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Macro-econometric modelling for the Nigerian economy: A 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. The models are applied to test the hypothesis of existing structural supply-side constraints versus demand-side constraints impeding the economic growth and development of the country. A review of the historical performance of the Nigerian economy reveals significant socio-economic constraints as the predominant impediments to high and sticky levels of poverty in the economy. Thus, a model which is suitable for policy analyses of the Nigerian economy 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 behaviour are incorporated through a public and monetary sector, whereas the interaction with the rest of the world is represented by a foreign sector, with specific attention being given to the oil sector. The models are estimated with time-series data from 1970 to 2006 using the Engle–Granger two-step co-integration 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 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 finds a substantial portion of its population in poverty. During the past three decades the country earned over US \$300 billion from oil sources alone. This should have transformed into a considerable socio-economic development of the country, but instead, Nigeria's basic social indicators now place her as one of the 25 poorest countries in the world. Ironically, it was among the 50 richest countries in the early 1970s.

The Nigerian economy has recorded rising growth in its Gross Domestic Product (GDP), especially over the past decade. But this has not translated to accelerated employment and a 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 fuelling the country's economic growth. It is, however, expected that the oil revenue should spill over to the rest of the

economy leading to a higher shared income for the owners of the factors of production.

The objective of the Millennium Development Goals (MDG) is to reduce poverty in developing and poor economies. This cannot be achieved if the socio-economic impediments to domestic investment and employment creation persist. Structural constraints limit socio-economic development and discourage foreign direct investment. These constraints include the poor state of physical infrastructure in the country and the absence of an appropriate institutional framework.

Therefore, in order to analyse the various sets of policy interventions that will generate 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 and estimate full-sector macro-econometric models for the Nigerian economy. These may provide a long-term solution for the major socio-economic problems facing the country. The models are then applied to:

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

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¹ This paper is based on the author's PhD thesis. Reference to the main document may be mentioned when necessary.

The rest of the study is organised as follows: [Section 2](#) presents a theoretical analysis of 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. [Section 4](#) presents an 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 highlights some limitations encountered in the study.

2. Theoretical analysis: growth and poverty

The theoretical analysis presented in this section focus on the literature dealing with growth and pro-poor growth (poverty trap) theories. The last few decades have 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 the neoclassical growth model ([Domar, 1957:8](#)).

The implications of the neoclassical growth model (i.e. [Solow \(1956\)](#), [Tobin \(1955\)](#), [Pilvin \(1953\)](#), and [Harrod \(1953\)](#)) can be viewed on a short and long-run basis. In the short-run analysis, policy measures such as tax cuts will affect the steady-state level of output. This is not the case with the long-run economic growth rate. Instead, economic 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, in turn, is determined by the proportion of output that is not consumed but used to create more capital (savings rate) and also the rate at which the level of capital stock depreciates. This implies that the long-run growth rate will be exogenously determined and the economy can therefore 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's economy will grow faster if it has a higher savings rate.

Modifications of the neoclassical growth model can be made along the lines of thought of [Ramsey \(1928\)](#), [Cass \(1965\)](#) and [Koopmans \(1965\)](#), which are all centred on social planning problems (not market determined outcomes) that use dynamic optimization analyses of households' savings behaviour (which is taken as a constant fraction of income by Solow). Their basic assumptions are that agents in the community are identical and that they live forever. This means that they will maximise their utility over their lifetime.

The new growth theory (also known as the endogenous growth theory) started gaining popularity in the growth literature of the early 1980s in response to a series of criticism on the assumptions made in neoclassical theory. These tend to discard the assumption of constant returns to scale, replacing it with increasing returns to scale and thus determining growth mainly by endogenous variables. Technology and human capital are regarded as endogenous, unlike the neoclassical model that assumed these to be exogenous. However, the main emphasis of the long-term growth model is that it does not depend on exogenous factors and, most importantly, that it allows for policies that tend to affect savings and investment ([King and Rebelo, 1990](#)).

The assumption of increasing returns posed a major challenge to the new growth models since it does not apply to a perfectly competitive market because production factors cannot be paid from the amount produced. However, by only using increasing returns that are external to the firm, this problem can be circumvented, as was observed by [Romer \(1986\)](#), [Lucas \(1988\)](#), and [Barro \(1990\)](#). Increasing returns have been fully specified in [Romer \(1986\)](#) as a major requirement in achieving endogenous growth, while emphasis on human capital accumulation as endogenous in growth models was explicit in [Lucas \(1988\)](#). The new growth theory has gained

tremendous popularity over the past few decades and its strength can be attributed to its ability to solve most of the limitations of neoclassical growth models as well as to include some socio-economic factors that will propel growth over the long run.

Against these backgrounds on neoclassical and endogenous growth theories, accelerated economic growth may not necessarily be sustainable or may not translate into 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 an improvement in the welfare of its citizens. In other words, the economic growth of a country should have a significant positive impact on its overall level of poverty. But this is not the case, especially if the experiences of most developing countries, where increases in the growth rates have not translated into a reduction in poverty, are taken into account. The Nigerian situation is an example where good economic performance in terms of GDP growth over a few years did not improve the living standards of its citizens. However, this occurrence might have been caused by a lack of persistent or insufficient rate of growth experienced by most developing economies. ([World Bank, 2006:103](#)).

It is therefore imperative for any economy experiencing a poverty trap to implement a focused strategic macroeconomic policy that relies either on pro-growth or pro-poor principles, since there is a bi-directional link between growth and poverty. In addition, it will be difficult to create growth if the conditions of the poor are not addressed. On the other hand, poverty will also not decline if there is no growth.

The growth–poverty relationship as a path to improved development may be viewed from two perspectives:

- i. The traditional view;
- ii. The poverty trap view.

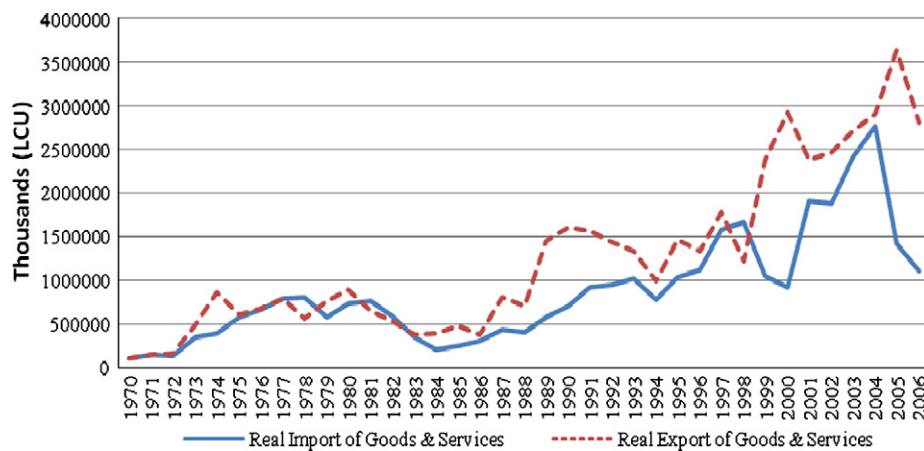
The traditional view of development describes a country's characteristics, institutions and its policies as major determinants of its pattern of growth. If these constraints are not favourable to growth, poverty levels will rise. The traditional view is that these constraints are exogenous, in other words they are not determined by the system ([World Bank, 2006](#)).

