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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 and Statistics 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. *The views and interpretation contained in the articles published in the Review are those of the authors and do not necessarily represent the views and policies of the Central Bank of Nigeria.*

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CONTENTS

Computation of Nigeria's Real Effective Exchange Rate Indices[1]

M. K. Tule & O. O. Duke (Mrs)*

The exchange rate is a useful macroeconomic indicator which aid policy makers to take informed actions to stimulate or sustain the economy on a long run growth path. Thus, several exchange rate indices (bilateral nominal/real exchange rate, nominal effective exchange rate, real effective exchange rate, purchasing power parity, etc) are computed for different policy information. In this paper, we computed Nigeria's real and nominal effective exchange rate (REER and NEER) indices using a pool of high frequency monthly data for the period 1996-2007. The paper observed that the REER index appreciated most of the period due to inflationary pressures in Nigeria, implying a loss in Nigeria's competitiveness relative to its major trading partners. The conclusion was that the naira was overvalued in real terms. The NEER also appreciated during the review period against the currency indices of the major trading partners, indicating a stronger naira. The paper advocated a basket approach to naira nominal exchange rate determination in which the relative macroeconomic developments in major trading partner economies are factored into the market exchange rate of the naira. A major shortcoming of the present study is that sub-regional effects of Nigeria's trade with its neighbors were not factored into the computations due to dearth of data. Current data indicate low level trade between Nigeria and its neighbors and other African countries

Keywords: Real effective exchange rate; nominal effective exchange rate; indices; currency

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I. Introduction

The real exchange rate is both an external and internal indicator of the competitiveness of an economy. As an external indicator, it is the nominal exchange rate adjusted for price differentials between countries, i.e. the ratio of aggregate foreign price levels or cost level, to the home country's aggregate price level or cost level measured in a common currency. The external real exchange rate derives from the concept of the purchasing power parity (PPP), which compares the relative value of currencies by measuring the relative prices of foreign and domestic consumption or production baskets in different countries. As a measure of domestic (internal) competitiveness, it is the ratio of the domestic prices of tradables to non-tradables in the home economy. The internal real exchange rate captures the internal relative price incentives in an economy, i.e. by allocating resources internally between the production and consumption of tradable and non-tradable goods. In this way, the real exchange rate serves as an indicator of the incentives for domestic resource allocation.

Each of the two broad categorizations of the real exchange rate gives rise to alternative formulations derived from different analytical approaches. For instance, three variants of the external real exchange rate can be identified based variously on the purchasing power parity, the Mundell-Fleming one-composite-good, and the law of one-price of internationally competitive traded goods approaches. Similarly, three variants of the internal real exchange rate are identifiable based on one-good, two-good or multi-good models. The differences in conceptualization and measurement adopted by the various approaches raise fundamental issues about the theoretical and empirical relationships among the resulting indices, the interpretation of differences in their behaviour and the appropriate measure to use in a given situation.

Conceptually, the multiplicity of the underlying theories of real exchange rate computation provides incredible problems of measurement and comparability of the emerging rates and indices. The reason is that the

underlying theories necessitate the use of different price and cost indices in the computation. Besides, the composition of the basket and weights for domestic and foreign goods enunciated in some of the theories display large ambiguity under empirical investigations, thus making comparability difficult. Although these problems are common in most countries, developing countries are particularly vulnerable due to the existence of large informal foreign exchange markets, smuggling and unrecorded cross border trade, shifts in trade policy, erratic volatility in the terms of trade and trade patterns; all of which create complexities that are not usually encountered when computing the real exchange rate for industrial countries. In addition to these, it is often difficult to find exact empirical measures of the desired indices in developing countries. In most developing countries therefore, the dearth of data has restricted the use of the empirical measures of the real exchange rate to CPI Indicators and GDP deflators even though in a number of cases, the underlying process that generated the data was fraught with substantial inconsistencies. These data related shortcomings notwithstanding, the real effective exchange rate has continued to be an important indicator of economic competitiveness across countries.

Given the policy relevance of the real exchange rate as a potent variable in economic analysis, policy evaluation, financial planning and economic forecasting, it becomes necessary for countries to consistently update their real exchange rate index to serve as a guide to exchange rate management. This is against the limitations of relying on the one currency based nominal exchange rate in a country with multiple trading partners. The limitations of using changes in dollar or euro based bilateral exchange rate to make policy decisions affecting other currencies has necessitated the need for developing an updated real effective exchange rate index that would more appropriately capture developments in one currency against the currencies of the other trading partners at a point in time. In this paper, therefore, we explore this possibility, limiting reference to the real exchange rate to the external real exchange rate. Consequently, the paper examines some of the methodological concerns involved in computing the real exchange rate and updated Nigeria's real exchange rate index for

the period 1996 to 2007. We benefited from the works of Mordi and Audu (1991), Obadan (1994) and Obaseki (2001), who had variously computed Nigeria's nominal/real effective exchange rate using different approaches.

The theoretical expose of the paper is anchored on the premise that an appropriate definition of the real exchange rate depends on a complicated interplay of the theoretical model of interest and much more on data availability. In computing the rates and indices for Nigeria, the period chosen covers two exchange rate regimes: a fixed official exchange rate regime (1996 and early 1999) and a market determined exchange rate regime (late 1999 to 2007). To achieve our objective, the paper examines some conceptual and common methodological concerns in Section II. In Section III, we employed the methodology we found most appropriate in the computations, while Section IV summarizes and concludes the paper.

II. Methodological Issues in the Computation of Exchange Rate Indices

II.1 Some Definitions

Nominal Exchange Rate

The nominal exchange rate is the number of foreign currency units per unit of home currency. In this case, we are looking at the bilateral exchange rate hence; only two currencies are involved in the transaction because a country with only one trading partner has between its currency and that of the trading partner only, to monitor. Consequently, only the nominal exchange rate or the bilateral real exchange rate would be needed to show the level of competitiveness between them. Changes in the nominal exchange rates could have important effects on the external trade of the countries concerned through the effects on the relative prices of goods, that is, the ratio of the price level of the home country to the price level in the trading partner country.

Nominal exchange rates can be measured either in terms of domestic currency (units of domestic currency per unit of foreign currency, E_{dc}) or in

foreign currency terms (units of foreign currency in terms of one unit of domestic currency, E_{fc}). Whichever definition is desired, the other becomes the inverse. This relationship is shown in equation (1) as:

$$E_{dc} = \frac{1}{E_{fc}} \quad \text{.....} \quad (1)$$

Where only one trading partner is involved, we define the exchange rate as:

$$R_i = \frac{R_i}{R_i^*} \text{ for all i = 1}$$

$$R_i = R_n \quad \text{for i = 1}$$

$$E_i = \frac{R_i^*}{R_n} = \frac{1}{R_i} \text{ for all i = 1} \quad \text{.....} \quad (2)$$

where:

$R_i =$ units of domestic currency per unit of the i[th] trading partner's currency

$R_n =$ units of domestic currency per unit of trading partner currency

$R_i^* =$ number of units of i[th] trading partner currency per unit of domestic currency

$E_i =$ units of the i[th] trading partner's currency per unit of domestic currency

The nominal exchange is important in determining the cost of imports and the level of revenue to the exporter.

Bilateral Exchange Rate

In a multilateral trading system where the country trades with several other countries, many different exchange rates and different price levels are involved. Consequently, where a country trades with many partners, the exchange rate is defined as units of home currency per unit of the currency of each trading partner, apiece. This then raises the issue of multilateral exchange rates commonly referred to as bilateral exchange rates. The bilateral exchange rate in a multilateral relationship is defined algebraically as:

$$E_i = \frac{R_i^*}{R_n} = \frac{1}{R_i} \text{ for all i = 1, 2, ...n} \quad \text{(3)}$$

$$R_i = R_n \text{ for i = n}$$

Where:

$R_i =$ units of domestic currency per unit of the i^{th} trading partner's currency

$R_n =$ units of domestic currency per unit of trading partner's currency

$R_i^* =$ number of units of i^{th} trading partner's currency per unit of domestic currency

$E_i =$ units of the i^{th} trading partner's currency per unit of domestic currency

In a multi-country trading relationship, it is often convenient and useful for policy and analytical expose to employ an index that reflects the relationship between the domestic currency and the currencies of the other trading partners. Consequently, we would measure the home country's competitiveness by the use of a bilateral exchange rate index, which approximates the ratio of the relative prices between the home country and the trading partners. However, the bilateral exchange rate has limited application to policy because of its inability to capture variations in the value of one currency against another due to changing economic fundamentals. Consequently, to make bilateral exchange rates useful in gauging changes in other currencies, the need to aggregate bilateral exchange rates in an index that would incorporate changes in the relative values of specified currencies against a base currency over a period of time becomes necessary.

Real Exchange Rate

The real exchange rate broadly defined, is the ratio of foreign currency to domestic currency based on some broad based price indices such as the CPI or GDP deflator, and expressed in a common currency by using the nominal exchange rate to convert the price level in one country to the currency of the other. In the context of developing countries, the real exchange rate is seen analytically either as the relative price of traded goods in terms of non-traded goods (the two-good internal real exchange rate), or as the relative price of exports and imports in terms of non-traded

goods(the three-good internal real exchange rates). Irrespective of the price or cost indicator used, the real exchange rate of a country can be defined in relation to one trading partner or to an average of all the major trading partners or competitor countries.

The bilateral real exchange rate is useful both as a bilateral and general indicator of the real exchange rate in conditions where a country is a member of a currency zone or has one dominant trading partner. The bilateral real exchange rate ($BRER_{dc}$) between the domestic economy (d)and a foreign trading partner country (f) can be defined as shown below:

$$BRER_{dc} = \frac{E_{dc} * P_{Gf}}{P_{Gd}} \quad \text{.....} \quad (4)$$

where:

E_{dc} is the index of the nominal exchange rate of the domestic currency, P_{Gf} and P_{Gd} are the foreign and domestic general or aggregate price indexes, respectively.

The subscript *dc* indicates that the bilateral real exchange rate is defined in terms of the domestic currency. A decline in the index of the RER_{dc} (which corresponds to a real exchange rate appreciation), reflects an increase in the prices of goods and services relative to that in the foreign country.

The inverse of the bilateral real exchange rate index in foreign currency terms is also defined as indicated in equation (5).

$$BRER_{fc} = \frac{E_{fc} * P_{Gd}}{P_{Gf}} = \frac{1}{BRER_{dc}} \quad \text{.....} \quad (5)$$

A change in the index of the bilateral nominal/real exchange rate is referred to as an appreciation or depreciation of the home currency in relation to the trading partner currency with respect to an underlying equilibrium exchange rate. A misalignment in the nominal/real effective exchange rate indicates a condition in which a country's actual nominal/real exchange rate deviates from the implicit or ideal nominal/real exchange rate.

Effective Exchange Rate

The effective exchange rate has developed due to the existence of multiple trading partners to capture the relative trade weights of the numerous trading partners with the home country in computing the nominal or real exchange rate. Consequently, when the various trade weights of the major trading partners are taken into account, the emerging exchange rate is the nominal effective exchange rate, while taking care of the relative trade weights and price differentials between the countries produces the real effective exchange rate. Thus, the effective exchange rate could be nominal or real, and both are potent tools for economic analysis, policy evaluation, financial planning and forecasting, amongst other uses.

Nominal Effective Exchange Rate

We define the nominal effective exchange rate as a product of the weighted average of the bilateral nominal exchange rates between the home country's currency and that of its trading partners. The nominal effective exchange rate could be computed for individual trading partners and for all the trading partners. When the nominal effective exchange rate is used to compute the real effective exchange rate, it creates the possibility for separately analyzing the effects of movements in nominal exchange rates and foreign prices. It also allows a further decomposition of the nominal effective exchange rate to express its movements in terms of changes in the exchange rate between the home currency and a reference currency, and in the nominal effective exchange rate relative to the reference currency as indicated in equation (6) below.

$$NEER_{dc} = E_{dc} * \frac{NEER_{dc_b}}{E_{dc_b}} \quad \text{.....} \quad (6)$$

where:

E_{dc_b} is the nominal exchange rate with the base or target currency.

This decomposition is useful where a peg or protected exchange rate exists. Consequently, such an exchange rate becomes typically a policy (target) variable while the nominal effective exchange rate relative to the

peg currency is an exogenous variable for the country using the peg. An important property for exchange rate index analysis is the attention on determining not only the level of the index at any material time but also the rate of appreciation and depreciation of the index over time.

Real Effective Exchange Rate

The real effective exchange rate is the nominal effective exchange rate adjusted for relative price differentials between the home country and its trading partners. It is defined in terms of the domestic currency in two ways: as a weighted geometric mean of the exchange rate of the trading partners and their relative price levels, or as a weighted arithmetic mean. If we define the effective real exchange rate as a geometric weighted average, it is shown as in equation (7).

$$REER_{dc} = \prod_{i=1}^{m}\left[E_{dc_1} P_{Gi}\right]^{\omega_{id}} * \frac{1}{P_{Gd}} \quad \text{.....} \quad (7)$$

where:
m is the number of trading partners of the domestic economy, Π denotes the product of the real exchange rate (the bracketed term) over all the trading partners, ω_{id} is the appropriate trade weight for each of the trading partners *i(i=1, 2, ..., m)* with the domestic economy. The trade weights of the trading partners sum to 1 as indicated in equation (8) below.

$$\sum_{i=1}^{m} \omega_{id} = 1 \quad \text{.....} \quad (8)$$

When the real effective exchange rate is defined in foreign currency terms, it is expressed as in equation (9).

$$REER_{fc} = \prod_{i=1}^{m}\left[\frac{E_{fc_i}}{P_{G_i}}\right]^{\omega_{id}} * P_{Gd} = \frac{1}{REER_{dc}} \quad \text{.....} \quad (9)$$

Two alternative methods for computing the real effective exchange rate are often employed. However, the statistical information generated by the two methods differs. For instance, the methods decompose the components

of the real effective exchange rate differently, but give additional information which is found useful in analyzing the resultant indices. In the first method, the real effective exchange rate is computed as a geometric weighted average of the bilateral real exchange rates of the home country with each major trading partner. This real effective exchange rate of the domestic economy is computed as shown in equation (10)

$$REER_{dc} = \prod_{i=1}^{m} BRER_{dc_i}^{\omega_{id}} \quad \text{.....} \quad (10)$$

where:

$BRER_{dc_i}$ is the bilateral real exchange rate of the domestic economy.

When the effective real exchange rate is computed as in equation (10), information on calculations of bilateral real exchange rate indices for individual countries can be made available. Where a country pegs to a major currency, it is useful to express the domestic effective real exchange rate in terms of changes in the domestic country's bilateral real exchange rate with the peg currency caused by differences in inflation at home and the peg countries. Also, it can be analyzed with respect to changes in the home country's real effective exchange rate relative to the bilateral real exchange rate with the peg currency caused by inflationary differences and exchange rate movement in third country currencies as demonstrated in equation (11)

$$REER_{dc} = BRER_{dc} * \frac{REER_{dc}}{BRER_{dc_b}} \quad \text{.....} \quad (11)$$

where:

$BRER_{dc_b}$ is the bilateral real exchange rate with the base or target currency.

In the second method, the real effective exchange rate is computed as the product of the nominal effective exchange rate and the effective relative price index. Thus, we rewrite equation (4) as shown in equation (12)

$$REER_{dc} = \frac{NEER_{dc} * EP_{Gf}}{P_{Gd}} \quad \text{.....} \quad (12)$$

where:

$$NEER_{dc} = \prod_{i=1}^{m} E_{dc_i}^{\omega_{id}} \quad \text{.....} \quad (13)$$

and

$$EP_{Gf} = \prod_{i=1}^{m} P_{Gi}^{\omega_{id}} \quad \text{.....} \quad (14)$$

But:

$NEER_{dc}$ is defined as the nominal effective exchange rate in terms of the currency of the domestic economy and its trading partners. EP_{Gf} is the geometric weighted average (or effective) of foreign aggregate price index for the home country's trading partners.

Undervalued/Overvalued Exchange Rate

An exchange rate is undervalued when it is more depreciated than the equilibrium exchange rate, and overvalued when it is more appreciated than the implicit exchange rate. An appreciation/depreciation in the real exchange rate is an increase/decrease in the value of the domestic currency relative to a foreign currency. An appreciation is an increase (upward movement) in the real exchange rate in foreign currency terms, representing a decrease (downward movement) in the index in domestic currency terms since this is the inverse of the foreign currency index. When a currency appreciates or depreciates, it does so against n-other currencies with varying degrees of change. A real exchange rate appreciation in the face of high inflation may lead to a deterioration of the current account position. Since real effective exchange rate indices are normally weighted averages of a number of exchange rates, their use avoids the wrong generalizations about the value of a currency that may arise by merely observing the fluctuations in the bilateral nominal or real exchange rate.

To know by how much a currency is overvalued/undervalued, we compare what the value of the domestic currency should be given domestic and foreign trading partner price levels with what it currently exchange for. If the real exchange rate dictates that the naira should exchange at x3.00/ US$1 given domestic and foreign price levels, but the current exchange rate of the naira is x5/US$1, then we say the naira is undervalued by x2

because we are paying more naira for dollar when indeed the fundamentals indicate that we should pay less. If however, the fundamentals indicate that we should pay x10/US$1, and the official exchange rate is x8/US$1, then, we say that the naira is overvalued by N2 since we are paying less naira per dollar when we should be paying more.

