Macro-Econometric Modeling for the Nigerian Economy: 
Growth-Poverty Gap Analysis

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Abstract

This study develops comprehensive full-sector macro-econometric models for the Nigerian economy with the aim of explaining and providing a long-term solution for the persistent growth-poverty divergence experienced by the country. A review of the historical performances of the Nigerian economy reveals significant socio-economic constraints as the predominant impediments to high and sticky levels of poverty in the economy. As such, a model of the Nigerian economy suitable for policy analysis needs to capture the long-run supply-side characteristics of the economy. A price block is incorporated to specify the price adjustment between the production or supply-side sector and real aggregate demand sector. The institutional characteristics with associated policy behavior are incorporated through a public and monetary sector, whereas the interaction with the rest of the world is presented by a foreign sector, with specific attention given to the oil sector. The models are estimated with time-series data from 1970 to 2006 using the Engle-Granger two-step cointegration technique, capturing both the long-run and short-run dynamic properties of the economy. The full-sector models are subjected to a series of policy scenarios to evaluate the various options for government to improve the productive capacity of the economy, thereby achieving sustained accelerated growth and a reduction in poverty in the Nigerian economy.

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1. Introduction

The Nigerian economy naturally endowed with immense wealth, still found a substantial portion of its population still in poverty. During the last three decades the country earned over US$300 billion from crude oil alone. Today, this should have transformed into a huge socio-economic development of the country. Instead, Nigeria’s basic social indicators now place her as one of the 25 poorest countries in the world.

The Nigerian economy has recorded a rising growth in its GDP especially over the last decades. But this has not translated into accelerated employment and reduction in poverty among its citizens. This development has also been the case for most African countries. The endowment of crude oil can be seen as the major factor fueling the economic growth. It is however expected that the oil revenue should spread to the rest of the economy leading to a higher shared income for the owners of factors of production.

The objective of reducing poverty among the poor economies in the Millennium Development Goals (MDG) may not be achieved if the impediments to a rising domestic investment and employment creation are still evident in the socio-economic environment. The impediments to the nation’s socio-economic development can be attributed to the existence of the structural constraints embedded in the economy. These structural constraints can be regarded as the poor state of physical infrastructure in the country and also the absence of a correct institutional framework (good governance) that could attract direct investment into the country.

Therefore, in order to analyze the various sets of policy interventions that will generate a pro-poor growth in Nigeria, there is a need for an appropriate framework to adequately capture the underlying structural characteristics existing within the country’s institutional environment.

Based on the above background, the main objective of this study is however, to develop an explicit and robust macro-econometric model to analyze the persistence in the growth-poverty divergence in Nigeria. The model is then applied to:

- Testing the hypothesis of existing structural supply constraints versus demand-side constraints impeding the growth and development of the country
- Analyze different policy simulations in order to detect the optimal policy options for the country

The rest of the study is organized as follows; Section 2 presents the theoretical analysis on growth and poverty. In Section 3 the performance of the Nigerian economy is evaluated in which the structural constraints embedded in the country is identified while Section 4 present the empirical analysis which contains the model specification, methodology, data description, core structural equations, model closures, and the policy simulations. Section 5 concludes the study, provides policy recommendations and some limitations encountered in the study.
2. Theoretical Analysis: Growth and Poverty

The theoretical analysis presented in this section focus on the literature on growth and pro-poor growth (poverty trap) theories. The last few decades has experienced resurgence in both the growth theory (development of the endogenous growth models) and the pro-poor growth models in the macroeconomic literature.

The framework of neoclassical economics can be viewed as a summation of the various contributions of authors to the model of long-run economic growth. Solow (1956) made a huge contribution to the growth theory in which he has been revered as the pioneer of neoclassical growth model (Domar, 1957:8).

The implications of the neoclassical growth model can be view on a short and long-run analysis. In the short-run, policy measures like the tax cuts will affect the steady-state level of output but not the long-run growth rate. Instead, growth will be affected as the economy converges to the new steady-state level of output which is determined mainly by the rate of capital accumulation. This is in turn determined by the proportion of output that is not consumed but is used to create more capital (Savings rate) and also the rate at which the level of capital stock depreciate. This implies that the long-run growth rate will be exogenously determined and the economy can be predicted to converge towards a steady-state growth rate which depends on the rate of technological progress and labour force growth. Therefore, a country will grow faster if it has a higher savings rate.

Modification of the neoclassical growth model can be greatly attributed to the line of thoughts of Ramsey (1928), Cass (1965), and Koopmans (1965) which are centred on social planning problem (not market outcomes) that uses a dynamic optimisation analysis of household’s savings behaviour which is taken as constant fraction of income by Solow. Their basic assumption is that agents in the community are identical and they live forever. This means that they will maximise their utility over their life time.

The new growth theory which is also known as the endogenous growth theory started gaining its feet firmly in the growth literature in the early 1980s. This came about as a response to series of criticisms with the assumptions made in the neoclassical theory. They tend to discard the assumption of constant returns to scale by replacing it with an increasing returns to scale and try to see growth as being generated by variables that are been determined within the model. So, technology and human capital are seen to be endogenous unlike the neoclassical model that assumed these to be exogenous. However, their main emphasis about the long-term growth is that they do not depend on exogenous factors and most importantly is that the model gives room for policies that tend to affect savings and investment (King & Rebelo, 1990).