The poverty trap perspective sees poverty as a major setback to growth. In other words, a country that is initially poor will tend to develop distinct features, like ineffective institutions and policies, and will thus transform into an unfavourable pattern of growth. A country that is initially poor will remain poor while those that are rich will remain rich. Growth models with increasing returns to scale (as explained by [Matsuyama](#)) are good examples of poverty traps since countries will tend towards different equilibrium, depending on their initial positions.

The reasons for poor economies not performing as well as rich economies, and for the benefits of good policies failing to materialize in poor economies are all embedded in the poverty trap models ([Azariadis and 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 reveals the oil dependency and structural constraints embedded in the economy. It also shows how the economic growth performance of the economy has not translated into a significant reduction in poverty. As mentioned earlier, the growth performance of the Nigerian economy over the years has not been pro-poor. Poverty remains a huge challenge despite the growth in the country's gross domestic product.



Source: World Bank, World Development Indicators

Fig. 1. Nigeria trade account (1970–2006). Source: World Bank, World Development Indicators.

Given the small productive capacity of the country, the trade account also reveals the wealth of the Nigerian economy. The country has experienced a large trade surplus over the past few decades. Fig. 1 shows the significant surpluses recorded between 1983 and 1997 as well as from 1999 onwards when the country entered a new democratic era. Despite the considerable imported component of domestic consumption, the country's export earnings (mainly from crude oil) are still significantly more than its import earnings. This explains the considerable amount of foreign exchange that the government receives from crude oil exports.

Oil exports have been on the increase and this has dominated overall export earnings with oil export revenue on average comprising about 95% of total exports over the years. Fig. 2 shows the divergence between oil and non-oil exports in Nigeria over the last three and a half decades. The ratio of non-oil exports to total exports has been on an increasingly sharper downward trend since 1970, while the ratio of oil exports to total exports has shown a rising trend over the same period. This is a clear 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 over emphasised. Total oil production as a share of GDP has been on a rising trend since 1970 as shown in Fig. 3, with an average of about 45% recorded between 1999 and 2000, and about 30% over the entire period. Total exports (oil and non-oil) and imports as a share of GDP reveal similar trends with about 30 and 21%, respectively, recorded on average.²

However, given the comparative advantage Nigeria has in oil production, it is expected to translate into a significant improvement in the productive capacity that could eventually reduce the high level of poverty over the long run period.

Fig. 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 mentioned earlier, the focus of the macro-econometric models 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;

- Analyse 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. These scenarios are presented in Fig. 5.

Government policy intervention (i.e. monetary or fiscal policy) targeted towards propelling 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 Fig. 6, 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 faced with huge structural capacity constraints, domestic production will fail to meet domestic demand. This will result into GDP being fuelled by increased domestic expenditure instead of increased domestic production, and hence will fail to achieve a better income distribution among the owners of the factors of production.

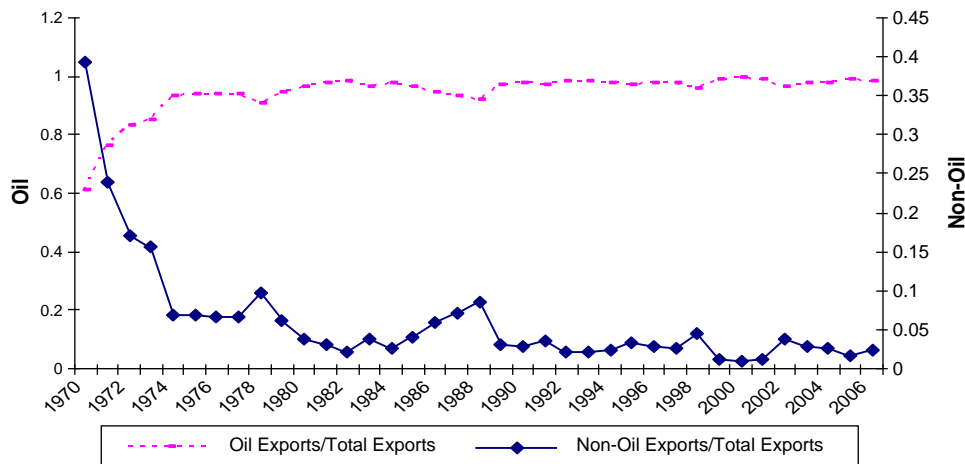
An economic environment with limited capacity to absorb more labour will generate a poverty trap, with depressing socio-economic implications. Fig. 7 shows the socio-economic implications of rising unemployment resulting from structural supply constraints. This leads to a low income level and high poverty among the majority of the population, thereby limiting access to various economic and social services. It further leads to a low level of self-esteem and respect and many will be discouraged and lose hope in the system, resulting in higher unemployment as many will remain unemployed 'by choice'. Due to low-level income, household saving will be low, resulting in low investment–output–employment. Therefore, unemployment and poverty becomes a self-fulfilling prophecy, solving of which 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 marginalised) model, representing an economy with structural constraints. In this model gross domestic product (GDP) is estimated in order to detect the constraints that could be impediments to the economic growth and development of the country. In this type of economy a limited capacity to absorb labour in the system results in high and increasing levels of unemployment with depressing socio-economic and growth implications.

Model B Demand-side orientated (supply-side marginalised) model, representing an economy with limited or no supply

² As discussed earlier, oil production dominates the country's total exports.



Source: World Bank, World Development Indicators

Fig. 2. Divergence of oil and non-oil exports in Nigeria. Source: World Bank, World Development Indicators.

constraints. In this model, GDP is generated following the Keynesian identity. In this type of economy, any government intervention through fiscal and monetary policy instruments will be effective in absorbing labour and also attracting investment capital into the system.

A comparison of the two models is expected to lay a solid support to the hypothesis that the Nigerian economy has been faced with huge socio-economic constraints impeding the development of the country.

4.2. Methodology

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

The models capture both the short-run and long-run dynamic properties of the economy following the procedure laid out in Enders (2004:335). Four sectors of the economy were captured and include the real sector, the external sector, the monetary sector, and the government (public) sector.

Since the oil sector comprises the most important component of the production structure of the Nigerian economy, the Nigerian production function is based on the following principles:

- i. Adopting the idea of the endogenous growth theories by endogenising the technological progress;
- ii. Applying the Kalman filter to the production function specification to make the technological progress time variant; and
- iii. Modelling the production function in two disaggregated functional forms, based on the structure of the economy³:
 - The oil sector,
 - The rest of the economy.

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, World-

³ Detailed specifications of the Kalman–Filter techniques are described in the main document which can be made available on request. Alternatively, Hamilton (1994:372–408) gave an extensive econometric application of the Kalman–Filter.

wide Governance Indicators, and the Central Bank of Nigeria Statistical Bulletin. Annual data series which cover the period 1970–2006 were used to estimate the parameters of the model and, where appropriate, the variables were transformed into real figures by using the GDP deflator (2000 = base year).⁴

Due to a 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:

4.3.1. i. rate of depreciation

The rate of depreciation can take different values for different countries. It depends on the structure of a particular economy. In general, it is common to assign a higher rate of depreciation to developing or low-income countries than to advanced economies. A high depreciation rate of 20% is adopted in this study since Nigeria do not allocate much to maintenance expenditure (see Bayraktar and Fofack (2007), Beddies (1999), and Vera-Martin (1999)).