Exchange rate misalignments have varying degrees of influence on the behaviour of economic aggregates. In particular, an exchange rate overvaluation could hinder the pace of economic growth, while an undervaluation is thought to provide an enabling environment for growth. In the real sense, however, both over-valuation and undervaluation are inimical to growth. However, unless the ideal exchange rate is clearly specified, an effective nominal or real exchange rate misalignment remains largely an abstraction. An ideal real exchange rate, therefore, is expected to achieve price competitiveness, while a weak domestic currency in real terms makes it easier to sell domestically produced goods abroad. In addition to achieving cost competitiveness, it takes account of the percentage mark-up in the price that compensates for labour productivity and rewards entrepreneurship. In this case, the real exchange rate is the nominal rate adjusted by wages and productivity levels and closely appears as a measure of competitiveness. Thus, as productivity level rises/falls, the real exchange rate appreciates/depreciates.

II.2 Some Methodological Issues

Choice of Weights

The first step in computing the real effective exchange rate is the choice of countries that constitute the major trading partners of the home country. This, however, is subject to the availability of trade data between the countries. Where a country, perceived to be a major trading partner, lacks adequate or reliable trade data, it could be replaced by less important countries that have adequate and reliable data. For instance, substantial trade exists between Nigeria and most of the countries in West Africa, but this trade is unrecorded and, therefore, the countries are excluded in the basket of Nigeria's major trading. Also, low inflation in major trading

partners not covered in a sample in preference to high inflation countries included in the sample could distort the emerging index. One guiding principle is that it serves no useful purpose to include many countries in the basket if better results could be produced with fewer countries. For instance, if Nigeria accounts for 60 per cent of trade with Benin Republic, and France accounts for 25 per cent, it serves no useful purpose to include a list of 15 countries that would make no difference in computing Benin's real effective exchange rate. Consequently, we settle for just two countries in computing the country's real effective exchange rate.

Weighting Criteria

Choice of Goods and Services

Closely associated with the choice of trading partners is the choice of goods and services to be included in the basket. The nature of goods and services in the basket significantly influence the choice of weights. For instance, the weight of West African countries with very large agricultural sector will be very weak if the index was made up mainly of manufactures. It would be higher if; however, the index took mainly agricultural raw materials into account. One approach is to choose a basket of goods and services that are comparable across countries because the tradable goods sector is the one most often exposed to shifts in the real exchange rate. Consequently, it is advisable that raw materials should be excluded from the basket of goods and services included in the computation. As is the practice, trade data on all goods and services exposed to international competition is preferred. The strength of this approach is that changes in the real exchange rate influence economic activity primarily through their impact on competitiveness in the tradable goods and services sector.

The Averaging Method

Geometric Averaging Method used here is often preferred over the arithmetic method even though the latter is simpler to calculate. This is because the geometric method has certain properties of symmetry and consistency that an arithmetic method does not possess. Although the

logarithm of a geometric average is the arithmetic average of the logs of the bilateral exchange rates, the geometric average method evaluates movements in exchange rate symmetrically, thereby avoiding the undesired properties associated with arithmetic averages. A geometric index gives real exchange rate levels for which the percentage change between two periods is not influenced by the choice of the base year and may; therefore, be readily rescaled to have a different base year. In a geometric average, currency depreciation and appreciation are treated in an entirely symmetric manner[2]. The geometric average is also indifferent to the definition of exchange rate adopted, and its index responds proportionally to depreciating and appreciating currencies. As shown by Mordi and Audu (1991), the geometric based index satisfies the time reversal test.

Although the geometric method is theoretically preferable, it is sometimes criticized for complicating the process of calculating the monthly and quarterly average real effective exchange rate indices. To derive the average value of the index over a quarter, daily readings of the index could be taken (calculated as a geometric average across all the bilateral exchange-rate pairs) from which the arithmetic average of these readings could be formed over the quarter. On the other hand, one could form the arithmetic average over the quarter of each bilateral real exchange rate, and then generate the geometric average across these quarterly average bilateral pairs. These two approaches do not generally yield the same results. For the same reason, constructing the real effective exchange rate index cannot be done by simply deflating the bilateral nominal exchange rate index by the ratio of the relative domestic price level. Rather, the use of the geometric averaging procedure is more generally accepted as capturing relative trade weights with the major trading partners.
The **Arithmetic Averaging Method** is presented in equation (15).

$$REER_A = \sum_{i=1}^{n} \propto^{i} \frac{\left(\frac{E_{it}^{pr}}{P_{it}^{pr}}\right)}{\left(\frac{E_{10}^{pr}}{P_{10}^{pr}}\right)} * 100 \quad \text{.....} \quad (15)$$

[2] *For further properties of the Geometric Average method, see Brodsky (1982) and Maciejewski (1983).*

Where:

$REER_A$ = real effective exchange rate calculated by the Arithmetical Average Method;

E_{it}^{pr} and E_{10}^{pr} are the ratios of the bilateral exchange rates of the ith trading partner country to the reporting country at time t=1 and time t=0, respectively. P_{it}^{p} and P_{10}^{pr} price index of the ith foreign country at time t relative to the base period and the price index of trading partner country at time t=1 and time t=0, respectively; ∞_i = weight assigned to the ith foreign currency.

Differences may occur in the percentage movements using the arithmetic method depending on whether the bilateral rates are expressed as units of home currency per foreign currency unit or not. Also, using the arithmetic method, exchange rate indices can be distorted when the base period is changed. In an arithmetic index, the percentage changes between any two periods depend on the base year used in computing the index so that rescaling (or rebasing) the index from the original base year to a different base year affects the percentage changes in the index. Also, an arithmetic index gives larger weights to currencies that have appreciated or depreciated to a significant extent relative to the domestic currency.

II.3 Import Competitiveness Indicator

The use of import-competitiveness indicator measures a country's competitive position at home, while an export-competitive indicator measures its competitiveness in the export markets. A useful real effective exchange rate index takes into account the global performance of the economy. Indices can thus be constructed using bilateral or multilateral trade weights. Using the bilateral approach, weights are computed based on the level of trade between the home country and individual trading partners. However, because this approach does not take account of competition between home country products in third markets, it tends to understate the degree of competition facing the home country in foreign markets. For instance, while Nigerian farmers may not be exporting cocoa to Ghana, they must compete with Ghanaian Cocoa producers in European

markets. This possibility is often overlooked in assigning weights and so does not reflect in ascertaining an economy's competitiveness. Import weights is shown in equation (16) below : Import weights:

$$wm^{i}_{j} = \frac{m^{i}_{j}}{m_{j}} \quad \text{.....} \quad (16)$$

Equation (17) for instance, can be used in computing the weight of US in (i) Nigeria's bilateral imports (*j*).

II.4 Export Competitiveness Indicator

Using the double weighing approach, Nigeria's competitiveness could be compared against that of Canada by ascertaining the weight of Canadian exports in Nigeria's exports. This is a reflection of direct competition between exports and imports in a given market, and the weight of Canada as Nigeria's competitor in third markets, a reflection of both countries' competition in third markets. This is shown in equation (17) as:
Export weights:

$$wx^{i}_{j} = \left(\frac{x^{i}_{j}}{x_{j}}\right)\left(\frac{y_{i}}{y_{i} + \sum_{s \neq i,j}^{N} x^{i}_{s}}\right) + \sum_{k \neq i,j}\left(\frac{x^{k}_{j}}{x_{j}}\right)\left(\frac{x^{k}_{i}}{y_{k} + \sum_{s \neq k,j}^{N} x^{k}_{s}}\right) \quad \text{.....} \quad (17)$$

where:

$x^{i}_{j}\left(m^{i}_{j}\right)$= exports (imports) of country *j* to (from) country *i*;

$x_{j}\left(m_{j}\right)$= total exports (imports) of country *i*;

y_{i} = Output of country *i* for the domestic market;

N = all countries considered in calculating the index;

S = businesses of countries other than countries *i* and *j*.

In equation (18), the weights calculated could account for the share of Nigerian exports to the US and the importance of US companies as competitors of Nigerian firms in US domestic markets and the share of US firms in third markets.

II.5 Total Trade Weights

The use of sector-specific trade data would be more useful under such circumstance because Nigeria and Canada may export to third markets but the exports may not be close substitutes, as such competition, may not exist between the two countries in those market. Double weighted index are represented by the following relationships:

Total weights: $$w_i = \left(\frac{m_j}{x_j + m_j} \right) wm_j^i + \left(\frac{x_j}{x_j + m_j} \right) wx_j^i \quad \text{..... (18)}$$

II.6 Use of Price or Cost Indicators

Apart from the choice of what goods and services to include in the index, another issue that needs to be determined is whether cost or price indicators are to be used. In practice, cost indicators are often preferred because individual firms can reduce their profits or prices in reaction to economic conditions to preserve their share of the market. The problem with using cost indicators is that there is no global measure of cost but partial measures or price indices provide a guide.

Export Prices

Export prices are the most direct measure of internationally traded goods. However, the composition of the goods may differ significantly between countries. Consequently, detailed data may not be available. Beside this, export based price indices could easily be influenced by commodity prices, which are often exogenously determined by world markets. Thus, for countries like Nigeria in which one commodity (oil) has a large share in exports; this can be a major problem. As Lafrance (1988) has shown, a drop in commodity prices could lower the real exchange rate based on export

prices, without necessarily implying that the domestic country's international competitiveness has improved.

Producer Prices

Producer Price Indices are a reflection of true sales and not just exports in that they reveal the behaviour of prices in the tradable goods sector rather than that of general exports. However, they still suffer the shortcomings of export price indices. Primarily, they are incomparable because their composition varies across countries. They may also include goods not traded internationally and may be affected by exchange rate variation. Unlike the CPI, the construction of the PPI varies across countries. Consequently, changes in weights could show up as changes in RER which could serve as a major limitation for the PPI approach. This coupled with the high components of imported intermediate goods, result in a RER that is not a suitable measure of competitiveness.

II.7 Choice of Indices

CPI Based Indices

The computations of most real effective exchange rate indices make use of consumer price indices (CPIs). Weig (1987) noted that there are theoretical reasons to prefer other types of price indices, but the CPI is highly favoured because of the availability of a wide array of data on several countries. Although majority of real exchange rate computations make use of the CPI, it is limited in applicability because the CPI may include a sizable proportion of imported goods, implying an understatement of the degree of improvement in competitiveness of the domestic economy, especially during times of devaluation of the domestic currency. Also, CPI includes non-internationally traded goods like housing and services instead of only consumer goods. In addition, CPI carries the weight of consumption taxes and subsidies, and these items are not normally considered when comparing competitiveness. Thus, the use of CPI indices is not generally accepted because it does not sufficiently measure the prices of non-tradables and weighs fairly heavily on non-traded goods and

services. Despite these limitations, the CPI based real exchange rate index computation is preferred due to data availability.

GDP Indices/GDP Deflators

By using GDP indices or GDP deflators, the principle of limitation to consumer goods associated with the CPI is violated because the GDP indices include capital goods and export products, but exclude imports. They also cover non-export sectors of the economy such as construction, household services and government. The use of unit labour costs (ULC) expressed in a common currency, often employed in international competitiveness measurement is not common in most developing countries due to data constraints. These are indicators of average expenditures on wages per unit of good or service produced. A good number of countries use the ULC or the cost of capital for international comparisons of competitiveness. ULCs, however, fail to capture cost of services for manufacturers, especially in sub-contracting some administrative and other services. The absence of appropriate mechanism for measuring productivity in the services sector makes for overestimation of productivity in the goods sector, thus, introducing a bias in international comparisons of competitiveness. Given these data constraints, limited use is made of these methodologies in this paper.

II.8 Choice of Base Year

The base year chosen for the computation may largely depend on the author's discretion. However, as a guide, recourse is made to the period of relative macroeconomic stability. Although the variables to be observed for the said stability depend on the author, nevertheless, the choice should be logically defendable. Generally, inflation and exchange rate play an important role.

III Computing Nigeria's Exchange Rate Indices

In computing Nigeria's exchange rate indices, we used data from 12 trading partners. The countries whose trade data with Nigeria was used include:

Brazil, China, France, Germany, India, Indonesia, Italy, Japan, Netherlands, Spain, United Kingdom and the United States. These twelve countries account for at least 79 per cent of trade with Nigeria for the period 1996 to 2007. The exchange rate used for France, Germany, Italy, Netherlands and Spain (who became members of the European Monetary Union with effect from 1st January 1999) was the euro which became the effective exchange rate for those countries as from that date. African countries were not included in the basket of trading partners because of the non-availability of reliable trade data. Although a large volume of informal trade takes place between Nigeria and her neighbors, African countries do not generally; have significant formal trade with Nigeria compared with any of the twelve countries in our sample.

To compute Nigeria's real effective exchange rate, trade data was obtained from Nigeria's National Bureau of Statistics and the International Monetary Fund's (IMF) Direction of Trade Statistics. We obtained the monthly consumer price indices and the country's nominal exchange rates with respect to the US dollar of the affected countries from the IMF's International Financial Statistics (IFS). The base year chosen for the computation of the relative consumer price indices and the exchange rate indices was May 2003, a period which coincides with Nigeria's CPI base year. The period January 1999 to December 2003 was chosen for computing the trade weights. The period represents the time Nigeria had the most phenomenal trade growth in decades in addition to increased oil revenues arising from rising oil prices. Given our trade data, we used the total trade volume and the bilateral weighing scheme for the computation. The geometric mean was employed in preference to the arithmetic mean because of the advantages of the former over the later, identified earlier. We also employed CPI indicators in preference to the other indicators due to data availability.

Table 1 shows the trade weights of Nigeria's major trading partners. The weights which sum up to one indicate that the US has the highest trade weight, accounting for 41.0 per cent of Nigeria's total trade for the period. This was followed by India (13.2%), France (7.2%), Spain (6.9%), Brazil (5.3%), and Italy (4.8%) amongst others.

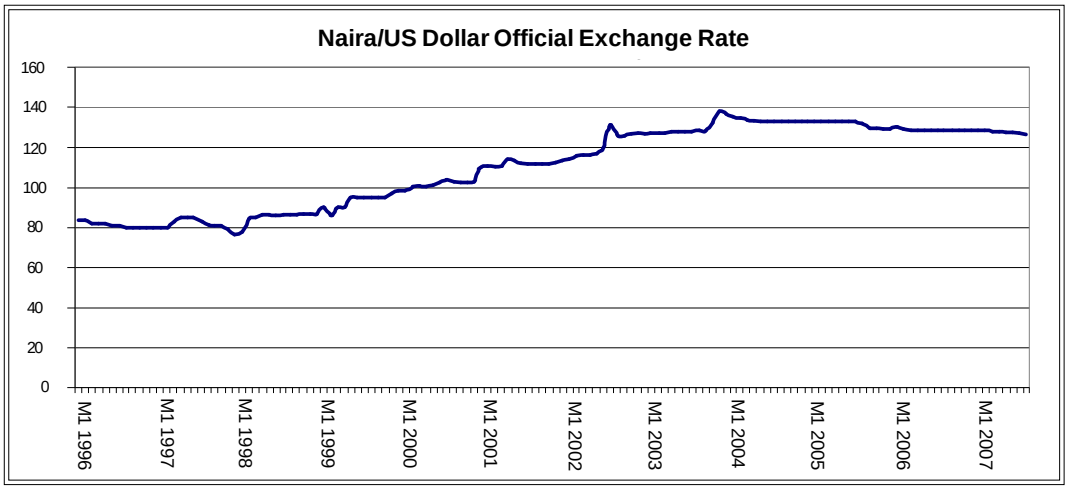
Table 1
Choice of Country Trading Partners

Country	Trade Weight (Percent)
Brazil	5.3
China	3.2
France	7.2
Germany	4.3
India	13.2
Indonesia	3.2
Italy	4.8
Japan	3.5
Netherlands	2.8
Spain	6.9
United Kingdom	4.6
United States	41.0

III.1 The Effective Nominal/Real Exchange Rate Indices Computations

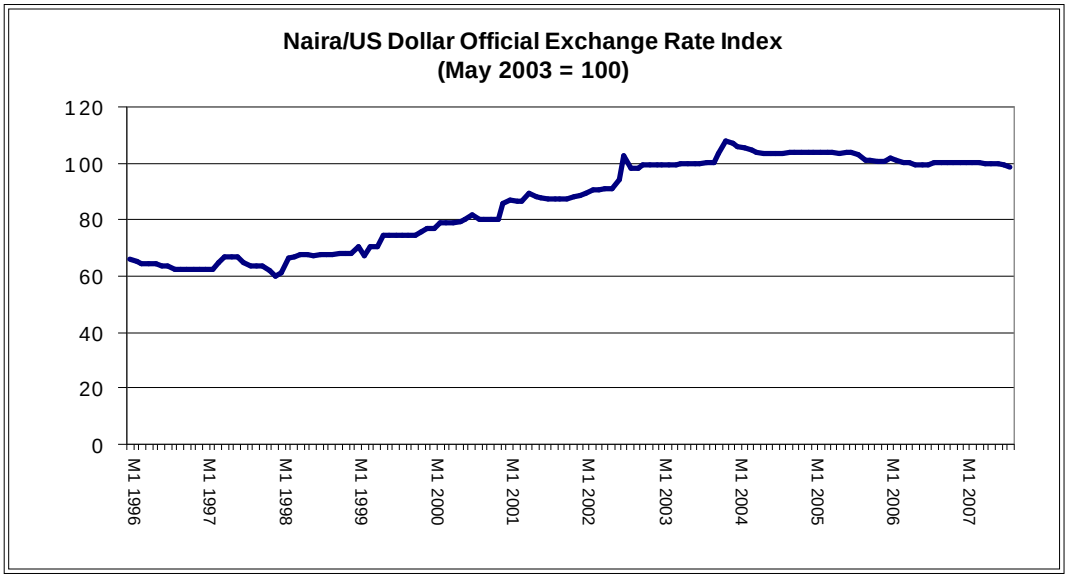
The effective nominal and real exchange rate indexes were computed based on the models outlined earlier in equations 4, 7, 8, and 9. Nigeria's official dollar based nominal exchange rate is presented in Table 2. The data shows that the dollar based exchange rate averaged x110.26/US$1 for the period January 1996-August 2007. From January 1996 to end-August 2007, the exchange rate depreciated in absolute terms.