The assumption of increasing returns was a major challenge in the new growth models since this is not applicable under a perfectly competitive market because the production factors cannot be paid from the amount produced. But this problem was circumvented by using the increasing returns that are only external to the firm and this was first seen in Romer (1986), Lucas (1988), and Barro (1990). Increasing returns has been fully specified in Romer (1986) as a major requirement in achieving an endogenous growth while emphasis on human capital accumulation as endogenous in growth models was explicit in Lucas (1988). However, the new growth theory has gained tremendous popularity over the past few decades and their strength can be attributed to their ability to
solve most of the limitations of neoclassical growth models and the inclusion of some socio-economic factors that will propel growth over the long run.

Against these backgrounds on neoclassical and endogenous growth theories, an accelerated economic growth may not necessarily be sustainable and translate into an accelerated economic development. Most developing economies are characterized by structural supply (capacity) constraints impeding the effects of any policy interventions targeted towards increasing growth (Focus, 2007).

It is expected that as an economy grows, one would see a sinking effect as an improvement in welfare of its citizenry. Meaning that, the growth of a country should have a huge positive impact on its level of poverty. There has been a controversy on whether a country should focus on achieving growth and thereafter ensure that the pattern of its growth is pro-poor or focus on reducing poverty by ensuring that this will lead to growth. However, poverty can be viewed as a barrier to growth in the sense that a country will not grow if they are poor. This line of thought has opened the door to the existence of poverty trap where poverty and growth interact in a vicious circle. Meaning that a high poverty level will lead to low growth and low growth will also lead to high poverty level (World Bank; 2006:104).

Therefore, it is imperative for any economy experiencing a poverty trap to maintain a focus strategic macroeconomic policy that would rely either on pro-growth or pro-poor since there is a bidirectional link between growth and poverty. In addition, it will be difficult to experience growth if the conditions of the poor are not addressed and also poverty will not decline if there is no growth. The growth-poverty relationship as a path to developmental height can be viewed from two perspectives:

i. The Traditional View

ii. The Poverty Trap View

The traditional view of development sees a country’s characteristics, institutions and its policies as a major determinant of its pattern of growth and if these constraints are not favorable to growth, poverty level will rise. The traditional view sees these constraints as exogenous, meaning that they are not been determined within the system.

The poverty trap view sees poverty as a major setback to growth. In other word, a country that is initially poor will tend to develop a unique characteristics, not well functioning institutions and policies and hence transforms into an unfavorable pattern of growth. So, a country that is initially poor will remain poor and those that are rich will remain rich. Growth models with increasing returns to scale as explained by Matsuyama are good example of a poverty trap since countries will tend towards different equilibrium depending on their initial positions.

The explanation why poor economies may not be able to perform well as the rich economies and why the benefits of a good policies fail to materialized in poor economies are all embedded in the poverty trap models (Azariadis & Stachurski; 2005, World Bank; 2006).
3. Evaluating the Performance of the Nigerian Economy-Some Stylized Facts

The stylized facts presented in this section focus on detecting the productive capacity of the Nigerian economy over the years. It revealed the oil dependency and structural constraints embedded in the economy. It also shows how the performance of the economy has not translated into a significant reduction in poverty. As mention earlier, the growth performance of the Nigerian economy over the years has not been pro-poor. Poverty remains a huge challenge despite the rising growth in the country’s gross domestic product.

Given the low productive capacity of the country, the trade account reveals the wealth of the Nigerian economy. The country has been experiencing a robust trade surplus over the last few decades. Figure 3.1 shows the significant surpluses that were recorded between 1983 and 1997 and also since 1999 when the country return back to democratic era. Despite the huge import component of the domestic consumption, the country’s exports (mainly from crude oil) are still significantly higher than its imports. This reveals the huge foreign exchange earnings that the government receives from crude oil exportation.

![Figure 3.1: Nigeria Trade Account (1970-2006)](source: World Bank; World Development Indicators)

Oil exportation has been on its increase and this has dictate on the average about 95 percent of total exports over the years. Figure 3.2 reveals the divergence between the oil exports and the non-oil exports in Nigeria over the last three and half decades. The ratio of non-oil exports to total exports has been on its downward trend with a higher steep since 1970, while the ratio of oil exports to total exports has been on its rising trend over the same period. This is a serious indication of an economy that is totally resource driven (oil) with a low and declining productive capacity.
Against this background, it is evident that the role played by the oil sector in the Nigerian production function cannot be undermined. Total oil production as a share of GDP has been on a rising trend since 1970 as shown in Figure 3.3, with an average of about 45 percent recorded between 1999 and 2000 and about 30 percent over the entire period. Total exports (oil and non-oil) and imports as a share of GDP reveals similar trends with about 30 and 21 percent recorded on the average respectively\(^3\).

\(^3\) As discussed earlier, oil production dominates the country’s total exports.
However, given the comparative advantage that Nigeria has in oil production, it is expected to translate into a significant improvement in the productive capacity that will eventually reduce the high level of poverty over the long run period.

**Figure 3.4: Nigeria’s Growth-Poverty Performance**

![Graph showing Nigeria's Growth-Poverty Performance](image)

Source: World Bank; World Development Indicators

Figure 3.4 reveals the Growth-Poverty performance of Nigeria over the years. There has been a sustained increase in the trend of both the GDP and poverty since 1970 indicating the presence of serious socio-economic constraints impeding a long-term pro-poor growth in the country.