4.3.2. ii. financing of gross domestic investment (financial constraint)

In a general equilibrium framework (i.e. system of national accounts), 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 following form:

$$\text{Financial Constraint} = \text{Gross Domestic Savings} + \text{Capital Flows} + \text{Changes in Reserves} + \text{Value of Depreciation.}$$

4.3.3. iii. poverty index

There are multiple dimensions of the measurement of poverty in the literature. The poor are generally classified as those without an adequate income or expenditure to cover their basic necessities. An index of poverty is derived for this study following the basic Foster–Greer–Torbecke (FGT) index as this is one of the most commonly used poverty indices in the literature.⁵ This measure has three components: (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* which relates to the distance separating the

⁴ A detailed exposition of all the data used in the study and their order of integration are carried out in the main document.

⁵ See Louw (2008) for detailed analyses of poverty measures and indices.

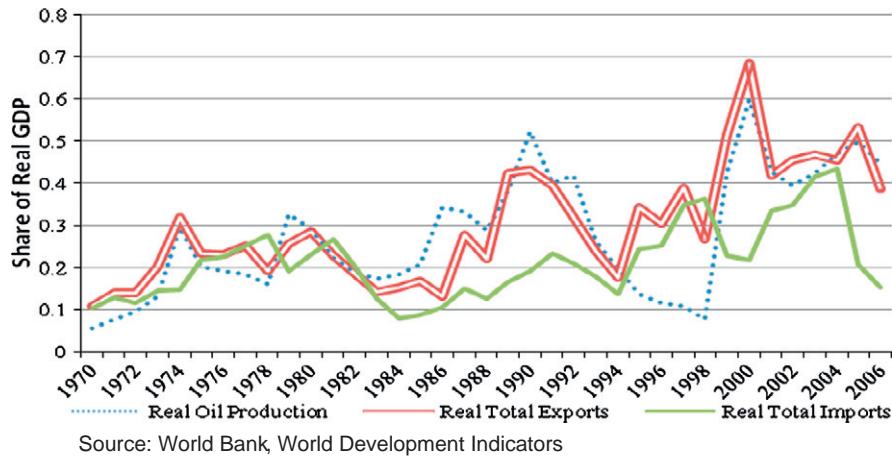


Fig. 3. Oil production, total exports, total imports as a share of GDP. Source: World Bank, World Development Indicators.

poorest households from the poverty line. The index is calculated as follows:

$$P = \frac{1}{N} \sum_{i=1}^Q \left[\frac{Z-Y}{Z} \right]^\alpha \quad (4.1)$$

where N = Population, Q = % of population living below poverty line (Proxy = Poor Population), Z = Poverty Line (World Bank estimate), Y = Household Final Consumption Expenditure per capita, α = 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 is also a measure of a poverty gap.

4.3.4. 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 of the previous period plus the stock of capital of the previous period, net of depreciation. This is shown as follows:

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

where K_t is the capital stock, I_t is gross domestic investment, and δ is the rate of depreciation.

The initial stock of capital is very important but if its value for a certain period is not known, it is assumed to be about 1.5 of the gross domestic product for that particular period.

4.3.5. v. real wages

Capital and labour are the major inputs in the production process. The derivation of real wages therefore follows the identity as follows:

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

Therefore,

$$\frac{K_t * int_t}{Y_t} + \frac{N_t * rw_t}{Y_t} = 1 \quad (4.4)$$

where Y_t is the GDP, N_t is employed labour, int_t is the interest rate, and rw_t is the real wage. $N_t * rw_t$ represents the total wage bill in the economy.

This implies:

$$rw_t = \left(1 - \left(K_t * int_t / Y_t \right) \right) * \left(Y_t / N_t \right) \quad (4.5)$$

4.3.6. vi. socio-economic index

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

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

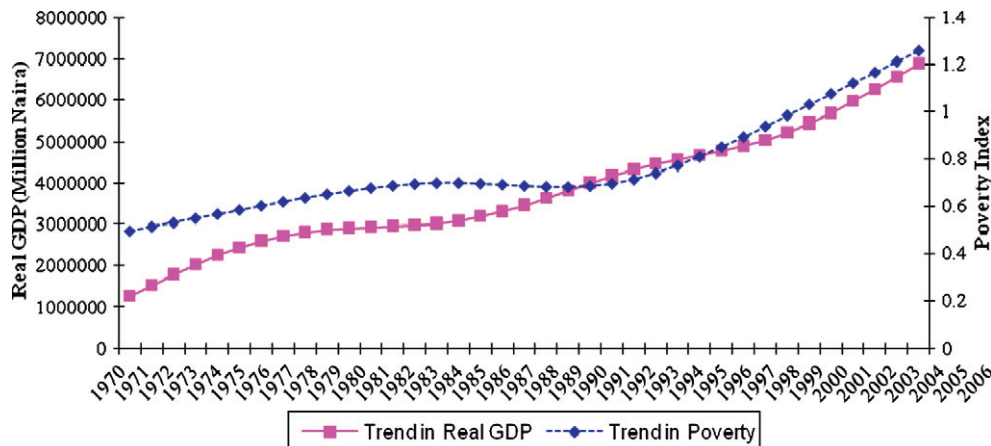
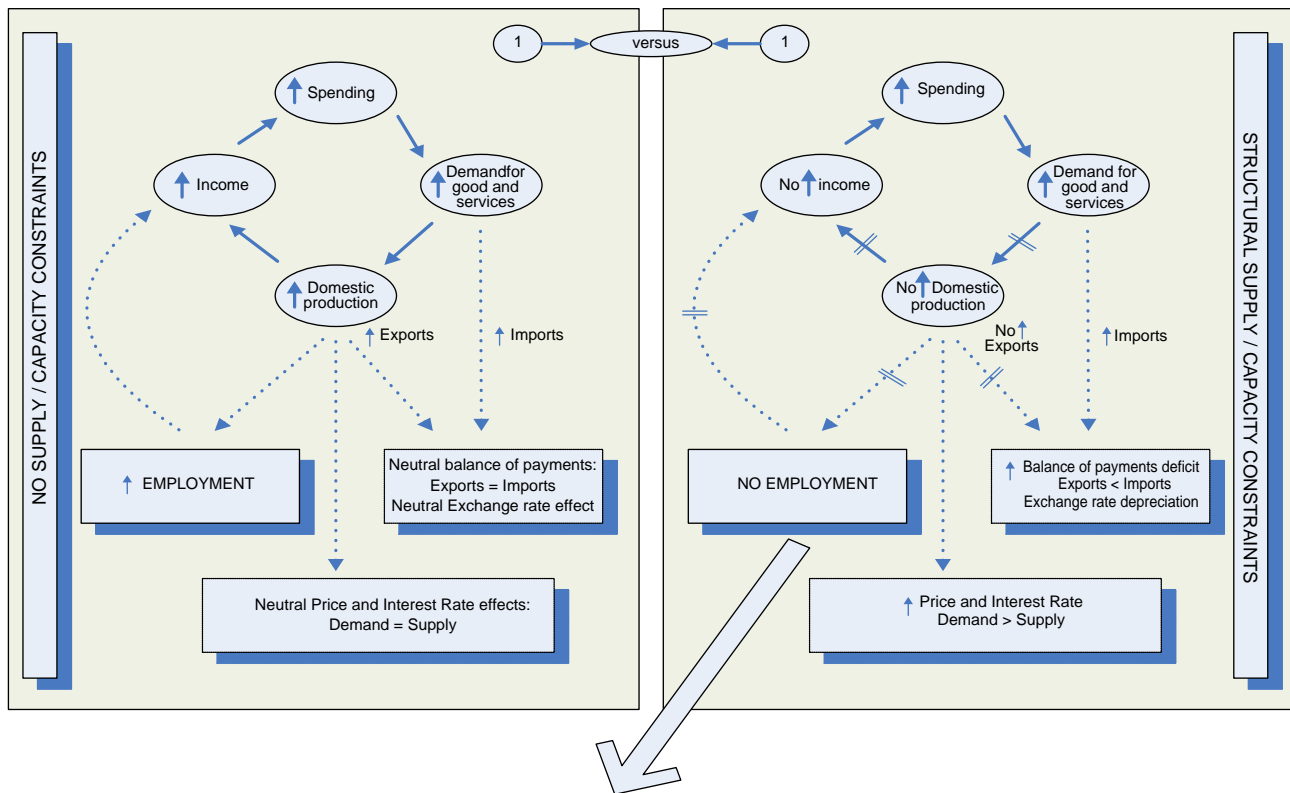
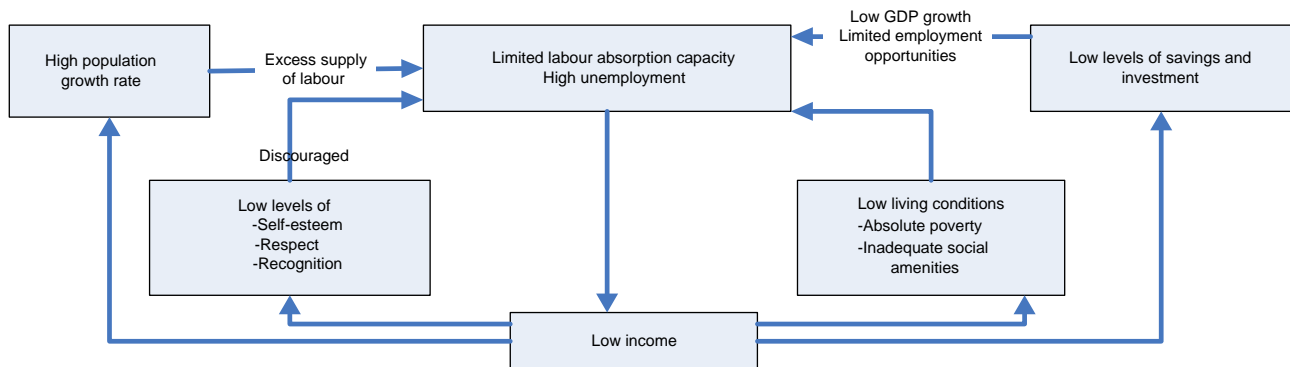