Chart 1



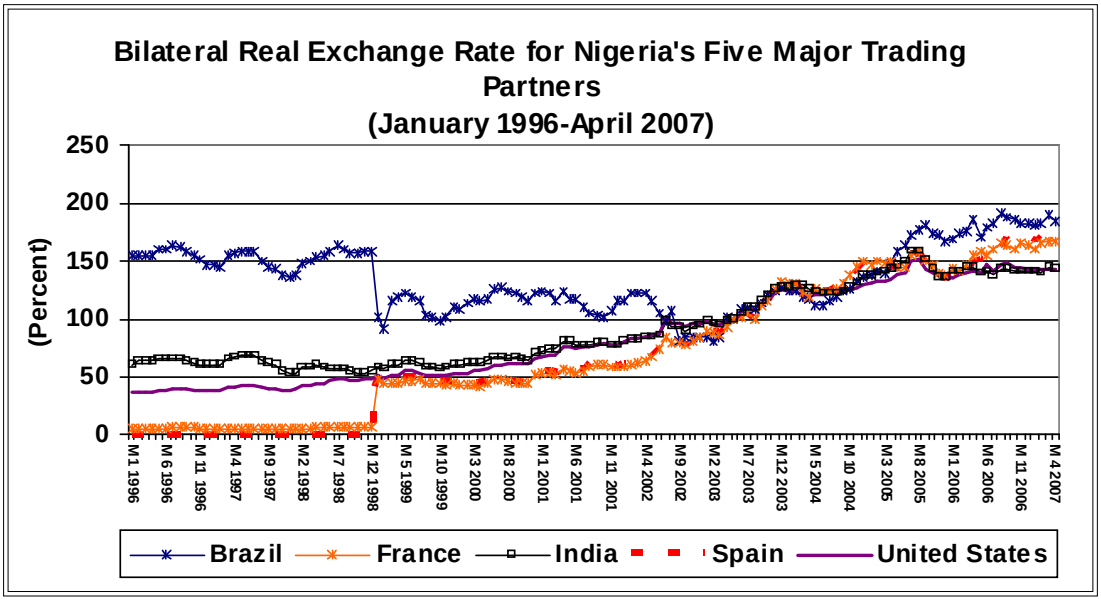
The index of the Naira/Dollar official exchange rate is presented in Chart 2 (The index has a base of May 2003).

Chart 2



The index shows that the dollar based official exchange rate depreciated steadily in nominal terms from January 1996 but stabilized between August 2002 (when DAS was reintroduced) and August 2003. Thereafter, the naira assumed a stable depreciation up to the third quarter of 2005 when it again appreciated in nominal terms.

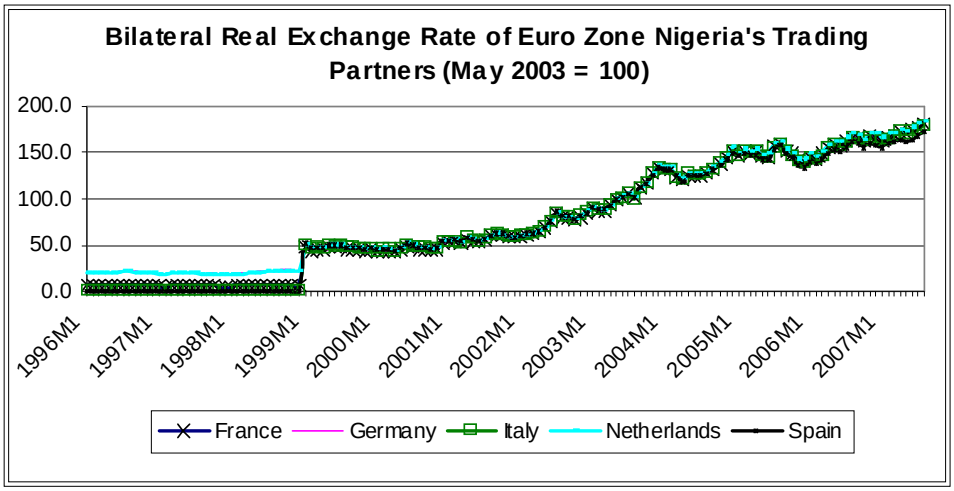
Chart 3



In Chart 3, we present the bilateral real exchange rate index for five of the major trading partners i.e. US (41.0%), India (13.2%), France (7.2%), Spain (6.9%) and Brazil (5.3%). The index show substantial real depreciation for all the countries, implying that on a bilateral basis, Nigeria's competitiveness worsened compared with that of its major trading partners due to persistently high inflation in Nigeria over most of the period. The divergence observed since 2003 reflects the relative efficiency of price management policies in the individual countries.

Following the adoption of the euro on 1st January 1999, the bilateral real exchange rate for the euro zone countries appreciated substantially because the euro was introduced at a highly appreciated rate for most countries. For Brazil, however, its bilateral real exchange rate depreciated on that day as its national currency appreciated. On the same day, Nigeria's national currency depreciated. The bilateral exchange rate for Brazil exhibits a peculiar feature compared with the other countries. For the euro zone countries (France and Spain), their bilateral real exchange rate reflected the change over from their national currencies to the euro on 1st January 1999.

Chart 4

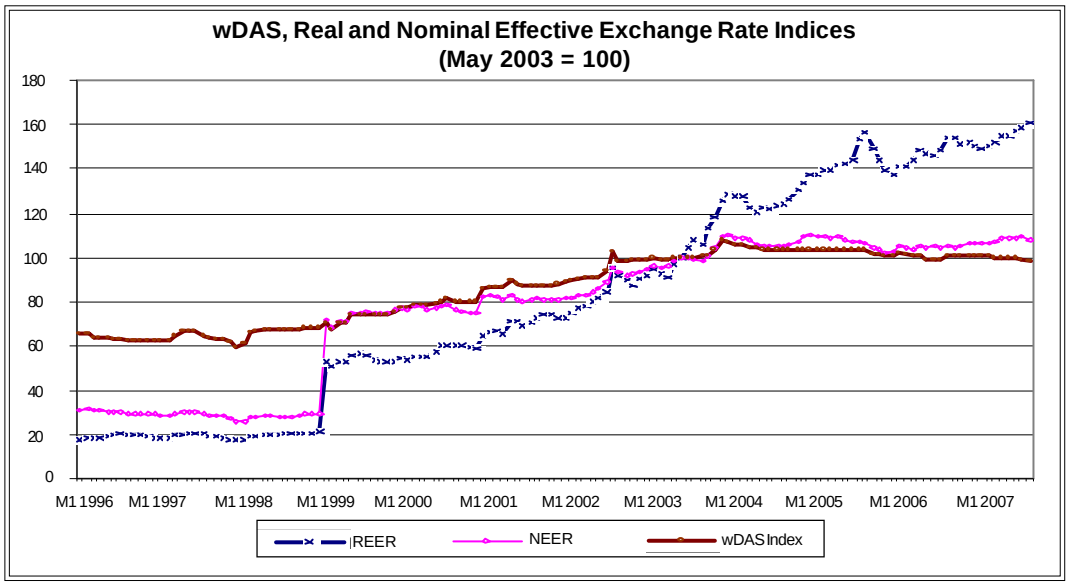


All the currencies of the euro zone countries appreciated in real terms against the naira before European unification and introduction of the euro on 1st January 1999. Following the introduction of the euro and prudent macroeconomic management their exchange rates appreciated continually against the naira in real terms. High inflationary tendencies, however, worsened the performance of the naira against the euro in the review period.

A decline in the index of the bilateral real exchange rate (representing a corresponding real exchange rate appreciation), is a reflection of low prices in the home country relative to the foreign country trading partner. Moderating domestic prices through fiscal discipline and efficient monetary management has far reaching implications on the country's external competitiveness. Although a weak domestic currency in real terms is an impetus for increased exports, in Nigeria, our inability to develop and explore the potentials of our non-oil export sector and the high dependence of the economy on imports makes such depreciations very costly to the economy.

The appreciations in the bilateral real exchange rate reflected in the overall real and nominal effective exchange rate indices. It was observed that in nominal terms, the naira depreciated continually throughout the review period.

Chart 5



The wholesale Dutch Auction System Index which reflects the official exchange rate appreciated continually from 1996 to July 2002 when it stabilized, reflecting the reintroduction of the Dutch Auction System. Although the reintroduction of DAS did not stem the depreciation of the naira, it nonetheless stabilized at around a 5 per cent upper band. The foreign exchange reforms of February and April 2006 initiated deliberate policy moves that would cause an appreciation in the nominal exchange rate of the naira as indicated above. Following complementary macroeconomic policies which improved non-oil foreign exchange flows and direct foreign investment, the naira has appreciated in the official window of the foreign exchange market since 2006.

As shown in the Chart above, the nominal effective exchange rate (NEER) index mimicked the behaviour of the wDAS index since January 1999. Consequently, the NEER appreciated consistently throughout the review period. The highly appreciated nominal effective exchange rate reveals the danger of ignoring the effects of macroeconomic changes in our major trading partner countries on our dollar based official exchange rate. Macroeconomic changes in countries with large trading ties with Nigeria will more readily impact on our exchange rate, which at present ignores

the magnitude of such effects. A highly depreciated nominal effective exchange rate has serious implications, especially for an import dependent economy like Nigeria. While the revenue implications favour the exporting countries, the high cost of imports has adverse effects on external sector stability and the country's economic development.

Similarly, the real effective exchange rate (REER) appreciated throughout the review period. A real effective exchange rate appreciation shows a loss of competitiveness by the computing country. The loss in competitiveness may arise from high domestic inflation and poor macroeconomic management. A depreciating REER may imply that the national currency is gaining strength against the currencies of the other trading partners in real terms; hence, fewer units of the national currency are buying more foreign goods. This may not be the case in nominal terms as the national currency may actually be depreciating against those of other trading partners, probably due to high domestic inflation. The implication is that an appreciation in the real exchange rate may typify an overvalued domestic currency.

Since April 2006, the wDAS index has been declining indicating an appreciation of the nominal exchange rate. However, this did not affect the NEER and the REER as both indices have continued to appreciate unabated. The appreciation in the REER is particularly worrisome as it shows continuous loss of competitiveness by Nigeria relative to our major trading partners. The need to consistently combat inflation with both monetary and fiscal policy becomes highly imperative. A consistent regime of high domestic prices when our major trading partners are successful in maintaining consistent low inflation regimes is injurious to Nigeria's trade. It is imperative therefore, for the monetary authorities to galvanize all efforts to achieve a regime of low prices on a consistent basis.

The continuous appreciation of the nominal exchange rate of the naira at the official window is only hurtful to Nigeria as it portends no economic benefits to the country. The nominal appreciations do not seem to stem from market fundamentals but rather, bear the marks of concerted collusion by market operators and a plan to congregate around a particular market

rate. In the medium term, the monetary authorities must insist on the full operation of the two way quote in wDAS where authorized dealers who quote ridiculous purchase rate are compelled to sell to the monetary authorities at that rate, irrespective of the liquidity position for the day. This punitive measure would deter the perpetuation of these unwholesome practices. In the long term, the Central Bank must work towards nurturing a virile foreign exchange market in which it is not a participant but a regulator who steps in only to achieve its monetary policy goal for the day/period. The envisaged market should create its own supply and demand, such that the evolving exchange rate would bear the inputs of the market.

IV Summary and Conclusion

The paper set out to compute Nigeria's real effective exchange rate indices. The country's trade data with major trading partners for the period 1996 to 2007, representing 79 per cent of Nigeria's international trade was used. Although the paper identified most of the common approaches used in real exchange rate computation, it was of the opinion that the use of any one methodology depended on the availability of data for both the home and trading partner countries in the basket. Whatever methodological choices are made, depending on data availability and the purpose for which the index is being computed, the emerging index/rate may show substantial variation from each other. Also, the choice of trade weights and countries in the basket, which are at the author's prerogative, played a major role in the diverse outcomes of the resulting index/rates.

The paper found that there was divergence between Nigeria's real effective exchange rate and the nominal effective exchange rate which tended to mimic the dollar based official exchange rate indices. The dollar based official exchange rate was found to be an inappropriate measure of the value of the naira because it failed to track major changes in trading partner economies.

The paper indicated that the monetary authorities must ensure price stability if Nigeria would benefit from trade relations with other countries.

A situation where the REER appreciated throughout the period under review was deemed unsatisfactory with respect to the price stability efforts of the monetary authorities. In addition it was shown that the appreciation in the nominal exchange rate of the naira was not beneficial to the country. Moreover, the monetary authorities should work towards the establishment of a stable foreign exchange market and then exit as a major player in the market to give way for the market to create its own demand and supply. Consequently, the monetary authorities would only intervene occasionally to achieve its liquidity management objective for the day/period.

The results should, however, be interpreted with caution because of some limitations of the study. For instance, the existence of a large informal foreign exchange market in Nigeria creates an added pressure for the official exchange rate. However, such effects were not captured in the computation of the real effective exchange rate. These drawbacks notwithstanding, the computed real exchange rate could serve as a useful input for policy. However, the issues raised here provide ample challenges for potential research in Nigeria's real effective exchange rate computation.

Appendix

Table 2
Nigeria's Real/Nominal Effective and wDAS Exchange Rate Indices
(May 2003=100)

Month/Year	REER	NEER	wDAS Index
M1 1996	17.9260	31.01	65.52
M2 1996	18.3228	31.24	65.33
M3 1996	18.3337	30.71	64.15
M4 1996	18.3446	30.51	64.15
M5 1996	19.1784	30.35	64.15
M6 1996	19.4715	30.05	63.37
M7 1996	20.2300	30.19	63.37
M8 1996	20.1616	29.75	62.59
M9 1996	19.8242	29.57	62.59
M10 1996	19.4732	29.63	62.59
M11 1996	19.0596	29.57	62.59
M12 1996	18.5656	29.44	62.59
M1 1997	18.4125	28.98	62.59
M2 1997	18.3515	28.67	62.59
M3 1997	19.7250	29.73	64.94
M4 1997	20.1036	30.25	66.50

Table 2 cont'd

Month/Year	REER	NEER	wDAS Index
M5 1997	20.5185	30.43	66.50
M6 1997	20.7001	30.29	66.50
M7 1997	20.4317	29.14	64.94
M8 1997	19.3830	28.38	63.57
M9 1997	18.7777	28.35	63.37
M10 1997	18.7316	28.43	63.37
M11 1997	17.8788	27.34	61.81
M12 1997	17.6134	26.05	59.85
M1 1998	17.2731	25.77	61.02
M2 1998	18.8034	28.10	66.15
M3 1998	19.0447	28.11	66.50
M4 1998	19.9188	28.84	67.60
M5 1998	19.6836	28.34	67.61
M6 1998	19.8124	27.69	67.28
M7 1998	20.5066	28.06	67.67
M8 1998	20.4720	28.22	67.67
M9 1998	20.3095	28.74	67.67
M10 1998	20.7433	29.50	68.06
M11 1998	20.8301	29.19	68.06
M12 1998	21.1282	29.29	68.06
M1 1999	53.0591	72.13	70.41
M2 1999	50.3438	68.14	67.28
M3 1999	53.0739	71.52	70.41
M4 1999	53.0907	71.44	70.41
M5 1999	56.0950	74.90	74.23
M6 1999	56.4235	74.85	74.23
M7 1999	56.0679	75.53	74.23
M8 1999	53.5710	74.94	74.23
M9 1999	53.0047	74.94	74.23
M10 1999	52.5879	75.21	74.32
M11 1999	53.1588	76.06	75.97
M12 1999	54.5902	77.20	76.83
M1 2000	53.4581	76.41	76.79
M2 2000	55.0506	77.93	78.59
M3 2000	55.1706	77.76	78.68
M4 2000	55.0915	76.33	78.52
M5 2000	57.0827	76.81	79.17
M6 2000	60.3521	78.14	79.96
M7 2000	60.2359	78.64	81.36
M8 2000	60.0893	76.74	80.23
M9 2000	59.9651	75.79	80.00
M10 2000	59.3206	74.73	80.19
M11 2000	58.7574	75.15	80.27
M12 2000	64.4068	82.09	86.10
M1 2001	65.9543	82.71	86.68
M2 2001	66.5525	82.07	86.53
M3 2001	65.6160	80.56	86.61
M4 2001	71.4142	82.81	89.34

