fall in commodity exports prices such as crude oil prices may trigger or create uncertainty about the economic conditions which in turn may induce capital flight from the domestic economy.

Shcherbakov defined capital flight as part of base money that would be exchanged for foreign assets if resident lose their confidence in the domestic economy due to currency and macroeconomic uncertainty. Basically, two measurements methods were suggested which include, first, comparing the ratio of M2 to GDP in the crisis and the reporting periods. Second, identifying the most liquid part of the base money, that household could exchange for foreign currency, due to macroeconomic and currency uncertainty in the domestic economy. These measures of base money reserves adequacy point to the fact that residents do exchange their domestic assets for foreign assets due to uncertainty in the domestic economy which could be termed capital flight.

Englama, et al. (2007) termed capital flight as a situation where residents exchange their domestic assets for foreign assets due to wrong fundamentals and uncertainty in the domestic economy to avoid extremely high losses. Consequently, we considered capital flight as a key variable in the estimate of appropriate level of reserves for Nigeria. A supportive reason for adopting the estimated capital flight in the model is that the money-base measure if represented by the net foreign assets (NFA) might be misleading since for the monetary authority these assets have already been captured in the reserve assets and cannot be assumed to be drainers or sources of outflows.

IV.1.2 Model Specification and Sources of Data

The choice of variables for the estimation was, therefore, based on the foregoing deductions from the drivers of reserves accumulation. The study integrated the three measures of reserves adequacy, namely, debt, imports and part of base money or capital flight to model the appropriate reserves adequacy for Nigeria. It used annual data for the period 1993 to 2008. All the data required were obtained from the various issues of the CBN Statistical Bulletin and Annual Reports and extracts from Englama, et al. (2007). The model equation is as presented below:

$$RA = I + D + M \quad (7)$$

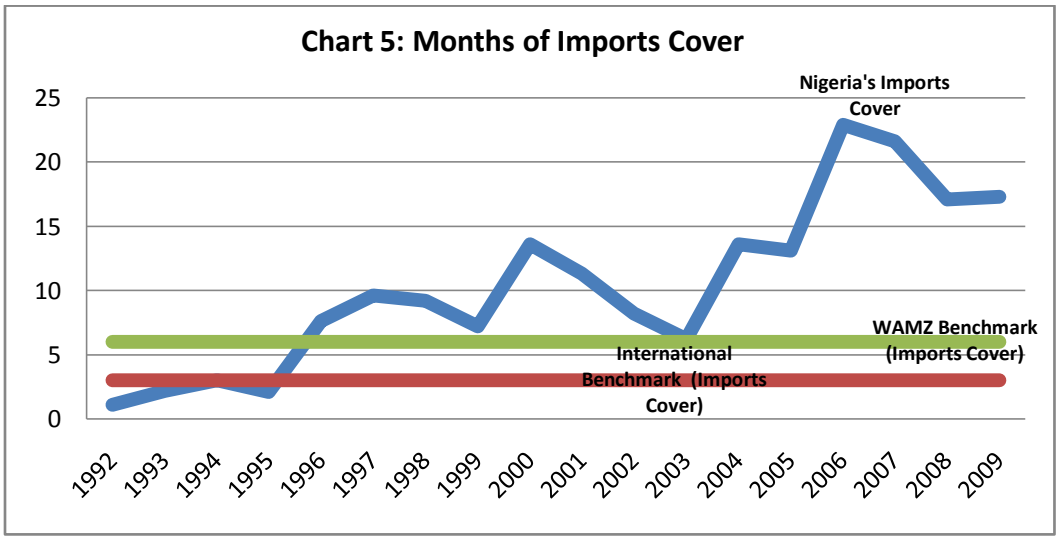
where:
RA = Integral measure of reserves adequacy in year t
I = Import-based measure of reserves adequacy in year t
D = Debt-based measure of reserves adequacy in year t
M= Money-based measure of reserves adequacy in year t

The (I), which represents import–based measurement of reserves adequacy for year t was derived from the CBN statistical bulletin using the import value for each year. Also, debt-based measurement of reserves adequacy (D) covered all debt service repayments for a particular year, the values of which were obtained from the CBN annual report for various issues. In the third component of reserves adequacy measure, money-based measurement, we simply leveraged on the study conducted by Englama, et al. (2007) which had estimates for capital flight for Nigeria from 1971 to 2006. The capital flight model was also updated to generate the estimates for the periods 2007 to 2009. The estimates of capital flight from 1992 to 2009 were used to represent the measure of base money reserves adequacy for these periods in this study. The estimate of capital flight was taken for each year, but for the periods when there were inward capital reversals, we assume zero capital flight in such periods.

IV.2 Analysis of Results

IV.2.1 International Benchmark of Three Months Import Cover

The analysis of reserves adequacy using the international benchmark of three-months of import cover revealed that the levels of external reserves were far in excess for most of the period except for 1992, 1993 and 1995. This judgment may be misleading if considered along the line of models of the 1990's. Similarly, if the West African Monetary Zone (WAMZ) convergence benchmark of six months is applied, the level of external reserves for Nigeria could be adjudged to be adequate except for 1992, 1993 and 1995, which would also be misleading if all external payments were considered (Table 7).

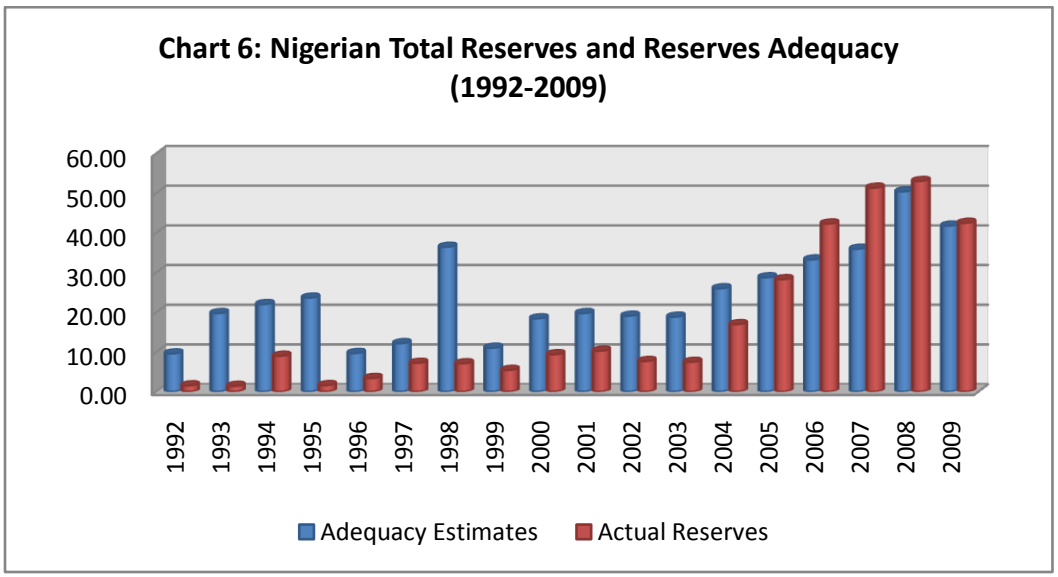


Source: *Authors, based on analysis of data from Central Bank of Nigeria*

Applying this measure, reserves in most of the year were adequate. However, considering the vulnerability of Nigeria's foreign exchange inflows to the vagaries of external shocks especially from the volatility of crude oil price shock, other external liabilities and the level of uncertainties associated with the domestic economy these measures of three or six months of imports cover as noted in the current literature, will underestimate reserves adequacy for Nigeria. Consequently, we intend to establish especially within the context of the events that followed the global financial crisis and the commodity price shocks of 2007/2009 that more level of reserves are required to withstand negative global commodity price shocks.

IV.2.2 Findings from the Estimated External Reserves Using the Integrated Model

Analysis of the estimated reserves adequacy level revealed that there have been shortfalls despite the assumed high levels of accumulations since 2005. In the period 1992-2005, the estimated reserves adequacy using the integrated model revealed that the actual reserves with the CBN were inadequate to meet all the country's external obligations. However, from 2006 through 2009 external reserves were in excess of actual reserves especially in 2006 and 2007. The actual reserves were in excess of the estimated external reserves to the tune of US$9.1 billion, US$15.4 billion, US$2.6 billion and US$0.7 billion in 2006, 2007, 2008, and 2009, respectively (Table 3 and Chart 6). The development was due to the sustained increase in inflows both from oil and autonomous sources which helped total reserves level to exceed the estimated trigger level or adequacy level. The rate of reserves accumulation dropped drastically in 2008 as a result of the lower crude oil prices, huge import bills, repatriation of dividend by foreign direct investment enterprises as well as capital reversal by foreign portfolio investors occasioned by the global financial and economic crises.

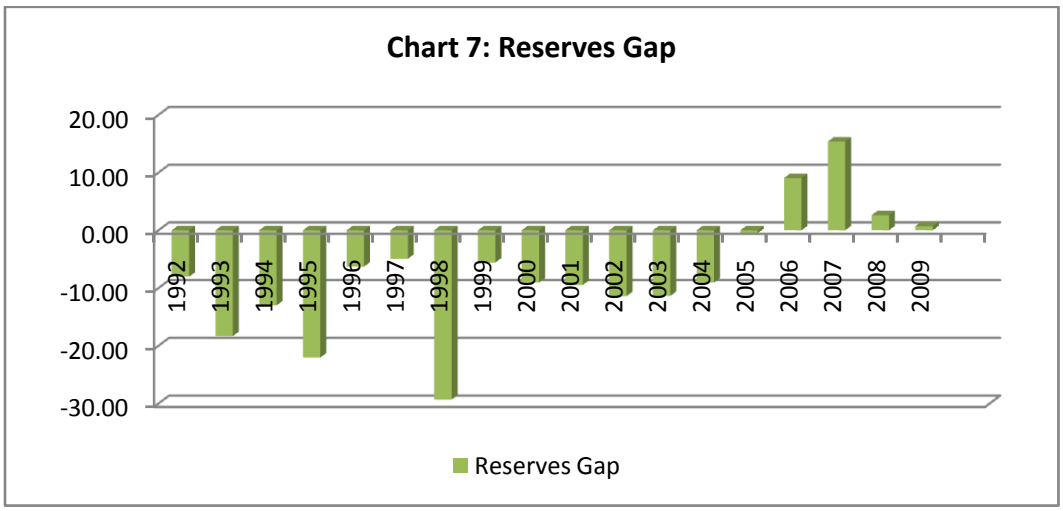


Source: *Authors, based on analysis of data from Central Bank of Nigeria*

IV.2.3 Analysis of External Reserves Gap

The gap analysis, measures the difference between the actual external reserves with the central bank and the model estimated reserves adequacy level. In the period 1992 – 2004, a negative gap position was recorded showing that the actual reserves levels were below the trigger points which represented the economy's adequacy levels. Huge differences were recorded in 1993, 1996 and

1998. An earlier study by Englama, et al. (2007) showed that these periods were commonly associated with huge capital flights. For instance, their estimated capital flight during 1993, 1994, 1995 and 1998 were US$10.5 billion, US$12.7 billion, US$12.7 billion and US$25.2 billion, respectively. The huge capital flight especially between 1993 and 1995 was attributed to the policy slippage to a control regime in 1994 which sent wrong signals to investors, as well as to the political uncertainty caused by the annulment of the June 12, 1993 elections (Table 3 and Chart 7).



Note: *Reserves gap is the difference between actual reserve and estimated reserve adequacy*
Source: *Authors, based on analysis of data from Central Bank of Nigeria*

However, from 2005 the trend revealed positive gap outcomes with a peak in 2007, thereafter; it started declining due to the low rate of reserves accumulation. During this period, the actual external reserve was greater than the estimated adequacy level.

IV.3 Inference from Current Global Meltdown

In Nigeria, the initial pass-through of the global financial crisis was via commodity prices. The collapse in commodity prices, especially crude oil prices from an all-time high of over US$147.1 per barrel in July 2008 to an average of US$59.98 per barrel in the last quarter of 2008, reduced export earnings and government's revenue. The foreign exchange market witnessed severe demand pressures occasioned by the divestment and repatriation of capital and dividend by foreign portfolio investors.

The increased outflows in the last quarter of 2008, coupled with reduced inflows, resulted in de-accumulation of external reserves, aggravated capital flight, which

in turn eroded the confidence in the foreign exchange market, thereby, causing panic foreign exchange purchases and increased demand pressures. If the fall in commodity prices persist especially the price of oil at the international market without adequate diversification of the economy from oil, the demand pressures in the foreign exchange market might be sustained which could drastically drawdown the foreign reserves in 2010 and beyond. This would adversely affect the comfortable reserve adequacy level achieved during 2006 through 2008.

V. Concluding Remarks

The study has attempted to model the optimum level of reserves adequacy for Nigeria using annual data from 1992-2009. The result from the adjusted model shows that the actual reserves with the CBN were inadequate to meet all the country's external obligations especially from 1992 to 2005. The result further indicates that for four consecutive years, 2006 – 2009, actual reserves were in excess of the trigger level due to the surge in inflow from crude oil revenue that started since 2003. Further analysis of the results also show that the period of high negative reserves gaps were associated with the periods of high capital flight induced by the unfriendly investments environment and political instability. The study recommends sustenance of reserves accumulation, as it is in line with the global trends. In addition, accumulation of reserves could be further enhanced by curtailing factors that precipitate massive outflows.

Table 4: Selected Country Total Reserves Accumulation

Country	Reserves 2007 (US$ Billion)	Ranking 2007	Reserves 2008 (US$ Billion)	Ranking 2008	Reserves 2ND QTR 2009	Ranking 2ND QTR 2009
China	1528.3	1st	1968	1st	1953	1st
Japan	948.4	2nd	1011	2nd	1056.7	2nd
Russia	464	3rd	427	3rd	384	4th
Taiwan, China	270.3	4th	296.4	4th	312.6	5th
India	266.6	5th	256.4	5th	264.6	6th
Korea	261.8	6th	201.2	6th	226.9	7th
Euro Area	203.2	7th	563.4	7th	685.4	3rd
Brazil	179.4	8th	193.8	8th	208.7	8th
Singapore	162.5	9th	174.2	10th	170.1	10th
Hong Kong SAR	152.7	10th	182.5	9th	193.4	9th
Algeria	110.2	11th	143.5	11th	145.4	12th
Malaysia	100.6	12th	91.2	15th	87.1	14th
Mexico	86.3	13th	95.3	13th	74.1	17th
Thailand	85.1	14th	111	12th	73.9	13th
Turkey	73.4	15th	73.7	18th	67.7	19th
Libya	79.4	16th	92.5	14th	79	15th
Indonesia	54.7	17th	51.6	21st	56.6	20th
Nigeria	51.3	18th	53	19th	45	22nd
United Kingdom	49	19th	53	29th	73.9	18th
United States	45.8	20th	77.7	16th	78.6	16th
Switzerland	44.5	21st	74.1	17th	164	11th
Argentina	44.2	22nd	46.4	22nd	46.4	21st
Canada	41	23rd	43.9	23rd	44.9	23rd
Saudi Arabia	32.3	24th	30.6	27th	34	26th
South Africa	29.6	25th	34.1	25th	34	27th
Australia	24.8	26th	32.9	26th	40.9	25th
Venezuela	24.2	27th	42.3	24th	42.6	24th
Kuwait	16.7	28th	17.2	28th	19.6	28th
Qatar	9.4	29th	9.9	29th	6.4	29th

Source: **International Financial Statistics**

Table 5: Foreign Exchange Reserves of Selected Countries (End-Period)

	1990	1999	2007	% Change (1990 & 1999)	% Change (1999 & 2007)
China	28.6	154.7	1528.3	440.9	887.9
Japan	69.5	277.7	948.4	299.7	241.5
Russia	NA	8.5	464	NA	5358.8
Korea	14.5	73.7	261.8	409.7	225.2
India	1.2	32	266.6	2554.9	733.1
Malaysia	9.3	29.7	100.6	218.1	238.7
Singapore	27.5	76.3	162.5	177.1	113
Algeria	0.7	4.4	110.2	510.4	2404.6
Brazil	7.4	34.8	179.4	368.2	415.5
Qatar	0.6	1.2	9.4	118.6	691.7
Saudi Arabia	8.6	15.5	32.3	80.5	108.4
Venezuela	8.3	11.7	24.2	40.9	106.8
Indonesia	7.4	26.2	54.7	256.9	108.8
Kuwait	1.6	4.2	16.7	163	297.6
Libya	5.1	6.2	79.4	22.5	1180.7
Nigeria	3.9	5.5	51.3	41.1	832.7

Source: **International Financial Statistics**

Table 6: Total Reserves of some Selected Oil Producing Countries (US$ Billion)

Year	Algeria	Qatar	Saudi Arabia	Venezuela	Indonesia	Kuwait	Libya	Nigeria
1990	0.7	0.6	8.6	8.3	7.4	1.6	5.1	3.9
1991	1.5	0.6	9.7	10.4	9.2	3.1	4.9	4.4
1992	1.5	0.6	4.6	9.3	10.2	4.8	5.4	1
1993	1.5	0.6	5.7	8.5	11	3.9	NA	1.4
1994	2.7	0.6	5.9	7.4	11.8	3.2	NA	1.4
1995	2	0.7	7.1	5.7	13.3	3.3	NA	1.4
1996	4.2	0.6	12.8	11.1	17.8	3.2	NA	4.1
1997	8	0.8	13.5	14	16.1	3.1	NA	7.6
1998	6.8	1	12.7	11.6	22.4	3.5	6.2	7.1
1999	4.5	1.2	15.5	11.7	26.2	4.2	6.2	5.5
2000	11.9	1.1	18	12.6	28.3	6.5	11.4	9.9
2001	18	1.2	14.8	8.8	27	9.2	13.7	10.5
2002	23.1	1.4	16.7	8	30.8	8.4	13.2	7.3
2003	32.9	2.8	17.7	15.5	34.7	6.6	18.3	7.1
2004	43.1	3.2	23.3	17.9	34.7	7.3	24.3	17
2005	56.2	4.5	24.1	23.5	32.8	8.4	38.2	27.3
2006	77.2	5.3	26	28.9	40.7	12.2	57.9	42.3
2007	110.2	9.4	32.3	24.2	54.7	16.7	79.4	51.3
2008	143.5	9.9	30.6	42.3	51.6	17.2	92.5	53.0

Source: **International Financial Statistics**

Table 7: Months of Imports Cover

Years	Nigeria's Import Cover	International Benchmark (Imports Cover)	WAMZ Benchmark (Import Cover)
1992	1.1	3	6
1993	2.2	3	6
1994	3	3	6
1995	2.1	3	6
1996	7.6	3	6
1997	9.6	3	6
1998	9.2	3	6
1999	7.2	3	6
2000	13.6	3	6
2001	11.3	3	6
2002	8.2	3	6
2003	6.2	3	6
2004	13.6	3	6
2005	13.1	3	6
2006	22.9	3	6
2007	21.6	3	6
2008	17.1	3	6
2009	17.3	3	6

Source: **Authors, based on analysis of data from Central Bank of Nigeria**

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Oil Prices and Exchange Rate Volatility in Nigeria: An Empirical Investigation

Abwaku Englama, Ph.D, Omolara Omotunde Duke, Toyin Segun Ogunleye and Fatima Umar Isma'il*

As a mono-product economy, where the main export commodity is crude oil, volatility in oil prices has implications for the Nigerian economy and, in particular, exchange rate movements. The latter is particularly important due to the twin dilemma of being an oil-exporting and oil-importing country, a situation that emerged in the last decade. The study examined the effects of oil price volatility, demand for foreign exchange, and external reserves on exchange rate volatility in Nigeria using monthly data for the period 1999:1 to 2009:12. Drawing from the works of Jin (2008), the authors utilized cointegration technique and vector error correction model (VECM) for the long-run and the short-run analysis, respectively. The results showed that a 1.0 per cent permanent increase in oil price at the international market increases exchange rate volatility by 0.54 per cent in the long-run, while in the short-run by 0.02 per cent. Also a permanent 1.0 per cent increase in demand for foreign exchange increases exchange rate volatility by 14.8 per cent in the long-run. The study reaffirms the direct link of demand for foreign exchange and oil price volatility with exchange rate movements and, therefore, recommends that demand for foreign exchange should be closely monitored and exchange rate should move in tandem with the volatility in crude oil prices bearing in mind that Nigeria remains an oil-dependent economy.