**4. Empirical Analysis**

**4.1. Model Specification**

As mention earlier, the focus of the structural macro-econometric model developed in this study is to:

- Test the hypothesis of existing structural supply constraints versus demand-side constraints impeding the growth and development of the country
- Analyze different policy simulations in order to detect the optimal policy options for the country

This is achieved by testing two different economic environments implying two different model closures in which policy interventions may have different economic impacts. This scenario is presented in Figure 4.1 below:
Government policy intervention (i.e monetary or fiscal policy) targeted towards propelling Gross Domestic Product (GDP) will be more effective in an economic environment without structural constraints impeding the capacity of the economy to increase labour employment. As shown in Figure 4.1, an expansionary monetary or fiscal policy in an economic environment with no capacity constraints will translate into higher GDP and a better income distribution among the owners of factors of production. However, in an economic environment that is face with huge structural capacity constraints, domestic production will fail to meet domestic demand. This will result into GDP being fuelled by an increased domestic expenditure instead of increased domestic production and hence fail to achieve a better income distribution among the owners of factors of production.

An economic environment with limited capacity to absorb more labour will generate a poverty trap with depressing socio-economic implications. Figure 4.1 shows the socio-economic implications of a rising unemployment that arises as a result of structural
supply constraints. This leads to a low income level and high poverty among the majority of the population thereby limiting the access to various economic and social services. This further leads to a low level of self-esteem and respect and many will be discouraged and lost hope in the system resulting into a higher unemployment since many will remain unemployed ‘by choice’. Due to low-level of income household saving will be low which will result into low investment-output-employment. Therefore, unemployment and poverty becomes a self-fulfilling prophecy and this requires an innovative intervention targeted at eliminating the significant structural impediments (Focus, 2007).

Against these backgrounds, the study develops two separate models:

Model A
Supply-side orientated (Demand-side marginalized): Representing an economy with a structural constraints

Model B
Demand-side orientated (Supply-side marginalized): Representing an economy with a limited or no supply constraints.

4.2. Methodology

The study adopted the Engle and Granger (1987) two-step estimation techniques. This procedure is widely accepted in the macro-econometric literature as it tries to avoid the common problem of spurious regressions that gives an incorrect impression of an existing long-run relationship between two or more variables.

The model captures both the short-run and the long-run dynamics properties of the economy following the procedure laid out in Ender (2004:335). The study modeled the four major sectors in the economy: the real sector; the external sector; the monetary sector; and the government sector.

Based on the structure of the Nigerian economy discussed earlier, the production function is modeled according to the following principles:

i. Adopted the idea of the endogenous growth theories by endogenising the technological progress.

ii. Applied the Kalmer filter estimation techniques to the production function specification in order to make the technological progress time variant

iii. Disaggregated the production function into two functional forms:
   - The Oil Sector
   - The Rest of the Economy

Detailed specification of the Kalmer-Filter techniques is carried out in the main document which can be made available on request. Alternatively, Hamilton (1994:372-408) gave an extensive econometric application of the Kalmer-Filter.
4.3. Data Description

All the data used in this study were obtained from the IMF (International Financial Statistics), World Bank database: African Development Indicators and World Development Indicators, Worldwide Governance Indicators, and the Central Bank of Nigeria Statistical Bulletin. Annual data series which covers the period 1970-2006 was used to estimate the parameters of the model and where appropriate the variables were transformed into real figures using the GDP deflator (2000=base year). Due to lack of availability of some time series data, the following time series had to be derived for the variables used in the various structural equations:

i. Rate of Depreciation

The rate of depreciation can take different values for individual country depending on the structure of that particular economy. In general, it is common to assign a higher rate of depreciation to developing or low-income countries. A higher depreciation rate of 20 percent is adopted in this study since Nigeria allocate much lower revenues to maintenance expenditures (see Bayraktar and Fofack (2007), Beddies (1999), and Vera-Martin (1999)).

ii. Financing of gross domestic investment (Financial Constraint)

In a general equilibrium framework (i.e system of national account), the financing of gross domestic investment equals total gross domestic investment (Du Toit, 1999). Therefore, the financial constraint variable is defined as an identity which enters into the system of equations in the form:

Financial Constraint = Gross Domestic Savings + Capital Flows + Changes in Reserve + Value of Depreciation

iii. Poverty Index

There are multiple dimensions and measurement of poverty in the literature. Though, the poor are generally classified as those without an adequate income or expenditure to cover their basic necessities. An indices of poverty is derived for this study following the basic Foster-Greer-Torbecue(FGT) indices and this serves as one of the most commonly used poverty indices in the literature. This measure are in three folds: (a) the incidence of poverty which shows the share of the population that are below the poverty line, (b) the depth of poverty which shows how far the households are from the poverty line, and (c) the severity of poverty relate to the distance separating the poorest households from the poverty line. These indices are calculated as follows:

\[ P = \frac{1}{N} \sum_{i=1}^{Q} \left( \frac{Z - Y}{Z} \right)^{\alpha} \]  

(4.1)

Where \( N \) = Population, \( Q \) = % of population living below poverty line (Proxy = Poor Population), \( Z \) = Poverty Line (World Bank estimate), \( Y \) = Household Final Consumption

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5 Detailed exposition of all the data used in the study and their order of integration are carried out in the main document.