Table 2 cont'd

Month/Year	REER	NEER	wDAS Index
M5 2001	71.4612	80.89	88.48
M6 2001	69.2827	79.94	87.62
M7 2001	70.5754	80.62	87.39
M8 2001	72.7598	81.67	87.31
M9 2001	74.0462	81.08	87.31
M10 2001	74.2492	80.51	87.31
M11 2001	72.4055	81.10	88.09
M12 2001	72.6697	81.68	88.76
M1 2002	75.0264	81.50	89.34
M2 2002	77.1285	82.67	90.52
M3 2002	77.5130	83.34	90.83
M4 2002	79.7786	84.34	90.99
M5 2002	81.2548	85.59	91.38
M6 2002	84.6225	89.02	93.88
M7 2002	95.5236	95.84	102.50
M8 2002	91.6583	93.05	98.58
M9 2002	89.8703	91.79	98.58
M10 2002	87.2969	92.58	99.16
M11 2002	90.3280	93.00	99.29
M12 2002	91.6001	94.69	99.28
M1 2003	94.5902	95.93	99.57
M2 2003	92.4082	95.65	99.37
M3 2003	91.4317	96.27	99.53
M4 2003	97.2857	98.16	99.99
M5 2003	100.0000	100.00	100.00
M6 2003	104.6113	99.58	100.08
M7 2003	108.0148	98.92	99.93
M8 2003	105.9807	98.53	100.38
M9 2003	113.1960	100.60	100.42
M10 2003	118.2449	104.31	103.68
M11 2003	125.5294	109.29	108.12
M12 2003	128.8741	110.33	107.18
M1 2004	127.8985	108.64	105.85
M2 2004	127.9858	108.57	105.62
M3 2004	122.5602	107.67	104.60
M4 2004	120.6281	106.04	104.29
M5 2004	122.6607	105.31	103.86
M6 2004	122.2938	105.13	103.86
M7 2004	123.2538	104.93	103.91
M8 2004	124.3056	105.27	103.92
M9 2004	126.7291	106.12	103.95
M10 2004	130.4413	107.29	103.95
M11 2004	133.7654	109.28	103.96
M12 2004	137.7222	110.54	103.94
M1 2005	137.3329	109.49	103.94
M2 2005	139.3366	109.77	103.94
M3 2005	139.5864	108.81	103.94
M4 2005	141.5446	109.11	103.94

Table 2 cont'd

Month/Year	REER	NEER	wDAS Index
M5 2005	142.5673	107.84	103.92
M6 2005	144.0861	107.25	103.95
M7 2005	153.7684	106.93	103.94
M8 2005	156.2655	106.41	103.30
M9 2005	149.4039	104.34	101.31
M10 2005	144.1433	103.76	101.34
M11 2005	139.3885	102.47	100.93
M12 2005	137.6937	102.61	100.92
M1 2006	140.9452	105.20	101.93
M2 2006	141.2021	103.99	101.14
M3 2006	144.2429	103.74	100.55
M4 2006	148.3750	105.16	100.49
M5 2006	146.9524	104.55	99.50
M6 2006	146.4376	104.74	99.50
M7 2006	148.7321	104.51	99.45
M8 2006	154.1027	105.16	100.37
M9 2006	154.4749	104.68	100.35
M10 2006	151.4127	105.29	100.38
M11 2006	152.1537	106.53	100.35
M12 2006	150.9079	106.72	100.35
M1 2007	149.3943	106.20	100.36
M2 2007	150.7554	106.82	100.36
M3 2007	152.2870	107.33	100.19
M4 2007	155.0887	108.64	100.04
M5 2007	154.9825	108.53	99.74
M6 2007	156.8829	108.43	99.60
M7 2007	158.7536	109.16	99.45
M8 2007	161.0256	107.92	98.73

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On the Determinants of Inflation in Nigeria: 1980 - 2003

Dipo T. Busari*

This paper sets out to examine the main economic determinants of inflation in Nigeria over the period 1980-2003 using quarterly data. Using, among other measures, the Hodrick and Prescott filter, inflation is decomposed into its trend, cyclical, seasonal, and, random components. Based on the time series characteristics of the variables used in the analysis, the paper adopted the general-to-specific modelling approach to investigate the main determinants of each component. The results confirm that, in the long run, inflation is largely and positively related to the level of (narrow) money supply and, marginally, to fiscal deficit. In the medium term inflation is observed to be positively related to exchange rate depreciation and the growth of money supply. In the short run, it is observed that inflation is positively related to growth in money supply and exchange rate depreciation while it is negatively related to growth in real GDP. Some marginal significance is observed for the influence of pump price adjustment of petroleum products. The paper further observes that inflation is positively related to growth in money supply, exchange rate and growth in non-oil GDP. It is further observed that money supply affects inflation in the short to long run while exchange rate is influential in the short to medium run. Since fiscal deficit and government borrowing in Nigeria are largely financed by the (central) banking system, the findings lend support to the conventional elements of a typical stabilisation programme that reducing both the budget deficit and credit to the government are crucial in fighting inflation. Finally, since the results indicate the negative impact of economic growth on inflation, structural reforms and infrastructural improvements to increase the country's productive capacity should be considered important elements of an overall economic reform program.

Keywords: Inflation decomposition, determinants.

JEL Classification: E31

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I. Introduction

Inflation in Nigeria as a socio-economic phenomenon has received much attention in recent times. With the consumer price index (CPI) assuming a value of 11.1 by end of 1970, it rose to 22.6 in 1975[1] (in 1985 prices). Of course, the Udoji salary increase award, large flow of petrodollars, courtesy of the crude oil boom in the early 1970s, and rapid monetization of the petrodollar were easily identified by scholars as possible factors responsible for this growth in the price index (see Masha 1999; Aigbokhan, 1991; Asogu, 1991; Ekpo, 1992; and, Ikhide, 1993 amongst others). By 1983 the CPI stood at 73.1 and it was obvious that the slow growth in the industrialised economies and the rising prices and interest rates in such economies have been imported into Nigeria courtesy of the high marginal propensity to import. By 1986 the CPI had climbed to 111 and other indicators, like an overvalued domestic currency, low capacity utilisation, massive importation, low external reserve, and mounting external indebtedness suggest that the economy was under serious strain. To qualify for some external financial assistance from both bilateral and multilateral sources, the country agreed to implement a package of reform measures popularly called SAP (Structural Adjustment Programme). One of the core elements of the SAP was "getting prices right" through unbridled market mechanisms (see Anyanwu, 1992; NCEMA, 2000 and Analogbei 2000 for detailed discussions of the SAP). Hence, the country embarked upon a series of exchange rate reform measures aimed at getting the price of the domestic currency right.

The CPI which stood at 111 in 1986 when the reform measures started rose sharply to 293 by the end of 1990. By the time the Babangida administration and its attendant political crises were dispensed with in 1993, the CPI had climbed to 853. By the time the Junta leaders were weary of their incursion into Nigerian politics and voluntarily marched (back) to their barracks in 1999, the CPI stood at 3273 (again, using 1985 prices). The Olusegun Obasanjo administration was ushered in with high

[1] *Data used in this and subsequent sections are from various issues of the Annual Report and Statement of Accounts and Statistical Bulletin of the Central Bank of Nigeria.*

hopes. The administration pursued (and still pursuing) several reform policies in line with neo-liberal thinking and by 2002 the CPI stood at about 4900. It seems all efforts to curb the rising CPI were futile as it continued an unrelenting upward journey. Several attempts have been made, particularly since the late 1980s to explain why the CPI is defying all attempts to abate its rapid progression (see, for example, Adeyeye and Fakiyesi, 1980; Ajayi and Awosika, 1980; Anyanwu, 1992; and, Egwaikhide, *et al*. 1995). In virtually all the studies, attempts have been made to explain aggregate price behaviour using annual series. This study posits that since a time series can, in principle, be separated into its different components, these components are likely to be influenced by fundamentals of varying intensity and duration. Hence, a proper analysis of the driving forces behind inflation will require the examination of the determinants of these components separately. For example, factors that influence short run fluctuations in inflation may not be relevant in the long run or might have a smaller effect in the medium term. To the best of my knowledge, this is the first attempt to examine the dynamics and determinants of the different components of inflation for Nigeria[2]. The use of annual data for studying inflation (as it was done by past studies) implies that, at best, only medium to long run movements would be captured by such studies as short run fluctuations, such as seasonal effects, would be completely obliterated (see for instance the study by Domac and Elbirt (1998).

The primary objective of this paper is to decompose inflation into its various time series components and examine if these components are driven by the same fundamentals. Inflation is decomposed into its trend, cyclical, seasonal, and irregular components and we examine the determinants of each component (except the irregular) separately and jointly using the general-to-specific modelling strategy. The study observed that all the components are driven by the index of money, *M*1, used in the study. The level rather than the growth of *M*1 is important in the long run while the growth rate is important in the short to medium term. The rate

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[2] *Discussions on the trend and evolution of Inflation in Nigeria are not pursued in this paper. Interested reader is referred to Ojameruaye (1998), Onwioduokit (1999), and Folorunso and Abiola (2000)*

of depreciation of the domestic currency and growth in GDP (real gross domestic product) were also observed to be important in the short term. In terms of the un-decomposed inflation series, it was observed that growth in money supply, exchange rate level and growth in non-oil GDP are the important variables. Marginal significance was observed for the impact of fuel price increase in the short run and the economic reform in affecting aggregate inflation rate. Hence, it is concluded that money supply is the only fundamental that is common in determining inflation in the short-to-long run, while other variables are important in the short-to-medium term. The rest of this paper is arranged as follows. Section 2 discuses the decomposition techniques used, while a core theoretical model of price determination is presented in section 3. In line with time series analysis, section 4 examines the time series properties of the data used in the analysis and the adopted estimation procedure. Section 5 discusses the results and the paper is concluded in section 6.

II. Inflation Decomposition

In time series analysis, it is traditional to decompose a time series into a variety of components, some or all of which may be present in a particular situation. If {*Y*} is the sequence of values of an economic index, then its generic element in additive form is liable to be expressed as:

$$Y_t = T_t + C_t + S_t + \varepsilon_t \quad \text{.....} \quad (1)$$

while the multiplicative form is given as:

$$Y_t = T_t \times C_t \times S_t \times \varepsilon_t \quad \text{.....} \quad (2)$$

where
T_t is the global trend,
C_t is a secular cycle,
S_t is the seasonal variation, and
ε_t is the irregular component.

It is clear that a log transformation of the multiplicative form will produce the additive version[3]. The trend component of the sequence represents the long run behaviour of variable *Y*. Simply put, trend implies the lack of a constant mean. That is, different sections of a series may have quite different sample means indicating that the population mean is time dependent. Trend is usually a low frequency component of the data. Trend could also be seen as the overall pattern of growth displayed by the series as a whole and is often referred to as the secular trend[4]. The secular trend may be one of persistent growth or decline, but it needs not be (Figure 1). The cyclical component represents the fluctuations caused by some predetermined events. It refers to patterns, or waves, in the data that are repeated after approximately equal intervals with approximately equal intensity. In other words, it is a sustained cyclical or quasi-cyclical component with period different from that of any seasonality in the data. Hence, it refers to any medium term fluctuation with a period of more than one year. The seasonal part is the periodic fluctuations which are assumed to have constant length and proportional depth caused by such factors as month of the year, holiday season, weather, and so on. These short term fluctuations are usually assumed to be calendar related. There may, however, be one or more peaks in a year.

When the trend, the secular cycle and the seasonal cycle have been extracted from the sequence, the residue is expected to correspond to an irregular component, ε_t , for which no unique explanation can be offered. It is expected that the residue should resemble a time series generated by a stationary stochastic process. Such a series has the characteristic that any segment of consecutive elements looks much like any other segment of the same duration, regardless of the date at which it begins or ends. If it is observed that the residue has a trend or any kind of regular pattern then it contains features which ought to have been attributed to the other components, which calls for a re-examination of the data generating process.

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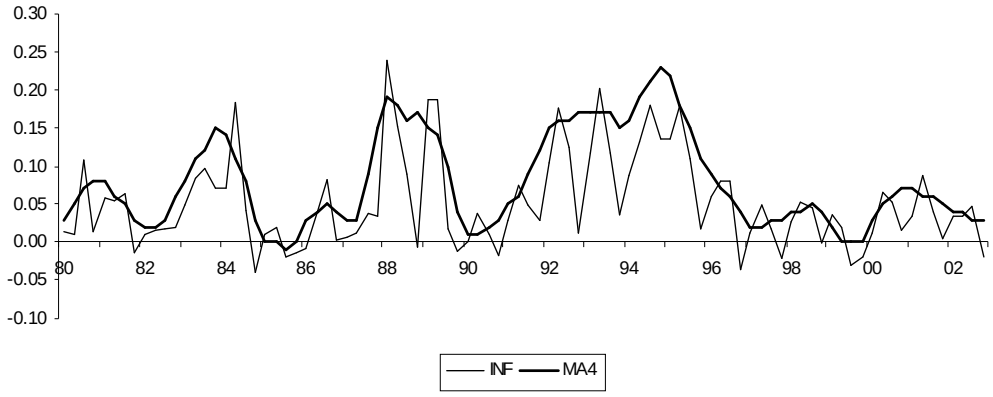
[3] *By our definition of inflation as* $\Delta \ln CPI_t$ *it implies that an additive model will be appropriate.*

[4] *The approximate mean values of inflation for the years 1980-85, 86-91, 92-97, 98-03, respectively, are 1.28, 1.82, 2.91, and 0.86. The overall mean value is 1.75.*

In general, there are two distinct reasons for embarking on decomposition (Domac and Elbirt (1998)). The first reason, which is pertinent to this study, is to obtain a summary description of the important but salient characteristics of the sequence. It is expected that the eradication of the irregular and seasonal pattern will produce an index which is expected to give a clearer explanation of such important characteristics. This can provide useful insight into the dynamics of the sequence and help us better understand the structure and process that generates the series. The other purpose is to predict future values of the series[5]. There are no proven "automatic" techniques to identify trend components in the time series data; however, as long as the trend is monotonous (consistently increasing or decreasing) that part of data analysis is typically not very difficult. If the time series contain considerable error, then the first step in the process of trend identification is smoothing. Smoothing generally involves some form of local averaging of the data such that the non-systematic components of individual observations cancel each other out. The most common technique is *moving average* smoothening which replaces each element of the series by either the simple or weighted average of *n* surrounding elements, where *n* is the width of the smoothening window. In this study 4 quarter centred moving average $(2\times 4MA)$ of the series is used[6].

Figure 1.
Inflation and Centered Quarterly MA



[5] *We do not pursue this in this study.*

[6] *To avoid (end points) missing data problem, the computation was carried out over the 1979:2 – 2004:2 period.*

Since the averaging window is 4, the smoothening process will eliminate 4 quarter (or less) fluctuations such as seasonality and irregular components leaving the trend and cyclical components. From equation 1, we have

$$Y - MA_4 = (T + C + S + \varepsilon) - (T + C) = S + \varepsilon \quad \text{.....} \quad (3)$$

The cyclical pattern can be removed by detrending the moving average as $MA_4 - T\ (= T + C - T)$. There are several methods available in the literature for detrending the moving average process. We use the Hodrick and Prescott (1997) filter, also known as *HP* filter, which is flexible, simple and can easily reproduce the series[7]. The cyclical component becomes the *MA* series less the detrended series from the filter. We now have the trend and cyclical components and what is left is to separate the seasonal component from the irregular component. This is done by deriving normalized (quarterly) seasonal indexes from the deviations in equation 2 and to use them to extract the seasonal components from the original series[8]. The various components are presented in Figure 2. The levels of linear association between these various components are presented as correlation figures in Table 1.

From Table 1 it can be observed that the secular cycle has a correlation of 0.20 with the trend and 0.66 with actual inflation. Also, the trend has a correlation of 0.48 with actual inflation while the seasonal component has a correlation of 0.89 with actual inflation. These results tentatively indicate that the various components are likely to be driven by different fundamentals. This represents the main hypothesis to be tested in this study.

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[7] *The trend series produced by direct application of least squares to the MA process with time and its squares as regressors has a correlation of 0.63 with the HP filter adopted at this stage.*

[8] *More advanced procedures such as the X11\X12 ARIMA styled methods exist, but I believe the procedure adopted here suffices for the focus of the paper.*

Figure 2

Components of Inflation

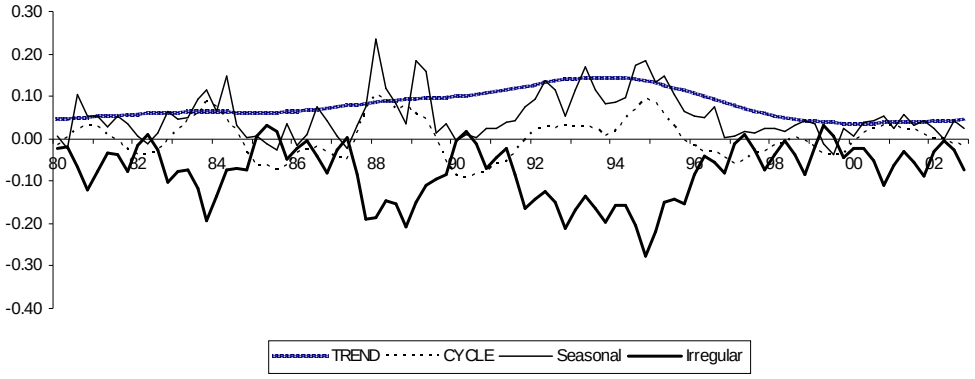

Table 1: Correlation Matrix of the Various Components

	Trend	*Cycle*	*Seasonal*	*Irregular*	*Inflation*
Trend	**1.00**				
Cycle	**0.20**	**1.00**			
Seasonal	**0.55**	**0.74**	**1.00**		
Irregular	**-0.64**	**-0.76**	**-0.77**	**1.00**	
Inflation	**0.48**	**0.66**	**0.89**	**-0.50**	**1.00**

III The Core Theoretical Model.