Keywords: Oil Price Volatility, Exchange Rate Volatility, cointegration, and Vector Error Correction Model (VECM).

JEL Classification: O24, F31

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I. Introduction

Volatility in exchange rate and oil prices can be defined as the rate of change in price over a given period. It is expressed as a percentage and computed as the annualized standard deviation of the percentage change in the daily price. The larger the magnitude of the change, or the more quickly it changes over time, the higher the volatility. Volatile exchange rates make international trade and investment decisions more difficult because it increases exchange rate risk. On the face of it, floating exchange rates would appear to be riskier than fixed rates since it is free to change regularly. For this reason, countries may choose fixed exchange rates in order to reduce volatility and encourage international trade and investment.

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The volatility in oil prices have varying consequences for different countries; while oil-producing countries reap the benefit of high oil prices, oil-importing countries experience unfavourable terms-of-trade in their external sector that can transfer into their economies in the long run. Several empirical studies have been undertaken to investigate the effect of oil price volatility on exchange rate movement in different economies. Although the literature are mixed on the causality between the two variables, most empirical studies show that oil price directly impact on exchange rate (Amano and Norden (1995);Jin 2008; Coudert, et al., 2008). Exchange rate volatility, however, tends to increase the risk and the uncertainty of external transactions and predisposes a country to exchange rate-related risks (Celasun 2003; Setser 2007; Jin 2008).

Crude oil became an export commodity in Nigeria in 1958 following the discovery of the first producible well in 1956. Prior to that, exports were mainly primary agricultural commodities that comprised groundnuts, cocoa beans, palm oil, cotton and rubber. Palm oil was the leading export from 1946-1958, followed by cocoa beans while groundnut/oil ranked third. From a production level of 1.9 million barrels per day in 1958, crude oil exports rose to 2.35 million barrels per day in the early 2000s. However, it had fluctuated between 1.26 and 1.8 million barrels per day between 2007 and 2010 which was far below the OPEC quota due to the socio-political instability in the oil-producing areas of the country. In terms of its contribution to total revenue, receipts from oil that constituted 26.3 per cent of the federally collected-revenue in 1970, rose to 82.1 per cent in 1974 and 83.0 per cent in 2008 largely on account of a rise in crude oil prices at the international market.

Non-oil exports on the other hand, as a percentage of total exports, declined from 7.0 per cent between 1970-1985 to 4.0 per cent between 1970 and 1986 (CBN, 2000). The discovery of crude oil in Nigeria led to what is commonly referred to as the "Dutch disease". Thus, the performance of the manufacturing sector remained less impressive and that of agriculture declined. In the early 1960s, manufacturing activities consisted of partial processing of agricultural commodities, textiles, breweries, cement, rubber processing, plastic products, and brick making. The economy gradually became dependent on crude oil as productivity declined in other sectors.

As a mono-product economy, Nigeria remains susceptible to the movements in international crude oil prices. During periods of favourable oil price shocks triggered by conflicts in oil-producing areas of the world, the surge in the

demand for the commodity by consuming nations, seasonality factors, trading positions, etc; the country experiences favourable terms-of-trade quantified in terms of a robust current account surplus and exchange rate appreciation. On the converse, when crude oil prices are low, occasioned by factors such as low demand, seasonality factors, excess supply and exchange rate appreciation, the Nigerian economy experiences significant drop in the level of foreign exchange inflows that often result in budget deficit and or slower growth. A recent example was the dramatic drop in the price of crude oil in the wake of the global financial and economic crises. The price of oil fell by about two thirds from its peak of $147.0 per barrel in July 2008 to $41.4 at end-December 2008. Prior to the crises, oil price was high, exchange rate was stable but with the advent of the global financial crisis (GFC) oil price crashed and the exchange rate caved-in, depreciating by more than 20 per cent. Since oil price volatility directly affects the inflow of foreign exchange into the country, there is a need to investigate if it has direct impact on the Naira exchange rate volatility.

The objective of this paper, therefore, is to examine empirically the relationship between oil prices and exchange rate volatility in the Nigerian economy. Specifically this study intends to investigate the dynamic relationship between oil prices and exchange rate volatility using monthly data from 1999 to 2009 for the analysis. Following this introduction, Section 2 reviews empirical studies on the volatility of oil prices and its effects on exchange rate volatility. The methodology adopted for the empirical study is discussed in Section 3. The empirical findings are analysed in Section 4. Section 5 summaries and concludes the paper.

II. Literature Review

Vast literature exists on the causal relationship between exchange rate and other variables in the developed and developing economies. Other distinguishing category is the position of the countries as either oil-exporting or importing country.

Following the study on the determination of the relationship between oil prices and the US dollar, Coudert, et al. (2008) highlighted the importance of the US dollar as a reserve currency and currency of choice for payment of oil transaction. This implies that the rate of exchange of the dollar to domestic currencies would affect the demand for oil. They posited that dollar depreciation reduces the oil price in a domestic currency with floating exchange rate, while the effect is neutral in countries that are pegged to the US Dollar. They concluded that the dollar depreciation has a priori positive impact on oil demand and oil price. On the supply side, a depreciation in the dollar would

cause a decline in supply as the movement in the dollar would affect the cost of production that are priced in dollar through the rate of exchange of the domestic currency to the dollar. On the impact of oil price on the dollar effective exchange rate, they stated that a surge in oil prices tend to boost producer countries wealth and demand for dollar assets. In addition, based on the behavioural equilibrium exchange rate, oil prices influence terms-of-trade, net foreign assets and, implicitly, impact on the exchange rate. Coudert, et al. (2008) found that the relationship between the two variables were unclear and seem to depend on the period investigated. In addition, the oil price variable tends to lead the exchange rate variable, thus, the causality runs from the oil price to the exchange rate. They concluded that speculation on oil price would lead to a speculation on the dollar.

Olomola (2006) in his empirical study on the oil price shock and aggregate economic activity in Nigeria, used a VAR model with quarterly data from 1970 to 2003. Volatility was measured as the conditional variance of the percentage change of the nominal oil price. The five variables used for the empirical study were gross domestic product (real GDP), proxied by industrial production index (y), domestic money supply, the real effective exchange rate (reer), the inflation rate (CPI), and real oil price (Poil). The specification used for the model is the scaled specification, a non-linear transformation of oil price that takes volatility into account. The findings showed that while oil prices significantly influence exchange rate, it does not have significant effect on output and inflation in Nigeria. He concluded that an increase in the price of oil results in wealth effects which appreciates the exchange rate and increases the demand for non-tradable, a situation that would result in "Dutch disease".

Ricken (2009) extended the literature on the subject by testing for the role of good governance on oil price and the exchange rates of oil-exporting countries. He derived a simple theoretical model based on the effect of oil price movements on the real exchange rates of oil-exporting countries that depends on the degree of government spending as well as the size of the oil sector compared to the domestic economy. He utilizes a panel of 33 oil-exporting countries with data from 1985 to 2005 to evaluate seven indicators and computed the average partial derivatives of real exchange rates with respect to the oil price. He found that higher oil prices triggers appreciation proportional to the size of oil in an economy and for oil-dependent economy, the covariance was more than in countries that were less dependent on oil. He also added that the characteristic of the political and institutional development was also associated with the covariance of the two variables. He concluded that oil-

exporting countries with credible governance can avoid the resource curse associated with volatile real exchange rate.

Gounder and Bartleet (2007) used a multivariate framework to measure the short-run impact of oil shocks on economic growth, inflation, real wages and exchange rate. Short-run impacts were examined using linear and non-linear oil price transformation. The Likelihood Ratios tests of Granger non-causality result indicated that linear price changer, asymmetric price increase and the net oil price variables impacted significantly on the economy unlike the asymmetric price decrease. The generalized impulse responses and error variance decomposition results confirm the direct link between net oil price shock and growth and its indirect linkages through inflation and the real exchange rate. The paper, thus, concluded that oil prices exhibit substantial effects on inflation and exchange rate in New Zealand.

Aliyu (2009), assessed the impact of oil price shock and real exchange rate volatility on the real gross domestic product in Nigeria using quarterly data that span the period 1986-2007. He used the Johansen VAR-based cointegration technique to examine the sensitivity of real GDP to change in oil prices and real exchange rate volatility in the long-run while the vector error correction model was used in the short-run. The result of the long-run analysis indicated that a 10.0 per cent permanent increase in crude oil prices increases the real GDP by 7.72 per cent, similarly a 10.0 per cent appreciation in exchange rate increases GDP by 0.35 per cent. The short-run dynamics was found to be influenced by the long-run equilibrium condition. He recommended the diversification of the economy and infrastructural diversification.

Jin (2008) employed a vector autoregressive model VAR to compare the effects of oil price and real effective exchange rate on the real economic activity in Russia, Japan and China. He first applied a Lag Augmented VAR (LA-VAR) approach causality test to investigate whether the oil price shock and exchange rate volatility granger-cause the economic growth in Russia, Japan and China. In addition, cointegration technique was used to examine how the real GDP of Russian, Japan and China are affected by changes in oil prices and the exchange rate in the long-run. To get the short-run of the model, a vector error correction model (VECM) was employed to analyze the short-run dynamics of the real GDP for the three countries. His findings indicated that oil price increases impact negatively on economic growth in Japan and China, and positively on economic growth of Russia. Specifically, a 10 per cent permanent increase in international oil prices is associated with a 1.67 per cent growth in Russian GDP

and a similar decline in Japanese GDP. On the one hand, an appreciation of the real exchange rate leads to a positive GDP growth in Russia and a negative GDP growth in Japan and China.

The debate on the influence of oil prices on the real exchange rate motivated Rautava (2004) to examine the relationship that exists between oil prices and real exchange rate in Russia. The study employed vector autoregressive (VAR) modeling and cointegration techniques to examine the impact of international oil prices and the real exchange rate on the Russian economy and its fiscal policy. The findings from the study indicate that the Russian economy was influenced significantly by fluctuations in oil prices and the real exchange rate through both long-run equilibrium conditions and short-run direct impacts. However, because of growth trends in the Russian economy which improved in the recent times, the role of oil prices have greatly reduced.

Sosunov and Zamulin (2007) supported the findings of Rautava (2004); they used a calibrated general equilibrium model to examine whether the 80 per cent real appreciation of the Russian ruble in 1998-2005 can be explained by the increase in oil revenues. The result indicated that the oil price alone is insufficient to explain the appreciation of the Russian ruble without assuming permanent increase in oil price. The study, therefore, concludes that accounting for the increase in the volume of oil exports could only be significant if oil prices are assumed permanent.

Korhonen and Juurikkala (2007) used basic data from OPEC countries for the period 1975 to 2005 to examine the determinants of equilibrium real exchange rates in some selected oil-dependent countries. The authors included three oil-producing Commonwealth of Independent States (CIS) countries in the analysis. They utilized different estimation techniques that included pooled-mean group and mean-group estimators. The result indicated that oil price had significant effect on real exchange rates in the group of oil-producing countries. It showed that higher oil price cause real exchange rate appreciation. The elasticity of the real exchange rate with respect to the oil price ranges from 0.4 and 0.5, but may be larger depending on the specification.

Habib and Kalamova (2007) examined whether real oil price had an impact on the real exchange rates of three oil-exporting countries namely, Norway, Russia and Saudi Arabia. The authors developed a measure of the real effective exchange rates for Norway and Saudi Arabia (1980-2006) and for Russia (1995-2006). They tested if real oil prices and productivity differentials against 15 OECD

countries influence exchange rates. The results showed that in Russia, there was a positive relationship between real oil price and real exchange rate in the long-run. In case of Norway and Saudi Arabia, the results indicated that there were no significant impacts of real oil price on the real exchange rates. The results further indicated that different exchange rate regimes for these countries could not explain why the impact of oil prices differs across countries but adduce the development to other policy responses, such as the accumulation of net foreign assets and sterilisation, as well as specific institutional characteristics.

Conflicting findings on the relationship between crude oil prices and exchange rates motivated Akram (2004) to explore the possibility of a non-linear relationship between oil prices and the Norwegian exchange rates. The non-linearity of the model improved its predictive power when compared with other similar linear and random walk models. The result from the model indicated that oil price was negatively related to the value of the Norwegian exchange rate when oil price was below US$14.0, contrary to other findings from other studies. Also, from the existing literature, Koranchelian (2005) estimated a long-run equilibrium real exchange rate path for Algeria. The result showed that the Balassa-Samuelson effect and real oil prices explained the long-run evolution of the equilibrium real exchange rate in Algeria.

Golub (1983) used a discrete model to test the effect of oil price on macroeconomic variables such as incomes, current-account balances, and saving. According to him, these have different influence on asset stocks and their distribution in oil-importing and oil-exporting countries, and thereby disturb asset-market equilibrium. He found that a rise in the price of oil generates a current-account surplus for OPEC and current-account deficits in the oil-importing countries. The resulting reallocation of wealth also influences exchange rates because of differential portfolio preferences. He found that if the OPEC countries' increased demand for dollars falls short of the reduction in the demand for dollars by the oil-importing countries, there will be an excess supply of dollars in the foreign-exchange market and the dollar will tend to depreciate (Golub, 1983).

III. Methodological Framework and Sources of Data

The paper employs monthly data for the period 1999:1 to 2009:12 sourced from the Central Bank of Nigeria.. The variables are oil price volatility (VOL_OPR), foreign reserves (LRE), demand for foreign exchange (LDD) and exchange rate volatility (VOL_EX). Both oil price volatility and exchange rate volatility were computed from their actual series as the annualized standard deviation of the percentage change in the daily price

Drawing from the works of Jin (2008), the paper adopted a VAR model and cointegration technique to get new insights into relationships that exist among oil price volatility (VOL_OPR), foreign reserves (LRE), demand for foreign exchange (LDD) and exchange rate volatility (VOL_EX). The vector autoregression model of order p (VAR (p)) is constructed as stated in Jin (2008).

In order to check the time series properties of the variables used in the model, we apply the unit root tests. We utilize the Augmented Dickey-fuller (ADF) and Philips Perron (PP) unit root tests to investigate the order of integration of the variabes in the model. The following equation (1) which include a constant and trend term is applied.

$$\Delta y_t = \propto 0 + \propto 1 y_t - 1 + \propto 2 trend + \sum_{i=1}^{p} \beta j \quad \Delta y_{t-j} + \mu_t \qquad (1)$$

where Δy_t denotes the first difference of y_t comprised of either real GDP, real exchange rate or real oil prices and p is the lag length of the augmented terms for y_t . Equation (1) permits the test to determine if the variable y_t is a stationary series. The null hypothesis in the ADF/PP tests is that y_t is non-stationary or has a unit root.

Table 1: ADF and PP Unit Root Test Results

Variables	Levels				First Differences			
	ADF1	PP1	ADF2	PP2	ADF1	PP1	ADF2	PP2
VOL_EX	-7.3331*	-7.0459*	-7.3302*	-7.0339*	-	-	-	-
VOL_OPR	-6.7119*	-6.7788*	-6.6876*	-6.7551*	-	-	-	-
LDD	-2.8354	-2.6185	-4.4337*	-4.3746*	-13.5972*	-13.7527*	-13.5156*	-13.6988*
LRE	-1.0628	-1.4889	-2.4860	-3.7022*	-19.8520*	-19.5845*	-19.7787*	-19.5141*

Notes: ADF1 and PP1 = Unit root tests with constant, and ADF2 and PP2 = Unit root tests with constant and trend.
*, **, and *** indicate statistical significance at the 1%, 5% and 10% level, respectively.
With constant only: McKinnon (1996) critical values are: -3.4812(1%), -2.8838(5%), and -2.5787(10%).
With constant and trend: MacKinnon (1996) critical values are: -4.0307(1%), -3.4450(5%) and -3.1474(10%).

The results of both the ADF and PP unit root tests are presented in table 1 which suggests that two variables VOL_EX and VOL_OPR in each of the test were stationary in levels, while the LDD is stationary in level with trend, but not stationary with constant only, and the LRE indicates non-stationary at levels. We, therefore, proceed to test for actual number of cointegration equations that exist among the variables.

IV. Empirical Analysis

IV.1 Long-run Analysis: VAR and Cointegration Test

The results allow the possibility of long-run relationship (cointegrating relations) among these variables. We are to determine how the exchange rate volatility reacts in the long run to volatility in oil prices, foreign reserves and demand for foreign exchange in Nigeria. A vector autoregression model of order p (VAR (p)) was constructed for this test in equation 2 (Jin 2008).

$$y_t = \Phi_0 + \sum_{i=1}^{p} \Phi_i \, y_{t-i} + \varepsilon_t \quad (2)$$

This VAR can be re-written in the VECM form as:

$$\Delta\gamma_t = \Phi_0 + \sum_{i=1}^{p-1} \Gamma_i \, \Delta\gamma_{t-1} + \prod y_{t-i} + \varepsilon_t \quad (3)$$

$$\text{where, } \prod = \sum_{i=1}^{p} \Phi_i - 1 \text{ and } \Gamma_i = -\sum_{j=i+1}^{p} \Phi_j \quad (4)$$

Where y_t a (4x1) matrix of foreign exchange demand (LDD), exchange rate volatility (VOL_EX), oil price volatility (VOL_OPR) and foreign reserves (LRE). is the (4x1) intercept vector and εt is a vector of white noise process. denotes an (4x4) matrix of coefficients and contains information regarding the short-run relationships among the variables. The matrix Π conveys the long-run information contained in the data. It is the rank of Π = αβ, β the matrix of cointegrating vectors; the elements of α are known as the adjustment parameters in the vector error correction model. The table below presents the test results for the number of cointegrating relations.

Table 2: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.3681	117.3773	63.8761	0.0000
At most 1 *	0.2304	58.1618	42.9153	0.0008
At most 2	0.1254	24.3830	25.8721	0.0757
At most 3	0.0535	7.0984	12.5180	0.3344

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.3681	59.2155	32.1183	0.0000
At most 1 *	0.2304	33.7787	25.8232	0.0036
At most 2	0.1254	17.2846	19.3870	0.0984
At most 3	0.0535	7.0984	12.5180	0.3344

From Table 2 above both the maximum eigenvalue test and the trace test indicate that there are two cointegrating equations at the 5 per cent significance level among the volatility of oil price, foreign reserves, demand for foreign exchange and exchange rate volatility. Since the long-run cointegrating relation is found among the variables, an estimation of cointegrating vectors was employed. The value of the cointegrating vectors (β) is presented below:

To determine the optimum lag length, we test for statistics which include Sequential Modified Likelihood Ratio (LR) test, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SC) and Hannan Quin Information Criterion (HQ) are diverse. The LR, FPE, AIC and HQ indicate lag length of two, while SC shows lag length of one. We therefore choose lag length of two.

Table 3: Var Lag Length Selection Test

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1231.143	NA	5271.923	19.92166	20.01263	19.95861
1	-993.959	455.2397	148.8359	16.35418	16.80906*	16.53896
2	-962.9463	57.52355*	116.9273*	16.11204*	16.93083	16.44465*
3	-954.04	15.94514	131.3725	16.22645	17.40915	16.70689
4	-944.0733	17.20058	145.3588	16.32376	17.87037	16.95203
5	-935.5808	14.10857	165.0954	16.44485	18.35536	17.22095
6	-920.9552	23.35376	170.36	16.46702	18.74144	17.39094
7	-913.7391	11.05689	198.8327	16.6087	19.24702	17.68045
8	-907.4908	9.170933	236.7454	16.76598	19.76822	17.98556

* indicates lag order selected by the criterion

To ensure the reliability of the coefficients of the Normalized Cointegrating model for the long-run and Vector Error Correction Model for the short-run, we employed AR root stability test. The estimated VAR is stable if all roots have modulus less than one and lie inside the unit circle. The result of AR root stability test satisfies the stability condition of the model in table 4.