Expenditure per capita, $\alpha = Poverty Aversion Parameter. \alpha = 0,1,2$ for absolute, depth and severity of poverty respectively.

Since the incidence of poverty measures absolute poverty in an economy, this study adopted the depth of poverty which also is a measure of poverty gap.

iv. Capital Stock

In the model, capital stock is derived through a perpetual inventory method. This means that the current stock of capital is equal to the investment in the previous period plus stock of capital from the previous period, net of depreciation. This is shown as:

$$K_t = (1 - \delta) * K_{t-1} + I_{t-1}$$  \hspace{1cm} (4.2)

Where $K_t$ is the capital stock, $I_t$ is the gross domestic investment, and $\delta$ is the rate of depreciation.

Since the initial stock of capital is very important and this is not known, it is assumed to be about 1.5 of the gross domestic product for that particular period.

v. Real Wages

Since capital and labour are the major inputs in the production process. The derivation of the real wages therefore, follows the identity:

$$\frac{K_t}{Y_t} + \frac{N_t}{Y_t} = \frac{Y_t}{Y_t} = 1$$  \hspace{1cm} (4.3)

Therefore,

$$\frac{K_t * \text{int}_t}{Y_t} + \frac{N_t * rw_t}{Y_t} = 1$$  \hspace{1cm} (4.4)

Where $Y_t$ is the Gross Domestic Product (GDP), $N_t$ is the labour employment, $\text{int}_t$ is the interest rate, and $rw_t$ is the real wage. $N_t * rw_t$ represent the total wage bill in the economy.

This implies:

$$rw_t = (1 - (K_t * \text{int}_t / Y_t)) * (Y_t / N_t)$$  \hspace{1cm} (4.5)

vi. Socio-Economic Index

The derivation of the socio-economic activity index follows Lind (1993) compound index of national development. This incorporates the human development factor in measuring the value of economic activities of a country. This is represented as:

$$L = b^w e^{(1-w)}$$  \hspace{1cm} (4.6)

Where $b = Real GDP per capita, e = Life Expectancy at Birth, w = Proportion of life spent in economic activity (Assume to be 1/6).
vii. User Cost of Capital

In the absence of corporate tax data and a truly long-term yield, a proxy for the user cost of capital was created through an exchange rate adjusted (since most of the investments are from abroad and an exchange rate is a signal to investors of country risk) prime lending rate of return. This is represented as:

\[ ucc_i = (1 + int_i) \times exch_i \]  \hspace{1cm} (4.7)

Where \( ucc_i \) is the user cost of capital, \( exch_i \) is the nominal exchange rate (expressed in terms of domestic to foreign currency).

viii. Governance Indicators

Since the governance indicators series (political instability and government effectiveness) are only available from 1996 onward and due to the persistence of governance over time, the 1996 value of governance is used for all previous years (Akanbi and Beddies, 2008). The governance scores ranges -2.5 to +2.5, with -2.5 representing the worst governance and +2.5 the best governance. Thou, most of the governance scores for Nigeria and especially developing countries are found to be in the negative range.

ix. Labour Employment

Due to lack of time series data on labour employment/unemployment and on any labour market variables (both formal and informal), the study uses the labour force as the closest proxy for labour employment.

4.4. Core Structural Equations

As mention earlier, the study captures both the short-run and long-run dynamic properties of the economy\(^7\). The long-run core structural equations estimated from the four sectors of the economy are presented as follows\(^8\):

4.4.1. The real sector

This consists of the aggregate supply, the aggregate demand, and the price block. The aggregate supply determines the real domestic output by estimating the production function, the domestic investment, labour demand, real wages and technological progress (total factor productivity). The aggregate demand determines the aggregate household real consumption expenditure in the economy while the price block estimates the producer and consumer prices.

Production function:

As discussed earlier the Nigerian production function is estimated following the Kalmer-Filter estimation techniques. Therefore, the long-run production function is presented as:

\[ Y_t = f(N_t, K_t, \xi_t) \]  \hspace{1cm} (4.8)

Where the generated technological progress is represented as \( \xi_t \).

\(^7\) All the estimated long-run and short-run equations, their simulations path and statistical properties (i.e cointegration tests and diagnostic tests) are presented in the main document which is available on request.

\(^8\) Detailed explanation of each of the structural equations can also be found in the main document.
Domestic Investment:
Different approaches such as the Keynesian model, cash flow model, and the neoclassical model (Jorgenson approach) has been used in modeling the investment behaviour. This study considered the neoclassical approach (Jorgenson: 1963) to be the most suitable approach in estimating the domestic investment function, since it incorporates all cost minimizing and profit maximizing decision making processes by firms. This approach has also been adopted in Du Toit, 1999; Du Toit and Moolman, 2004; and Pretorius, 1998.

The link between investment and capital stock can be captured empirically either by estimating capital stock and deriving investment subsequently, or estimating investment and the subsequent derivation of capital stock (Du Toit, 1999: 91). This study adopted the estimation of investment and the domestic investment in Nigeria is modeled as a function of output, user cost of capital, capacity utilization, and the level of political instability (governance indicator). The long-run result is presented below as:

\[ I_t = f(Y_t, ucc_t, cu_t, p_t) \]  \hspace{1cm} (4.9)

Where \( cu_t \) is the level of capacity utilization, and \( p_t \) is the level of political instability \(^9\).