Fig. 4. Nigeria's growth-poverty performance. Source: World Bank, World Development Indicators.



Poverty Trap



Source: Focus, 2007 (Adopted from the Todaro Model)

Fig. 5. Demand-side fuelled growth strategy. Source: Focus, 2007 (Adopted from the Todaro Model).

where b = Real GDP per capita, e = Life Expectancy at Birth, w = Proportion of life spent in economic activity (assumed to be 1/6).

4.3.7. 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 of country risk to investors) prime lending rate of return. This is represented as follows:

$$ucc_t = (1 + int_t) * exch_t \quad (4.7)$$

where ucc_t is the user cost of capital, $exch_t$ is the nominal exchange rate (expressed in terms of domestic to foreign currency).

4.3.8. viii. governance indicators

The worldwide governance indicators developed by Kaufmann et al. (1999) are utilized in this study as measures of governance. The

indices cover a broad range of policy and institutional outcomes for a large number of countries, which include; the rule of law, corruption, government effectiveness, regulatory quality and political instability. Since the governance indicators series are only available from 1996 onwards and due to the persistence of governance over time, the average value from 1996 to 2006 governance scores are used for all previous years (Akanbi and Beddies, 2008). The governance scores range from -2.5 to +2.5, with -2.5 representing the worst governance and +2.5 the best governance. However, most of the governance scores for Nigeria, and for developing countries in general, are negative.

4.3.9. ix. labour employment

Due to a 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 best proxy for labour employment.

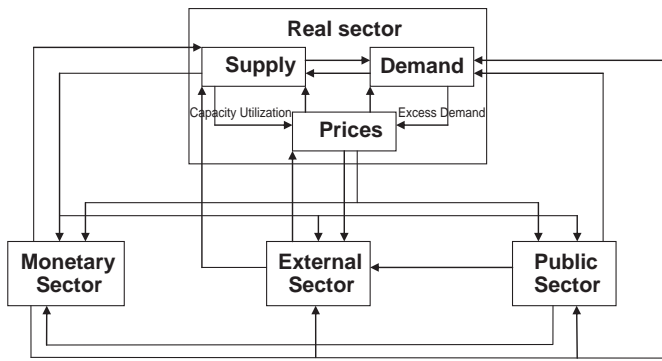


Fig. 6. A flow chart of the model.

4.4. Core structural equations

As mentioned earlier, the study captures both the short-run and long-run dynamic properties of the economy.⁶ The long-run core structural equations estimated from the four sectors of the economy are as follows⁷:

4.4.1. The real sector

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

4.4.1.1. *Production function.* As discussed earlier, the Nigerian production function is estimated following the Kalman–Filter estimation techniques.⁸ Therefore, the long-run production function is presented as follows:

$$Y_t = f\left(\overset{+}{N}_t, \overset{+}{K}_t, \overset{+}{\xi}_t\right) \tag{4.8}$$

where the generated technological progress is represented as ξ_t .

4.4.1.2. *Domestic investment (real gross capital formation).* Different approaches, such as the Keynesian model, cash flow model, and the neoclassical model (Jorgenson approach) have been used in modelling investment behaviour. This study considered the neoclassical approach (Jorgenson, 1963) to be the most suitable approach in estimating the domestic investment function because it incorporates all cost minimizing and profit maximizing decision making processes by firms. This approach has also been adopted by 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 by estimating investment and the subsequent derivation of capital stock (Du Toit, 1999: 91). This study adopted the estimation of investment and domestic investment in Nigeria is modelled as a function of output, user cost of capital, capacity utilization, and the level of political instability (proxy for good governance). The long-run result is presented as follows:

$$I_t = f\left(\overset{+}{Y}_t, \overset{-}{ucc}_t, \overset{+}{cu}_t, \overset{+}{pi}_t\right) \tag{4.9}$$

where cu_t is the level of capacity utilization, and pi_t is the level of political instability.⁹

4.4.1.3. *Labour demand and real wage determination.* In modelling 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 investigated 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 was found to be statistically significant.

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

$$N_t = f\left(\overset{-}{rw}_t, \overset{+}{Y}_t, \overset{+}{SE}_t\right) \tag{4.10}$$

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 follows:

$$rw_t = f\left(\overset{+}{labprod}_t\right) \tag{4.11}$$

where $labprod_t$ is the labour productivity.¹⁰

4.4.1.4. *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 categorized into macroeconomic stability, openness of economy, human resource development and financial sector development.¹¹ Against this background, which is in line with the new growth theories, the long-run technological progress (ξ) is presented as follows:

$$\zeta_t = f\left(\overset{-}{ms}_t, \overset{-}{hd}_t, \overset{+}{fd}_t\right) \tag{4.12}$$

where ms_t is a form of macroeconomic stability (proxy by consumer prices), hd_t is the human development variable (proxy by poverty level), and fd_t represents 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.