Tabe 4: Stability Test

Root	Modulus
0.98099	0.98099
0.842447	0.842447
-0.502025	0.502025
0.287164 - 0.360442i	0.460849
0.287164 + 0.360442i	0.460849
0.442617	0.442617
-0.21477	0.21477
-0.148237	0.148237

No root lies outside the unit circle.

VAR satisfies the stability condition.

Table 5: Long-Run Models

Cointegrating coefficients				
CointEq1				
VOL_EX(-1)	VOL_OPR(-1)	LDD(-1)	LRE(-1)	C
1.0000	0.493832	11.75946	-4.79562	9.454034
CointEq2				
VOL_EX(-1)	VOL_OPR(-1)	LDD(-1)	LRE(-1)	C
1.0000	-0.542072	-14.751	6.152268	-13.894

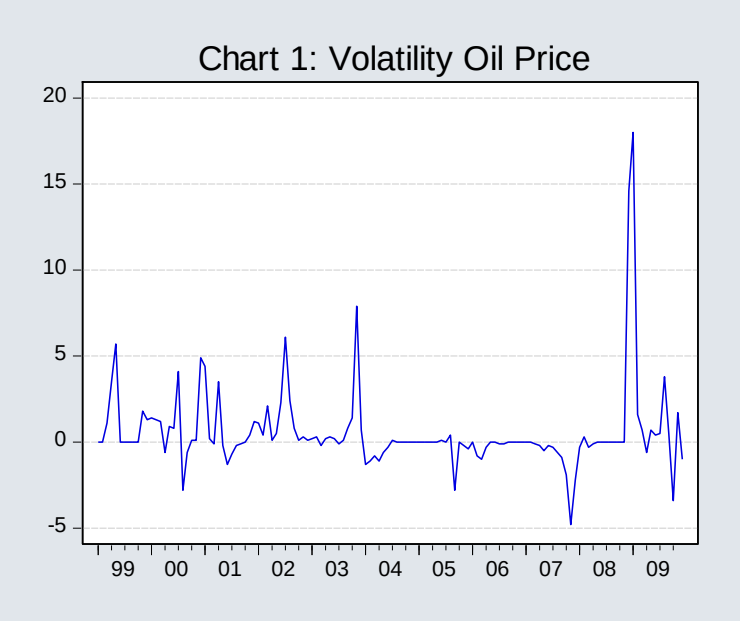
From Table 5 above, we derive a cointegrating equations among the exchange rate, oil price, foreign reserves and demand for foreign exchange. The normalized equations become: The value of the cointegrating vectors (β) is presented below:

$$VOL\_EX = -0.49\ VOL\_OPR + 4.80LRE - 11.76LDD \quad (5)$$

$$VOL\_EX = +0.54VOL\_OPR - 6.15LRE + 14.75LDD \quad (6)$$

Analysis is focused on equation 6 because it reflects theoretical expectation. The cointegrating vector indicates a stationary long-run relationship in which the level of exchange rate volatility (VOL_EX) depend on the oil price volatility, foreign reserves and demand for foreign exchange. From equation 6, a 1.0 per cent permanent increase in the level of international oil prices volatility causes the exchange rate volatility to increase by 0.54 per cent in Nigeria. This conforms to expectation, as an increase in oil price volatility should increase exchange rate volatility in the Nigerian economy. Also a permanent 1.0 per cent increase in demand for foreign exchange increases exchange rate volatility by 14.8 per cent, while the co-efficient of foreign reserves is negative. It implies that increase in reserve accumulation would decrease exchange rate volatility. The result also showed that foreign exchange demand has much devastative effect on exchange rate volatility than oil volatility This result confirms the general belief that volatility in exchange rate is greatly influenced by the foreign exchange demand and the volatility in oil price in the international market. Thus it can be concluded that there is a net transfer income from oil importing countries to Nigeria when oil prices rise at the international market. In addition, in spite of foreign reserves level of about US$51.0 billion in October 2008, exchange rate

instability was experienced in Nigeria, because of the drastic fall in crude oil prices at the international market.



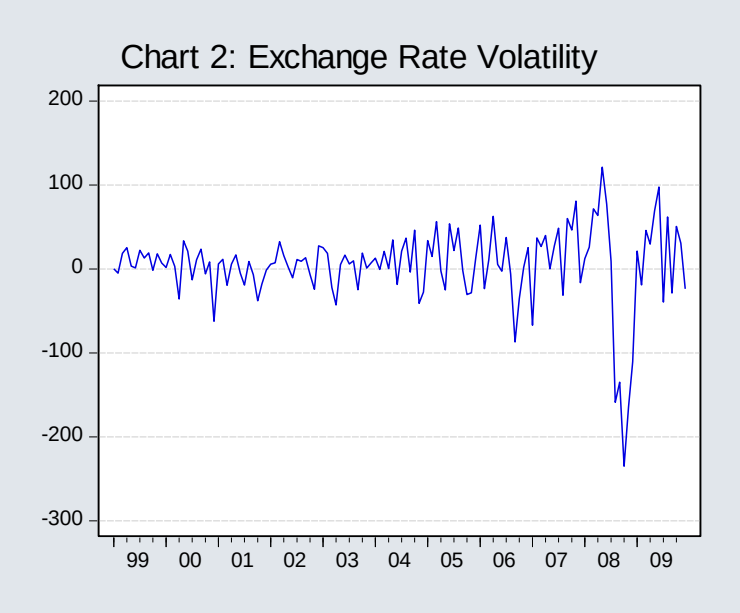


Chart 1 and 2 show the volatility in oil prices and the Naira exchange rates in Nigeria from 1999:1-2009:12. As indicated in the VAR model, the a priori

expectation is for an increase in oil price volatility to lead to an increase in exchange rate volatility. The effect of sharp reduction in oil price in the last quarter of 2008 was reflected in sharp depreciation in exchange rate during the period. The movements of the two variables in the graph are in line with a priori expectation.

IV.2 Short-run Analysis: A Vector Error-Correction Model (VECM)

In econometric analysis, a cointegrated set of time series variables must have an error-correction representation, which reflects the short-run adjustment mechanism. The focus of this section is to examine the influence of the estimated long-run equilibrium on the short-run dynamics, i.e. the cointegrating vectors. Thus the parameters of the error-correction term implied by cointegrating vectors for exchange rate is investigated to determine if they are appropriately signed and significant. After specifying with two lags, we examined the effects of oil prices, foreign reserves, and demand for foreign exchange on the exchange rate in the short-run by using a vector error-correction model (VECM) as follows:

$$\Delta\gamma_t = \emptyset_0 + \sum_{i=1}^{p-1} \emptyset_i \, \Delta\gamma_{t-1} + EC_{t-1} + \varepsilon t \quad \text{----------} \quad (7)$$

where

EC_{t-1} indicates the error-correction term. = -

Table 6: Short-Run Model

	Error Correction:	D(VOL_EX(-1))	D(VOL_OPR (-1))	D(LDD(-1))	D(LRE(-))
CointEq2	-0.3591	0.1995	0.0219	0.0708	-0.3053
	-0.0549	-0.0937	-0.0059	-0.5948	-0.5156
	[-6.54399]	[2.12842]	[3.72600]	[0.11906]	[-0.59221]

The sign of the error-correction parameter in the equation of interest is as expected and statistically significant.

The sign of the coefficient of error-correction terms for the exchange rate is negative and statistically significant. A value of −0.36 for the coefficient of error-correction term suggests that the exchange rate will converge towards its long-run equilibrium level within 36 days after the shock of oil price. In the short-run the coefficients of the demand for exchange rate and external reserves were not

statistically significant and, therefore, these variables do not exact any influence on exchange rate volatility in the short-run.

V. Summary and Policy Implications

The study empirically examined the relationship between oil price volatility and exchange rate volatility in Nigeria. Vector Autoregressive model (VAR) and cointegration technique were used to examine the long-run relationship, while vector error correction model (VECM) was used for the short-run analysis. The empirical results showed that exchange rate volatility is greatly influence by the swings or volatility in oil prices at the international market both in the long-run and short-run. In the long-run a 1.0 per cent permanent increase in the level of international oil prices volatility causes exchange rate volatility to increase by 0.54 per cent. Also a permanent 1.0 per cent increase in demand for foreign exchange is likely to increase exchange rate volatility by 14.8 per cent. However, the main drivers of volatility in exchange rate in the long-run are demand for foreign exchange and oil price volatility. From the results obtained, exchange rate management policies should focus on foreign exchange demand strategies and in addition, incorporating the movement of international oil prices into exchange rate management, as Nigeria remains an oil dependent economy. The consequences of oil price shocks on the economy are real since oil remains the major foreign exchange earner for the country. As the world move in search for greener energy, the diversification of the economy to increase supply of foreign exchange from other commodities is critical to avoid damage to the economy of an oil exporting country like Nigeria that could result from the higher outward transfer of wealth during prolonged oil price shocks.

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Domestic Macroeconomic Policies and Capital Flight from Nigeria: Evidence from a Macro-econometric Model

Chukwuma Agu*

There is no scarcity of empirical studies into the causes of capital flight or the associated attempt to relate the phenomenon to economic growth and other macroeconomic stability indicators. Studies that undertook that include Onwuoduokit, (2002), Ajayi (1992, 2002) Pastor (1990), among others. The emerging list of causal variables is equally diverse - ranging from balance of payments disequilibrium and real exchange rate distortions to political risks and other social imbalances. Expectedly too, different works place different premia and weights on different causal variables. Indeed, distilling from the menu of variables that influence capital flight will continue to be a major challenge to macroeconomic researchers. However, there is still intense debate on how effective or otherwise domestic fiscal and monetary policies can be in reducing capital flight, either through impacting on its causes or by directly influencing capital flows. This work aims to contribute to this debate for a typical developing country. It proposes a macroeconomic model with the intent first of empirically evaluating the place of risk in capital movements and, thereafter, to evaluate the effectiveness of domestic fiscal and monetary policies in combating capital flight. It found evidence in support of risk and volatility influencing the outflow of capital and of capital flight responding directly to capital controls, but could not find evidence to support indirect control of capital flight using fiscal and monetary policies to control uncertainty.

Keywords: Capital flight, Macro-econometric Model
JEL Classification: F21, F41, H30
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I. Introduction

Over the years, Africa and, indeed, the rest of the developing world has witnessed massive outflow of investible resources. This is both counter-intuitive and atheoretical given the high returns to investment in many of the countries concerned. Boyce and Ndinkumana (2001) estimate that compared to the size of the region's debt, capital flight from SSA put at about $193 billion in 1996 dollars between 1970 and 1996 makes the region a net creditor to the world. The figures are even more intriguing when imputed interest earnings are added to the accumulated stock of capital abroad bringing the total to $285 billion against a total debt stock of $178 billion. Ndinkumana and Boyce (2002) note that for every dollar of external borrowing in SSA; roughly 80

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cents flowed back as capital flight in the same year. Pastor (1990) estimates that capital flight bled Latin America of $15l billion between 1973 and 1987. His estimates are that approximately 43% of total debt build-up in the region within the same period was used to finance capital flight and a high percentage of new debt in most cases "slips out" again as flight capital.

More importantly, such outflows constrain economic policy as they reduce investible resources. If reversed, these outflows have the potential for largely easing the capital constraints facing developing countries and providing the quantum leap developing countries need to reverse their perennial dependence on aid and conditional transfers from the rest of the world. This is all the more needed given the dwindling foreign aid and credit to developing countries in the last decade. Capital flight perpetuates the debt crises not only through diversion of savings but also because retention of assets and earnings abroad erodes the domestic tax base and lead to more budget deficits that require contracting further debts to finance. Besides, the non-repatriation of earnings on foreign assets retards growth as it exacerbates the foreign exchange shortage that constrains the import of capital goods necessary for development. Furthermore, it accentuates instability in the polity, and sends (possibly wrong) signals of the potentials of the economy thereby putting monetary and fiscal policies on the defensive. Resource constraints generally entail reductions in the options for macroeconomic intervention open to governments, but also, it increases the risk perception of the countries in question and tends to lead to even more outflows of capital.

While this last point seems intuitive enough, it is a point of contention in the literature. In particular, Cline (1985) claims that it is largely within the power of debtor countries to limit capital outflows by adopting appropriate domestic policies on interest rates, exchange rates, capital account convertibility, and fiscal balance (see also Ajayi, 2002). But this stance is very debatable. For most SSA countries, the movement of capital out of the region is persistent despite long years of attempts at forcing the macroeconomic policy numbers to add up. And so far, it is difficult to assert with certainty that capital flight persists because macroeconomic policy numbers did not add up and even more difficult to assert that it persists despite the policy numbers having added up. This is because empirical works on capital flight have generally been concerned with definitional and measurement issues. Not much has been done on the impact of macroeconomic policies on capital flight for a typical highly-indebted poor country.

This work is an attempt to present evidence on the nature of the relationship between capital flight and domestic macroeconomic environment and policies. It proposes a medium-sized macroeconomic model of Nigeria which shall be used to evaluate the relationship between capital flight and domestic risk variables as well as the relative impact of alternative monetary and fiscal policy measures in ameliorating or accentuating capital flight. The broad objective is to contribute to the debate on and understanding of the mechanism of capital flight from developing countries and its relationship with domestic risk factors as well as fiscal and monetary policies. The remainder of this paper is organized as follows: Section II reviews the literature on capital flight and political risk; the empirical model for analysis is presented in Section III and the findings discussed in Section IV while Section V concludes.

II. Issues in the Literature

II.1 Capital Flight

A knotty issue in the capital flight literature is the underpinning argument for the 'arbitrary' classification and nomenclature of 'flight' for some capital and 'FDI' for others. The use of 'flight' for capital movement across borders in certain circumstances is considered pejorative by some in the literature. The argument is that there is inconsistency when capital from other quarters are termed FDI and encouraged while those considered flight capital are discouraged (Onwioduokit, 2002; Schneider, 2003). Specifically, optimal portfolio choice for individuals in any country, especially in a globalizing world necessarily implies the diffusion of investment among different countries, based on their risk-return perception of assets in those places. Therefore, such discriminatory classification is considered by some as unwarranted.

Nor is the problem with capital flight only in terms of the variations in theoretical conception. The empirical estimation of what constitutes flight as a subset of broad private capital flows is often as problematic leading to varying estimates and definitions of what constitutes capital flight. Like the real exchange rate, while conceptually admitted as being a problem, capital flight is difficult to track. The disagreement in concept also shows up in the ambiguity arising from an attempt to distinguish capital outflows responding to positive incentives and returns across the border from those responding to negative incentives and risks within a country. Particularly, the line of distinction is often very thin and defined by the even less tangible and measurable motives of private agents. It, therefore, comes as no surprise that several different capital flight measures are available in the existing literature (Kant, 1996, Lensink, et al 1998, Hermes and Lensink, 2001).

Three methods of measuring capital flight have emerged over time. The ***Residual Method*** measures capital flight indirectly from the balance of payments statistics by comparing the sources of capital inflows *(i.e.* net increases in external debt and the net inflow of foreign investment) with the *uses* of these inflows *(i.e.* the current account deficit and additions to foreign reserves). If the sources exceed the uses of capital inflows, the difference is termed as capital flight. It is so far the most widely used and currently has a number of variants among them World Bank (1985), Morgan Guaranty (1986) and Cline (1987). The second method referred to as the ***Hot Money Method*** measures capital flight by adding up net errors and omissions and non-bank private short-term capital outflows (Cuddington, 1986; Gibson and Tsakalotos, 1993). This measure reflects the idea that capital flight goes unrecorded, due to the illegal nature of these capital movements. It is argued that the unrecorded capital movements appear in the net errors and omissions. Moreover, by concentrating on short-term flows, medium- and long-term outflows are excluded, which are considered more *normal* in character. The third is the ***Dooley Method*** (proposed by Dooley, 1986). It defines capital flight as all capital outflows based on the desire to place assets beyond the control of domestic authorities, excluding normal outflows. Consequently, this measure includes all capital outflows that do not receive and/or register interest payments. However, Claessens and Naudé (1993, pp.5-7) show that the calculation of capital flight as proposed by Dooley (1986) is in fact partly based on and gives rather identical magnitudes as the Residual Method, although it uses a different concept of capital flight.

The causes of capital flight have been a subject of much debate. Lensink, et al (1998), Hermes and Lensink (2001) among others identify governance and political risks as the key factors responsible for 'counter-intuitive' capital flows. Cuddington (1986), Ajayi (1992) and Onwioduokit (2002) identify macroeconomic mismanagement in the form of expansive fiscal and monetary policies and exchange rate overvaluation and misalignment as creating uncertainty and making the domestic environment unattractive for investment. McKinnon (1999) identified the whole gamut of exchange rate and regime-related disturbances as risk-boding even for a net absorber of private capital. Other factors identified in the literature include declining terms-of-trade, changes in tax regimes, budget deficits, financial repression and debt (Pastor, 1990; Ul Haque and Khan, 1985; Khan and Ul Haque, 1987). Duwendag (1989) particularly notes that the relationship between poor countries' indebtedness and capital flight is a bit complicated. Much of the funds contracted in debts aimed at financing short-term balance of payments crises usually found their way back into foreign accounts of private residents without being put to use in the countries where they

were originally designated. This was accentuated by Pastor (1990:4) in discussing the Brady Plan of the Bush (Snr) administration who insists that capital flight impedes the resolution of the overall debt problem of the Latin American (and by extension developing countries') debt problem because the continued extension of new credit or debt relief is counter-productive when a high percentage of the new resources 'slips out' of the region again as flight capital. He estimates that approximately 4.3 percent of the debt build-up in the region was used to finance capital flight

While there is some agreement in the risk-content of the factors determining capital flight, there is very little on what constitutes optimal policy response to the problem. A number of the identified factors are external and probably cannot be directly influenced by domestic macroeconomic policies. The variables lumped under 'relative country risk' in Ajayi, 1992, 2002 and Onwiodiokit, 2002, among others are wide and require varying (and sometimes conflicting) measures to contain. For many poor countries, therefore, with segmented product and factor markets and subject to a range of external shocks, there are genuine questions as to the practicality and feasibility of policy combinations that can stop or reverse capital flight. McKinnon (1999) and a number of other researchers have extensively pursued the efficacy of policies in this direction and a number of (at least theoretically plausible) policy recommendations have been proffered. But to what extent these are practicable for a typical developing country especially given the pressure for further liberalization of the capital market is not known. If as Pastor (1990) noted and confirmed by a number of other works (Ajayi 1992, 2002, among others), there is a high correlation between debt accumulation/overhang and capital flight, what are the policy options open to an average developing country and what are the rooms available for effective combination of monetary and fiscal policies in engaging the movement of capital away from the shores of the country? This is part of the questions that this work sets out to answer.

II.2 Political Risk

As in the capital flight literature, despite the widespread coverage of political risk, modern authors continue to grapple with the definition and classification of political risk. Most definitions agree that risk exists when there are discontinuities in the business environment arising from political change and such discontinuities are difficult to anticipate (Robock and Simmonds, 1973). In some of the literature, distinctions are made between transfer risks (potential restrictions on transfer of funds, products, technology and people), operational risks (uncertainty about policies, regulations, governmental administrative procedures which would hinder results and management of operations), and risks on control of capital

(discrimination against foreign firms, expropriation, forced local shareholding, etc) as in Root (1973). Clark (1991) concentrates on the non-diversifiable variations in a country's internal rate of return and the financial risk premium associated with a country's ability to generate the net foreign exchange necessary to meet interest and principal payments on outstanding foreign debt. There are other lines of not-too-fine distinction in the definitions as in that between global and specific political risks, macro and micro risks as well as soft and hard risks. There is the idea that the distinctions and the diversities in the forms of risk confirm the fact of the presence of political risk in almost all forms of business endeavours with a wide range of sources.