It is now quite common to start the analysis of the determinants of inflation in developing economies from the popular *IS-LM* model framework for a small open economy (see Kim 2001 and Lissovolik 2003). The general price level is postulated to be a weighted average of some basket of goods and services. Goods and services are categorized as tradable and non-tradable. Hence, the aggregate price index is expressed as[9]:

$$p_t = \eta p_t^t + (1-\eta) p_t^n, \quad 0 < \eta < 1. \qquad \text{.....} \quad (4)$$

[9] *All the variables are expressed in logarithm except interest rates.*

where the superscript (*t*) indicates tradable and (*n*) non-tradable goods. The general assumption is that the price of tradable goods in a small open economy is determined by the world market price p_t^f and the domestic exchange rate e_t as follows:

$$p_t^t = \alpha e_t + \beta p_t^f \quad \text{.....} \quad (5)$$

For the non-tradable goods, the demand is assumed to be related to the nature of the overall demand in the domestic economy hence, the price of non-tradable goods is a function of domestic money market conditions such that real money supply ($m_t^s - p_t$) equals real money demand ($m_t^d - p_t$) giving:

$$p_t^n = \lambda\left[(m_t^s - p_t) - (m_t^d - p_t)\right] = \lambda(m_t^s - m_t^d) \quad \text{.....} \quad (6)$$

and λ is considered a scale factor which expresses the relationship between aggregate demand and demand for non-tradable goods. Hence, an increase in money supply will increase the price of non-tradable goods. It is further assumed that the demand for nominal money balances is an increasing function of, a scale variable (income, wealth, or expenditure, in real terms) and an index of expected real rates of return (own rate of return on money and opportunity cost of holding money) adjusted for expected inflation rate as follows:

$$m_t^d = \phi_1 + \phi_2(y_t - p_t) + \phi_3(r_t + \pi^e) \quad \text{.....} \quad (7)$$

In this study, expected inflation rate is assumed to be determined by the inflation rate in the previous period

$$\pi^e = \Delta p_{t-1} \quad \text{.....} \quad (8)$$

Substituting equations 8 and 7 into equation 6 yields

$$p_t^n = \lambda\left[m_t^s - (\phi_1 + \phi_2(y_t - p_t) + \phi_3(r_t + \Delta p_{t-1}))\right] \quad \text{.....} \quad (9)$$

Hence, substituting equations (9) and (5) into equation (4) the general price level p_t can be expressed as:

$$p_t = p(e_t, p_t^f, m_t^s, y_t - p_t, r_t + \Delta p_{t-1}) \quad \text{.....} \quad (10)$$

Hence, the estimable static long run equation would be represented linearly as follows:

$$p_t = \beta X_{it} + \mu_t \quad \text{.....} \quad (11)$$

where β is a vector of estimable coefficients, X is a vector of proposed fundamentals as reflected in equation (10) and μ_t is an unobservable component that is assumed 'white noise'. The above equation serves as a core model in the analysis of the determinants of inflation in Nigeria. However, some modifications need to be made to the equation to reflect Nigerian peculiarities. We introduced three dummy variables to capture the effects of wage adjustment, adjustments to pump price of petroleum products, and the economic reform period that commenced in 1986. Furthermore, the core price equation has no fiscal variable. However, analysts are of the opinion that government fiscal behaviour in terms of the size of its deficit and\or borrowing from the banking system are key driving forces behind the rapid growth in money supply (see for example Masha (1999). Hence, we include a measure of fiscal behaviour of the government.

IV. Time Series Properties of Variables

It is now a common practice to examine the time series properties of variables to be used in modelling as this could inform the modelling strategy and reduce (if not eliminate) the risk of spurious regression. We use the ADF (Augmented Dickey-Fuller) and the KPSS (Kwiatkowski-Phillips-Schmidt-Shin**)** procedures to test for the order of integration of the series (and where conflicting results are given we checked using the Phillip-Perron test). The lag length of the ADF is based on the lag that minimises the AIC (Akaike Information Criterion) with an upper bound of 11 lags, while in the KPSS test, the Newey-West bandwidth was selected through a Bartlett Kernel estimation technique. The estimations were done with the intercept alone and intercept and trend options. All the variables are expressed in logarithm (except interest rate). The ADF tests the null of a unit root against the alternative of stationarity while the KPSS tests the null of stationarity against the alternative of a unit root. The choice of the KPSS test to supplement the widely used ADF test is based on evidence that tests designed on the basis of the null that a series is *I*(1) have low power in rejecting the null. Reversing the null and alternative hypotheses is helpful in overcoming this problem (Kwaitkowiski *et al*. 1992).

Table 2 presents the unit root tests for inflation and its components. For each variable we report the ADF and the KPSS *t*-statistic with the constant only option then followed by the constant and trend options. Strictly, since the components (except trend) are supposed to be detrended series, using the trend option is not required[10]. Furthermore, since the irregular component is by assumption containing unexplainable variations, it should be ignored. The unit root tests present mixed results. Inflation is observed to be mean stationary in level (hence in first difference) but trend stationary in first difference. The trend component is confirmed mean stationary in level by the KPSS and mean and trend stationary in first difference. The ADF does not confirm the variable to be either mean or trend stationary[11]. The secular cycle component is confirmed mean and trend stationary in levels (hence in first difference) by both tests. The seasonal component is also confirmed mean and trend stationary in levels by both tests[12].

Table 2: Unit Root Tests

	Level		1st Diff		Remark
Variable	**ADF**	**KPSS**	**ADF**	**KPSS**	
Inflation	-2.98**	0.15**	-6.02**	0.16**	*I*(0)
	-2.94	0.15	-6.02**	0.10**	
Trend	-2.17	0.28**	-2.44	0.43**	*I*(0)/*I*(1)
	-1.36	0.27	-2.96	0.11**	
Cycle	-4.97**	0.03**	-5.15**	0.02**	*I*(0)
	-4.95**	0.03**	-5.12**	0.02**	
Seasonal	-4.85**	0.15**	-8.28**	0.50*	*I*(0)
	-4.82**	0.14**	-8.25**	0.50*	
Irregular	-2.35	0.16**	-4.68**	0.28**	*I*(0)/*I*(1)
	-2.30	0.16**	-4.73**	0.27**	

Note: **(*) 5(10) percent significance. 5 percent critical values for ADF and KPSS with only a constant option, respectively, are approximately -2.8951 and 0.4630.

[10] *We report these for completeness.*

[11] *The Phillip-Perron test (though not reported here) confirms inflation to be mean and trend stationary in level and first difference and also the trend variable to be mean and trend stationary in first difference.*

[12] *The lags for the tests were selected based on the Akaike Information Criterion while bandwidths were selected based on Bartlett Kernel estimation. Individual intercepts is assumed.*

In general, the components of inflation could be described as stationary in levels (i.e., are *I*(0) variables). Unit root tests (for constant only option) for the other variables identified in section 3 are presented in Table 3[13]. From both the ADF and KPSS tests we observed that exchange rate depreciation and federal fiscal deficit are stationary in levels while others are not. The KPSS test suggests that all the variables are stationary in first difference while the ADF test tends to suggest that M1 (narrow money) and M2 (broad money) are not stationary at first difference[14]. The small sample size of the data (compared with the asymptotic properties of the tests) allows us to conclude that apart from fiscal deficit and exchange rate depreciation which are stationary in level (and government borrowing by the KPSS and Phillip-Perron tests), other variables are stationary in their first difference.

Table 3: Unit Root Tests on Proposed Fundamentals

	Level		1st Diff		Remark
Variable	ADF	KPSS	ADF	KPSS	
Exr.	-0.43	1.27	-8.81**	0.127**	*I*(1)
Exr_Depr	-8.81**	0.13**	-6.17**	0.174**	*I*(0)
DEFICIT	-5.04**	0.19**	-6.81**	0.104**	*I*(0)
M1	0.25	1.29	-2.10	0.204**	*I*(1)
M2	1.27	1.30	-1.34	0.307**	*I*(1)
NONOIL GDP	0.21	1.29	-6.55**	0.036**	*I*(1)
Real GDP	-1.67	1.03	-2.67*	0.181**	*I*(1)
Govbr	0.39	0.19**	-7.25**	0.035**	*I*(0)/*I*(1)
Interest.	-1.53	1.08	-3.85**	0.047**	*I*(1)

Notes: **(*) Significant at 5(10) percent. 5 percent critical values for the ADF and the KPSS are, respectively, -2.895 and 0.4630. Exr_depr is exchange rate depreciation, positive sign indicates depreciation. Deficit is calculated as log of government expenditure less log of government revenue. Govbr is net government borrowing from the banking system. Int. is interest rate in percent.

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[13] *There are several measures of exchange rate that can be used to examine inflation dynamics. However, in an import dependent economy like Nigeria, a depreciation of the nominal exchange rate is expected to push up prices of final consumer imports and basic inputs that are imported if the price increase is passed on. Furthermore, in the short run, domestic prices are likely to react to (expected) changes in the nominal rate rather than the real rate. For practical purposes, in the short-to-medium term, movements in the real and nominal rate are similar (IMF, 2004). Hence, in this study we use the nominal exchange rate depreciation.*

[14] *The Phillips-Perron test indicates that all the variables are mean stationary at first difference and that in fact government borrowing is mean stationary in level.*

IV.1 Estimation Procedure

The unit root test results (presented in Tables 2 and 3) suggest that the variables do not have the same order of integration. Inflation, exchange rate depreciation, deficit, and to some degree, government borrowing, were observed to be stationary in their levels while other variables are stationary in their first differences. Thus, now-fashionable time series econometric procedures that are appropriate for *I*(1) variables are not applicable in this case. However, given the presence of non-stationary variables, it is necessary to guard against the possibility of estimating spurious relationships. The time-series approach to overcoming this difficulty is to difference the non-stationary variables (to achieve stationarity) and use them in their transformed form together with the other (stationary) variables. This procedure, while statistically acceptable, has the disadvantage of ignoring long-run relations embodied in level variables. We therefore opt to use the general-to-specific modelling procedure of Hendry, which minimises the possibility of estimating spurious relations while retaining long-run information (Hendry 1995). Under this procedure, the long-run relationship being investigated is embedded within a sufficiently complex dynamic specification, including lagged dependent and independent variables, in order to minimise the possibility of estimating spurious relationships (Athukorala and Sen 1996). The estimation procedure starts with an over-parameterised autoregressive distributed lag (ADL) specification of an appropriate lag order:

$$Y_t = \alpha_0 + \sum_{i=1}^{m} A_i Y_{t-i} + \sum_{i=0}^{m} B_i Z_{t-i} + \mu_i \quad \text{.....} \quad (12)$$

where α_0 is a constant, *Yt* is a (*n* x 1) vector of endogenous variables, *Z*t is a (*k* x 1) vector of explanatory variables, and *Ai* and *Bi* are (*n* x *n*) and (*n* x *k*) matrices of parameters. Equation 11 constitutes the "maintained hypothesis" of our specification search[15]. The estimation procedure is first to estimate the unrestricted equation (using OLS) and then progressively simplify it by restricting statistically insignificant coefficients to zero and reformulating

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[15] *We conducted the J-test as proposed by Davidson and Mackinnon (1981) and the result tends to favour the use of m1 as against m2 in the analysis.*

the lag patterns where appropriate in terms of levels and differences to achieve orthogonality and maintain the long run relationship. To be acceptable, the final equation must satisfy various diagnostic tests. In applying this estimation procedure, we set the initial lag length on all variables in the general ADL equation at six periods. This is the established practice in modeling with quarterly data[16].

V. Results

Different estimations were carried out for inflation and the various components of inflation (except the irregular component). Table 4 presents the results from these estimations. We report the results for our preferred models. For the coefficients we set the 10 percent significance level as the reporting benchmark.

From Table 4 we observed that one, two, and four period lags of the trend component of inflation are significant in explaining variations in the trend components. We also observed the significance of current and one period lag in money supply and one quarter lag in fiscal deficit (at 10 percent). The result indicates that largely, the past behaviour of the trend component of inflation and money supply are the main determinants of long run inflation in Nigeria. In other words, long run behaviour of inflation in Nigeria is influenced largely by monetary variables.

In terms of the secular cyclical component, we observed that one and second quarter lags of the cyclical component, fourth quarter change in exchange rate; third and fourth quarter lags in money supply affect the cyclical component. The fourth quarter lag of money was significant but with a negative sign. Generally, all the variables have their expected signs and the model explains about 90 percent of the variation in the cyclical component. It could be observed that the cyclical component is largely driven by growth in the fundamentals rather than the levels of the fundamentals.

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[16] *Quarterly values for output were derived by interpolation using a procedure developed at the Centre for Econometric and Allied Research (CEAR), University of Ibadan*.

The seasonal component is largely influenced by one period lags of growth in money supply, real GDP, and change in exchange rate, and current change in exchange rate. The dummy for petroleum price adjustment was observed to be significant at 10 percent. Seasonal dummies were included and observed to be insignificant. All the variables have the expected signs. However, the model could only capture about 47 percent of the variation in the seasonal behaviour of inflation. The seasonal component of inflation is observed to be largely influenced by short run movements (quarterly growth) in money supply, GDP, and exchange rate.

In modelling the (un-decomposed) inflation series, we observed that the first, second, and fourth quarter lags of inflation were significant at 5 percent in explaining current inflation. The main fundamentals are two quarter lag of growth in money supply, current and two quarter lag of exchange rate and current and four quarter lag of growth in non-oil GDP. The economic reform dummy (period $\geq$ 1986:03 =1, others zero) is observed to be significant at 10 percent. Essentially, inflation is determined by money growth, exchange rate, and growth performance in the non-oil sector. About 54 percent of the variation in inflation is captured by the model and all the variables have the expected signs.

Table 4: Final OLS Estimates of Inflation Components

$TR_t = 0.01 + 0.88TR_{-1} + 0.33TR_{-2} - 0.25TR_{-4} + 0.02\,M1 - 0.02M1_{-1} + 0.005DEF_{-1}$
1.37 8.75** 2.62** -3.47** 1.99** -2.02** 1.80*

$\overline{R^2}$ = 0.98, SER = 0.004, DW =2.17, F =984.29(0.00), $BG1_{LM}$ = 3.30(0.12), $BG2_{LM}$ = 1.04(0.15), ARCH1 = 0.01(0.92), ARCH2 = 0.01 RESET1 = 0.03(0.85), RESET2 =1.73(0.111).

$CY_t = -0.003 + 1.47CY_{-1} - 0.65CY_{-2} + 0.02\Delta EXR_{-4} + 0.21\Delta M1_{-3} - 0.18\Delta M1_{-4}$
-1.03 19.13 ** -8.57** 2.00** 3.39** -2.80**

$\overline{R^2}$ = 0.90, SER = 0.015, DW =2.22, F =158(0.00), $BG1_{LM}$ = 2.31(0.13), $BG2_{LM}$ = 1.34(0.27), ARCH1 = 0.00(0.98), ARCH2 = 0.54 RESET1 = 0.134(0.716), RESET2 =0.452(0.638).

$SEAS_t = 0.004 + 0.05SEAS_{-1} + 0.25\Delta M1_{-1} - 0.29\Delta RGDP_{-1} + 0.04\Delta EXR + 0.04\Delta EXR_{-1} + 0.02D\_F$
0.49 5.95** 2.43** -2.25** 1.67* 1.76* 1.92*

$\overline{R^2}$ = 0.47, SER = 0.04, DW =2.05, F =12.65(0.00), $BG1_{LM}$ = 0.11(0.74), $BG2_{LM}$ = 0.15(0.86), ARCH1 =0.053(0.817), ARCH2 = 0.03 (0.971), RESET1 = 0.103(0.749), RESET2 =0.512(0.601).

$INF_t = 0.01 + 0.33INF_{-1} - 0.23INF_{-2} + 0.33INF_{-4} + 0.48\Delta M1_{-2} + 0.05EXR - 0.06EXR_{-2} - 0.50\Delta NGDP - 0.47\Delta NGDP_{-4} + 0.04D\_R$
0.71 3.62** -2.64** 4.25** 3.93** 2.75** -3.38** -2.30** -2.56** 1.76*

$\overline{R^2}$ = 0.54, SER = 0.044, DW =1.83, F =10.42(0.00), $BG1_{LM}$ = 1.65(0.202), $BG2_{LM}$ = 0.85(0.432), ARCH1 =0.03(0.873), ARCH2 = 0.065 (0.936), RESET1 = 3.67(0.060), RESET2 =1.95(0.149).