Labour Demand and Real Wage Determination:
In modeling the labour market, a labour demand equation and a wage adjustment equation are defined and estimated. The demand for labour equation estimated in this study follows Chletsos (2005) who investigates the socio-economic determinants of labour demand in Greece using an autoregressive distributed lag framework. The role played by the socio-economic variables included in his estimation is found to be statistically significant.

The labour demand framework utilized in this study also incorporate the socio-economic activity as a determinant factor and the long-run labour demand function is presented as:

\[ N_t = f(rw_t, Y_t, SE_t) \]  \hspace{1cm} (4.10)

Where \( SE_t \) is the level of socio-economic activity.

The real wage equation follows Allen and Nixon (1997:147) and is specified in this study as:

\[ rw_t = f(labprod_t) \]  \hspace{1cm} (4.11)

Where \( labprod_t \) is the labour productivity \(^10\).

Technological Progress (Total Factor Productivity):
Technological progress is estimated following Khan (2006) who investigated the macro determinants of total factor productivity in Pakistan. These determinants are broadly

\(^9\) Political instability is not in its natural logarithms due to negative values in the series (see data description for more details).

\(^10\) The rate of unemployment is excluded from the specification due to data limitation.
categorized into macroeconomic stability, openness of economy, human resource development and financial sector development. Against this background which are in line with the new growth theories, the long-run technological progress ($\xi$) is presented as:

$$\xi_t = f(hd_t, fd_t)$$  \hspace{1cm} (4.12)

Where $hd_t$ is the human development variable (proxy by poverty level), and $fd_t$ represent the level of financial development (proxy by financial constraint). These variables are expected to influence the growth of technology in Nigeria since the developing economies are characterized by these factors.

**Household Real Consumption Expenditure:**

The theoretical underpinning of the household real consumption expenditure follows the permanent income and life-cycle hypothesis. Therefore, the long run household consumption is a function of real disposable income, real wealth, and the real interest rate and this is specified as:

$$hh\_rconexp_t = f(hh\_dis\_inc_t, rwealth_t, rint_t)$$  \hspace{1cm} (4.13)

Where $hh\_rconexp_t$ is the household real consumption expenditure, $hh\_dis\_inc_t$ is the household real disposable income, $rwealth_t$ is the real wealth (proxy by real money supply), and $rint_t$ is the real rate of interest.

**Consumer and Producer Prices:**

The price system helps to achieve a good coordination and communication system in a purely market economy, so that the various sectors can be able to interact efficiently with one another. This system operates on the principle that everything bought and sold has a price. Through the price system, producers and consumers transmit valuable information to each other that help keep the economy in balance.

The production price equation however, follows Layard and Nickell (1986) and the long-run specification is presented as:

$$P_t^p = f(w_t, cu_t, ucc_t)$$  \hspace{1cm} (4.14)

Where $w_t$ is the nominal wage rate and $P_t^p$ is the production price index.

Consumer prices which are directly related to production prices are also specified as:

$$C_t^p = f(P_t^p, imp_t^p, excessd_t, exch_t)$$  \hspace{1cm} (4.15)

Where $C_t^p$ is the consumer prices, $imp_t^p$ is the import prices on consumption goods, and $excessd_t$ is the excess demand.

**4.4.2. The external sector**

\footnote{11 There is a closer similarity between the Pakistan economy and the Nigerian economy than the UK economy.}
The external sector identified the major components in the current account of the balance of payment and the variation in the level of exchange rate. It estimates the real exports of goods and services, the real imports of goods and services and the Naira/Dollar nominal exchange rate.

Real Exports of Goods and Services:
The demand for real exports of goods and services in the long run is mainly driven by the level of world income and relative prices of goods and services. The fluctuations in the exchange rate is also expected to have an influence in the long run specification of real exports but this depends on the productive structure of that particular economy. Therefore, the fluctuations in the price of world oil prices are expected to have a huge impact on the Nigeria’s exports. The Nigerian real exports function is however, specified as:

\[ r_{exp,t} = f(wY_t, r_{elp}, oil_{oil,p}) \]  

Where \( r_{exp,t} \) is the real exports of goods and services, \( wY_t \) is the real world (U.S) income, \( r_{elp} \) is the relative price of goods and services (the ratio of domestic prices to U.S prices), and \( oil_{oil,p} \) is the world oil prices.

Real Imports of Goods and Services:
The demand for real imports of goods and services in the long run is mainly driven by the level of domestic income and relative prices of goods and services. The fluctuations in the exchange rate are also found to have a significant impact on the long run specification of real imports for Nigeria since imports dominates a large component of the country’s consumption expenditure. The Nigerian real imports function is therefore, specified as:

\[ r_{imp,t} = f(Y_t, r_{elp}, exch_t) \]  

Nominal Exchange Rate:
The underlining theory behind the specification of the nominal exchange rate equation follows the Dornbusch (1976,1980) and the Frankel (1979). These studies assumed that prices are sticky in the short run and this explains the prolong departure of the exchange rate from the long run Purchasing Power Parity (PPP). Against this background, the long-run nominal exchange rate is specified as follows:

\[ exch_t = f(\bar{rel}Y_t, rel{Ms}, rel{elp}) \]  

Where \( \bar{rel}Y_t \) is the relative income (the ratio of domestic GDP to U.S. GDP), and \( rel{Ms} \) is the relative money supply (the ratio of domestic money supply to U.S money supply).