As the scope of political risk increased, so also did the literature attempt to quantify and clarify the mechanism for objective evaluation of investment climates. Rummel and Heenan (1978) is among studies in this group and proposes a method of converting polemical instability into probabilistic terms thus providing a scientific definition of political risk. This is closely followed by the Business Environment Risk Information Index (BERI), developed as a quantitative guide to political risk ratings. BERI reviews more than forty-five countries three times a year and is based mainly on the judgments and appreciations of a panel of outside experts which try to rank countries according to fifteen factors affecting business climate. Thereafter in 1979, the Political-Risk Services (PRS) evaluation system was developed and this has been extensively used by many multinationals. Subsequently, a new offshoot of the literature tried to evaluate political risk and integrate it into the decision-making process of an enterprise. Generally, the 1990s saw the scientific refinement of the political risk concept through the contributions of other fields of research such as political science, sociology, decision theory and psychology.

The magnitude, nature and direction of non-financial risks affecting businesses are uniquely dependent on the features of the businesses themselves. The latter vary widely and so do the interpretations of the potency and magnitude of the risks associated with them (Jensen, 2005). In a restrictive sense, the definition of political risk encompasses only political instability (activities originating from the activities of the state) and restricted to only unpredictable political events. A more inclusive definition, however, takes in all kinds of politically-motivated acts no matter where these are rooted – political or societal instability. Under this set of definitions there are fewer restrictions to what constitutes political risk and even economic variables, in so far as they are related to monetary and fiscal policy enter in the definition of political risk. In this latter group is the definition by Agmon (1985), who defines political risk as the unanticipated changes in political factors

that affect the relative prices of traded factors of production, goods and services caused by the actions and reactions of governments and other political groups within and between countries. As a financial phenomenon, political risk includes unpredictable demands raised by the state or society on the assets, returns or cash available for shareholders from corporate investment. For Haendel (1979), it is the risk or probability of occurrence of some political events that will change the prospects for the profitability of a given investment. These definitions generally assume the 'essential state'[1] and view the activities of rent-seeking groups as contributing to a higher level of uncertainty in an economy and, therefore, a major source of political risk especially in developing countries.

A major challenge of the empirical literature over time has been the measurement of political risk. Several of the available definitions do not yield to easy and immediate quantification. Several techniques, especially since 1990 have been developed to overcome this problem and scientifically assess political risk. A number of risk rating agencies have consequently emerged and the different data generated by their activities have fed into the massive research that has gone into the area lately. However, it must be noted that no matter the means adopted, measuring political risk will always involve some measure of subjective judgment. Particularly, the sources of risk are not very easy to measure and so would always task the ingenuity of the researcher in transforming them into measurable terms. In addition, the limit of the 'essential state' is a question for debate. Even for the neoclassical, this is not clearly and unambiguously spelt out. In effect, while government actions could lead to instability, government inactions could also be very destabilizing. How these are to be equally treated remains a matter for empirical question.

Empirically, there have been attempts at measuring how important an understanding of country risk is for investors. Erb, et al (1996) measure the economic content of five different measures of country risk: The International Country Risk Guide's political risk, the financial risk, economic risk and composite risk indices and Institutional Investor's country credit ratings. Through conducting trading simulations, they explore whether any of these measures contain information about future expected stock returns and, thereafter, linked these measures to future expected returns using time-series-cross-sectional analysis. They also analyze the linkages between fundamental attributes within each economy and the risk measures. The results show that the country risk measures are correlated with future equity returns and that the country risk measures are

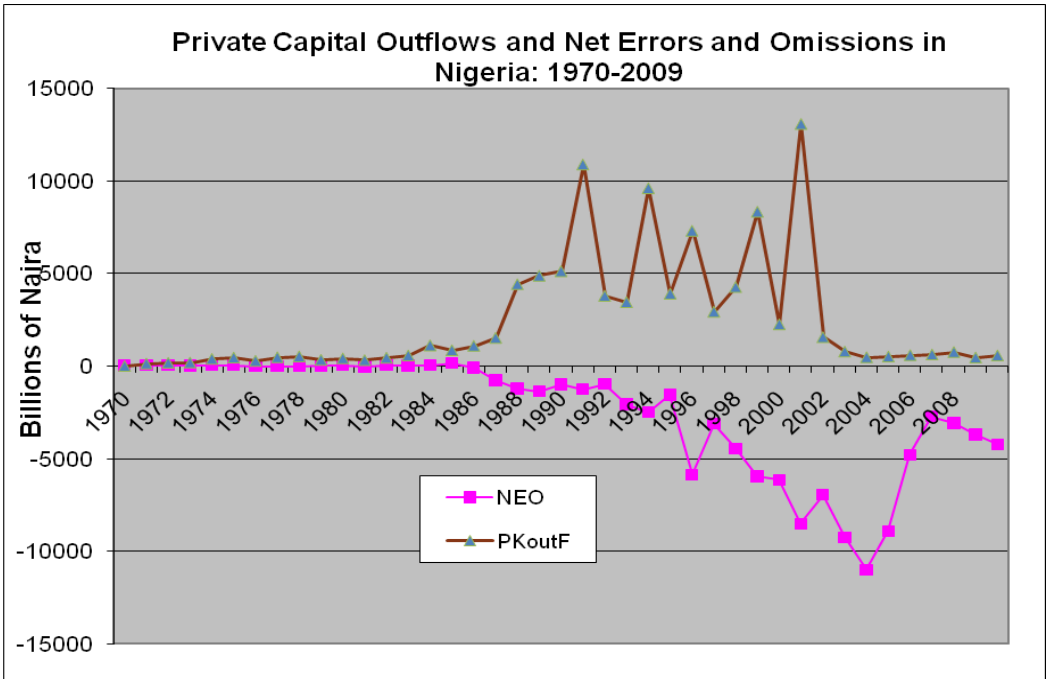
[1] The essential state is viewed in terms of the strict responsibilities of the state within a neo-classical definition

inter-correlated with one another. However, they noted that financial risk measures contain the most information about future equity returns. On their part, Busse and Hefeker (2005) explore the linkages between political risk, institutions and foreign direct investment inflows. Using different econometric techniques for a data sample of 83 developing countries for the years 1984 to 2003, they tried to identify those indicators that matter most for the activities of multinational corporations. Of the 12 different indicators for political risk and institutions that they used, they found that government stability, the absence of internal conflict and ethnic tensions, basic democratic rights and ensuring law and order are highly significant determinants of foreign investment inflows – and we may add, …and other forms of investment.

II.3 Capital Flight and Political Risk in Nigeria

Capital flight studies in Nigeria are not divorced from the already mentioned problems of measurement. First, different definitions of capital flight yield different measures and magnitudes of the phenomenon. Secondly, even when only 'run-away funds' are to be captured as flight capital, they are not (and, indeed, cannot be) reported to authorities. So it is generally difficult to deduct capital that flees abnormal risks at home from total capital outflows. So measurement of capital flight in Nigeria has traditionally incorporated total resident capital outflows (see Onwioduokit, 2002). The alternative that has also been widely adopted is to assume that since such funds are unrecorded, they could only appear in the net errors and omissions. The empirical section of this work shall evaluate trends in both so as to capture their relative strengths and weaknesses. The diagram below shows the trends in both aggregate capital outflow and net errors and omissions[2].

[2] Actually, trade misinvoicing should be explicitly incorporated, but again, the assumption is that such sharp practices would reflect in the records in the form of errors and omissions.



Within the sample period, given whatever measure of instability that one may choose to adopt, Nigeria has been highly unstable. There have been 10 regimes and 9 changes in regimes, six of which were through coups, some violent and others non-violent. Recorded disputes stand at a total of 5,742 with about 294.5 million man-days lost as a result. Even associated macroeconomic policy variables like monetary and fiscal instruments have also been unstable with even more unstable outcomes. Domestic inflation has remained in double digits for over two decades, while monetary policy targets were hardly ever met throughout the 1990s. Terms-of-trade shocks seem to have magnified the internal instability as oil price changes have literally been translated to domestic fluctuations as government spending gyrated with such changes. In fact, on many indicators of volatility and risk, Nigeria is considered to have performed even worse than developing countries' average (Addison, 2002). Whether such instability is in any way related to capital movements may be difficult to say at this point, that being one of the subject matters of interest in the present enquiry. However, anecdotal evidence through a correlation analysis seems to point to some relationship between net errors and omissions and disputes with a positive coefficient of 0.5.

III. The Empirical Model

The work presents a medium-sized, multi-sectoral general equilibrium model for Nigeria, a developing country. The model is situated within the reforms in the country, particularly the National Economic Empowerment and Development Strategy (NEEDS)[3]. The model has 44 equations, 24 stochastic and 20 definitional, covering 6 sectors – domestic production and supply, domestic absorption, central government activities, monetary policy, domestic prices and the external sector. In this section, we lay out the broad outline of the provisions of the model. Detailed equations are presented in the appendix 1.

III.1 Production and Supply

Aggregate output in the model is given as the sum of both the oil and non-oil sectors and production in the oil sector is a function of the country's quota from OPEC which is divided between domestic consumption and exports. Non-oil output is modelled to follow a simple growth model with aggregate production function relating non-oil output to the capital stock and the labour force. Following Soludo (1996), capital is disaggregated into public and private capital stocks and includes raw materials imports (including oil imports) as factors of production. The non-oil production function is standard Cobb-Douglas. Net factor payment is the sum of debt repayments and servicing, and payments on invisible services. Demand for labour is specified as a function of output and the wage rate while import demand is determined by output, the real exchange rage and tariff.

III.2 Domestic Absorption

Private consumption is specified as a function of disposable income and wealth. Private investment expenditures, on the other hand, are modelled to follow the burgeoning literature in investment and risk.

III.3 Government Operations

Government operations consist of its expenditure and revenue, and monetary policy. Government revenue consists of oil and non-oil revenues. Oil revenues are also broadly divided into Petroleum Profits Tax and other oil-related revenues.

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[3] NEEDS is the reform agenda of the Federal Government of Nigeria. Components of the agenda include the reining in of government through reducing access to Central Bank financing of deficits, reducing the maximum size of deficits, strict organization and tracking of public expenditure through a medium-term expenditure framework, growing the private sector and a social charter that commits government to poverty reduction and empowerment of private agents. Under NEEDS, real private consumption is expected to grow by 4.83% per annum, consistent with the broad objectives of poverty reduction and reallocation of investible resources.

Petroleum profits tax is modeled to depend on oil production with appropriate deflator. Other oil-related revenues depend on domestic oil consumption and price. Non-oil revenues consist of tariff and income tax revenues. Tariff revenue depends on imports while income tax revenue depends on the tax rate and aggregate income. Estimations of all specified equations in this section are in logs, even where not so explicitly indicated.

Government expenditure is disaggregated into debt payments and public capital and consumption expenditures. Public debt further comprises domestic debt and foreign debt. Domestic debt servicing depends on the local interest rate (proxied by the minimum rediscount rate) and the debt stock while foreign debt is a function of the stock of foreign debt and foreign interest rate (proxied by the London Inter-bank Offer Rate, LIBOR). For both capital and recurrent expenditures, government is assumed to follow WAMZ protocol which requires it to limit Central Bank's financing of Central Government deficit to no more than 10 percent of previous year's tax revenue.

We also present an inter-temporal fiscal closure rule imposed externally on the economy. In the rule, lending agencies and creditors compare the country's rate of output growth with the relevant interest rate for debt servicing in making financing available to government for expenditures beyond its current income.

III.4 Monetary Policy

A monetary policy reaction function is specified linking the policy interest rate to domestic price level, output, reserves and the exchange rate. The traditional money supply identity (as the sum of domestic credit and international reserves) is presented. Change in credit to the public sector comes either from the domestic banking sector or borrowing from abroad, but private sector credit depends on output growth. The stock of money is made a function of real income, interest rate and expected inflation.

III.5 Domestic Prices

Changes in domestic prices are affected by movements in the levels of non-oil production, nominal exchange rate (to capture pass-through of the exchange rate), government activities, and broad money supply. Domestic wages on the other hand is determined by capacity utilization (also in the non-oil sector) and changes in the domestic price level following an adaptive expectation framework. Stock prices follow a random walk indicating that macroeconomic fundamentals matter.

Exchange rate changes affect domestic prices in two main ways – a direct channel which runs through the price of imports and an indirect channel which runs through domestic wage and other production cost structures (see Hufner and Schroder 2002: 2; Hampton 2001: 2; Goldberg and Knetter 1997). Given its open structure, other domestic and foreign prices also affect the domestic level such that it can be safely assumed that uncovered interest parity relationship holds. Given the size and structure of government, fiscal policy stance, without adequate intervention from monetary policy quickly translates to changes in price level. The credibility of the monetary authorities is fast gaining relevance as a major determinant of the direction and pace of inflation. This last point is incorporated using a measure of expected inflation, in this case following adaptive principles as earlier expounded.

III.6 The External Sector

Exports constitute both oil and non-oil. The value of oil exports are determined by production quota and the international price of oil appropriately deflated. Non-oil exports on the other hand, is determined by output and prices at the international market. Capital flows is the sum of both short- and long-term net capital movements. Total capital outlay are modelled to follow a risk-return framework which is influenced by both monetary and fiscal policy measures. Relative risk is captured using the volatility of the real exchange rate while monetary and fiscal policies are captured with fiscal deficit and money supply. Capital flight is made a function of volatility, output, government expenditure (proxying fiscal policy stance) and the minimum rediscount rate (proxying monetary policy stance).

IV. Empirical Results

Summary of the estimated results are presented in Appendix 2. One of the major confirmations of the estimates is the positive interaction between domestic real and monetary sectors with the external sector (especially the current account balance). Output in the oil sector is simply driven by exports and local consumption while output in the non-oil sector is driven by shifts in imports of raw materials and combined public and private sector consumption. Domestic output, import taxes (represented by implicit tariff) and economy-wide relative price (the real exchange rate) determine aggregate imports. Gross consumption in turn is a function of output and gross domestic savings, while capital formation depends on the lending rate and real exchange rate volatility. Unlike its relationship with the lending rate, the relationship between gross capital formation and real exchange rate volatility is much weaker. Petroleum taxes as expected simply respond to total oil exports (even though relatively weakly at 5%

level of significance4), while other oil taxes depend on the proportion of total output that is consumed locally.

Government expenditure is affected by ECOWAS WAMZ protocol, gross output and money supply while monetary policy reflects the parallel exchange rate, output, interest rate spread (between deposit and lending rates) and broad money supply. The relationship of domestic prices (inflation) and the specified monetary policy reaction function with real variables seem weaker than a priori expectations. Domestic price changes follow changes in parallel market exchange rate, government expenditure to output ratio and real money supply. The closeness between average wage movements and capacity utilization in the manufacturing sector is comparatively weaker than that between wages and broad money supply. The adoption of the standard random walk hypothesis as done in modeling the stock market is a statement of a weak relationship between the stock market and real sector (and indeed, other macroeconomic) fundamentals. Interestingly, the coefficient estimates of the random walk specification confirm this position, even though only up to the first lag.

Oil export is simply a reflection of oil production and the terms-of-trade though industrial disputes, expectedly, play a significant part. Oil sector volatility manifests in increased hostility between oil firms and their host communities. For a long period within sample, for example, a number of the major oil-producing firms lost significant output and exports to disputes and other forms of socio-economic instability in the Niger Delta. Non-oil exports on the other hand did not show much of the variations arising from disputes and other forms of volatility as oil exports. It is in any case very small in both absolute and relative terms, and depends mainly on output in the non-oil sector.

It was difficult pinning private capital inflow to any of the regular economic fundamentals. Even as a function of its own lag, it was not significant. This owes much to a number of reasons. Some aspects of the literature indicate that private capital inflow does not respond significantly to regular policy variables. The suggestion for future studies may be to try modeling it as autonomous component of capital flow. Capital outflow, on the other hand, is positively influenced by two major indicators of macroeconomic distortions – real exchange rate volatility and output variability. This is the only place where the impact of output variability is felt and such impact is equally very weak. However, while the impact of real exchange rate volatility is very high, that of output

[4] It might be probably helpful for future research to link oil taxes to total production instead of just exports as capturing other activities of oil firms might be a bit delicate and difficult to do.

variability is not. Net errors and omissions are affected by real exchange rate volatility, government expenditure and the minimum rediscount rate. Real exchange rate volatility is impacted by coups and capital flight and displays a ratchet effect.

In the capital account, greater attention was paid to private capital flows (indeed public flows over the sample period could in some sense be considered exogenous)5. The model tried to capture all components of the account – private inflows and outflows and net errors and omissions (the latter standing in for capital flight and unrecorded flows) – independently. A number of instability indicators were severally used – real exchange rate volatility, number of man-days lost on account of social and industrial disputes and dummies for coup d'etat and changes in regimes.

Changes in domestic capital formation (GFCF) are determined mainly by the lending rate and real exchange rate volatility. As noted earlier though, the impact of real exchange rate volatility was not as strong as that of the lending rate, but at least it showed stronger than most other instability indicators used in the modeling at one stage or the other. Higher volatilities of both the real exchange rate and output translate to higher outflows of capital. It could not be confirmed that fiscal and monetary policy instruments affect real exchange rate volatility, which itself has been a major determinant of both domestic and external indicators of capital flows.

From the estimation output then, it becomes clear that with the exception of capital inflows, which exhibit high policy independence, both legal private capital outflows and net errors and omissions are highly circumscribed by indicators of volatility. However, net errors and omissions seem to be much more highly sensitive to both monetary and fiscal policy instruments.

Finally, an attempt was made to endogenize real exchange rate volatility. This was not originally proposed in the theoretical model, but the idea is that there may be some information content of such an estimate that may be useful in explaining the whole gamut of relationships and interconnectivity among the variables as outlined above. It was difficult to identify any systematic

[5] For a highly indebted country like Nigeria, long years of positive current account balance have often been offset by negative capital account balance owing to the high net factor payments that are made. Such factor payments in many cases do not depend on output for any current year as they do on the proportion of total debt for which amortization is either due or remitted as well as the size of the interest payments made (some of the latter of which may have little or no relationship with either the origins of the debt or output but more with the nature of penalties attachable to the debt in question).

dependence of real exchange rate volatility on any one of the established variables. Both monetary and fiscal policy variables were introduced into the model but in each case, they showed up inconsequential in determining volatility. Of course, the component of policy that was taken into consideration in the equation could only be that captured by data i.e. government fiscal balance and the minimum rediscount rate. The limitation to quantitative component of policy owes more to the fact that personal experience in modeling instability has shown that choosing a representation for political instability could be quite tricky and would largely depend on the context and issues under investigation. Four other measures of instability were introduced – two dummy variables representing coups and regime changes, GDP variability and man-days lost on account of disputes. The modeling shows that of all the indicators of socio-political instability, only coup seemed to have any significant impact on volatility. Interestingly though, capital flight in turn matters for volatility.

Incorporating the impact of risk on capital flight in the model involved at least three alternative approaches. The first of these is the estimation of a capital flight equation incorporating almost all the risk variables alongside other regular explanatory variables. The second involved a two-way independent evaluation of private capital movement within the macro model to capture the varying factors that individually might account for capital flows. Yet the third approach involved modeling volatility itself as a function of some measures of fiscal and monetary policies, also among other variables. For the capital flight equation (the first approach), only real exchange rate volatility proved a significant variable in flight capital. One way to read this is that having captured much of macroeconomic and policy distortions, real exchange rate volatility 'crowds out' the rest of the measures of instability. Whatever the case though, it was highly significant, and none of the rest of the measures was significant. This direct estimation also showed both monetary policy (through the MRR) and fiscal policy (through government expenditure) as very significant factors in influencing capital flight. Some slight difference, however, emerges when this result is compared with the result from the real exchange rate volatility equation (approach number three). None of the monetary and fiscal policy instruments is significant in determining real exchange rate volatility, itself a major determinant of capital flight. The implication is that the channel of transmission which we proposed in this work (i.e. influencing capital flight through influencing real exchange rate volatility) using monetary and fiscal policies, does not hold and that monetary and fiscal policies have direct impacts in determining capital flight. Interestingly, capital flight in turn affects real exchange rate volatility which makes for a loop. Breaking the chain of impact in this sort of relationship could be

difficult given that volatility leads to capital flight and more capital flight engenders even more volatility. All the while, monetary and fiscal policies cannot affect the volatility.