4.4.1.5. *Household real consumption expenditure.* The theoretical underpinning of household real consumption expenditure follows

⁶ Tables 1 and 2 of the Appendix A presents the elasticities of the long-run structural equations in the model.

⁷ All the estimated short-run equations, the simulation paths and statistical properties of the entire structural equations in the model (i.e. co-integration tests and diagnostic tests) are presented in the main document which is available on request.

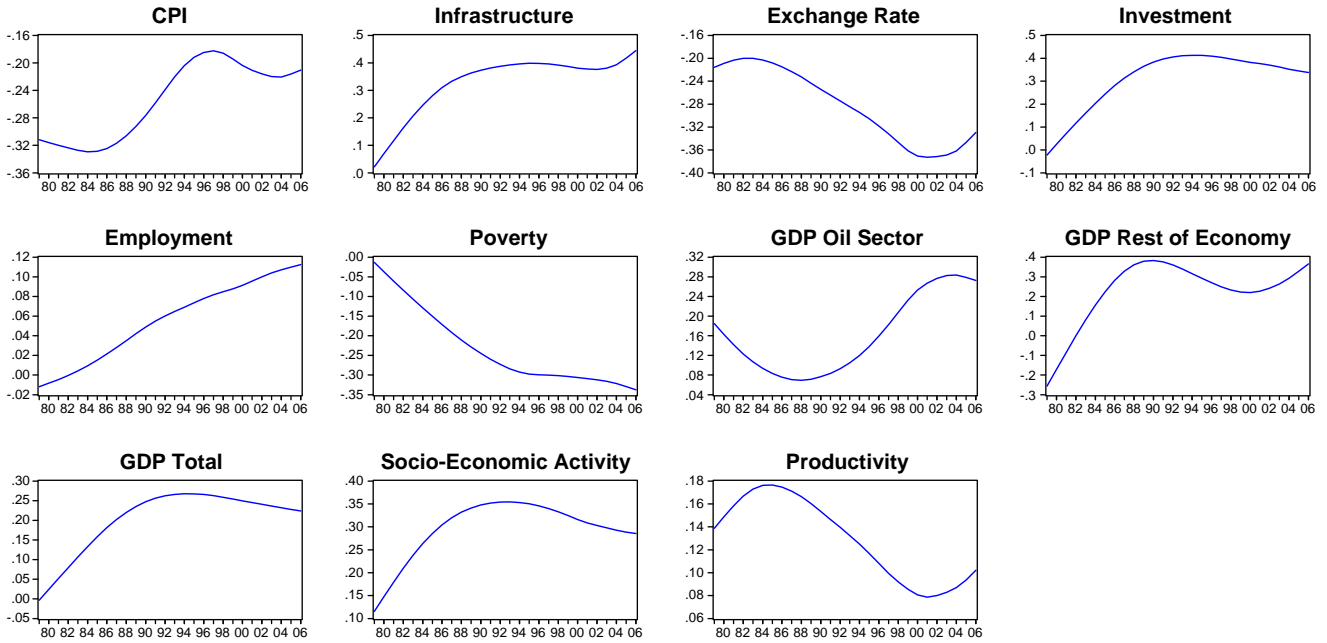
⁸ Since the production function is disaggregated into two functional forms, output and technological progress in the total economy and oil sector are estimated in the model (see the main document for a more detailed explanation).

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

¹⁰ The rate of unemployment is excluded from the specification due to data limitation.

¹¹ There is a closer similarity between the Pakistan economy and the Nigerian economy than the UK economy.

A. Shock on Total Government Expenditure (Model A)



B. Shock on Total Government Expenditure (Model B)

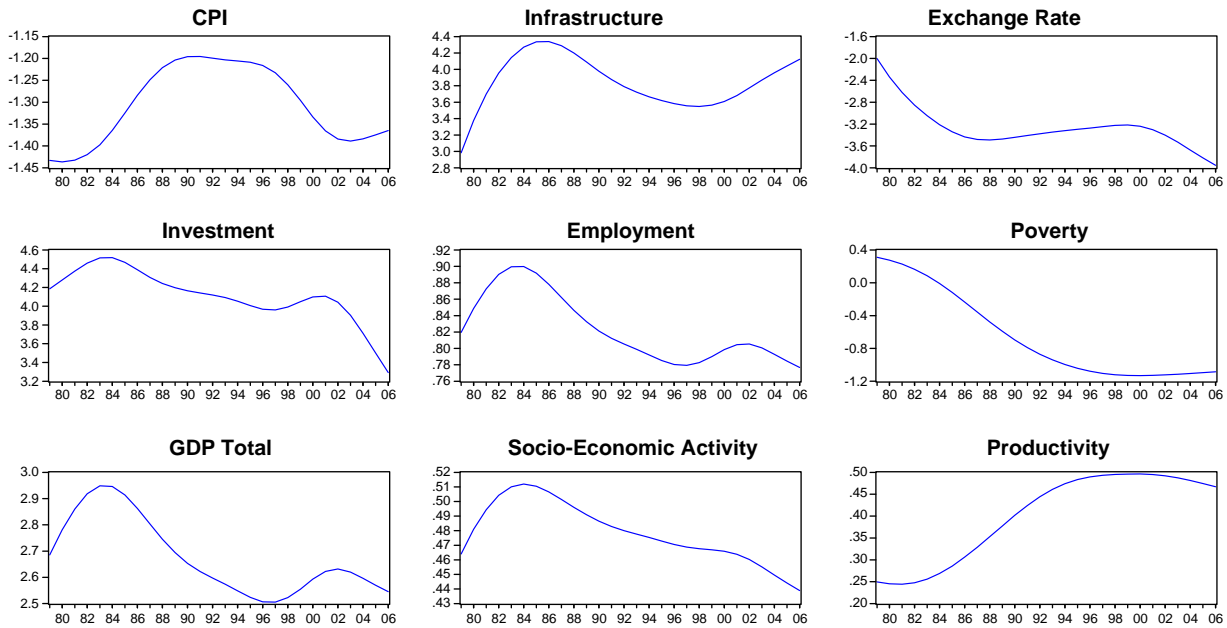


Fig. 7. A. shock on total government expenditure (model A). B. shock on total government expenditure (model B).

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

$$hh_rcon\ exp_t = f\left(hh_dis_inc_t^+, rwealth_t^+, rint_t^+\right) \quad (4.13)$$

where $hh_rcon\ exp_t$ is household real consumption expenditure, $hh_dis_inc_t$ is household real disposable income, $rwealth_t$ is real wealth (proxy by real money supply), and $rint_t$ is the real rate of interest.

4.4.1.6. Consumer and producer prices. The price system helps to achieve a good coordination and communication system in a purely

market economy, enabling the various sectors to interact efficiently. 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, helping to keep the economy in balance.

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

$$P_t^p = f\left(w_t^+, cu_t^+, ucc_t^+\right) \quad (4.14)$$

where w_t is nominal wage rate and P_t^p is production price index.