4.4.3. Monetary sector

In the case of Nigeria, exchange rate is found not to have any influence on the long run determination of real exports. This confirm again the unproductive nature of the Nigeria economy and the fact that over 90 percent of its exports/foreign exchange earnings comes from oil.
The essence of modeling the monetary sector in this study is to elicit information regarding the extent to which the monetary variables feed into the rest of the economy. The model estimates the interest rate while assuming that the supply of money is exogenously determined in the system. This is done following the principle that the monetary authority does not directly control interest. The monetary policy instrument being used by the Central Bank of Nigeria over the years is the monetary aggregate.

Nominal Interest Rate:
The nominal interest rate equation is assumed to be an inverted money demand function. This is derived from the money demand equation as:

$$ RMs_t = f(Y_t, int_t) \Rightarrow int_t = f(RMs_t, Y_t) $$

(4.19)

Where $RMs_t$ is the real monetary aggregate.

4.4.4. The government sector
The government sector is assumed to be exogenously determined in this study. Total government expenditure is divided into three major components: expenditures on social development, government transfer payments and other government expenditures. These components of government expenditures are seen as one of the main catalysts in breaking through the socio-economic constraints that have been the major impediments in reducing the level of poverty in the country.

Government revenue is excluded in the study since over 90 percent of revenue comes from oil production and this has been captured extensively in the study. Tax revenue plays a very insignificant role in the economy.

4.4.5. Other behavioural equations in the model
In order to be able to detect fully the socio-economic impediments facing the country over the years, the study try to endogenized some of the variables used in explaining the equations identified above. Therefore, the study further estimates the level of socio-economic activity in the country, poverty, agricultural production, infrastructural development, and household disposable income. These variables are expected to be driven mainly by some institutional factors that have been imbedded in the economy.

Socio-Economic Activity:
Since socio-economic progress is expected to translate into a good state of wellbeing of the people, socio-economic activity is therefore specified as:

$$ SE_t = f(hh\_dis\_inc, govt\_exp, fr_t) $$

(4.20)

Where $govt\_exp$ is a component of government expenditure that is channeled towards social development, and $fr_t$ is the level of infrastructural development. These variables are expected to positively influence the socio-economic activity in Nigeria.

Household Disposable Income:
Disposable income which is directly related to real wages is presented as:

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13 The role played by monetary policy in Nigeria over the years has been very insignificant.
\[ hh\_dis\_inc_t = f(rw_t,transfer_t) \]  
(4.21)

Where \( transfer_t \) is a form of transfer payment from the government to the people.

**Poverty:**

Analysis of macro-poverty linkages has gained a tremendous ground among policy makers over the last few years. The impacts of specific macroeconomic policies (i.e. fiscal policy, inflation, and financial liberalization) on poverty have just started dominating the literature\(^\text{14}\). This study attempts to explain poverty using some important macroeconomic variables and this is specified as:

\[ poverty_t = f(C^p_t, hh\_dis\_inc_t, aid_t, fr_t, agricprod_t) \]  
(4.22)

Where \( poverty_t \) is the level of poverty, \( aid_t \) is the flow of aid, and \( agricprod_t \) is the level of agricultural production.

**Agricultural Production:**

The level of agricultural production is being determined by the availability of natural resources (i.e. land), level of infrastructural development and some form of production prices in the economy. This is presented as:

\[ agricprod_t = f(land_t, P^p_t, fr_t) \]  
(4.23)

Where \( land_t \) is the availability of land for agricultural production. These variables are expected to influence agricultural production significantly.

**Provision of Infrastructure:**

The role played by infrastructure in economic development cannot be undermined. The challenge of a long-term development requires economic policies that are geared towards investment in infrastructure. Lack of basic infrastructural building or misappropriation of government expenditure on infrastructural development has been the major feature of the Nigerian economy over the years since its independent. However, government role in the provision of public infrastructure is enormous.

The provision of infrastructure in Nigeria is model as a function of economic activities and the level of government effectiveness (good governance). This is presented as:

\[ fr_t = f(Y_t, ge_t) \]  
(4.24)

Where \( ge_t \) is a governance indicator representing the level of government effectiveness.

### 4.5. Model Closures

The two models developed in this study are closed based on the following identities:

**Model A**

In this model the production function (GDP) is estimated making the supply-side of the economy more active than the demand-side. Therefore, the price (producer and

\(^\text{14}\) Gunter et al (2005) summarises some important macro-poverty debates that have just recently emerged.
consumer) equations serve as the link between the demand-side and the supply-side of the economy through the excess demand and the capacity utilization. This is presented as:

\[
\text{Excess Demand} = \frac{\text{GDE}}{\text{GDP}}
\]

\[
\text{GDE} = \text{C} + \text{I} + \text{G}
\]

\[
\text{Capacity Utilization} = \frac{\text{GDP}}{\text{GDP}_{\text{POTENTIAL}}}
\]

Where GDE is the gross domestic expenditure, C is the household consumption expenditure, I is the domestic investment, G is the total government expenditure, and GDP_POTENTIAL is the potential level of GDP.

The potential level of output in the economy is estimated using the coefficients of labour and capital from the production function with the potential level of capital stock, labour employment, and total factor productivity. These variables are generated using the Hodrick-Prescott (HP) Filter technique.