For the two-way capital flows (inflow and outflow), policy and macroeconomic impact seems to rest more on capital outflows (reinforcing the results obtained on capital flight). Capital outflow was made a function of real exchange rate volatility, output and output variability. The implication again is that real exchange rate volatility is a key factor in determining outflow of capital from the economy. Put in other words, instability leads to high capital outflow from the economy. Contrary to specification, the estimations were unable to establish the same kind of relationship between private capital inflows on the one hand and key macroeconomic fundamentals, including instability on the other. Private capital inflow outcomes do not seem to respond to changes in major macroeconomic fundamentals. Indeed, it was not even possible to establish significant temporal dependence of the inflows. The signal sent by the estimated result is that historical data do not suggest that policies to attract capital into the economy work; it rather makes better sense to assume capital inflows into the economy exogenous to both policy and macroeconomic changes. This though is subject to future verification. Income changes also affect both regular (and recorded) capital outflows and capital flight. Increasing income increases the chances of leakage through capital flight as well as through recorded private capital outflow.

V. Conclusions

The work confirms that volatility and risk are critical factors in determining capital flight corroborating previous studies like Chen and Funke (2003), Chang and Cumby (1991) and Cones (1987). In making policy recommendations after his study, Onwioduokit (2002), after making the point of the necessity of appropriate fiscal and monetary policies adds "…policy measures should be instituted to make the domestic economy more attractive for private investment if capital flight is to be confronted and flight capital recaptured. Specifically, anti-inflationary policies such as non-expansionary monetary and fiscal policies and positive real interest rate should be instituted. Furthermore, market-determined exchange rate policy should be pursued. Foreign exchange reserves build-up should also be pursued as a policy priority…" Shibuya (2001) on his part makes a strong case for sequencing of liberalization and introduction of policies to combat capital flight "… the economy may be trapped in (the) low capital equilibrium if liberalization is implemented before sufficient accumulation of domestic capital." Of course, there may be a few disagreements among authors

and policy advisors on the exact nature and components of such risk and instability factors as well as the composition and sequencing of corrective policies, but there is no disagreement as to the fact that risk ranks high among the factors causing and sustaining capital flight. Many African countries (with Nigeria at the forefront) already risk not meeting the MDGs even when, according to Boyce, the continent is a net creditor to the world. Most investors consider the continent too risky and unstable for investment. Reducing this risk is a major means of increasing investment, generating employment and reducing poverty. The fact of Africa having high returns to investment cannot count in investment decisions as long as the continent is so prone to wars and other forms of political instability.

However, the other question is the effectiveness of domestic fiscal and monetary policies in curbing capital flight. Several forms of volatility and instability were tried as proxies for the work – real exchange rate volatility, coup, man-days lost on account of disputes, output variability, etc. In many cases, the real exchange rate volatility showed up very significant unlike many other volatility measures. This is probably due to the encompassing nature of real exchange volatility as an economy-wide distortion. As such, real exchange volatility was modelled as a function of monetary and fiscal policies. However, the outcome was not significant. If anything, capital flight itself and coup are the two variables that seem to affect real exchange rate volatility – beside the linear dependence on its own lag, that is. Thus, it seems real exchange rate volatility answers little to quantitative indices of fiscal and monetary policies. However, there is need for some caveats. The use of quantitative data is admittedly incomplete, as policy (including fiscal and monetary) instruments numerously transcend the quantitative. In addition, the composition of real exchange rate (as a relative price) definitely transcends the quantitative such that the numbers generated indicate underlying macroeconomic characteristics that include the unquantifiable. Thus, there would definitely be other forms of government activities that affect real exchange rate volatility and other indicators of instability. Also, federalism in Nigeria implies fiscal instruments that go beyond the Central Government (accounting for approximately than 50% of consolidated government activity) and includes the states; but in the course of the work, it was not possible to lay hands on consolidated expenditure and revenue. The implication could have been that while volatility measures is encompassing and includes outcomes of activities of states, monetary and fiscal policy instruments used to evaluate impact here belongs only to the Federal Government. Under such circumstances, the challenge then is to kick-start the process of data

generation and storage to include consolidated fiscal and monetary activities of all tiers of government.

There is yet an option, even though the window for its use is gradually closing with trends in integration of both the financial and technological systems of the world. This is the use of capital account controls to minimize capital flight. While flight capital consists mainly of unrecorded flows, stringent penalties could be attached to illegal shipment of funds out of the country. However, it is important, if this is ever to be used, to also create incentives and improve the domestic investment environment to ensure that when such capital outflow is made difficult, there are domestic options for returns to capital. This is a great challenge to institutional capacity building as it would entail a great deal of monitoring and incentive packaging, which is currently lacking in the country. This recommendation is made on the strength of the impact that monetary and fiscal policies have on capital flight when evaluated directly; but such controls are gradually becoming unattractive. Incentives rather than sanctions are increasingly preferred. The challenge then is to maximize the use of incentives in such a way that they impact maximally on the direction of capital movements in the economy.

This section has included caveats to the findings in order to show that there is undoubtedly an array of instruments available to the policymaker that cannot be quantified. Policy control goes beyond government expenditure and the minimum rediscount rate as used here. The structure of the political system and the nature of enacted laws all impact upon the macroeconomic environment in profound ways. These need also to be straightened. Indeed, as shown in the first section of the methodology, these are the forces that lead to capital flight in the first place. As such, regularizing the political system, making laws that promote free economic enterprise and increase chances for gainful employment could all go a long way in controlling the movement of capital out of the economy. Second, it is possible that given that much of the funds classified as flight capital were acquired through corruption, the challenge would not be that of finding means of instilling stringent capital controls using traditional stabilization programmes and instruments, but that of controlling the corruption that aid the private acquisition of such funds in the first place. The fight against corruption by the government is laudable in this direction, but there is need for its prosecutors to engender more credibility to the project. Also, the present work purposefully limited the regressors to the traditional variables – fiscal balance (the net of revenue and expenditure capturing fiscal policy) and the Minimum Rediscount Rate (capturing policy interest rate and monetary policy). Intermediate policy

instruments like the tax system, for varying reasons, could not be used. This again would also prove a fruitful area for future research on this issue.

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Appendix 1 – Detailed Equations

1 Production and Supply

Production in the oil sector is given as:

$$Y^o = \left\{X^o + DOil - M^o)\right\} * OilP \quad (1)$$

Where Xo is oil export, Mo is oil import, DOil is domestically consumed oil, and oilP is (average) oil price.

2 Domestic Absorption

Gross output is given as:.

$$Y = Y\ (PK, GK, L, RM) \quad (2)$$

where PK is private capital, GK is public capital, L is labour and RM is raw materials imports (taken as intermediate inputs). Expressing the output function above in growth rates gives

$$\frac{dy^n}{y^n} = f_{PK}, (^{dPK}/_{y^n} + f_{GK}), ^{dGK}/_{y^n} + \left\{\left(f_L, ^{L}/_{y_n}\right).dL/L\right\} + \left\{\left(f_{RM}.RM/y_n\right).dRM/RM\right\} \quad (3)$$

dPK and dGK above are the rates of gross real investment in both the private and public sectors, which can otherwise be represented with *IRp* (for the private sector) and IRg (for the public sector) respectively[6]. So a log-linear approximation to the equation above would render the capacity output growth equation as:

$$\Delta \log Y^n{}_t = \alpha \log\left(IR_G/Y\right)_t + \beta \log\left(IR_P/Y\right)_t + \delta \log\left(L/Y\right)_t + \gamma \Delta \log\left(RM/Y\right)_t \quad (4)$$

where $\alpha = f(Gk); \beta = f(Pk); \delta = f(L); \gamma = f(RM); \alpha + \beta + \delta + \gamma = 1$

[6] While we treat IRg as exogenous, IRp is contextually important. As such, we endogenise private investment as responding to several risk factors and macroeconomic policy instruments. Flight capital is assumed to have private identity; in which case, it is a part of the stock of private capital. The implication here is that it has impact on gross private investment.

Thus, total capacity output is given as

$$Y_{CAP} = Y^{o} + (Y^{n} - RM) \quad (5)$$

where Y_{CAP} is total capacity output, Y^{o} and Y^{n} are output in the oil and non-oil sectors while RM is raw materials imports.

Net factor payments (NFP) are specified as follows:

$$NFP = i^{*}(TDebt) + AMT + (TDebt - Tdebt_{t-1}) + NPFS \quad (6)$$

where amortization AMT, interest payments on debt (i*(TDebt), change in debt ($TDebt–Tdebt_{t-1}$) and payment on invisible services (NPFS) are defined in net value terms.

So Gross National Product (GNP) is given as

$$GNP = C + I + G + (X-M) + i^{*}(TDebt) + AMT + (TDebt - Tdebt_{t-1}) + NPFS \quad (7)$$

Where C, I, G, (X-M) all follow standard notations and the rest are as earlier defined.

Given the rigidities and segregated nature of the Nigerian labour market, it is assumed that the demand for labour in the non-oil sector[7] is a function of output and the wage rate as follows.

$$LD_t = \alpha RW_t + \beta Y_t + \gamma LD_{t-1} \quad (8)$$

where LD is the demand for labour and RWG is real wage. Taking logarithms and obtaining growth rates, real wage would be defined as nominal wage rate (W) less inflation rate (INF) i.e.

$\log(RW) = \log(W) - \log(INF)$ such that

$$\Delta\log(RW) = \Delta\log(W) - \Delta\log(INF) \quad (9)$$

[7] We refrain from specifying labour demand in the oil sector given that the sector absorbs only a small proportion of total labour demand and the incentive structure in the market is not closely linked to that in the non-oil sector.

The incorporation of period t-1 labour demand takes care of structural non-market characteristics of and rigidities affecting the labour market.

Import demand is specified to be a function of output (demand) and two price variables, the real exchange rate (RER) as a relative price and tariff as an absolute price of imported inputs[8] as follows:

$$M_t = \alpha GDP_n + \beta RER_t + \delta Tariff_t + \gamma M_{t-1} \quad (10)$$

where M is import demand and GDP is gross output. The real exchange rate (RER) captured as calculated real effective exchange rate figures of the Central Bank of Nigeria is defined as

$$RER = NER_{dj} * \frac{\left(\sum_{i}^{j} P_{ij}^{*}.TW_{ij}\right)}{P_{dj}} \quad (11)$$

where NER is the nominal exchange rate of the domestic currency vis-à-vis the currencies of the country's trading partners, and P* is the price level in individual trading partners, P_d is the domestic price level, TW is the trade weight of the i_{th} country at period j.

Standard consumption models assume that private consumption is the weighted average of consumption by constrained and unconstrained intertemporal optimizing consumers (Soludo, 1996). So consumption is related to disposable income and wealth as follows

$$C_t = \alpha + \beta Yd_t + \eta RW_t \quad (12)$$

Where Ct is consumption at current period, Yd is disposable income (i.e. total income less taxes and depreciation on capital) and RW is real wealth.

[8] The relationship between REER and tariff in the import demand function is a subject for continuous empirical debate. For an economy with a relatively overvalued exchange rate and highly variegated tariff regime, a widely held view is that the impact of tariff might be outweighed by that of the real exchange rate. While this is unresolved, the intuitive approach is to specify import demand as a function of both REER and tariff – each representing a different set of price that affects imports.

We specify private investment expenditures using the uncertainty and irreversibility approach, which has quickly gained acceptance as a realistic representation of investment decisions (Dixit and Pindyck, 1994; Chen and Funke 2003; Alvarez and Stenbacka 2003, Zilberman 1999; Erdal 2003; Ingersol and Ross, 1992). As such, instead of merely modelling returns, the risk factors in investment are considered very important. Within this framework, the derivation of the movement of the risk factors like the real exchange rate, interest rate, political risk, among others follow a Brownian or Weiner process of the form

$$di = (-i)dt + i(dz) + et$$

where i is the risk variable of interest differentiated with respect to time (t) and a vector of other determinants (z) and time constrained error term (e). However, the approach shall be non-restrictive so as to give room for empirical validation of findings within the model. This leads to the specification of a non-restrictive model of private investment as a function of volatility in the real exchange rate, interest rate, and political risk as follows

$$i = \alpha + \beta RER + \delta IR + \eta PR \tag{13}$$

where RER is the real exchange rate; IR is the interest rate; PR is a measure of political risk.

3. Government Operations

Government revenue historically consists of oil and non-oil revenues. Oil revenue further consists of petroleum profits tax (PPT) and other oil-related revenues.

$$OILTAX_t = a_0 + a_1 PPT_t + a_2 OILRX^t \tag{14}$$

Following Soludo (1996), petroleum profits tax is specified as a function of nominal oil exports and log-linearized as follows:

$$\Delta PPT = a + \beta \Delta \log (OILP * GDPDef) \tag{15}$$

PPT is petroleum profits tax, OILP is nominal oil production and GDPDef is GDP deflator.

Other oil-related revenues consisting of oil sales revenue/tax and the rents and royalties of the petroleum firms (OILRX) are presented as an identity reflecting the

consumption of oil in the domestic economy (OilC) and the domestic price of oil(OilP)[9]. This is given as,

$$OILRX_t = a_0 + a_1 Log(OilC_t + OilP_t) \quad (16)$$

Another major source of government revenue is imports tariff, yielding a sizable proportion of total government revenue. This is posited to be a function of total imports and average tariff rate.

$$TRev_t = \delta_1 Tariff_t + \delta 2(M^*ExtDefl) \quad (17)$$

TRev is total revenue from tariff and other import taxes, M is the imports value and ExtDefl is the external sector deflator.

Other income taxes are assumed to be a function of total domestic output and the tax rate as follows:

$$YTax = TRate * (GDP^*CPIDefl) \quad (18)$$

Where CPIDefl is the domestic output deflator and TRate is the income tax rate, YTax is the income tax.

Thus, total government revenue is the sum of revenue from all four sources as follows

$$GRev = PPT + OILRX + TRev + YTax \quad (19)$$

Government expenditure is discussed under the main headings of public debt service and public capital and consumption expenditures

Public debt is the sum of domestic and external debts. Domestic debt service payment is a function of total stock of domestic debt and the domestic interest rate as follows:

$$DDServ = i * DDebt \quad (20)$$

[9] For convenience we will assume that this price is uniform nationwide and is fixed by government. However, the fact is that government is gradually pulling out of fixing domestic prices of oil consumption in its liberalization programme. This is still a contentious issue in the Nigerian economy and though the hand of liberalization is going steady, the impact of that on the data may yet come in the future.

External debt is postulated to be a function of total government external debt stock and the external debt service rate proxied by the London Inter-bank offer rate (LIBOR) such that

$$EDServ = LIBOR * EDebt \quad (21)$$

where DDServ is the domestic debt service, DDebt is the domestic debt stock and i is the domestic interest rate proxied by the minimum rediscount rate. EDServ is the external debt service, LIBOR is the London Interbank Offer Rate and EDebt is the external debt stock[10].

For the rest of government expenditure, it is assumed that government will constrain itself by the WAMZ protocol to which it is a signatory and to the medium term expenditure framework with both providing the levels of allowable deficits. Thus, both capital and recurrent expenditures are subject to the deficit financing constraints under the WAMZ protocol. Other determinants of government expenditure are domestic output and money supply. The respective specifications for recurrent and capital expenditures are as follows:

$$\text{Log } (REXP)_t = a0 + a1\ (1.125*Def_{t-1}) + a2\text{log } GDP_t + a3\text{log}RMS_t \quad (22)$$

$$\text{Log } (CEXP)_t = a0 + a1\ (1.125*Def_{t-1}) + a2\text{log } GDP_t + a3\text{log}RMS_t \quad (23)$$

Where RExp and CExp are recurrent and capital expenditures respectively and variables captured under coefficient a1 are the West African Monetary Zone provision of no more than 12.5% of previous period deficit for current year financing.

Given the small and almost inelastic domestic non-oil tax base, there exists little room for instituting a closure rule by assuming significant changes in the tax structure (as is the case with Soludo, 1996) Experience has rather shown that government expenditure and debt are often exogenously constrained. Such external constraint considers the trajectory for debt, interest rate and growth summarized in the relation

$$\Delta\ dt+1 = dt * (r - g)/(1 + g) \quad (24)$$

[10] It is assumed that the bulk of public debt is held by the Central Bank and Commercial banks at concessionary rates. In the same vein, Nigeria has not followed any systematic strategy in amortization of its external or domestic debts. As such, it may not be helpful to specify equations tracking amortization of debt.

Further debt accumulation and lending are considered unsustainable when growth rate (g) is lower than interest rate (r).

4. Monetary Policy

Monetary policy follows a base money targeting framework (see CBN 2002) assuming a stable money demand function of the form:

$$M_t = P_t + kY_t - \eta i_t + \nu_t \tag{25}$$

where M_t is the money supply, Y_t is aggregate income, i_t is the interest rate, P_t is the price level, and v_t is a white noise error term. Re-writing the equation to endogenize interest rate and normalize base money impact on interest rate to unity, the policy interest rate is specified to react to domestic price level, output, reserves and the exchange rate[11].

$$i_t = \frac{P_t}{n} - \frac{M_t}{n} + \frac{k}{n}(Y_t) + \alpha PREM + \beta \log\left(\frac{RES_t}{RES_t^*}\right) - (\text{int}\, diff_t) + \gamma \Re_t + \mu_t \tag{26}$$

where PREM is the premium in the parallel market for exchange rate defined as $PREM_t = \left\{\frac{(off_e - par_e)}{par_e}\right\} * 100$ and $\text{int}\, diff_t = Lendr - depr$, i_t is the policy interest rate (in this case the minimum rediscount rate – MRR), P_t is the price level, M_t is broad money supply, $PREM_t$ is the premium of the parallel market exchange rate, RES_t is foreign exchange reserves, $intdiff_t$ is interest rate differentials defined in this case as the difference between average lending (lendr) and average deposit rates (depr) each at time t within chosen frequency.

For money supply, the traditional identity of money as the sum of the banking system's balance sheet in the form of domestic credit and international reserves holds i.e.

[11] Prior estimations of the impact of exchange rate both in pass through and reaction function show that the parallel market exchange rate is the more useful indicator of the effects of changes in exchange rate on other macroeconomic variables (see Agu et al 2003 for example). While output growth is one of the broad targets, instrument variation with respect to output is not well defined and so it is considered more practicable to target credit growth and leave output as an implicit target. For reserves, the WAMZ protocol which gives a minimum of six months imports cover and to which Nigeria is signatory will be of relevance.

$$M_t = DA_t + NFA_t \quad (27)$$

where DA is domestic assets comprising domestic credit (DC) and other assets (net) and NFA is net foreign assets consisting reserves and other components of net foreign assets. While other assets (net) is a large component of money supply, it will not be distinctly determined in this model partly because it could be difficult explicitly defining its determinants. Domestic credit, however, is further divided between private and public credit. Change in credit to government comes from either the domestic banking sector (given weak capital market) or borrowing from abroad i.e.

$$\Delta DCGt = Gt - Tt - \Delta FIGt \quad (28)$$

while change in private credit (ΔDCPt) is a function of output growth and interest rate i.e.

$$\Delta DCPt = a0 + a1\Delta Yt + i_t \quad (29)$$

Following neoclassical conventions, real money balances is related to income, interest rate and expected inflation in a log-linear relationship as follows:

$$\text{Log } (M/P) = a \log(Y) + b\pi \quad (30)$$

Introducing interest rate and defining inflation in terms of expectation (adaptive expectations consistent with earlier specifications), the money demand function is expressed as a standard demand for money equation relating the desired stock of real money balances (m^d) to real income (y), the rate of interest on deposits (r), and the expected rate of inflation πe (see Mallick, 1997) as follows;

$$Md_t = \alpha Y_t - \beta r_t - \delta \pi e_t \quad (31)$$

5. Domestic Prices

Change in price level is given by:

$$Ln\Delta P_t = \alpha + \delta \ln \Delta Y_t^n - \gamma \ln NERP_t + \eta\left(\frac{GEXP}{GDP}\right)_t + \beta \ln \Delta M_{2t} + \lambda \ln_{t1} \Delta P_t \quad (32)$$

γ, η, β, ρ and λ > 0 while δ < 0

where Y_t^n is non-oil production, NERP is the parallel market exchange rate, GEXP/GDP is the ratio of government expenditure to GDP and M2 is broad money supply.