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

$$C_t^p = f\left(\overset{+}{P}_t^p, \overset{+}{imp}_t^p, \overset{+}{excessd}_t, \overset{+}{exch}_t\right) \quad (4.15)$$

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

4.4.2. The external sector

The external sector identifies the major components of the current account of the balance of payments and the variation in the level of the exchange rate. It estimates the real exports of goods and services, the real imports of goods and services and the naira/U.S. dollar nominal exchange rate.

4.4.2.1. Real exports of goods and services. The demand for real exports of goods and services is in the long run mainly driven by the level of world income and relative prices of goods and services. Fluctuations in the exchange rate are also expected to have an influence in the long-run specification of real exports, but depend on the productive structure of that particular economy.¹² Fluctuations in the price of world oil prices are therefore expected to have a significant impact on Nigeria's exports. The Nigerian real exports function is specified as follows:

$$r\exp_t = f\left(\overset{+}{wY}_t, \overset{-}{relp}_t, \overset{+}{oil}_t, \overset{+}{p}_t\right) \quad (4.16)$$

where $r\exp_t$ is real exports of goods and services, wY_t is world (U.S) income in real terms, $relp_t$ is the relative price of goods and services (the ratio of domestic prices to U.S prices), and oil_p_t is world oil prices.

4.4.2.2. Real imports of goods and services. The demand for real imports of goods and services is in the long run mainly driven by the level of domestic income and relative prices of goods and services. Fluctuations in the exchange rate are also having a significant impact on the long-run specification of real imports for Nigeria since imports dominate a large component of the country's consumption expenditure. The Nigerian real imports function is, therefore, specified as follows:

$$rimp_t = f\left(\overset{+}{Y}_t, \overset{+}{relp}_t, \overset{-}{exch}_t\right) \quad (4.17)$$

4.4.2.3. Nominal exchange rate. The underlining theory supporting the specification of the nominal exchange rate equation is based on Dornbusch (1976, 1980) and Frankel (1979). These studies assume that prices are sticky in the short run and explain the prolonged departure of the exchange rate from long-run Purchasing Power Parity (PPP). Given this background, the long-run nominal exchange rate is specified as follows:

$$exch_t = f\left(\overset{-}{relY}_t, \overset{+}{relMs}_t, \overset{+}{relp}_t\right) \quad (4.18)$$

where $relY_t$ is relative income (the ratio of domestic GDP to U.S. GDP), and $relMs_t$ is relative money supply (the ratio of domestic money supply to U.S money supply).

4.4.3. Monetary sector

The essence of modelling the monetary sector in this study is to elicit information regarding the extent to which the monetary

¹² In the case of Nigeria the exchange rate is not expected to have any influence on the long-run determination of real exports. This is due to the unproductive nature of the Nigerian economy and the fact that over 90 percent of its exports/foreign exchange earnings come from oil.

variables feed 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 by following the principle that the monetary authority does not directly control interest rates. The monetary policy instrument being used by the Central Bank of Nigeria over the years is the monetary aggregate.¹³

4.4.3.1. 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 follows:

$$RMs_t = f(Y_t, int_t) \Rightarrow int_t = f\left(\overset{-}{RMs}_t, \overset{+}{Y}_t\right) \quad (4.19)$$

where RMs_t is the real monetary aggregate.

4.4.4. The government sector

In this study, the government sector is assumed to be determined exogenously. Total government expenditure is divided in three major components: expenditure on social development, government transfer payments and other government expenditure. These components of government expenditure are regarded as some of the main catalysts in breaking down 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 more than 90% of revenue comes from oil production, which has been captured extensively in the study. Tax revenue plays an insignificant role in the economy.

4.4.5. Other behavioural equations in the model

In order to fully detect the socio-economic impediments facing the country over the years, the study endogenises some of the variables used to explain the equations identified above. 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 imbedded in the economy.

4.4.5.1. Socio-economic activity. Since socio-economic progress is expected to translate into a good state of wellbeing of the people, socio-economic activity is specified as follows:

$$SE_t = f\left(\overset{+}{hh_dis_inc}_t, \overset{+}{govtexp}_t, \overset{+}{fr}_t\right) \quad (4.20)$$

where $govt\exp_t$ is a component of government expenditure that is channelled 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.

4.4.5.2. Household disposable income. Disposable income is directly related to real wages and presented as follows:

$$hh_dis_inc_t = f\left(\overset{+}{rw}_t, \overset{+}{transfer}_t\right) \quad (4.21)$$

where $transfer_t$ is a form of transfer payment from the government to the people.

4.4.5.3. Poverty: Analyses of macro-poverty linkages have gained substantial ground among policy makers over the past few years. Debates on the impact of specific macroeconomic policies (i.e. fiscal policy, inflation, and financial liberalisation) on poverty have recently

¹³ The role played by monetary policy in Nigeria over the years has been very insignificant.

started to dominate the literature.¹⁴ This study attempts to explain poverty by using some important macroeconomic variables and this can be specified as follows:

$$poverty_t = f\left(C_t^+, hh_dis_inc_t^-, aid_t^-, fr_t^-, agricprod_t^-\right) \quad (4.22)$$

where $poverty_t$ is the level of poverty, aid_t is the flow of aid, and $agricprod_t$ is the level of agricultural production.

4.4.5.4. Agricultural production. The level of agricultural production is determined by the availability of natural resources (i.e. land), the level of infrastructural development and some form of production prices in the economy. This can be represented as follows:

$$agricprod_t = f\left(land_t^+, P_t^+, fr_t^+\right) \quad (4.23)$$

where $land_t$ is the availability of land for agricultural production. These variables are expected to influence agricultural production significantly.

4.4.5.5. Provision of infrastructure. The role of adequate infrastructure in economic development cannot be over emphasised. The challenge of long-term development is to design economic policies that are geared towards investment in infrastructure. A lack of basic infrastructural expansion and the misappropriation of government expenditure earmarked for infrastructural development has been a major feature of the Nigerian economy since its independence. However, government's role in the provision of public infrastructure remains seminal.

The provision of infrastructure in Nigeria is modelled as a function of economic activity and the level of government effectiveness (proxy for good governance). This is presented as follows:

$$fr_t = f\left(Y_t^+, ge_t^+\right) \quad (4.24)$$

where ge_t is a governance indicator representing the level of government's effectiveness.

4.5. Model closures

Model closure reveals the important inter-linkages and feedbacks of the various macroeconomic variables and estimated equations in the system. The type of closure reveals the features of the model developed and how the various policy simulations/scenarios would feed back into the entire system. Therefore, the two models developed in this study are closely based on the following identities:

4.5.1. Model A

In this model the production function (GDP) is estimated by making the supply-side of the economy more active than the demand-side. Therefore, the price (producer and consumer) equations serve as the link between the demand-side and the supply-side of the economy through excess demand and capacity utilization. This is presented as follows:

$$\begin{aligned} GDP &= f(L, K, T) \\ \text{Excess Demand} &= GDE / GDP \\ GDE &= C + I + G \\ \text{Capacity Utilization} &= GDP / GDP_POTENTIAL \end{aligned}$$

where L is labour employment, K is capital stock, T is technology, GDE is gross domestic expenditure, C is household consumption expenditure, I is domestic investment, G is total government expenditure, Z is imports of goods and services, and GDP_POTENTIAL is the potential level of the GDP.

The potential level of output in the economy is estimated by 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.