**Model B**

In this model the production function (GDP) is generated following the Keynesian demand identity making the demand-side of the economy more active than the supply-side. Therefore, the production function is not disaggregated in this model. The price equations remain a linkage between the demand-side and the supply-side of the economy through the excess demand and capacity utilization. This is presented as:

\[
\text{GDP} = \text{C} + \text{I} + \text{G} + \text{X} - \text{Z}
\]

\[
\text{GDE} = \text{GDP} + \text{Z} - \text{X}
\]

Where X is the exports of goods and services, and Z is the imports of goods and services. All other identities follow as in Model A.

The summary of the entire model is presented in the form of a flow chart in Figure 4.2. The chart highlights the major interactions between the major sectors that are investigated in the model. Details of all the structural equations have been analyzed in the previous sections.
As shown in the diagram above, the price block serve as a major linkage between the supply-side and aggregate demand-side through the capacity utilization and excess demand. Changes in these variables causes fluctuation in prices, which affect production and demand and also causes changes in the other sectors of the economy. The monetary, external and public sector are linked directly to the supply-side and demand-side of the economy through changes in interest rate, government spending, and exchange rate. The institutional characteristics of the economy with its associated policy behaviour are incorporated through the public and monetary sector, whereas the interaction with the rest of the world is captured through the external sector.

4.6. Simulation Results: Model Comparison for Policy Analysis

In this section the long-run elasticities (relative percentage changes) of the two models are determined. A series of dynamic simulations are carried out by shocking a purely exogenous variable in the system to determine the elasticity for every response (endogenous) variable in reaction to the shock variable.

The elasticities are computed by comparing every response variable’s baseline simulation path with its shocked simulation path. Elasticity is defined as the percentage change in the response variable relative to the percentage of the shock that is applied. The dynamic elasticities are determined along the simulation path while the elasticities at convergence are the long-run elasticity (Klein, 1983:135).

A positive shock of 10 percent was applied to an exogenous variable from 1979 onwards in order to determine the shock simulation path. The model is therefore, dynamically simulated and every response variable’s simulation path was compared with its baseline
path to determine the response elasticities. These processes are repeated for every selected exogenous variable in the system.

Given the small sample size, it is difficult to ensure convergence within the sample. To facilitate the detection of convergence, Hodrick-Prescott (HP) filters were applied and the smoothed dynamic elasticities were graphed. The elasticities of the major response variables for a particular shock are presented in Figure 4.3-6. 10 percent positive shocks were applied to some major exogenous variables in the system. The key objective of the entire process of these macro-econometric models is to see the different impacts of a certain policy scenario on the long-term growth and poverty situation in the economy.

4.6.1. Total Government Expenditure Shock:

The increase in total government expenditure by 10 percent shows a positive response on the major macroeconomic variables in both Model A & B. But this impact is more successful in an economic environment with limited supply constraints.\(^\text{15}\)

Figure 4.3A: Shock on Total Government Expenditure (Model A)

\(^{15}\) The effect of monetary shock is not analyzed due to the marginal role that monetary policy has been having in stabilizing the economy over the years. This is coupled with the fact that the Nigerian financial system has not yet been well integrated into the local and global economy.
In Model A, the growth in total GDP as a result of the shock has been positive throughout the periods reaching a high level of about 0.3 percent. The rest of the economy GDP is able to reveal a better positive impact than the oil sector GDP. The expansionary fiscal policy has boosted domestic investment and the level of infrastructural development over these periods reaching a high of about 0.4 percent each. These have resulted into an increase in socio-economic activities, employment, and productivity which eventually lead to a reduction in the level of poverty at a low of about 0.4 percent. The growth in consumer prices has also been negative through out the period coupled with an appreciation of the exchange rate.

Model B produces a more successful impact of the expansionary fiscal policy. The growth in GDP which has been positive throughout the period reaches a high of about 2.9 percent. A high level of about 4.5 percent increase were recorded each for domestic investment and the level of infrastructural development which translated into a more higher positive impact in socio-economic activities, employment, and productivity leading to a lower reduction in poverty of about 1.2 percent. A more significant improvement in the value of the currency is recorded over the long-run and the growth in consumer prices has also dropped drastically when compared to Model A.

4.6.2. World Oil Price Shock:

The oil price shock has been seen as the major external shock that can directly affect the real variables in any economy. The impact of oil price shock should be felt more in a country like Nigeria whose main source of revenue comes from crude oil exportation. It is expected that a rise in the oil prices should increase the productive capacity and also improve the general living standard in the country. Model B reveals a positive impact on the economy as a result of a 10 percent rise in oil prices while in Model A, a negative impact on the economy is revealed.
Except for the oil sector GDP, the growth in total GDP and the rest of the economy in Model A has been negative in all the periods with a more severe impact in the rest of the economy’s GDP. Irrespective of any structural constraints, the oil GDP still records a positive increase reaching a high of about 2.4 percent. Through this effect the domestic investment and level of infrastructural development fell by about 1 percent each over the same period. These resulted into a fall in employment and productivity but with a marginal and insignificant rise in socio-economic activities which leads to a rise in the level of poverty reaching a high of about 0.4 percent. Consumer prices also grew on a high of about 1.2 percent with a depreciating exchange rate through out the period. The constraints impeding the spread of the oil revenue to translate into increased production
and improvement in the welfare can be attributed to the huge import of refined petroleum products still going on in the country which have a direct impact on the production prices. A positive impact of the oil price shock on the entire economy is shown in Model B. Growth in total GDP has been positive over the period reaching a high of about 2.2 percent. This has translated into an increase in domestic investment and infrastructural development. Poverty reduces due to the rising level of employment, socio-economic activities, and productivity in the country. The effect of the shock on production prices is not significant in this economic environment and this has led to a falling consumer prices over the period coupled with an appreciating exchange rate.