Notes: **(*) implies 5(10) percent significance level. TR, CY, and SEAS are, respectively, the trend, cyclical, and seasonal components of inflation. NGDP is real non-oil GDP, DEF is fiscal deficit, EXR is exchange rate, INF is inflation, RGDP is real GDP. ? implies first difference. *t*-statistics are reported under the coefficients. D_F and D_R are the fuel price increase and economic reform dummies. The diagnostic tests are reported below each result. SER is the standard error of regression, DW the Dubin-Watson statistic, F the test of joint significance, BG_{LM} the Breusch-Godfrey Serial Correlation LM Test (using one and two lags), ARCH is the Engle's autoregressive conditional heteroscedasticity test (using one and two lags), RESET is Ramsey test for functional form mis-specification (using one and two fitted terms). The F values (and their equivalent *prob*. values in brackets) are reported.

V. 1 Summary of Findings

In general, some tentative findings emerged from the analyses. First, it is observed that the long run (trend) behaviour of inflation in Nigeria is largely influenced by the past levels of trend inflation and money supply. This lends credence to studies like Adamson (1989) that argued that "Nigeria's inflationary experience can be traced ultimately to excessive monetary growth". However, this study observed that the level rather than the growth of money is the important factor in the trend behaviour of

inflation in Nigeria. It is observed that the cyclical movement in inflation is due to exchange rate changes and monetary growth (with the cycle itself being self propagating). Studies like Masha (1999) have also argued that variation in the parallel market exchange rate was one of the determinants of price level behavior in Nigeria.

The main factor driving seasonal fluctuation in inflation is growth in money supply and real GDP, with exchange rate changes having some marginal effects. In the general case, it is observed that growth in money, exchange rate changes (defined as $\Delta \ln exc$) and growth in non-oil GDP (with the reform dummy at 10 percent) are the main determinants of inflation in Nigeria. In all the components, monetary variables feature prominently as a major determinant of inflation. Except for the trend component, exchange rate also features as a significant determinant of inflation in Nigeria.

It is observed that the shorter the duration of the fluctuation in inflation the more difficult it is to explain the variations in inflation, For example, large proportion of the variation in the trend component was captured while less than half of the variation in the seasonal component was captured by our model. When inflation is modelled as a single series, just above half of the variation in inflation was captured by the model. In terms of policy, the paper suggests that in the long run, a well coordinated monetary policy that ensures optimal money supply will help reduce the rapid growth in price level. In the short-to-medium term, it will be important to put in place measures that will stem rapid growth in money supply, stem devaluation of the currency and enhance growth performance in the non oil sector.

VI. Conclusion

This paper examined the determinants of the various time series decomposition of inflation in Nigeria. It was observed that the behaviour of money, narrowly defined, is a major driving force behind the observed behaviour of inflation in Nigeria particularly in the long run. In the short-to-medium term, output and exchange rate were observed to play some significant role in determining movements in the price level in Nigeria.

Hence, based on the proposed hypothesis, the paper argues that money supply is the only common determinant of inflation in the short-to-long term. Other variables are relevant depending on the duration under consideration. Hence, the paper submits that the various components of inflation are driven by different fundamentals. This evidence supports the view that pure monetarist theories of inflation are able to account, to a large extent, for the price dynamics in Nigeria from the eighties up to 2003. The paper finds that it is easier to capture long run behaviour of inflation than capturing short run fluctuations in inflation, given the model adopted. This finding has significant implications for inflation predictions. Attempts to predict aggregate movement in inflation might require taking into consideration, separately, the various time series components of inflation. In terms of policy dimension, it is argued that since fiscal deficit and government borrowing in Nigeria are largely financed by the banking system, with serious implications for monetary growth, the findings lend support to the conventional elements of a typical stabilisation program that reducing both the budget deficit and credit to the government are crucial in fighting inflation. Finally, since the results indicate the negative impact of economic growth on inflation, structural reforms and infrastructural improvements to increase the country's productive capacity and ease supply constraints should be considered important elements of an overall economic reform program. Future studies can investigate other decomposition methods and use other means of generating quarterly data for the relevant variables.

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The Lending Channel of Monetary Policy Transmission in Nigeria; Vector Autoregressive (VAR) Verification

Mbutor O. Mbutor*

Using the standard Cholesky decomposition, preliminary evidence shows that the price of bank loans rises contemporaneously with an unexpected monetary policy tightening. Also, the quantity of loans made by deposit money banks falls, in response to the same policy shock, though with a lag, and the point estimates are statistically significant. There is, therefore, a confirmation that the lending channel exists in Nigeria. Thus, an increase in the MRR causes a contraction in banks' credit to the economy. However, the GDP does not respond appropriately, evidencing the weak nature of the link between monetary policy actions and the real sector of the economy.

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I. Introduction

Following the recent drive for the consolidation of the financial system, public interest in monetary policy in Nigeria has heightened. Stakeholders in the economy want to establish in clear terms, the exact impact of monetary policy action on the development of the real sector in particular and the overall growth in aggregate output. However, the specific direction and size of the impact of monetary policy actions on the real sector of any economy are not known with precision.

The lending channel of monetary policy transmission proposes that changes in the quanta and the associated prices of loans made by deposit money banks could be used as a measure of the impact of monetary policy in the economy. Specifically, proponents of this school of thought argue that an increase in the policy interest rate (tight monetary policy stance) will lead to a fall in the quantity of loans made by commercial banks (even when

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there are perfectly good loans to make) and a rise in the price of loans which, ceteris paribus, will lead to a fall in investment and consequently cause the volume of aggregate output to decline.

The reforms embarked upon by the Central bank of Nigeria are aimed at strengthening the financial system. The impetus for the reforms follows from the understanding that a sound financial system will render monetary policy more effective and also support growth in the real sector of the economy. This perception that the existence of sound banks will help to effectuate monetary policy therefore, must be a consequence of the conviction that there exists a definite link between monetary policy action and the lending behaviour of the deposit money banks. However, as in other stabilizing economies, the functional relations among the variables that convey monetary policy impulses through the banks to the real sector are multi-dimensional. For instance, the Central Bank of Nigeria uses the minimum rediscount rate (MRR)[1] as its anchor rate for all other interest rates in the economy. Thus, when monetary tightening is desired the Bank increases the MRR with the anticipation that all other interest rates will follow in the same direction. However, a close scrutiny of the use of the MRR as an anchor rate reveal that deposit rates in the short end of the market fall contemporaneously with the decrease in MRR, but the same cannot be said of the lending rates. Therefore, the quest to identify the perfect form of the transmission mechanism of monetary policy for various economies is a continuous one.

Generally, deposit money banks play a major role in the provision of funding for the private sector. Some empirical findings show that the ratio of bank loans to total credit of non-financial firms for Germany, France, Italy and Spain are 85 per cent, 80 per cent, 95 per cent and 77 per cent, respectively. The figure for US is 30 per cent. In Nigeria where the 'bonds' market is underdeveloped, the preeminence of banks in the intermediation process is almost total. Edo (1997) confirms the near total dominance of banks in financial intermediation when he reported that the contribution of the capital market to private sector funding in Nigeria is insignificant. As in

[1] *The MRR is equivalent to the Fed fund rate in the United States of America and the overnight call rate in Japan*

other economic jurisdictions, banks in Nigeria, commit a substantial quantum of their total deposit liabilities to loans. At 41.2 per cent, between 1970 and 2000, the loan-deposit-ratio of commercial banks was lowest in the first quarter of 2000 and highest at 85 per cent in 1982.

The major impact of banks on the real sector could be gauged, roughly, by the quantity and quality of loans and advances to the sector. Anecdotal evidence suggests that, in a liberalized financial system, a consistent increase in the quantity of loans made by the commercial banks to any sector of the economy could be interpreted to mean that banks have stable and secure returns to their investments in the sector. In order words, the marginal productivity of capital in the preferred sector of interest must be positive. However, this observation may not necessarily hold when the performance of a loan can only be enhanced with an increase in the loan stock[2]. Therefore, the increase in the quantity of loans made to the sector would not be driven by the current stream of returns to investments. Evaluating the lending channel of monetary policy transmission mechanism in Nigeria will enable an understanding of the independent roles which banks play in the economy.

The objective of this paper is to ascertain whether the lending channel of monetary transmission mechanism exists in Nigeria.. The rest of the paper is organized in the following order. Section 2 presents review of literature and examines some conceptual issues, Section 3 discusses the data, methodology and states the hypothesis, while Section 4 analyses the results and extracts policy issues. The paper ends with conclusion in Section 5.

II. Review of Literature

II.1 Issues in Monetary Transmission

The main objective of all theories of monetary transmission is the analysis and description of the long, indirect, and complex relationship between monetary policy actions of a central bank and their effects on the final

[2] *A loan could be under-performing because the amount falls short of the requirement of the enterprise. Therefore, an increase in the loan amount would be required.*

targets of macroeconomic policy (Bofinger 2001). Specifically, studies of monetary policy transmission mechanism would focus on the direction and/or magnitude of the impacts of a monetary policy action on aggregate output and price levels.

The understanding of the exact process of monetary transmission is a daunting task. Blinder (1998) in support of this view alludes to the lack of consensus among economists on the appropriate econometric model to be applied and the long and variable lags associated with tracking the transmission process. Friedman and Schwartz (1963) argued that when the authorities are pursuing a restrictive monetary policy, there is an average lag of 12 months, with a fluctuation range of 6 to 29 months and when they are pursuing an expansionary policy, there is an average lag of 18 months with a fluctuation range of 4 to 12 months.

The problem with determining the 'right' transmission mechanism is made more complicated in developing economies where structural and behavioural changes are regular features of the financial system. However, the concerns notwithstanding, the potency of monetary policy has been established in Japan (Suzuki 2004) and other economies, so that there cannot be any denying the certain link that exists between monetary policy actions and the wider economy..

Several channels of monetary transmission exist. However, the interest rate component has featured prominently in leading textbooks and theoretical studies. The emphasis on the interest rate channel arose from the recommendation of the Radcliffe report in the United States of America, which recommended that those deciding monetary policy should regard the structure of interest rates rather than some notion of the 'supply of money' as the centre piece of monetary action. The interest rate channel is exposed in the marginal efficiency of capital function which posits an inverse relationship between the real interest rate and the present value of capital and consumer durable goods. The implication here is that a reduction in the real interest rate will lead to an increase in the present value of capital and durable consumer goods and increase the Tobin's q[3].

Impetus, therefore, will be given the growth in aggregate demand through the application of the multiplier to the now increased production of durable goods. The assumption underlying the above process is a low inflation regime. There is evidence in the literature that monetary policy does not only affect the interest rate but also the external finance premium. This brings to light the notion of credit channel of monetary transmission mechanism. The credit channel is merely an amplifying mechanism and not independent of the interest rate channel (Bemanke and Gertler (1995).

The main focus of the lending view is on banks and this is consistent with the finding that banks are the principle conveyors of monetary policy impulses to the real sectors of the economy. The lending channel of the transmission mechanism is a subset of the credit channel and works through the instrumentality of bank loan-supply. The major tenet of the process is embedded in the proposition that monetary tightening by authorities will increase the cost at which reserves are made available to deposit money banks by the central bank. The increased cost would consequently reduce the volume of reserves which DMBs hold at any point in time. With the reduced volume of reserves, DMBs are forced to reduce the quantity of loans which they advance to their customers. The reduced lending would lead to a fall in the level of investments thereby leading to a fall in the aggregate level of output and a rise in the rate of unemployment. The argument is hinged strongly on the assumption that capital market imperfections do not allow banks to switch, without friction, from their dependence on reserves with the central bank to alternative sources of raising funds in the wake of monetary tightening. A corollary to this in the non-financial firms states that firms that have their loan sourcing potentials eroded by high interest rates tend to look elsewhere but usually with adjustment costs (the balance sheet view). Pioneer advocates (Bernanke and Blinders 1992) of the lending channel have traced the impact of monetary tightening to include an immediate drop in bank deposits and their holding of securities, a lagged fall in bank loans, while measures of aggregate output respond to monetary impulses with a similar lag, thus declining roughly contemporaneously with bank loans.

The lending channel was developed to address the limitations of the

[3] *Tobin's q is the Quotient: market value over asset value.*

traditional money view. The traditional view, typified by the IS-LM framework is modeled using three variables, money, bonds and reserves that banks hold with the central bank (Bofinger 2001). The implication of this trivariate model is that the role of banks in the transmission process is extremely insignificant. According to Kashyap (1997), banks do nothing unique on the asset side of their balance sheets -like the household sector, they too invest in bonds. The other shortcoming of the money view is that the central banks' (minimum) rediscount rates are neglected making the rate on bonds the only cost of all credits in the system. Also, the assumption of sticky prices renders changes in nominal interest rates identical to real interest rates. The money view, therefore, presents an over simplification of the transmission process in an economy with complexities in the financial system. The lending channel is a variant of multivariate techniques for measuring the transmission mechanism which were proposed by Brainard (1964) and others. Summarily, the model represents the money view with bank loans included as a variable. A major assumption of the model is that alternative sources of funding cannot be perfectly substituted for one another. The major advantage of this view over the traditional view is the admission of multiple interest rates in the model

Since the interest on the lending view, several studies have been conducted with intriguing findings and controversies. Some authors have argued that the notion of the central bank altering the loan supply behaviour of banks by just tampering with their reserves is not plausible. Romer and Romer (1989) suggest that banks can easily and without friction substitute their sources of funds such that their loan supply function is effectively insulated from monetary policy tightening.

Bernanke and Blinders (1992) seeking to verify the lending channel estimated their model using US data between 1959 and 1978. The included variables were Fed fund rate, unemployment rate, consumer price index, bank deposits, loans and securities. They found that monetary contraction (increase in Fed fund rate) led to a fall in loans and a rise in the rate of unemployment. Kashyap and Stein (1994) extending the same data to 1990 and using the same methodology arrived at the same conclusions. Suzuki (2004) has also confirmed the existence of the lending channel in Japan.

Some authors disagree with these findings with the presence of the supply-versus-demand puzzle. The issue is that it is unclear whether the fall in the quantity of loans was occasioned by the inability of firms to ask for new loans due to a gloomy business outlook, or that the suppliers of the loans could not afford to meet all demands for loans as a result of the increased cost of accessing reserves with the Central Bank. As the argument goes, the observed fall in loans may be interpreted that drops in aggregate output, following the traditional money channel, depressed firms' demand for loans so that the presence of the lending channel may not necessarily have the contribution credited to it.

In an attempt to determine whether the observed fall in bank loans was occasioned by a fall in loan demand of firms or merely a change in the composition of the loan portfolio, Kashyap, Stein and Wilcox (1993) considered the fluctuations in bank loans and commercial papers. Their results showed that when monetary policy is tight; the issuance of commercial papers increased even when bank loans fell. This result confirms that banks, when faced with tight monetary policy conditions tend to switch to other sources of advancing credit which are not subject to the statutory reserve requirements of the central bank.[4]. Also, in a bid to solve the supply-demand puzzle, Suzuki (2004) assumes that an observable quantum of bank loans is the equilibrium value given by the intersection of demand and supply curves in the bank loans market. Given the imposed equilibrium a negative correlation between price and quantity identifies a shift in supply while a positive link signals a shift in the demand function.

The effort of Kashyap, et al, in identifying the shift in supply using fluctuations in loans and commercial papers has been criticized by Oliner and Ruderbusch (1996). They argue that the credit behaviour of small firms is different from that of the big firms in the sense that the latter could rely on own funds or even resort to other avenues for funding with relative ease, while the former are predominantly bank dependent. .The contention is that their model assumed a homogenous loan demand function for all

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[4] *Commercial papers are not treated as balance sheet items for the purposes of computing reserve requirements.*

firms. The reasoning is that large firms are more likely to raise funds through the issuance of commercial papers than the smaller ones, implying that the suggested inward shift in loan supply may not capture the behaviour of smaller firms. This point shows that the use of aggregate data for the analysis of the lending channel of monetary transmission mechanism is inadequate.

Kashyap (1997) has presented a micro approach to analyzing the lending channel. The advantage of this method derives from the introduction of heterogeneity in the demand functions of firms. He disaggregated firms according to sizes and tested the prediction that monetary policy tightening affects smaller firms more than larger ones mainly because smaller firms are more dependent on bank loans than other sources of funding. The prediction was confirmed. The downside of this approach rests in the fact that the aggregate impact on the economy of any monetary policy action may not be properly gauged.

Testing for the existence of the credit channel of transmission mechanism in Japan, Suzuki (2004), using quarterly data from 1980Q1 to 2000Q4, affirms that monetary tightening, represented by an unexpected increase of 0.25 percentage point in the overnight call rate causes the quantity of new loans to shrink by about 3.5 per cent in the quarter following the policy action. Loan prices also increased with the policy action. In the same research, Suzuki found that monetary policy works efficiently in Japan with the observation that real GDP falls by 0.5 per cent in the 11^{th} to 12^{th} quarter after a 0.25 percentage point hike in the overnight call rate. His findings are, therefore, supportive of the existence of the lending channel of monetary policy transmission mechanism.

In their quest to confirm the lending channel for continental Europe (Germany, France, Spain, and Italy), Carlo et al (1999) utilized information from 651 banks from the included countries to determine how bank lending responded to the monetary tightening of 1992. Their results show that the lending channel of monetary transmission does not hold in the area. However, they conclude that the shift in the loan functions of strong banks are more insulated from monetary policy action than smaller ones.