4.5.2. Model B

In this model the production function (GDP) is generated by 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 the linkages between the demand-side and the supply-side of the economy through excess demand and capacity utilization. This is presented as follows:

$$\begin{aligned} GDP &= C + I + G + X - Z \\ GDE &= GDP + Z - X \end{aligned}$$

where X is exports of goods and services, and Z is 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 Fig. 8. The chart highlights the major contemporaneous feedback processes of the interactions between the sectors investigated in the model. Details of all the structural equations were analysed in the previous sections.

As shown in Fig. 9, the price block serves as a major linkage between the supply-side and aggregate demand-side through capacity utilization and excess demand. Changes in these variables cause fluctuations in prices, which affect production and demand and also cause changes in the other sectors of the economy. The monetary, external and public sectors are linked directly to the supply-side and demand-side of the economy through changes in interest rates, government spending, and the 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.

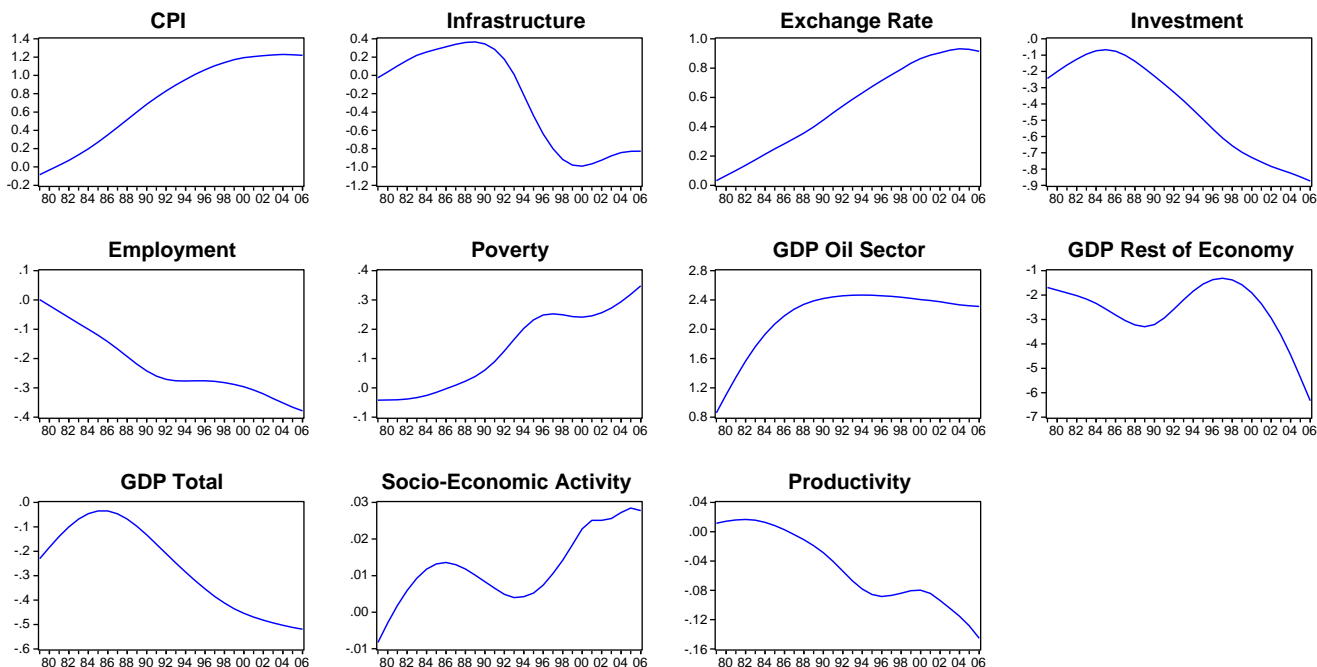
The elasticities are computed by comparing every response variable's baseline simulation path with its shocked simulation path. Elasticity is defined as the percentage change in the response variable relative to the percentage of the shock applied. The dynamic elasticities are determined along the simulation path, whereas elasticities at convergence are the long-run elasticity (Klein, 1982: 135).

Since the major focus of the paper is to detect a long-term solution to the socio-economic problems of Nigeria, permanent shocks were carried out in the model. A positive shock of 10% was applied to an exogenous variable from 1979 onwards to determine the shock simulation path. The actual values of a selected exogenous variable were increased by 10% and the model is therefore dynamically simulated. Every response variable's simulation path was compared with its baseline path to determine the response elasticities. The process was repeated for every selected exogenous variable in the system.

Because of the small sample size it was difficult to obtain convergence within the sample. To facilitate the detection of convergence, Hodrick–

¹⁴ Gunter et al. (2005) summarises some important macro-poverty debates that have just recently emerged.

A. Shock on World Oil Prices (Model A)



B. Shock on World Oil Prices (Model B)

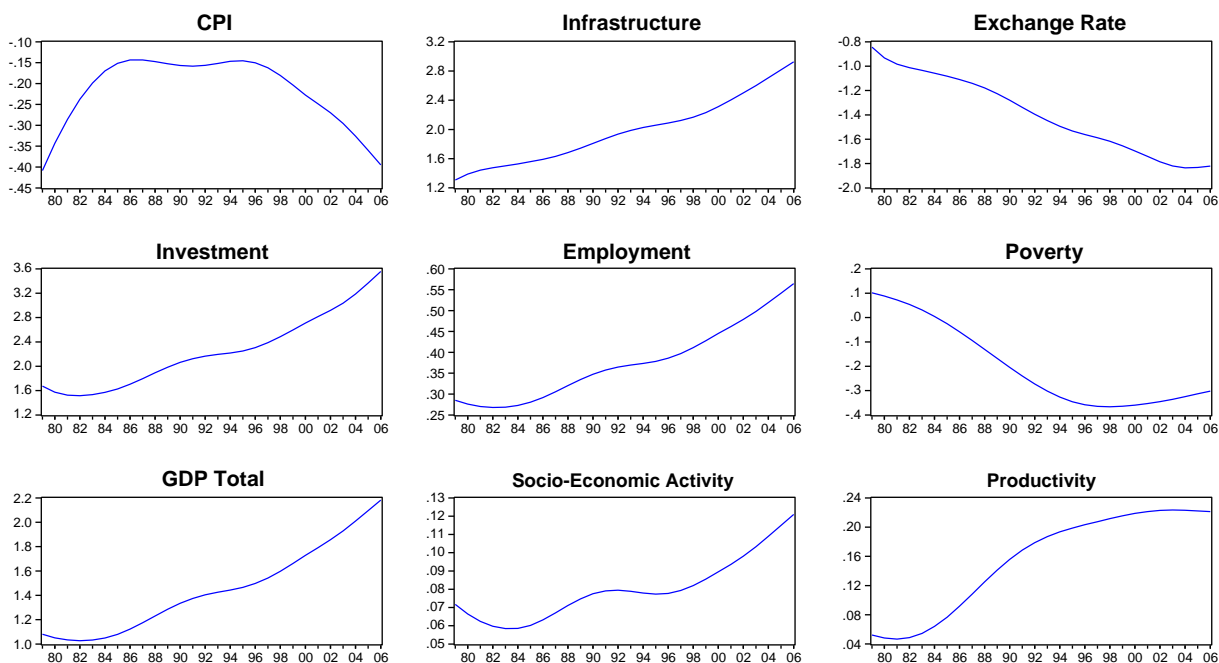


Fig. 8. A. shock on world oil prices (model A). B. shock on world oil prices (model B).