**4.6.3. World Income Shock:**

The shock on world GDP (proxy by U.S GDP) is expected to have a positive impact on the domestic economy via the external sector. The depreciation of the country exchange rate as a result of the rise in world income should lead to an additional improvement in the country exports demand. But since the country is not competitive in the global environment and negative impact of the exchange rate on consumer prices, the level of is deemed to rise over the years. This negative of the exchange rate on the consumer prices can be attributed to the huge import component of the country’s consumption pattern.

Despite this background, the impact of the rise in world income is positive on the domestic economy in Model B and with a less severity of poverty, while Model A shows a negative impact on the domestic economy with a more severe level of poverty.

**Figure 4.5A: Shock on World Income (Model A)**

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16 Note: the country is a major exporter of crude petroleum.
The shock on world income increases total GDP in Model B through out the entire period reaching a high of about 3.5 percent. The domestic investment and level of infrastructural development also received a boost with a high of about 5 percent. These translated into a rising employment and socio-economic activity reaching a high of about 0.9 percent and 0.2 percent respectively. Productivity recorded a fall over the period simply due to the inflationary effect of the shock.

The growth in total GDP is found to be negative through out the period in Model A with a more severe impact on the oil sector GDP. Domestic investment and infrastructural development also recorded a fall with a low of about 3 percent each over the period leading to a fall in employment, socio-economic activities, and productivity.

4.6.4. Governance Shock:

Good governance has been the central key debate among world policy makers in recent years. The major stumbling block to the implementation of many macroeconomic policies in the developing and low-income economies has been the absence of the political will that have been imbedded in the leadership structure. The extent at which a country’s governance can impact on the socio-economic environment and productive capacity cannot be underestimated. The Nigerian governance structure has been in a mess over the years and this has been a serious challenge in achieving the set developmental objectives. The poor effectiveness of government and the re-occurrence of political unrest have caused serious damages to the economy.

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17 This may be due to the significant role the oil sector plays in the country production function.
Irrespective of the kind of economic environment, good governance plays a crucial role in the economy. This fact is revealed from the results in both Model A & B. A negative and similar impact of worse governance is recorded in the two economic environments. The growth in total GDP has been negative throughout the period in the two models while the level of poverty has also been rising over the same period but with a more severe impact on poverty in Model A. However, the role played by the effectiveness of government in the provision of infrastructure is enormous.

5. Conclusions and Policy Recommendations

This study has developed an explicit and robust macro-econometric model that analyzed the persistence in the growth-poverty divergence in Nigeria. The historical performance of the economy has identified the existence of socio-economic constraints that serve an impediment to the high and sticky level of poverty in the country. The model is however, applied to testing the hypothesis of existing structural supply constraints versus demand-
side constraints impeding the growth and development of the country. Different policy simulations were also applied in order to detect the optimal policy options for the government.

Based on the historical performance of the economy and the results from the models developed, the study concludes that a macro-econometric model capturing structural supply constraints will be appropriate for the Nigerian economy in addressing the high and sticky level of poverty.

Therefore, a supply-side policy intervention is needed. A new paradigm of policy making has to come into the Nigerian policy environment. To enable the oil endowment to trickle down to the rest of the economy where poverty and unemployment is predominant, the need to address the socio-economic impediments that will give rise to employment creation and reduction in poverty should be the focus of any government policy intervention.

In order to achieve the optimal objective of a sustained economic growth and reduction in poverty, a well structured and coordinated policy mix is needed:

- There should be improvement in the quality of government spending. Fiscal policy expansion should tend towards increasing the component of government expenditure that will lead to a sustained growth and also an improvement in the standard of living of the citizens.
- In order to be able to reap the benefits of a positive external shock-there is a need to increase the level of competitiveness and the productive capacity of the country.
- Investment in basic infrastructures such as power and roads are very crucial at this stage of the Nigerian economy.
- Bad governance has been the major feature of the Nigerian economy over the last decades. There is an urgent need to refocus the government role in some certain critical areas of the economy. Government institutions need to be more strengthened by improving the coordination that exists within the government structures. The political environment needed to be more secured in order to attract more private investment. The maintenance of public order, ensuring property rights, a sound regulatory structure and also creating a framework that will increase the provision of public goods and services and the maintenance of infrastructure is urgent in order to achieve the set macroeconomic objectives.

Moreover, it is imperative to note the difficulties encountered in analyzing poverty using a macro-econometric model. The study however, acknowledges areas that need further investigation. The major limitation of this study is the unavailability of quality data for some key macroeconomic variables and these have created a major obstacle in the estimation processes. This problem was circumvented through the use of generated indices and dummy variables as proxies for the unavailable data. This has also resulted to the limited scope of specification of some equations in the model. There is however, a need for improvement and extension of the database. It is also imperative to investigate further in later research some of the specification adopted in this study.
REFERENCES