The latter finding is consistent with the extended lending channel prediction that tight monetary policy disproportionately impact on smaller firms.

II.2 Some Facts on the Lending Behavior of Deposit Money Banks in Nigeria

In Nigeria, two broad monetary policy regimes could be distinguished. The first regime was characterized by direct administrative controls on credit and interest rates, while the other dwells on the era where credit to the private sector was competitively distributed. In the first period banks were assigned mandatory guidelines on how much credit to make to preferred sectors of the economy. Thus, banks made loans essentially in order to meet government regulations and not necessarily based on the expected returns. Nnanna (2001) found that distortions in the pricing of loans caused by the administrative intervention in the market rendered financial intermediation by the deposit money banks ineffective. In the liberalised era, deposit money banks engage in diligent credit packaging and risk analysis before making loans in order to reduce carrying non-performing assets in their books. Nnanna and Dogo (1998) have shown that financial liberalization has led to increased credit to the private sector of the economy. However, evaluating the sectoral distribution of loans by the deposit money banks in Nigeria, it could be observed that the real sectors of the economy have not benefited proportionately. This situation could be attributed to the relatively high risk premium and the long period of pay back associated with the sector.

III. Model, Data and Hypothesis

III.1 The Model and Included Variables

The method adopted in this paper is the Vector Autoregressive (henceforth VAR) methodology and draws mainly from the benchmark specification for the euro area as presented by Peersman and Smet (2003). The major attraction to the use of the VAR methodology is the fact that it enables the estimation of the interdependence amongst variables without necessarily holding the impacts of any of the variables constant. The method

also captures the contemporaneous and lagged responses of the variables simultaneously. The VAR takes the form;

$$Y_t = A(L)Y_{t-1} + B(L)X_t + U_t \quad \text{.....(1)}$$

Y is a vector of endogenous variables while X is a vector containing the exogenous (foreign) variables. The assumption underlying the exogeneity of the foreign factors is that there is no feedback from the domestic variables to the foreign variables (see Ignazio, et al 2003)

The benchmark specification for the vector of exogenous variables X contains world commodity price index (wp_t), United States real GDP (y_t^{US}) and the US short term real interest rate (s_t^{US}).

$$X_t = (wp_{t,}\ y_t^{US} s_t^{US}) \quad \text{.....(2)}$$

While the vector of endogenous variables Y includes domestic GDP (y_t), domestic prices (p_t), domestic short term nominal interest rate (s_t), broad monetary aggregate ($m3_t$), and the real effective exchange rate (x_t)

$$Y_t = (y_t\ p_t, s_t, m3_t, x_t) \quad \text{.....(3)}$$

This paper will be concerned primarily with the vector of endogenous variables Y_t. The concentration on the endogenous variables is informed by the fact that the Nigerian economy is largely mono-product, relatively small and does not have an internationally competitive manufacturing sector. Therefore, the impact of world commodity prices on the GDP can be assumed to be insignificant. Also, the financial market is relatively small and the current account component of the balance of payment (BOP) is not fully liberalised. Thus, there would be little reason to affirm that interest rate developments in the US could have an observable direct impact on the money market in Nigeria[5].

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[5] *Saying otherwise would imply that substantial foreign direct investment have flown in to Nigeria on account of the very high differential between interest rates in Nigeria and the United States*

Without the inclusion of the exchange rate variable, equation (3) is the standard IS-LM model; output, prices, short term interest rate and money. The lending channel as propounded by Bernanke and Blinders (1992) extends the IS-LM model to include the loans market. Thus, key variables to capture the developments in the loans market will be included in the model. These additional variables include the quantity of loans (q^L) and the corresponding loan prices (p^L). These are the key variables being evaluated by the lending channel of monetary policy transmission mechanism. As the Nigerian economy is considerably small and open, it will be worthwhile to retain exchange rate in the model especially, bringing to reckon the fact that the Nigerian economy is an import dependent one. Thus, a depreciation in the exchange rate could cause an increase in import prices (ceteris paribus), leading to a corresponding increase in the demand for letters of credit (LCs) and other forms of foreign loans made to exporting countries The variable also provides a veritable source for reflecting other forms of trade and monetary policy shocks in the rest of the world. The measure of monetary aggregates (m3) has also been replaced with broad money (m2). The model to be estimated can be presented as follows,

$Yt = (y_t\ p_t, s_t, m2_t, x_{t,} q^L\ p^L)$ ……………………………………………………………(4)

Where;

y_t = GDP

p_t = Domestic prices (proxied by the consumer price index)

s_t = Treasury Bills Rate (proxy for MRR)

$m2_t$ = Broad Money

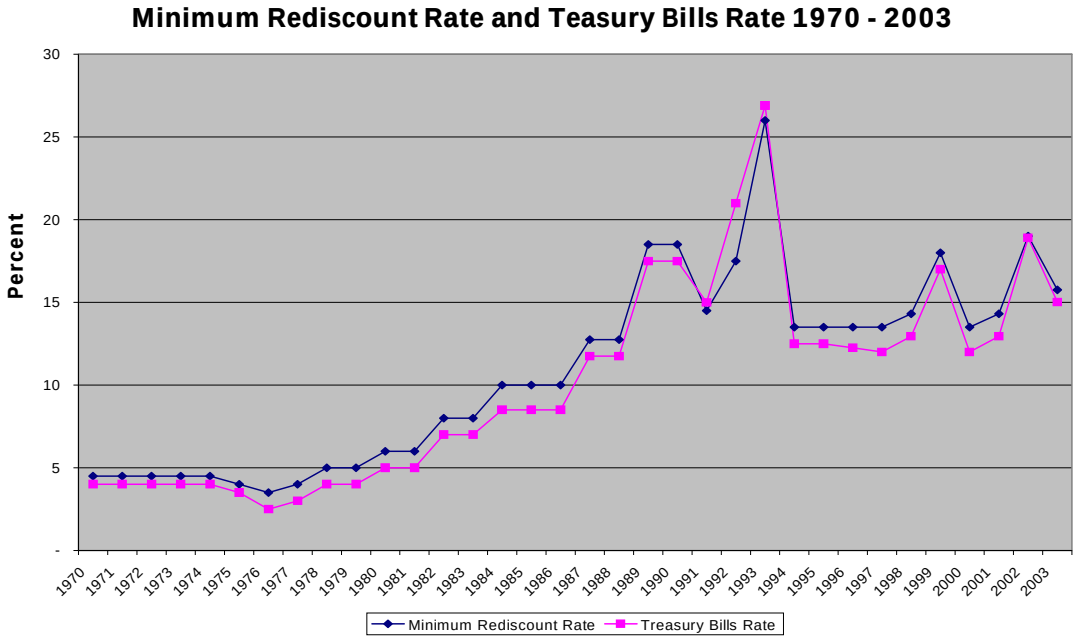
x_t = Exchange rate

q^L = Total quantity of all loans

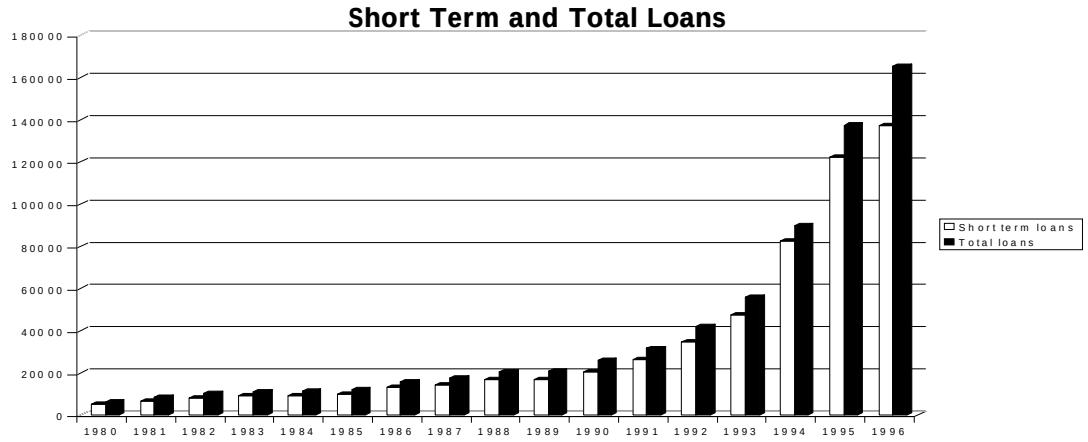
p^L = Price of loans (average maximum lending rate)

The MRR will be used as the source of monetary policy shock in the model. Since the MRR is merely an anchor rate, (but not a transactions rate), a proxy for it will be used in the model instead. To derive a suitable proxy, the paper utilizes the positive correlation between the MRR and the treasury bills rate in Nigeria as a guide (see chart below). Therefore, the TB rate will be used as the policy rate. This approach may be justified

for Nigeria on the grounds that an increase in the Treasury bill rate may attract banks to increase their investment in government securities which are almost risk-free to the detriment of loan seekers.



The price of loans will be represented by the deposit money banks' weighted average maximum lending rate. Also, the total loan stock can be assumed to be an inventory of new loans since commercial bank loans in Nigeria are predominantly short termed (see chart below)



Operationally, all the variables in the model are evaluated in their log forms except the loan price and the policy interest rate which are in percentages. The use of the log values of the variables will enable the estimated coefficients of the variables to be interpreted as elasticities. The operational equation is presented below,

$Yt = (Logy_t\ Logp_t, s_t, Logm2_t, Logx_{t,}\ Logq^L, p^L)$ .....(5)

The annual series data used in the paper span between 1970 and 2000

III.2 Statement of Hypotheses

The hypothesis to be tested, **H0** is that the lending channel (of the transmission mechanism) holds in Nigeria, against the alternate hypothesis, **H1**, the channel does not hold in Nigeria. To accept **H0**, the result of the estimates must show that as a result of an increase in the TB rate (monetary tightening,)

1. The quantity of loans ($Logq^L$**)** advanced by commercial banks decreases and/or
2. The price (p^L) of loans increases

Otherwise H1 will be accepted.

IV. Estimation Results

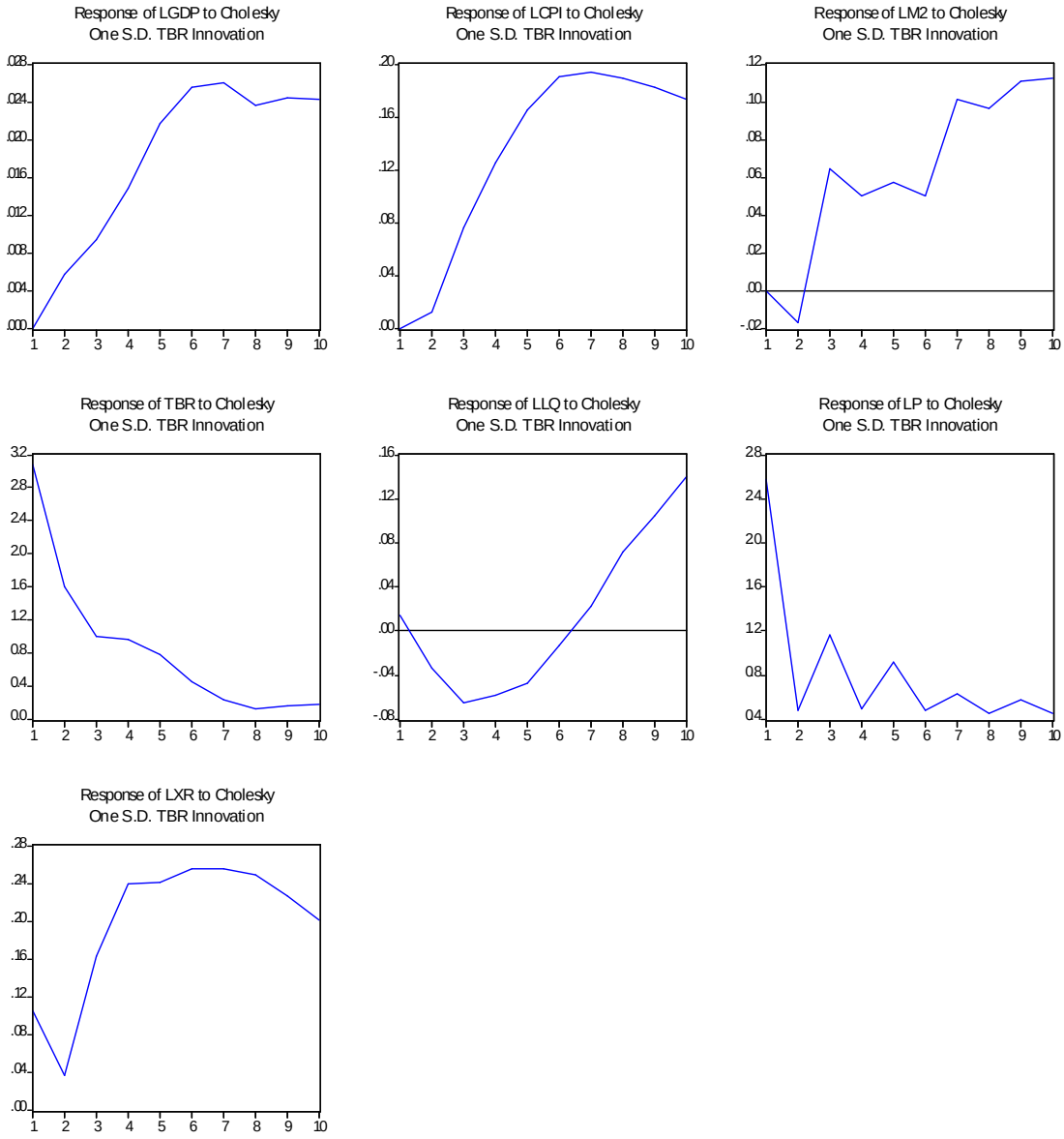
The results of the estimates are presented as follows. The ordering of the variables follows the standard cholesky procedure. $Yt = (Logy_t, Logp_t, Logm2_{t,} s_t, Logq^L, p^L, Logx_t)$. The reasoning behind the ordering is that a monetary policy shock does not have a contemporaneous impact on output, general price level and the quantity of loans. Exchange rate is expected to respond immediately to policy shocks while the response of loan prices will show up immediately in new loans. It can also be shown that the impulse responses are robust to alternative orderings. (Several other ordering alternatives were done)

The empirical findings shown in the figure 1 below represent the various responses of GDP, CPI, Quantity of loans, Price of loans and the (nominal)

exchange rate to a one standard deviation (0.25 percentage point) positive shock on the treasury bills rate at 5 to 10 per cent level of significance..

As the result shows, an increase of the minimum rediscount rate by 0.25 percentage points will leave the quantity of loans made by the commercial banks unaffected in the first period. The lagged fall in the quantity of loans is consistent with expectations that loan contracts take some time to be adjusted. In the second period, the quantity of loans drops by 3.3 per cent. The highest fall in the quantity of loans as a result of the monetary policy innovation is recorded in the third period at 6.5 per cent. All the results were statistically significant. This evidence confirms that an increase in the MRR causes banks to reduce the quantity of loans which they extend to their customers. The null hypothesis that the lending channel of monetary policy transmission mechanism exist in Nigeria is therefore accepted.

Figure 1


Response of LGDP to Cholesky
One S.D. TBR Innovation
Response of LCPI to Cholesky
One S.D. TBR Innovation
Response of LM2 to Cholesky
One S.D. TBR Innovation
Response of TBR to Cholesky
One S.D. TBR Innovation
Response of LLQ to Cholesky
One S.D. TBR Innovation
Response of LP to Cholesky
One S.D. TBR Innovation
Response of LXR to Cholesky
One S.D. TBR Innovation

The response of deposit money banks' loans to changes in the MRR could be explained by the following points

1) Deposit money banks, until recently, were not sufficiently disposed to interbank lending as they showed preference to offloading funds in excess of transaction requirement at the central bank. Therefore, a contraction in the policy rate would affect the quantity of loans made out.

2) The capital market is not well developed - since the capital market is not well developed the problem of information asymmetry is deeply seated in the process of financial intermediation. The implication of the situation is that speculation becomes an added implicit cost factor in the funds market- working to increase the premium on alternative sources of capital.

3) The savings rate is low in an economy - low savings rate in an economy presupposes increased difficulty on the reliance on own funds and alternative sources of funds.

4) The length of time for adjustment by banks is long - the length of time it takes banks to grab alternative avenues for funds poses a form of cost which would render their actions susceptible to central bank's dictates. The time of adjustment is particularly important in the sense that banks do not wait until they have sufficient deposit base before making loans. Rather deposit money banks, most times, make loans then begin to look for the resources to consummate the contract. Therefore, if the adjustment period is long, when the monetary authorities increase the rediscount rate banks are forced to shed new and marginal loans in order to be able to sustain current contracts.

The behaviour of loan prices also confirms the presence of the channel in Nigeria. A 0.25 percentage point increase in the MRR leads to an increase of the prices of loans by 2.57 per cent in the first period. In the second period the rate of increase drops to about 1 per cent. The increase in the

price of loans persists, though with remarkable fluctuations in the rate, all through the sample period. However, the observed increases in prices were not statistically significant.