The determination of wages in this work pays more attention to the non-traded sector, as the traded sector consists basically of oil with total employment of only about 2%. Proxying the non-traded goods sector with non-oil output and given the production function expressed earlier, real wage is, therefore, expressed as a function of labour demand in the non-traded sector. Meanwhile, labour demand in the non-tradables sector will be assumed to reflect in total capacity utilization, so that the wage determination function is given as

$$\Delta RW = \Delta W - \Delta PN = \alpha_0 \Delta CU - \beta \Delta PN \tag{33}$$

Plausible assumptions, however, have to be made about changes in the price level and the implicit formation of expectation for the wage bargaining adopting an adaptive process as follows[12].

$$\Delta RW = \Delta W - \Delta PN = \alpha_0 \Delta CU - \beta \Delta PN = 1 \tag{34}$$

where domestic absorption inflation ΔPN=1 is given as the weighted average of output and imported inflation.

Given both its age and size, the testable form of the standard random walk model is adopted to capture the behaviour of the Nigerian stock market as follows:

$$\Delta R_t = \alpha_1 \Delta R_{t-1} + e_t \tag{35}$$

Where Rt is the stock return at time t; et is a sequence of an independent and identically distributed random variable.

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12 While the modeling of expectation is an empirical issue, historical trends in Nigeria seem to indicate that agents make demands for wage increases with reference to the impact of previous inflation rates on their real wage. Soludo (1996) used a mix of adaptive and rational expectations termed 'incomplete forward-looking' expectation. But we observe that the politics of wage setting has been that of reactionary wage bargaining especially in the public sector where agents tend to always bargain for wages in order to make up for 'erosion of real wages' by previous inflation rates. Indeed, the history of wage setting is such that given the employment situation and generally declining output, workers are 'shy' to make bold demands for increases in anticipation of future inflationary trends

Intuitively, the random walk efficiency hypothesis implies that macroeconomic fundamentals matter but it is a different issue determining which ones they are that matter. Empirical evidence varies widely in this aspect.

6. The External Sector

Oil production is determined by the OPEC cartel and exports closely follow production as most of domestic consumption consists of imports. So underneath, the work proceeds to specify exports as a function of the quota as follows:

$$OILX = \alpha + \beta(PQUOTA^{*}\, POIL / NER) / ExtDef \tag{36}$$

where OILX is total oil exports, PQUOTA is the OPEC production quota, POIL is the international price of oil denominated in US dollars, NER is the nominal exchange rate and ExtDelf is the external sector deflator.

In the non-oil export market, Nigeria is a typical price-taker with a basket of primary and semi-processed commodities. These commodities are assumed to be the residual of domestic production over domestic consumption. So non-oil export is specified as follows:

$$NonoilX = \alpha + \beta \log GDP + \delta \log PX / NER \tag{37}$$

Total exports (TX) is the sum of oil and non-oil exports

$$TX = OILX + NonoilX \tag{38}$$

For accounting purposes, total capital flows sum up short-term and long-term capital movements. But here a risk-return summary of capital flows is presented, where high risk premium raises the attractiveness of short-term and highly convertible capital inflows while low risks acts otherwise. Assuming total capital outlay to be a zero-sum game, the two components of capital movement may no longer be viewed as complementary but substitutionary. As such, both long-term and short-term capital flows are modelled as exclusive and each depending on the nature and size of the international risk premium r. If relative risk premium is captured in the equations using volatility of the real exchange rate, the equation for both the short-term and long-term capital flows will be given as

a function of growth of domestic output, monetary and fiscal policy variables as follows[13].

$$Kst = \alpha + \beta RERVOL + \delta \log GDP + \eta Def + \gamma MS \quad (39)$$

$$Klt = \alpha + \beta RERVOL + \delta \log GDP + \eta Def + \gamma MS \quad (40)$$

Total capital flows is the sum of short-term and long-term capital flows i.e.

$$Kt = Kst + Klt \quad (41)$$

Where Kst and Klt are short-term and long-term capital movements respectively, RERVOL is real exchange rate volatility, a measure of policy deviations; Def is Central Government Fiscal Deficits and MS is money supply (the last two capturing monetary and fiscal policy stance)

Finally, an attempt is made to incorporate 'net errors and omissions' as a function of basic fiscal and monetary policy variables. No doubt, standard capital account equations would reflect the interactions between capital and policy instruments. But an explicit capital flight equation would complement whatever information that could be obtained from the estimates obtained from standard capital account interactions with monetary and fiscal policy variables. Given the scenario then, net errors and omissions is made a function of volatility, output, government expenditure (proxying fiscal policy stance) and the minimum rediscount rate (proxying monetary policy stance). The equation is given as

$$NEO = NEO(RERVOL, Y, GEXP, MRR) \quad (42)$$

13 A potentially interesting aspect of enquiry into the possible crowding out relationship between long-term and short-term capital will be the growth of financial instruments and market relative to real sector activities. The current study, however, will not delve deep into this

Appendix 2 – Summary of Coefficients and Tests for Behavioural Equations

Total system (unbalanced) observations 607

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	7.108376	0.435122	16.33650	0.0000
C(2)	0.153691	0.030091	5.107555	0.0000
C(3)	5.463055	0.679400	8.040995	0.0000
C(4)	0.138947	0.020959	6.629459	0.0000
C(5)	0.290981	0.077045	3.776756	0.0002
C(6)	0.166876	0.046503	3.588516	0.0004
C(7)	1.325731	0.030744	43.12117	0.0000
C(8)	-1.099271	0.077680	-14.15121	0.0000
C(9)	-0.013113	0.004499	-2.914601	0.0037
C(10)	0.988373	0.002252	438.9696	0.0000
C(11)	-6.81E-06	1.26E-06	-5.404121	0.0000
C(12)	10.08332	0.214338	47.04402	0.0000
C(13)	-0.052887	0.013774	-3.839679	0.0001
C(14)	-0.001480	0.000886	-1.670192	0.0954
C(15)	5.426429	1.886973	2.875732	0.0042
C(16)	0.337162	0.189000	1.783924	0.0750
C(17)	-3.591146	1.326527	-2.707178	0.0070
C(18)	0.882485	0.093675	9.420757	0.0000
C(19)	-4.831456	2.457508	-1.965998	0.0498
C(20)	-1.37E-05	4.78E-06	-2.874798	0.0042
C(21)	0.798349	0.218616	3.651827	0.0003
C(22)	0.564487	0.108303	5.212113	0.0000
C(23)	59.32856	23.91409	2.480904	0.0134
C(24)	-0.105743	0.014136	-7.480313	0.0000
C(25)	-7.154948	2.183147	-3.277355	0.0011
C(26)	0.906388	0.085462	10.60574	0.0000
C(27)	2.895479	0.255918	11.31411	0.0000
C(28)	-0.150357	0.101186	-1.485953	0.1379
C(29)	-57.34852	43.65718	-1.313610	0.1895
C(30)	3.582580	1.162216	3.082543	0.0022
C(31)	5.301335	1.332217	3.979333	0.0001
C(32)	0.602639	0.096574	6.240197	0.0000

C(33)	0.004852	0.002500	1.940553	0.0528
C(34)	-0.184458	0.046647	-3.954351	0.0001
C(35)	1.396583	0.720943	1.937162	0.0532
C(36)	0.766502	0.125951	6.085719	0.0000
C(37)	-19.71953	4.131222	-4.773292	0.0000
C(38)	2.248034	0.302061	7.442330	0.0000
C(39)	-0.169086	0.072056	-2.346610	0.0193
C(40)	0.003205	0.000994	3.223445	0.0013
C(41)	0.619240	0.010392	59.58858	0.0000
C(42)	6.388275	0.217908	29.31636	0.0000
C(43)	0.000201	0.000112	1.800129	0.0724
C(44)	68.84239	10.73390	6.413548	0.0000
C(45)	-0.008607	0.001957	-4.398424	0.0000
C(46)	-5.557764	0.944773	-5.882644	0.0000
C(47)	-0.015407	0.008128	-1.895610	0.0585
C(48)	-3784.165	1263.420	-2.995176	0.0029
C(49)	1.018226	0.255784	3.980810	0.0001
C(50)	454.1835	122.0164	3.722315	0.0002
C(51)	-133.8057	58.83627	-2.274204	0.0233
C(52)	-21.02056	4.799306	-4.379917	0.0000
C(53)	0.625288	0.087026	7.185037	0.0000
C(54)	69.94718	23.79924	2.939051	0.0034
C(55)	0.196744	0.041780	4.709027	0.0000
Determinant residual covariance		1.56E-08		
Equation: LOG (OILGDP) = C(1) + C(2)* LOG ((OILX + OILCONS - OILM)*OP)				
Observations: 34				
R-squared	0.434155	Mean dependent var		9.327469
Adjusted R-squared	0.416472	S.D. dependent var		0.187009
S.E. of regression	0.142854	Sum squared resid		0.653032
Durbin-Watson stat	0.480515			
Equation: LOG (NONOILGDP) = C(3) + C(4)*LOG (MRM) + C(5)*LOG (PRIVCONS) + C(6)*LOG(GOVTCONS)				
Observations: 34				
R-squared	0.899513	Mean dependent var		11.24902

Adjusted R-squared	0.889464	S.D. dependent var	0.243283
S.E. of regression	0.080884	Sum squared resid	0.196267
Durbin-Watson stat	1.494031		
Equation: LOG (RM) = C(7)*LOG (GDP1984) + C(8)*LOG (REER1990) + C(9)*IMPTARIFF			
Observations: 34			
R-squared	0.954615	Mean dependent var	9.106517
Adjusted R-squared	0.951687	S.D. dependent var	1.072556
S.E. of regression	0.235751	Sum squared resid	1.722929
Durbin-Watson stat	1.354561		
Equation: LOG (GROSSCONS) = C(10)*LOG (GDP1984) + C(11) *SAVINGS			
Observations: 34			
R-squared	0.868221	Mean dependent var	11.14865
Adjusted R-squared	0.864103	S.D. dependent var	0.272198
S.E. of regression	0.100344	Sum squared resid	0.322205
Durbin-Watson stat	0.944060		
Equation: LOG (GFCF) = C(12) + C(13)*PLR + C(14)*RERVOL			
Observations: 34			
R-squared	0.359309	Mean dependent var	9.302971
Adjusted R-squared	0.317974	S.D. dependent var	0.503521
S.E. of regression	0.415832	Sum squared resid	5.360400
Durbin-Watson stat	0.630301		
Equation: LOG (PPT) = C(15) + C(16)*LOG (OILX)			
Observations: 33			
R-squared	0.087954	Mean dependent var	8.785604
Adjusted R-squared	0.058533	S.D. dependent var	0.745172
S.E. of regression	0.723034	Sum squared resid	16.20614
Durbin-Watson stat	0.494879		
Equation: LOG (OTHEROIL) = C(17) + C(18)*LOG ((OILCONS*OP))			
Observations: 34			
R-squared	0.723016	Mean dependent var	8.882616
Adjusted R-squared	0.714360	S.D. dependent var	0.907237
S.E. of regression	0.484876	Sum squared resid	7.523342
Durbin-Watson stat	0.868784		

Equation: LOG (GEXP) = C(19) + C(20)*(1.125*FISBAL) + C(21)*LOG (GDP1984) + C(22)*LOG (RMS)			
Observations: 34			
R-squared	0.609672	Mean dependent var	9.777283
Adjusted R-squared	0.570639	S.D. dependent var	0.369655
S.E. of regression	0.242219	Sum squared resid	1.760100
Durbin-Watson stat	0.853483		
Equation: MRR = C(23) + C(24)*PAREXRATE + C(25)*LOG (GDP1984) + C(26)*(PLR-ADR) + C(27)*LOG(M2)			
Observations: 34			
R-squared	0.929313	Mean dependent var	10.91235
Adjusted R-squared	0.919563	S.D. dependent var	5.754474
S.E. of regression	1.632049	Sum squared resid	77.24393
Durbin-Watson stat	1.333215		
Equation: INF = C(28)*PAREXRATE + C(29)*(GEXP/GDP1984) + C(30) *LOG (M2)			
Observations: 34			
R-squared	0.108503	Mean dependent var	20.53971
Adjusted R-squared	0.050987	S.D. dependent var	17.47646
S.E. of regression	17.02510	Sum squared resid	8985.470
Durbin-Watson stat	0.954878		
Equation: LOG (AVWAGES) = C(31) + C(32)*LOG (AVWAGES(-1))+ C(33)*MANKUTIL + C(34)*LOG (M2)			
Observations: 33			
R-squared	0.987924	Mean dependent var	9.158022
Adjusted R-squared	0.986675	S.D. dependent var	1.191455
S.E. of regression	0.137536	Sum squared resid	0.548569
Durbin-Watson stat	1.758397		
Equation: LOG (NSEVALUE) = C(35) + C(36)*LOG (NSEVALUE(-1))			
Observations: 33			
R-squared	0.528814	Mean dependent var	5.716773
Adjusted R-squared	0.513614	S.D. dependent var	1.068765
S.E. of regression	0.745372	Sum squared resid	17.22295
Durbin-Watson stat	1.980186		
Equation: LOG (OILX) = C(37) + C(38)*LOG (OILPROD) + C(39)*LOG			

(DISPUTES) + C(40)*TOT			
Observations: 34			
R-squared	0.730036	Mean dependent var	9.962436
Adjusted R-squared	0.703040	S.D. dependent var	0.645464
S.E. of regression	0.351739	Sum squared resid	3.711614
Durbin-Watson stat	0.830643		
Equation: LOG (NONOILX) =C(41)*LOG (NONOILGDP)			
Observations: 34			
R-squared	-0.030303	Mean dependent var	6.968405
Adjusted R-squared	-0.030303	S.D. dependent var	0.681787
S.E. of regression	0.692040	Sum squared resid	15.80433
Durbin-Watson stat	0.381289		
Equation: LOG (PKINF) = C(42) + C(43)*PKINF(-1)			
Observations: 33			
R-squared	0.089416	Mean dependent var	6.644172
Adjusted R-squared	0.060042	S.D. dependent var	1.009646
S.E. of regression	0.978866	Sum squared resid	29.70353
Durbin-Watson stat	1.670832		
Equation: LOG (PKOUTF) = C(44) + C(45)*RERVOL + C(46)*LOG (GDP1984) + C(47)*GDPPTDEV			
Observations: 34			
R-squared	0.510325	Mean dependent var	5.847005
Adjusted R-squared	0.461358	S.D. dependent var	1.287565
S.E. of regression	0.944973	Sum squared resid	26.78921
Durbin-Watson stat	1.085204		
Equation: NEO = C(48) + C(49)*RERVOL + C(50)*LOG (GDP1984) + C(51)*LOG (GEXP)+C(52)*MRR			
Observations: 34			
R-squared	0.745626	Mean dependent var	-150.3158
Adjusted R-squared	0.710540	S.D. dependent var	212.5347
S.E. of regression	114.3469	Sum squared resid	379181.3
Durbin-Watson stat	1.330388		
Equation: RERVOL = C(53)*RERVOL(-1) + C(54)*COUP + C(55)*NEO			
Observations: 33			
R-squared	0.798888	Mean dependent var	-3.547576

Adjusted R-squared	0.785481	S.D. dependent var	123.9026
S.E. of regression	57.38703	Sum squared resid	98798.13
Durbin-Watson stat	1.957460		

Financial Sector Development and Economic Growth: Empirical Evidence from Nigeria

Samson O. Odeniran, PhD and Elias A. Udeaja, PhD*

The paper examines the relationship between financial sector development and economic growth in Nigeria. It tests the competing finance-growth nexus hypothesis using Granger causality tests in a VAR framework over the period 1960-2009. Four variables, namely; ratios of broad money stock to GDP, growth in net domestic credit to GDP, growth in private sector credit to GDP and growth in banks deposit liability to GDP were used to proxy financial sector development. The empirical results suggest bidirectional causality between some of the proxies of financial development and economic growth variable. Specifically, we find that the various measures of financial development granger-cause output even at 1per cent level of significance with the exception of ratio of broad money to GDP. Additionally, we find that net domestic credit is equally driven by growth in output, thus indicating bidirectional causality. The variance decomposition shows that the share of deposit liability in the total variations of net domestic credit is negligible, indicating that shock to deposit does not significantly affect net domestic credit. The findings from the paper indicate that the current reforms in the Nigerian banking sector should not be emphasized unilaterally. Rather, attention should be given to the complimentary and coordinated development of financial reforms and changes in the real sector of the economy.

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I. Introduction

One of the salient features of Nigeria's growth drive is a conscious development of the financial sector. For example, in the early seventies, as a result of the prevailing economic paradigm at that time, the sector was highly regulated with government holding controlling shares in most of the banks. In 1986, the liberalization of the banking industry was a major component of the Structural Adjustment Programme (SAP) put in place at that time to drive the economy from austerity to prosperity. In 2004, the consolidation exercise in the banking industry took a leading role in the National Economic Empowerment and Development Strategy (NEEDS), which was in place at that time to drive the economic agenda of the government. In 2009, as part of the broad economic measures to respond to the adverse effects of the global financial and economic crises, the Central Bank of Nigeria in conjunction with the fiscal authorities

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engineered measures to avert a collapse of the financial system with a view to maintaining economic growth.

The essence of emphasis on the development of the Nigerian financial sector is in the theory of financial repression which posits that efficient utilization of resources via a highly organized, developed and liberal financial system enhances economic growth (McKinnon, 1973; Shaw, 1973). This thesis, more or less, confirmed the conclusions of earlier works on the importance of the financial system which could be traced back to the works of Bagehot (1873), Schumpeter (1912) and Hicks (1969). Further enhancements to this hypothesis were explored in the works of Galbis (1997); Mathieson (1980); Fry (1988); Roubini and Sala-i-Martin (1992); Kwan, Wu and Zhang (1998) and King and Levine (1993b). This school of thought is classified as supply-led theory of finance-growth nexus.

While there is a near consensus that a well-functioning financial sector is a precondition for the efficient allocation of resources and the exploitation of an economy's growth potential, the economic literature is less consensual on how and to what extent finance affects economic growth. This, invariably, culminated in the emergence of demand-led theory of finance-growth nexus. Among others, Robinson (1952) argues that where enterprise leads, finance simply follows, suggesting that it is economic development which creates the demand for financial services and not vice versa. Giving further support to this line of argument, Gurley and Shaw (1955) contend that if income grows at a warranted pace, then the demand for financial assets also grows at a specifiable pace. Moreover, Lucas (1988) has argued that economists "badly overstress" the importance of the financial system on economic growth. It is simply a "sideshow" for economic activity. Recent developments in some economies around the world seem to provide further support for this school of thought. Specifically, the rapid growth of many Asian economies was accomplished despite a domestic financial sector that could not be regarded as developed (Shan, et al, 2001). This observation also holds for China (Lardy, 1998). With an average real GDP growth of 13.5 percent between 2005 and 2007, China's economic performance is extremely difficult to reconcile with the widespread view that its repressive financial system (in the McKinnon-Shaw sense) grossly distorts the optimal allocation of loanable funds and is, therefore, inefficient. In view of this puzzle, some empirical analysis is required at country level to examine whether it is the development of the financial sector that leads to economic growth or vice versa.

Time series studies have been conducted on U.S, U.K, Japan, Netherlands and Canada towards resolving this issue (See: Wachtel and Rousseau (1998); and Lee

and Wong (2005)). However, not much has been done on Africa, in general and Nigeria, in particular. The studies carried out on Nigeria have not clearly resolved the issue as most of them concluded that financial sector development did not promote economic growth while a few of them found evidence to support demand-leading hypothesis. A closer examination of these previous studies reveals that conscious effort was not made to explore various proxies of financial development as most of them used only the ratio of broad money to national income (M2/GDP). Hence, these studies actually modelled the impact of financial deepening on economic growth in Nigeria. In addition, there is the problem of endogeneity, which has not been carefully addressed in previous studies.

This study contributes to the literature by examining the relationship between financial sector development and Nigeria's economic growth, hence, addressing the country's specific dimension to finance-growth debate. The study is different from previous studies in scope (number of years is considerably longer). In addition, the effects of different measures of financial sector development on economic growth are examined, thereby providing a comprehensive empirical investigation of finance-growth nexus in Nigeria. The study also made conscious efforts to address the endogeneity issue and provide the framework for examining the possibility of the impact of economic growth on financial development.

The main objective of the paper, therefore, is to empirically investigate the nature of relationship between financial sector development and economic growth in Nigeria, in other words, whether it is demand-driven or supply-driven. Other specific objectives include the identification of the specific channels through which the financial sector affect economic growth while at the same time examine the effect of various financial measures on each others.
The remainder of this paper is structured as follows. Section two deals with the literature review while section three describes the methodology adopted, followed by a discussion of results in section four. Section five concludes.

II. Literature Review

II.1 Finance-Growth Relationship: Theoretical Underpinning

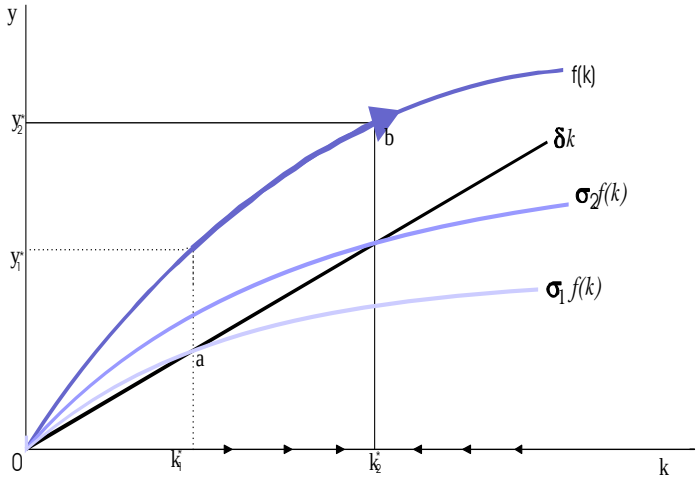
Major theoretical literature on financial development and economic growth process postulate four distinguishable, but not mutually exclusive, effects of financial activity and development on overall economic performance. The first is the provision of an inexpensive and reliable means of payment. The second is the volume and allocation effect, in which financial activity increases resources that

could be channeled into investment while improving the allocation of resources. The third is a risk management effect by which the financial system helps to diversify liquidity risks, thereby enabling the financing of riskier but more productive investments and innovations (Greenwood and Jovanovic, 1990: Bencivenga and Smith, 1991). The fourth is an informational effect; according to which an ex antes information about possible investment and capital is made available, ameliorating although not necessarily eliminating the effects of asymmetric information (Levine, 2004).

From an aggregate production function point of view, each of these financial effects may contribute to the transformation of a given amount of savings and investment inputs into a larger amount of output through either a capital accumulation channel (Hicks, 1969) or a technological change channel(Schumpeter, 1912).

Taking the capital accumulation channel as an example, the familiar Solow growth model shows that an increase in the savings rate, δ, will increase the steady-state levels of capital (k) and per capita output (y). Such a shift in δ is illustrated in figure 1. The shift from δ_1 to δ_2 causes steady state k to rise from k^*_1 to k^*_2 and per capita output to rise from y^*_1 to y^*_2

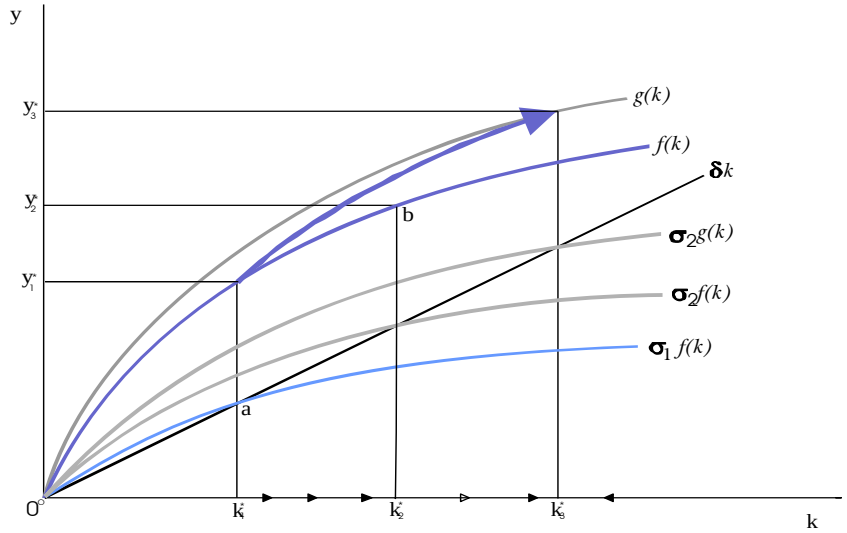
Figure 1: Effects of Savings on Capital Accumulation



The elimination of financial repression and a reduction in financial market failures are also likely to improve the quality of investment because only projects with returns greater than the interest rate are funded. This implies that the entire production function will shift up, from f(K) to g(K). This increase in the economy's

efficiency further increases savings because $\delta_2 g(K) > \delta_2 f(K)$, as shown in figure 2. It could be seen from figure 2 that the new steady-state levels of per-worker capital stock and per-worker output, k^*_3 and y^*_3, exceed not just the original levels, k^*_1 and y^*_1 but also the higher levels caused by just the increase in savings and investment, k^*_2 and y^*_2.

Figure 2: Effects of Savings on Output



Among other likely reasons, the financial sector's role as a monitor of how investment projects are managed contributes to the raising of the production function. The Solow model captures only the short-run and medium-run effects of improvements in financial development as it does not explain technological progress or long- run economic growth. The limitation of Solow growth model leads to Schumpeterian model of growth. Schumpeter posits that a well-developed financial sector is absolutely necessary if entrepreneurs are to successfully engage in a process of ingenuity. New projects require financing because innovation is not costless, and the upfront investment cannot always be covered by the entrepreneurs themselves. Without a financial sector to channel funds from savers to the most capable entrepreneurs, to monitor the projects, and to spread risk for savers, who are the sources of the investment funds, innovation would be nearly impossible and there would be little permanent economic growth.

II.2 Review of Empirical Literature

The role of financial sector in economic growth has intrigued macroeconomists and financial economists for decades. Numerous econometric studies such as the ones by Fernandez and Galetovic (1994) and Arestis and Demetriades (1996)

have led to conflicting results on causality, with some indicating reverse causality and others resulting in insignificant parameters. Arestis and Demetriades (1996), in particular, using twelve countries as case study, show that the direction of causality depends on the variable used and that each country exhibit different results. These results do not exhibit a pattern for developed or developing countries which confirms the hypothesis that institutional considerations and policies of countries do play a role in the relationship between finance and growth.

In general, empirical studies suggest three types of causal direction between finance and growth. First, the Harrod-Domar growth model would lead to a hypothesis of one-way causality from financial development to economic growth. Second, there is unidirectional causality from growth to finance. Such finding confirms Shan, et al (2001) conclusion that economic growth causes China's financial development. Nonetheless, a third alternative, the co-evolution (bidirectional causality) between economic growth and financial development hypothesized in both early and recent literature (Gurley and Shaw 1960, 1967; Bencivenga and Smith, 1991) cannot be ruled out.

In one of the early studies on this subject, Goldsmith (1969) analyzed data from thirty-five countries for the period 1860-1963 and found that financial and economic development are positively correlated over periods as long as several decades. Financial development was measured in his study by the ratio of financial intermediary assets divided by gross national product. The result from Goldsmith's study still leaves the puzzle unresolved because each variable has a feedback effect on the other. In an attempt to explain the puzzle, Goldsmith (1969) stresses that financial development largely occurs during the early stages of economic development when countries have low levels of income. This rationale seems to be debunked by the finding of Besci and Wang (1997) who point out that even though financial development occurs and may precede economic growth, it is unclear that it provides causality in an economic sense.

The finding of Goldsmith (1969) was later confirmed by De Gregor and Guidotti (1995) who note that over time, the correlations between financial development and economic growth are strong in the early stages of development and are diminished or even eliminated for OECD countries. They further show that the effect of financial development on growth becomes weaker as countries become more developed, perhaps because of problems with measuring financial development or because financial intermediaries actually have larger effects in less developed countries than in more developed ones. This finding was

further reinforced in the work of Wachtel and Rousseau (1998). It was found in a study of five industrialized economies at their early stages of development that the banking and securities markets mattered for industrialization and the expansion of commerce in four economies that are generally considered to have experienced "financial revolutions" over the past century. Similarly, Rousseau and Sylla (1999) examine the historical role of finance in the U.S from 1790-1850 and find a strong support for finance led growth. In addition, Rousseau (1999) investigates the Meiji era of Japan (1868-1884) and shows that the financial sector was instrumental in boosting Japan's explosive growth prior to the First World War.

Furthermore, some studies have examined the direction of causality through the use of instrumental variables that are correlated with financial development but not with growth beyond their link to financial development. La Porta, et al (1998) show that economies could be classified into four types, depending on whether their commercial/company laws were derived from English, French, German, or Scandinavian law. Using this measure of legal origin as instrumental variables, Levine (1998), Levine, et al (2000) find that it is correlated with the degree of financial development. Their results reveal a strong positive connection between instrumental variables and growth.

Some researchers have also explored causality with time series analysis such as Granger-type causality tests and vector autoregressive equations. Though some of these studies have mixed results over causality, nevertheless, majority of the works indicate that financial development leads to stronger growth. Xu (2000), using a VAR analysis, rejects the hypothesis that finance simply follows growth. Similarly, Chritopoulous and Tsionas (2004), using a panel data, show that causality runs from finance to growth. However, Jung (1986) and Demetriades and Hussein (1996), using time-series analysis, find causality running both ways, especially for developing economies.

Attempts have also been made on regional analysis within a country. Jayaratne and Strahan (1996) examine U.S liberalization over the restrictions on interstate branching in some states. They confirm that branch reform boosted bank-lending quality and accelerated real per capita growth rates. In addition, Guiso, et al (2002) examine individual regions of Italy and find that local financial development enhances the probability that an individual starts a business, increases industrial competition, and promotes the growth of firms.

Aside from the effect of financial sector development on growth at the macro level, some studies have examined the relationship between financial sector

development and growth at the microeconomic level. Rajau and Zingales (1998) show that industrial sectors that are relatively more in need of external finance develop more disproportionately faster in countries with more developed financial markets. Beck and Levine (2002) alluded to this finding through the use of different measures of financial development while Wurgler (2000) rationalizes the finding by showing that countries with a higher level of financial development increase investment more in growing industries and decrease investment more in declining industries than financially underdeveloped economies.

Another dimension in the study is the use of endogenous growth approach. Bencivenga and Smith (1991) employ an overlapping generation model and demonstrate that "an intermediation industry permits an economy to reduce the fraction of its savings held in the form of unproductive liquid assets and to prevent misallocation of invested capital due to liquidity needs". Thus, economic growth is induced via the capital stock. Greenwood and Jovanovic (1990) employ a general equilibrium approach and conclude that as savers gain confidence in the ability of the financial intermediaries, they place an increasing proportion of their savings with intermediaries. Greenwood and Smith (1997) use two models with endogenous growth formation and found that banks and stock markets allocate funds to the highest value user(s).

Apart from connecting the relationship between financial development and growth, one of the key issues is the indicator of financial development that should be used. The choice of indicators could produce differences in results about potential routes connecting the financial aspect of the economy and the real side of the economy. King and Levine (1993a) used measures such as liquid liabilities of banks and non-bank financial intermediaries (currency + demand and interest-bearing liabilities) over GDP; bank credit over the sum of bank credit and central bank domestic assets; credit to private enterprises over GDP. These measures were shown to have positive correlation with economic growth. However, Arestis and Demetriades (1996) show that King and Levine's causal interpretation is statistically fragile and that cross-sectional datasets cannot address the question of causality in a satisfactory way. Arestis and Demetriades (1997), using time series analysis, later conclude that the evidence favors a bidirectional causality relationship between financial development and economic growth. Moreover, Murinende and Eng (1994) find evidence of such bidirectionality in the case of Singapore, as do Demetriades and Hussein (1996) for 16 developing countries. Likewise, Luintel and Khan (1999), who investigate the finance-growth nexus in a multivariate VAR model, find bidirectional causality between financial development and economic growth in all their sample countries.

In China, a study by Shan, et al (2006) not only finds bidirectional causality between financial development and economic growth but also concludes that the Granger causality from economic growth to financial development is stronger than that from finance to growth. Yet an earlier study by Aziz and Duenwald (2002) concludes that the positive link between finance and economic growth in China is more apparent than real because the non-state sector, which contributed most of China's remarkable growth, did not resort to the domestic financial system in any substantial way for financing. A more disturbing result was provided by Boyreau-Debray's (2003) study on Chinese financial development and growth, which finds that credit extended by the banking sector at the state level has a negative impact on provincial economic growth. Similarly, DeGregorio and Guidotti (1995) find evidence for a negative relationship between financial development and growth in twelve Latin American countries during the period from 1950 to 1985.

Empirical studies on Nigerian finance-growth dynamics are not only limited in number but restricted in scope in terms of the measure of financial development. Ndebbio (2004), using an ordinary least square regression framework, finds that financial sector development weakly affect per capita growth of output. He attributed the result to shallow finance and the absence of well functioning capital markets. The finding of Nnanna (2004) was more disturbing. He, also using ordinary least square regression technique, concluded that financial sector development did not significantly affect per capita growth of output. Similarly, Nzotta and Okereke (2009), based on two stages least analytical framework for a period starting from 1986 t0 2007, concluded that financial deepening did not support economic growth in Nigeria. However, Afangideh (2009), using three stage least square estimation technique on a data spanning 1970 to 2005, found that a developed financial system alleviates growth financing constraints by increasing bank credit and investment activities with resultant rise in output. The finding of Agu and Chukwu (2008) is quite different from other authors on Nigeria. They employed the augmented Granger causality test to ascertain the direction of causality between financial deepening and economic growth in Nigeria between 1970 and 2005. Their findings revealed evidence to support both demand- and supply-leading hypotheses, depending on the financial deepening variable that is used. In addition to the existing literature on finance and economic growth, this study sets to investigate the path of finance-growth nexus in Nigeria.

III Methodology;

III.1 Description of Variables and Data

The study employed quarterly data on selected variables from 1960-2008. As in the empirical literature, real GDP per capita is used to measure real growth rates with 1990 as the base year. However, a limitation of studies on the financial sector is that there is no single measure of financial sector development, therefore, instead of a single proxy; four measures are employed in this study in order to improve the robustness of the results.

The first measure is M2-to-GDP (MCY) ratio otherwise known as measure of financial deepening. The ratio measures the degree of monetization in the economy as well as the depth of the financial sector while it also shows an expansion of payment and saving functions. The second measure used in the study is the ratio of bank deposit liabilities to GDP (BDCY). This determines the capacity of the banking sector to perform its core role of allocating funds between savers and firms. The third ratio employed in this study is domestic credit to GDP (DCCY), which reflects the extent to which financial intermediaries allocate society's savings as well as firms' use of credit in addition to internal funds. The last measure is the ratio of private sector credit to GDP. The basis for this indicator is that commercial financial intermediaries are able to identify profitable investments, monitor managers, facilitate risk management, and mobilize savings.

III.2 Unit Root Test

The Augmented Dickey Fuller (ADF) and the Phillips-Perron tests are used to test for unit roots in the following equation

$$\Delta y_t = c_1 + \omega y_{t-1} + c_2 t + \sum_{t=1}^{p} d_i \Delta y_{t-l} + \mu_t \qquad (1)$$

y_t = relevant time series
Δ = an operator for first difference
t = a linear trend
μ_t= error term

The null hypothesis of the existence of a unit root is Ho: ω=0. Failure to reject the null hypothesis leads to conducting the test on further differences of the series. Further differencing is conducted until stationarity is reached and the null hypothesis is rejected. We use the Akaike Information Criteria (AIC) to determine the lag length.

III.3 Cointegration Test

Cointegration regressions measure the long-term relationship between the variables whose existence guarantees that the variables demonstrate no inherent tendency to drift apart. We employ the Johansen Cointegration tests (Johansen 1988; Johansen and Juselius, 1990), which set up the non-stationary time series as a vector autoregression (VAR) of order p:

$$\Delta y_t = \prod y_{t-1} + \sum_{i=1}^{p-1} \Gamma i \, \Delta y_t + \beta x_t + \in_t \quad (2)$$

$$\prod = \sum_{i=1}^{p-1} Ai\text{-}1, \qquad \Gamma = -\sum_{i=i+1}^{p} Aj \quad (3)$$

where yt is a k-vector of the I(1) variables, x_t is a vector of the deterministic variables, r is the number of the cointegrating relations, and ε_t is an identically and independently-distributed error term.

Two test statistics, the trace test and the maximum eigenvalue test, are used to test the hypothesized existence of r cointegrating vectors. The trace test statistic tests the null hypothesis that the number of distinct cointegrating vectors is less than or equal to r against a general alternative while the maximum eigenvalue test statistic tests the null hypothesis that the number of cointegrating vectors is r against the alternative of r+1 cointegrating vectors..

III.4 Vector Auto Regressions (VAR)

A VAR system is constructed to test the null hypothesis that financial sector development does not Granger-cause economic growth. The Vector AutoRegressive approach facilitates investigation of dynamic interactions among jointly endogenous variables in stationary multivariate systems without imposing a priori structural restrictions. One advantage of this approach is that it relieves the investigator of the task of deciding which variables are endogenous or exogenous. In addition, the problems associated with simultaneous equation models are avoided because VARs do not include current variables as regressors. A VAR regression of this form is estimated.

$$X_t = C + \prod X_{i,\,t-1} + \prod_1 X_{i,\,t-2} + \ldots\ldots\ldots + \prod_{t-p+1} X_{i,t-p+1} + \varepsilon_t \quad (4)$$

$$t = 1, 2\ldots p \qquad i = 1,2\ldots\ldots\ldots m$$

where c is a constant and x_t is a vector of m x 1 variables in the system.

A variable X_{1t} is said to Granger cause another variable X_{2t} if any lagged value of X_{1t} is significant in the equation for X_{2t}. On the other hand, the null hypothesis will be accepted if all the lagged values of X_{1t} are jointly insignificant in the equation.

The model employed a modified version of Lee and Wong (2005) in which the equations in the VAR system contain the real per capita output and various measures of financial development. The Schwarz criterion is used to determine the number of lags to be included.
The VAR equations are specified as follow:

$$\Delta PGDP = \alpha_1 + \beta_{11}\Delta PGDP_{t-1} + \beta_{12}\Delta PGDP_{t-2} + \delta_{13}\Delta FI_{t-1} + \Delta_{14}\Delta FI_{t-2} \quad (5)$$

$$\Delta FI = \alpha_2 + \beta_{21}\ \Delta PGDP_{t-1} + \beta_{22}\ \Delta PGDP_{t-2} + \delta_{23}\Delta FIt\text{-}_1 + \Delta_{24}\Delta FI_{t-2} \quad (6)$$

If it is only the lagged values of the financial sector variables in equation 5 that are significant, we can infer that financial development Granger- causes economic growth. If the lagged independent variables in the two equations are significant, then, we can infer a bi-directional causality. However, if it is only the lagged value of the growth variable in equation (6) that is significant, we conclude that economic growth granger-causes financial development.

IV. Estimation Results

IV.1 Results from the Stationary Tests:

Unit root tests were performed on all the four variables using both the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) statistics. The null hypothesis of a unit root cannot be rejected at the 1percent level for any the variables at the levels. Each of the variables becomes I(0) after differencing, showing that all the variables at their levels are non-stationary but their growth rates are stationary. The results of these tests are presented in table 1.