Other Findings

The GDP is expected to decrease with an increase in the MRR. This position would hold given the a priori expectation that the fall in the quantity of loans leads to reduced investment and therefore a fall in the aggregate level of production. Evidence from these estimates does not confirm this notion for Nigeria. A monetary policy shock induced by a 0.25 percentage point's increase in MRR does not have any observable impact on the GDP in the first period. However, in the 2nd and 3rd periods, GDP responds with a growth of 1.6 per cent and 1.7 per cent, respectively. In all the periods covered by the analysis, the growth in GDP is positively signed and, therefore, run counter to theoretical expectations. The outcome of this study appears consistent with credit flows in Nigeria. The increase in foreign assets, received mainly as oil revenue, which accrues to the federation account is distributed among the various tiers of government every month. The consequence of this is that accretion to credit (for investment) mainly emanates from government payments (especially for contracts) and not necessarily as a result of DMBs activities. Suzuki (2004) reported that GDP responded correctly to increases in the overnight call rate in Japan. The finding led him to conclude that monetary policy is effective in Japan. Agreeing with the position and extending the reasoning to Nigeria, it could be said that the link between monetary policy and the real sector of the economy is weak. Nnanna (2001) also posted the same finding that the expansion in domestic credit did not reflect in the anticipated increase in the aggregate level of output.

The model was re-estimated to verify whether the response of GDP to the policy shock would be different without the oil component. The non-oil GDP was used instead of the total GDP in the model. However, the result of the estimate remained the same.

The response of exchange rate meets the theoretical expectation. Theory posits that the exchange rate will rise with an increase in the policy interest rate. In the first period, a 0.25 percentage point increase in the MRR was followed by an increase, in the nominal exchange rate, of 10.4 per cent. In the second, through all the sample periods, the response of exchange rate was correctly signed and the estimates were statistically significant. The result here appears consistent with developments in the Nigerian financial system. Two reasons support this view. One, the frequency (now held twice in a week) of the Dutch Auctions System of disbursing foreign exchange makes it easy for any monetary policy shock to be felt immediately in the foreign exchange market. Two, the foreign exchange market is a competing outlet for banks' resources.

The response of broad money (M2) to the shock from the increase in MRR meets the a priori expectation. A 0.25 per cent increase in the MRR will cause M2 to contract by 1.7 per cent in the second period.

Lastly, the general level of prices as depicted by the CPI is not affected contemporaneously by an increase in the MRR. However, in the second period, it rises by 1.2 per cent. The increase in the CPI persists all through the sample period. This finding confirms that hikes in the interest rate cause the rate of inflation to rise. This could well be the case in Nigeria where wholesale production is largely supported by bank credits.

IV.1 Policy Issues

Some policy issues to be noted here are that,

1. An increase in the MRR causes the quantity of loans advanced by the deposit money banks to fall with a lag of about 12 months
2. The price of loans tends to rise contemporaneously with an increase of the MRR.
3. Treasury bills rate has a contemporaneous and positive relationship with the minimum rediscount rate in Nigeria.
4. Government securities are veritable investment alternatives to commercial banks

V. Conclusion

This paper has evaluated the nature of the lending channel of monetary policy transmission mechanism. The major prediction of the approach is that a monetary tightening through increase in the policy interest rate will lead to a decline in the quantity of loans granted by commercial banks. Nigerian data from 1970 to 2003 have been utilized to ascertain the correctness of this hypothesis, using the vector autoregressive methodology. The results show that increases in the Treasury bill rate lead to a contemporaneous rise in the price of loans and a fall (with a lag) in the quantity of loans. Both affirm the existence of the lending channel medium for monetary policy transmission in Nigeria.

Also, the estimate of the response of GDP to monetary policy tightening showed that the increased price of loans and the decline in the quantity of loans do not translate to a corresponding fall in the aggregate level of output. Based on this, the paper suggests that the link between monetary policy and the real sector is weak. The response of the exchange rate indicates that there is a link between the foreign exchange market and the domestic market in Nigeria. Finally, the paper also found that increases in the policy interest rate in Nigeria leads to persistent rise in domestic prices.

Limitation of the Study

The major limitation of the study is the fact that annual data were used and this does not leave sufficient room to gauge the correct lag of policy actions on the included variables. It is therefore suggested that the lending rate channel should be investigated using higher frequency data.

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The Persistence of Corruption and Slow Economic Growth+- A review

A.U. Musa*

I. Introduction

As submitted by the author, corruption and all aspects of poor governance and weak institutions have significant adverse effects on economic growth and welfare. However, many countries, especially developing countries, seemed to have been caught up in a vicious cycle that perpetuates corruption and underdevelopment in their societies. Thus, because bureaucratic, legal, social and other vital institutions are weak and/or inadequate, poverty is widespread, the political class is corrupt, and no effective check for corruption exists. Besides, poverty and lack tend to further weaken the electorate's ability to challenge the corrupt political class. Individuals lack incentives to fight corruption even though everyone is better off without it. The paper's objective is to study, formally, these interactions among the individuals engaged in corruption, and between the individual and the corrupt political class. In doing this, two models involving strategic complementarities that lead to multiple equilibra were used to show these relationships.

II. Summary of The Paper

The author identified two situations in a corrupt society; (i) the individual bureaucrat who allocates his labour services between productive activity and theft of government resources in a classical case of portfolio adjustment and (ii) the corrupt politician who sets a bribe collection system (a bribe rate) with the maximization of utility as his goal vis-à-vis similar decisions by fellow politicians. Both situations involve strategic complementarities in that the decision of **A** to steal encourages and

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reinforces that of **B** to do the same or the decision of **A** not to steal encourages and reinforces that of **B** to follow suit.

Model I

In the first case, the author employed Barro's model of endogenous growth where government expenditure **(G)** enters as an input. The author reasoned that since not all **G** reaches the production process (some are stolen by corrupt individuals), economic growth would be adversely affected. Given total available **G** and available labour services, which the individual can allocate between productive work **(L)** or theft **(S)** or a combination of both, the author showed that the individual's decision boils down to a comparison between the net wage **(W)** and the Marginal Propensity for Rent Seeking or net gains from theft of **G (MPRS)**. He analyzed:

Given a unit of labour, which can be allocated to either Productive work **(L)** or Theft of Government resources **(S)**, Total labour usage becomes,

$$L + S = 1 \text{ or } S = 1 - L$$

A good steady state exists when **L = 1** or nobody is stealing since all labour services is allocated to productive work. The other extreme is when **L = 0** and all **G** is simply being stolen while nobody engages in productive work. However, since strategic complementarity leads to multiple equilibra, the author equated the net wage and net gains from corruption functions and solved the resultant quadratic equation. L_1 (the upper boundary) was found to be unstable while L_2 (the lower boundary) was stable.

He drew four scenarios from the results above.

1. The wage curve lies permanently above the **MPRS** curve (they do not intersect and **L = 1** is the only steady state)

2. The two curves intersect at two points and $L_2 < L_1 < 1$

L_2 is stable while L_1 is unstable. This is because an increase in the amount of L from L_2 leads to **W < MPRS** and, thus, the individual supplies less

labour until he returns to L_2 while an increase in L from L_1 leads to **W > MPRS** and the individual increases his **L**, which further reinforces the initial increase.

3. The two curves intersect as in **(2)** above but $1 < L_2 < L_1$ (the only steady state is in **L = 1**)

4. The two curves intersect as in **(2)** above but $L_2 < 1 < L_1$ (only L_2 is stable)

In **(2)** above, $e_1(L_2)$ is a **"bad"** equilibrium while $e_2(L_1)$ is a **"good"** one. This is because more **L** enters the production process in L_1 than in L_2. Moreover, while an increase in **L** from L_1 leads to higher productive work as against theft, an increase in **L** from L_2 is counteracted by individuals supplying less **L** so as to force wages back to its initial higher level. Evidently, the former generates more growth than the latter.

Model II

The second model, which also involves strategic complementarity, assumes that a corrupt politician will set up a bribe collection system and a bribe rate (to maximize his utility but which has an upper limit tm (a bribe rate higher than this will lead to exposure and punishment). The citizen and the politician both face the problem of maximization of utility.

The Citizen's Problem

a. If the citizens do not oust the corrupt government, they obtain a lifetime utility that is reduced by the bribe rate tm.
b. If they do oust the government, they obtain utility reduced by an efficiency loss represented by l (efficiency loss can be as a result of less competent successor government, political instability, social unrest causing production disruption, etc)

The author theorized that the citizens could only oust the government if and only if $l < tm$.

The Politician's Problem

c. If the government is not ousted, the politician obtains a lifetime utility commensurate with a bribe rate lower than the efficiency loss.

d. If the government is ousted, however, the politician obtains a utility commensurate with the maximum bribe rate (tm).

e. The author theorized here that for the cooperative solution, the politician will choose a bribe rate lower than the efficiency loss ($t < \lambda$) if utility is higher in b than in a above while he will choose (m) if utility is higher in b than in a.

The Bad Equilibrium

All politicians levy a maximum bribe rate, tm and since the government will collapse anyway, any marginal politician would levy, tm. Investment, growth and development are seriously hampered and poverty is perpetuated.

The Good Equilibrium

Here, the author theorized that if utility is higher in a than in b, all politicians will levy a bribe rate lower than the efficiency loss and, thus, the government is not ousted while investment and growth rate are high, at least higher than in the Bad Equilibrium.

III. Comments

The author has done an excellent analysis linking corruption and economic growth through the mechanisms of the Barro's model of endogenous growth. Let me expatiate on two contributions.

(i) In a succinct way, he showed us formally how an individual bureaucrat's decision to steal from the government results in lower investment and growth. This has implications for several things in African countries. With reference to Nigeria, we focus on two:

1. Poverty: In spite of the enormous resources (about x12.14 trillion and x13.63 trillion earned and spent, respectively, by the three tiers of government in Nigeria in the last ten years (1995 – 2004), it is not surprising that poverty has not abated and the welfare indices still look gloomy. An empirical research could be conducted to determine the actual proportion of those budgets that ended up in the intended production process and by extension those that did not.

2. Research: As it is now, research is done primarily by data presented by various government agencies among others. If a more reliable data is not available in the short term, then an index (capturing estimates of how much did not reach the production process) should be factored into all econometric research involving government spending. The issue is even more urgent for research into human development components such as education, health and food security. This would forestall faulty policy design.

(ii) In his second model, he has also shown us that the citizen faced with corrupt politicians has to determine whether the bribe rate is sufficient enough to warrant ousting the government and incurring an efficiency loss. Thus, Non-Governmental Organizations (NGOs), donor agencies and other developed nations concerned about widespread corruption in developing countries can target their anti-corruption campaign towards a reduction in the bribe rate (or a reduction in the efficiency loss). In the former, complete transparency in government accounts and activities can help lower the average bribe rate charged and the scope while sensitization campaigns on the rights of citizens can aid them to gauge that actual l is less than a lifetime t.

However, the study was silent on some issues concerning the peculiarities of developing countries especially those in the Sub-Saharan Africa:

(i) The author analyzed the problem while assuming institutional arrangements found only in the developed world. In most African countries for instance, the civil society is sharply divided into those

significantly above the poverty line and those below it. Nothing like a virile middle class. Expectedly, the latter that face economic deprivation seem to lack the will to challenge any corrupt bureaucrat or politician. It does not seem likely that this group (the poor) or the few rich who are mostly "comfortable" would make a choice of ousting a government and, thus, breaking the vicious cycle of corruption. A much stronger support from external and international agencies is required. Examples of such worthy causes that are becoming increasingly prominent are the World Bank anti-corruption campaign, the Transparency International (TI) initiatives, the UN and other international agencies, Good Governance watch, etc.

(ii) The author also suggested that a politician makes a choice between two bribe rates that offer two different utility levels. He picks the maximum bribe rate if he perceives the government would collapse. Since he is in power (and the legal and constitutional structures are usually weak and full of loopholes), why can't he levy the maximum bribe rate and perpetuate himself for sometime or at worst ensure someone who is his stooge succeeds him? In fact, that is exactly what is happening in most developing countries of Africa and Latin America. The case for a more involved campaign for good governance by all stakeholders cannot be overemphasized.

(iii) A third issue, which is rather a suggestion than a disagreement, is that of factoring in religion in the fight against corruption. In Nigeria for instance, over eighty per cent of the population profess and practice one of the two major religions both of which fortunately condemn, in the strongest of terms, corruption and in all its ramifications. This, in my opinion, is the strongest and most potent weapon against corruption. Being that corruption is more of a micro issue that culminates in a macro issue, the print media, electronic media, fora, campaigns, churches, mosques, christian and islamic associations, social gatherings, schools, every conceivable medium should be employed to sensitize and remind people of what their religions say about corruption. The age-long defense among researchers that economics should avoid value-laden issues is fast crumbling in the face of stifling socio-economic problems in Africa.

Promoting Innovation in Developing Countries: A Conceptual Framework+ - A Review

O. Adesanya*

I. Introduction

The paper aimed at providing a solid conceptual framework for the promotion of innovation in developing countries from which appropriate policies can be developed. The author opined that the growing interest in innovation promotion particularly technological innovation in developing countries stems from limitations experienced through traditional economic policies encapsulated in neo-liberalization. Furthermore, government interventions in building infrastructures for sustainable development in developing countries have not been able to yield the expected results.

The author snow dived into the concept of "innovation policies" embraced in the last four decades to have explicitly contributed to the sustainable growth of some economies. According to the author the concept of innovation encompasses not only technological innovation such as new products, but also includes new management styles, improved communication techniques and other new logistic arrangements. The challenges facing developing countries in applying the innovation processes arises from obstacles derived from inappropriate governance climates and insufficient education. These impediments, however, can be surmounted when the innovative processes are adapted to the needs and possibilities of developing countries.

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Ⅱ Major Highlights of the Paper

The authors' in-depth discussion on innovation elucidated the following highlights;

Innovation borders on anything new, it also borders on changes for better products and processes whether technological or non-technological. Technological innovation encompasses the diffusion of new products and services, that is, new processes to generate new output. On the other hand, non-technological innovation (organizational innovation) involves the introduction of new management or marketing techniques. Innovation policy schemes need to be fashioned out according to the specific features of economies. According to the author, this is the "one size does not fit all" concept. The crystallization of this concept lies in the fact that innovative approaches in countries would differ depending on the stage of economic development of that country. The drive for modernization of traditional activities through new technologies has been polarized and intensified through globalization. In simple terms, globalization applauds innovation.

The author alluded to other vagaries that constrain innovation in developing countries as, a large informal sector, limited Research and Development (R&D) and public sector dominance of economic activities. To alter this status quo in developing countries, innovation should be viewed as something new to local context. This would be achievable through local improvements in welfare conditions and the development of competitive industries. The country experience of Uganda in this light is attributable to the fact that despite their limited institutional capabilities, its policies were focused on basic investment in technological infrastructure which stimulated improvements in welfare, education and agriculture.

The author underlined the need to tie innovation processes into broader economic development strategy, such as incorporating the innovation policy into the Poverty Reduction Strategy Progamme (PRSP). He also underscored the need for economic stability and growth for the success of technological projects. The authors' experience showed that innovation flourishes in countries where there is talent, energy and vision. In the same vein, a

pragmatic approach towards education would snowball into greater innovation.

In the author's concluding remark, he posited that innovation in a broad sense is something new to a given context and the notion thus becomes generally acceptable to the peculiarities of developing economies from the most basic welfare improvements to the building of vibrant competitive industries. Consequently, the adoption, adaptation and creation of innovation should be engendered in the strengths of technological and institutional capabilities. Furthermore, the facilitation of international research cooperation and reducing the brain drain processes in developing countries would help to surfeit innovation opportunities.

Foreign direct investment (FDI) is crucial in stimulating change and innovation. It is also an important driving force behind improvements of a country's climate and governance conditions. The primary motivation for developing countries to attract FDI is to obtain advanced technology from developed countries and subsequently establish domestic innovation capability, through the demonstration effect which stimulates local firms' creative thinking to generate new products and processes.

III Comments

The paper has implicitly brought into retrospect the concept of innovation in addressing the current reform processes in Nigeria. China's innovation policy thrusts were built on first attracting FDI for cheap mass production manufacturing and then gradually establishing R&D capability.

Second, China exploited change agents such as the local communities, the educational system and high technological advancements. Coherent efforts were also geared towards pilot operations through technological parks. Nigeria could learn from the wealth of experience of China, by setting up technological parks in or close to universities and partnership with dynamic business enterprises to guaranty the technological innovation success. Efficient institutions and organizations, operating with sufficient autonomy should be established and the facilitation of international research cooperation should also be strengthened.

Reform is an imperative ingredient for innovation to thrive. The quality of the business environment usually linked to governance is of crucial importance to innovation performance taking cognizance of the legal and regulatory framework. Research and Development (R&D) institutes in Nigeria are not well funded and exposed to the new happenings in the global economy. The relevant established institutions should be strengthened to give them the necessary autonomy, especially in financial resources to enable them function optimally. Finally, since FDI is volatile, Nigeria would enjoy changes if it swiftly overhauls its regulatory framework through good governance and a high absorptive capacity through the availability of skilled labour force necessary for technology transfer and trade expansion.

SUBMISSION OF MANUSCRIPT TO CBN ECONOMIC AND FINANCIAL REVIEW

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