Table1: Results of Unit Root Tests (Constant, trend included)

Variable	Augmented Dickey-Fuller (ADF) Test		Phillips-Perron (PP) Test		Remarks
	Prob. Value (level)	Prob. Value (1st Difference)	Prob. Value (level)	Prob. Value (1st Difference)	
PGDP	0.3624	0.0000*	0.2144	0.0000*	I(1)
MCY	1.0000	0.0017*	0.9993	0.0000*	I(1)
NDCY	0.3624	0.0000*	0.9963	0.0000*	I(1)
DDY	1.0000	0.0054*	0.8935	0.0000*	I(1)

** Rejection of null hypothesis of unit root at 1%*

IV.2 Results from Cointegration Test

We test for the number of cointegrating vectors under the assumption that the series have a linear trend and the cointegrating equations have intercepts. Hannan-Quinn Information Criterion (HQ) and Schwarz Information Criterion (SIC) give a lag length of five as the appropriate lag structure.

Table 2: Johansen Multivariate Cointegration Test Result

Sample (adjusted): 1961Q3 2008Q4
Included observations: 190 after adjustments
Trend assumption: Quadratic deterministic trend
Series: GDDY GNDCY MCY PGDP
Lags interval (in first differences): 1 to 5

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.164749	80.49391	55.24578	0.0001
At most 1 *	0.112926	46.28957	35.01090	0.0021
At most 2 *	0.099943	23.52252	18.39771	0.0088
At most 3	0.018335	3.516027	3.841466	0.0608

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.164749	34.20434	30.81507	0.0185
At most 1	0.112926	22.76705	24.25202	0.0776
At most 2 *	0.099943	20.00649	17.14769	0.0187
At most 3	0.018335	3.516027	3.841466	0.0608

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The Trace statistics and the Maximum Eigenvalue statistics for the model are presented in Table 2. The null hypothesis of the absence of a cointegrating

relation among the variables is rejected at the 95 percent confidence level for both statistics. Furthermore, the Trace statistics indicates that there are three cointegrating equations while the Maximum Eigenvalue statistics indicates one cointegrating equation. The existence of Cointegration is indicative of a long run relationship between real output and the financial variables and is consistent with the finance-led theories.

V.3 Correlation Results

Table 3 summarizes the correlation among the variables used. As expected, there is a positive correlation between real GDP per capita and the various measures of financial sector development. Similarly, there is positive correlation among the various measures of financial development with the highest level of correlation between financial deepening variable and deposit liability of the Deposit Money Banks..

Table 3: Correlation Results

Covariance Analysis: Ordinary
Sample: 1960Q1 2009Q4
Included observations: 200

Correlation Probability	PGDP	MCY	NDCY	DDY
PGDP	1.000000			
MCY	0.414392	1.000000		
NDCY	0.464415	0.922951	1.000000	
DDY	0.397231	0.995741	0.902480	1.000000

V.4 VAR Estimation Results

The results of some selected variables from VAR estimates are presented in Table 4 while the full results are shown in Appendix 1. The test showed that credit to the private sector (CPSY), financial deepening (MCY), and deposit liability (DDY) were significant at 1 per cent while financial deepening was significant at 5 per cent level of significance. The results suggest that all the measures of financial development employed in the study granger-cause output. The result on financial deepening in particular is contrary to the finding of Nnanna (2004) as well as most of the studies on Nigeria. In addition, per capita output granger-

causes both net domestic credit and credit to the private sector at 1 per cent level of significance. This is a typical case of bidirectional causality.

The result on domestic credit is in tandem with findings in some developing economies. In China, for instance, Jean-Claude (2006) shows evidence of causality from domestic credit to economic growth which was predicated on the fact that the large share of the state budget and direct credit in China constitute some of the official development tools used by the Chinese authorities. The entire result revealed that the various measures of financial sector development have impact on economic growth contrary to most of the earlier studies on Nigeria. In view of this finding, the development of the financial sector is still very critical to overall economic growth. Nevertheless, the bi-directional causality on net domestic credit and credit to the private sector implies that both demand-led and supply-led hypotheses hold in Nigeria, lending support to the finding of Agu and Chukwu (2008).

Both net domestic credit (NDCY) and credit to the private sector (CPSY) were not significant at 5 per cent level, indicating that these variables do not granger-cause economic growth. On the other hand, financial deepening (MCY) and deposit liabilities (DDY) were significant at 5 and 1 per cent, respectively, suggesting that both variables granger-cause economic growth. Furthermore, output does not granger-cause financial deepening and deposit liabilities at 5 per cent level of significance while it granger-causes net domestic credit and private sector credit at 1 and 5 per cent, respectively.

Finally, the results from this study tend to corroborate the evidence (Arestis and Demetriades, 1996) that the causal link between finance and growth is crucially determined by the nature and operation of financial institutions and policies pursued in each country.

Table 4: Granger Causality Results

Pairwise Granger Causality Tests

Sample: 1960Q1 2009Q4
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
NDCY does not Granger Cause PGDP	196	2.67331	0.0334
PGDP does not Granger Cause NDCY		3.54008	0.0082
MCY does not Granger Cause PGDP	196	6.30290	9.E-05
PGDP does not Granger Cause MCY		1.81815	0.1270
DDY does not Granger Cause PGDP	196	5.06742	0.0007
PGDP does not Granger Cause DDY		2.04039	0.0905
CPSY does not Granger Cause PGDP	196	5.86096	0.0002
PGDP does not Granger Cause CPSY		4.49354	0.0017

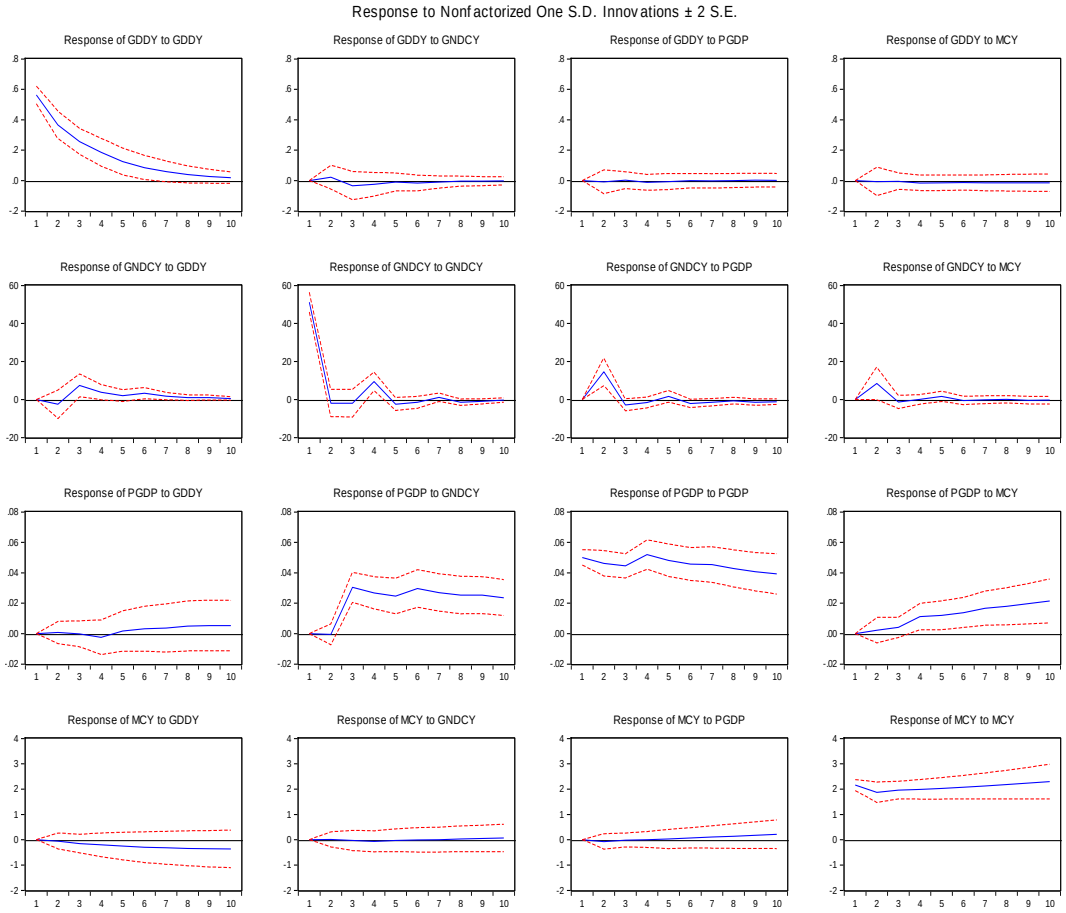
IV.5 Results from Impulse Response Function

Figure 3 presents impulse response functions which trace the long-run responses of the system variables to one standard deviation shocks to the system innovations spanning over the ten (10) quarters. The result shows that each variable responds significantly to its own one-standard deviation shock. Furthermore, the results reveal per capita output responds to shocks in net domestic credit (GNDC) and financial deepening (MCY). For example, a one standard deviation shock to the innovations in net domestic credit would lead to a significant positive response in output from the third quarter and the increases would be sustained up to the tenth quarter horizon (column 2, row 3). Similarly, a one standard deviation shock to financial deepening would commence a moderate shock in per capita output from the second quarter and it would rise consistently up to the tenth quarter. Consistent with the Granger analysis,

innovations to deposit liabilities of the domestic money banks did not yield significant output response.

Finally, it could be observed from the impulse response function is that it takes per capita output at least two quarters to respond to shocks in both financial deepening and net domestic credit. This has implication for policy makers to be forward-looking in tinkering with the various policy variables.

Figure 3: Impulse Response Function



IV.6 Variance Decomposition

The results of variance decomposition of the model over a 10-quarter horizon are presented in Appendix 2. The variance decomposition apportions the total fluctuations in a particular variable to the constituent innovations in the system. The results show that the variables are largely driven by themselves. For example, about 99 per cent of the variations in per capita output are due to its own innovations during the first two quarters of the forecast horizon. The contribution of net domestic credit to the variations in per capita output becomes significant from the third quarter when it reaches 11.83 per cent. The net domestic credit contributes about 23 per cent to the innovations in per capita output by the tenth quarter. The contributions of other variables become noticeable in the tenth quarter as deposit liability contribute about 2 per cent, financial deepening

contribute about 6 per cent and net domestic credit contribute about 23 per cent. Thus, the principal drivers of PGDP are itself and net domestic credit.

The variances of net domestic credit are driven primarily by itself in the first quarter, contributing about 99.9 per cent of the total variations. By the second quarter, all the other variables collectively contribute about 5 per cent of the total variations in net domestic credit. The per capita output emerges as the second major driver of GNDCY, contributing about 4.0 per cent of the total variations in GNDCY by the end of the tenth quarter. The shares of deposit liability and financial deepening in the total variations of net domestic credit stand at 2.85 and 1.75 per cent, respectively. This result is suggestive that a reasonable portion of total deposit mobilized by the DMBs does not translate to credit to the domestic economy.

With regard to variations in financial deepening (MCY), its own contribution stands at 68.64 per cent while that of per capita output is 31.01 per cent during the first quarter of the forecast horizon. By the end of the fifth quarter, the share of per capita output in total variation of financial deepening increases to 31.41 per cent. The total contribution of the two remaining variables is less than one per cent of the total variations in financial deepening at the end of the tenth quarter. Thus, the key model variables driving financial deepening are itself and per capita output.

The variations in deposit liability of the DMBs are basically driven by itself. For instance, variations in deposit liability contribute the whole of the total variations in the first quarter of the forecast horizon while at the end of the tenth quarter; it still contributes about 99.0 per cent.

In sum, the variance decomposition shows that the significant variation for each variable is due to its own variations but the case of the deposit liability of the DMBs is on the extreme side. Variation from itself accounts for almost 100 per cent of total variations in the deposit liability of the DMBs. Lastly, the results of variance decomposition analysis confirm the significant influence of the net domestic credit and output on each other, suggesting that both financial sector developments and output growth complement each other.

VI. Summary and Policy Considerations

The paper aims to provide an empirical framework for understanding the finance – growth nexus in Nigeria. Most of the earlier studies used financial deepening to proxy financial sector development and concluded that there was no relationship between financial sector development and economic growth in Nigeria. This study, however, employed four measures, financial deepening, growth in net domestic credit, and growth in deposit liability of DMBs to proxy financial sector development. To this end, the analysis empirically tested competing finance-growth nexus hypothesis using the Granger non causality tests for Nigeria over the period 1960-2009. Unlike most of the earlier studies, the major empirical results show that financial deepening does not have any influence on Nigeria's economic growth. The VAR results indicate that changes in net domestic credit impact on economic growth while per capita output also influences net domestic credit, that is, there is bi-directional causality between net domestic credit and economic growth. Changes in deposit liabilities appear to have no major impact on economic growth.

The long-run responses of the system variables to one standard deviation shocks show that a one standard deviation shock to net domestic credit would lead to a significant positive response in output from the third quarter and the increases would be sustained up to the tenth quarter horizon. The variance decomposition shows, among others, that the contribution of net domestic credit to the variations in per capita output reaches 11.83 per cent by the seventh quarter and increases above 20 per cent by the tenth quarter. Furthermore, the shares of deposit liability in the total variations of net domestic credit are negligible, suggesting, among others, that a reasonable portion of total deposit mobilized by the DMBs does not translate to credit to the domestic economy.

The fact that the growth in the net domestic credit positively influences output has major implications. To fully realize the growth potentials of the Nigerian economy, it is necessary to remove all obstacles that could undermine the growth of credit to the domestic economy. Among other measures, the establishment of the proposed Asset Management Corporation should be hastened to free the DMBs from non-performing loans, and thereby, enhance their ability to extend credit to the economy.

Lastly, the evidence of bidirectional causality between net domestic credit and economic growth implies simultaneity between financial development and economic growth. The finding suggests that the development of financial institutions should not be emphasized unilaterally; rather, attention should also be

given to the complimentary and coordinated development of reforms in other areas. Development of the financial sector should not proceed at a faster pace than structural changes in the real sector or changes taking place in institutional setting.

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Appendix1: The full Estimated VAR Results.

Vector Autoregression Estimates
Sample (adjusted): 1960Q3 2008Q4
Included observations: 194 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	GDDY	GNDCY	PGDP	MCY
GDDY(-1)	0.649466	-4.408328	0.001263	-0.092441
	(0.07334)	(6.67450)	(0.00653)	(0.28123)
	[8.85604]	[-0.66047]	[0.19356]	[-0.32871]
GDDY(-2)	0.035638	15.85554	-0.002234	-0.126767
	(0.07355)	(6.69411)	(0.00654)	(0.28205)
	[0.48453]	[2.36858]	[-0.34136]	[-0.44944]
GNDCY(-1)	0.000437	-0.037261	-1.04E-05	0.000230
	(0.00076)	(0.06921)	(6.8E-05)	(0.00292)
	[0.57479]	[-0.53839]	[-0.15352]	[0.07898]
GNDCY(-2)	-0.000918	-0.035784	0.000602	-0.000714
	(0.00076)	(0.06910)	(6.8E-05)	(0.00291)
	[-1.20932]	[-0.51784]	[8.90595]	[-0.24536]
PGDP(-1)	-0.166642	290.5638	0.922199	-1.426310
	(0.78307)	(71.2689)	(0.06967)	(3.00287)
	[-0.21281]	[4.07700]	[13.2359]	[-0.47498]
PGDP(-2)	0.185118	-308.1234	0.043878	2.189901
	(0.77499)	(70.5338)	(0.06896)	(2.97190)
	[0.23887]	[-4.36845]	[0.63632]	[0.73687]
MCY(-1)	-0.002904	3.918219	0.001060	0.868167
	(0.02170)	(1.97500)	(0.00193)	(0.08322)
	[-0.13380]	[1.98391]	[0.54911]	[10.4328]
MCY(-2)	0.000852	-4.167140	6.31E-05	0.155175
	(0.02310)	(2.10262)	(0.00206)	(0.08859)
	[0.03687]	[-1.98188]	[0.03072]	[1.75156]

C	0.000509	14.72419	0.014757	-0.275807
	(0.09964)	(9.06830)	(0.00887)	(0.38209)
	[0.00511]	[1.62370]	[1.66459]	[-0.72184]
R-squared	0.458625	0.129597	0.965287	0.955074
Adj. R-squared	0.435214	0.091958	0.963786	0.953131
Sum sq. resids	58.66083	485905.1	0.464401	862.6285
S.E. equation	0.563104	51.24953	0.050103	2.159365
F-statistic	19.59032	3.443142	643.0528	491.6093
Log likelihood	-159.2537	-1034.387	310.1078	-420.0103
Akaike AIC	1.734575	10.75657	-3.104204	4.422787
Schwarz SC	1.886176	10.90817	-2.952602	4.574388
Mean dependent	-0.008679	5.072178	0.577807	5.488529
S.D. dependent	0.749284	53.78198	0.263283	9.974335
Determinant resid covariance (dof adj.)		6.650709		
Determinant resid covariance		5.499813		
Log likelihood		-1266.454		
Akaike information criterion		13.42736		
Schwarz criterion		14.03376		

Appendix 2: Variance Decomposition (percent of total variance)

Appendix 2a: Variance Decomposition of GDDY:

Period	S.E.	GDDY	GNDCY	PGDP	MCY
1	0.563104	100.0000	0.000000	0.000000	0.000000
2	0.671461	99.87667	0.112170	0.005179	0.005985
3	0.719502	99.66805	0.314596	0.009619	0.007732
4	0.743173	99.54232	0.408732	0.010879	0.038064
5	0.753649	99.51044	0.416346	0.011134	0.062078
6	0.758662	99.43911	0.459727	0.018684	0.082480
7	0.761144	99.38979	0.474635	0.025775	0.109805
8	0.762332	99.34993	0.476745	0.038667	0.134659
9	0.762989	99.30566	0.479413	0.056545	0.158381
10	0.763400	99.26198	0.479584	0.074945	0.183491

Appendix 2b: Variance Decomposition of GNDCY:

Period	S.E.	GDDY	GNDCY	PGDP	MCY
1	51.24953	0.006358	99.99364	0.000000	0.000000
2	52.70107	0.045369	94.72595	3.459363	1.769313
3	53.26732	1.838160	92.85201	3.538587	1.771246
4	54.27160	2.260441	92.53526	3.497970	1.706332
5	54.39425	2.417159	92.31950	3.501832	1.761513
6	54.52999	2.721523	91.92947	3.588767	1.760238
7	54.58345	2.804271	91.79558	3.642632	1.757516
8	54.61477	2.829700	91.75846	3.655980	1.755856
9	54.64371	2.851719	91.69076	3.699915	1.757609
10	54.65535	2.855224	91.65508	3.730692	1.759001

Appendix 2c : Variance Decomposition of PGDP:

Period	S.E.	GDDY	GNDCY	PGDP	MCY
1	0.050103	0.497425	0.110561	99.39201	0.000000
2	0.067384	0.641757	0.149192	99.12981	0.079240
3	0.084751	0.568958	11.83992	87.37727	0.213850
4	0.099943	0.452718	14.96074	83.56632	1.020220
5	0.111268	0.643795	16.51738	81.21856	1.620269
6	0.121738	0.902372	19.31610	77.53998	2.241548
7	0.130567	1.156459	20.75923	75.02089	3.063420
8	0.137901	1.476944	21.75597	72.85015	3.916940
9	0.144405	1.772637	22.72735	70.65163	4.848389
10	0.150080	2.027049	23.38651	68.68217	5.904268

Appendix 2d: Variance Decomposition of MCY:

Period	S.E.	GDDY	GNDCY	PGDP	MCY
1	2.159365	0.252682	0.090693	31.01081	68.64581
2	2.885386	0.158175	0.110725	32.30672	67.42438
3	3.492293	0.132389	0.083687	32.09381	67.69012
4	4.017130	0.168517	0.063488	31.79598	67.97202
5	4.493617	0.244472	0.057525	31.41669	68.28131
6	4.936996	0.345052	0.057931	30.85684	68.74018
7	5.356370	0.442445	0.063519	30.26587	69.22817
8	5.758662	0.531182	0.081189	29.65853	69.72909
9	6.148428	0.608823	0.105317	29.03220	70.25366
10	6.528991	0.672314	0.135144	28.41225	70.78029

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