Prescott (HP) filters were applied and the smoothed dynamic elasticities were graphed. The elasticities of the major response variables for the particular shocks are presented in Figs. 7–10. Shocks results from both Model A and B were compared in order to determine the existing simulation differences. The key objective of the entire process of these macro-econometric models is to observe 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

An increase in total government expenditure by 10 percent shows a positive response on the major macroeconomic variables in both

Model A and B. This impact is more successful in an economic environment with limited supply constraints.¹⁵

In Model A, the growth in total GDP as a result of the shock has been positive throughout the period, peaking at a level of about 0.3%. The rest of the economy's GDP is able to reveal a better positive impact than the oil sector's GDP. The expansionary fiscal policy boosted domestic investment and the level of infrastructural development over the period,

¹⁵ The effect of a monetary shock was not analysed due to the marginal role that monetary policy has played in stabilising the economy over the years. This is coupled with the fact that the Nigerian financial system has as yet not been well integrated into the local and global economy.

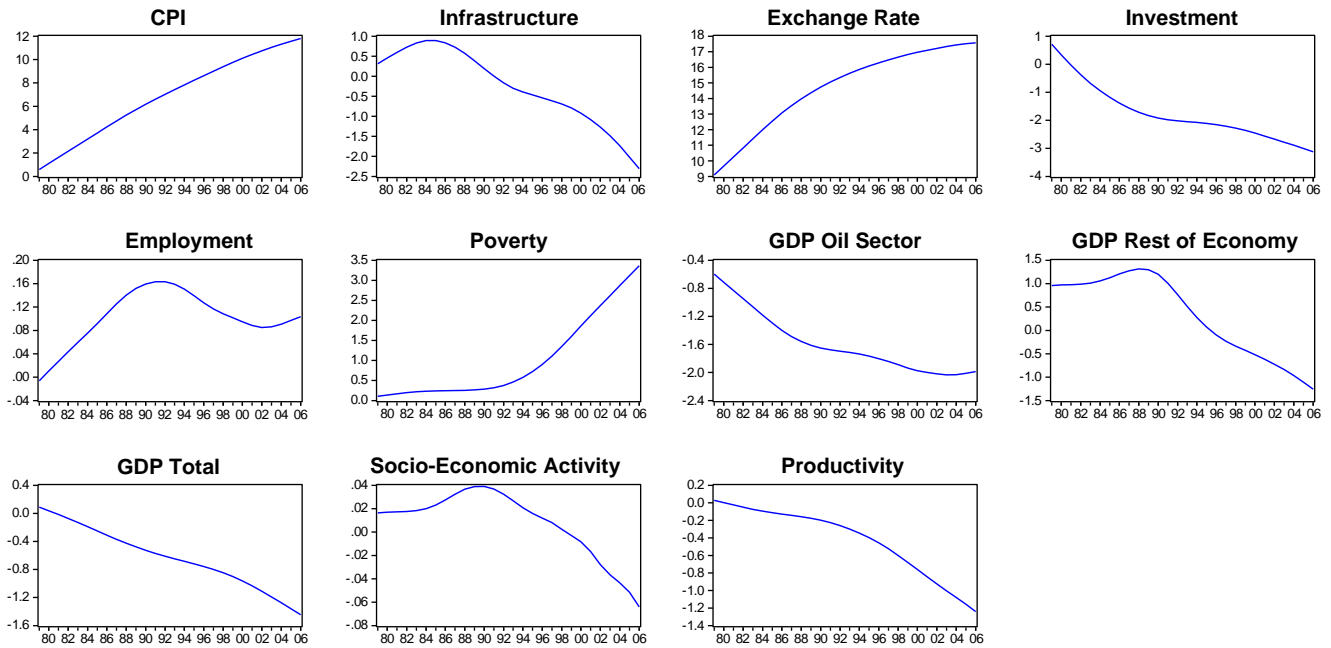
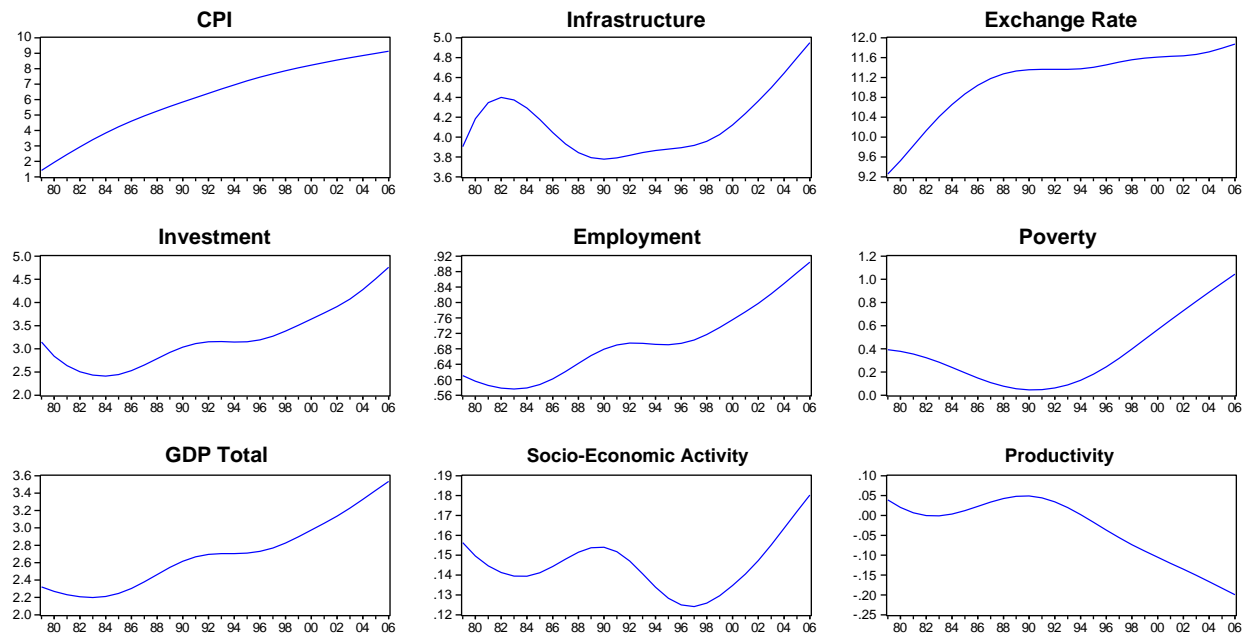
A. Shock on World Income (Model A)**B. Shock on World Income (Model B)**

Fig. 9. A. shock on world income (model A). B. shock on world income (model B).

reaching a high of about 0.4% in each case. This led to an increase in socio-economic activity, employment and productivity, which eventually caused a decline in the level of poverty at a low of about 0.4%. Growth in consumer prices was negative throughout the period, coupled with an appreciation of the exchange rate.

In Model B the expansionary fiscal policy produced a more successful impact. The growth in GDP, which has been positive throughout the period, reached a high of about 2.9%. An increase of about 4.5% was recorded for domestic investment as well as for infrastructural development, translating into a more pronounced positive impact on socio-economic activity, employment and productivity and leading to a lower reduction in poverty of about 1.2%. A more significant improvement in the value of the currency was

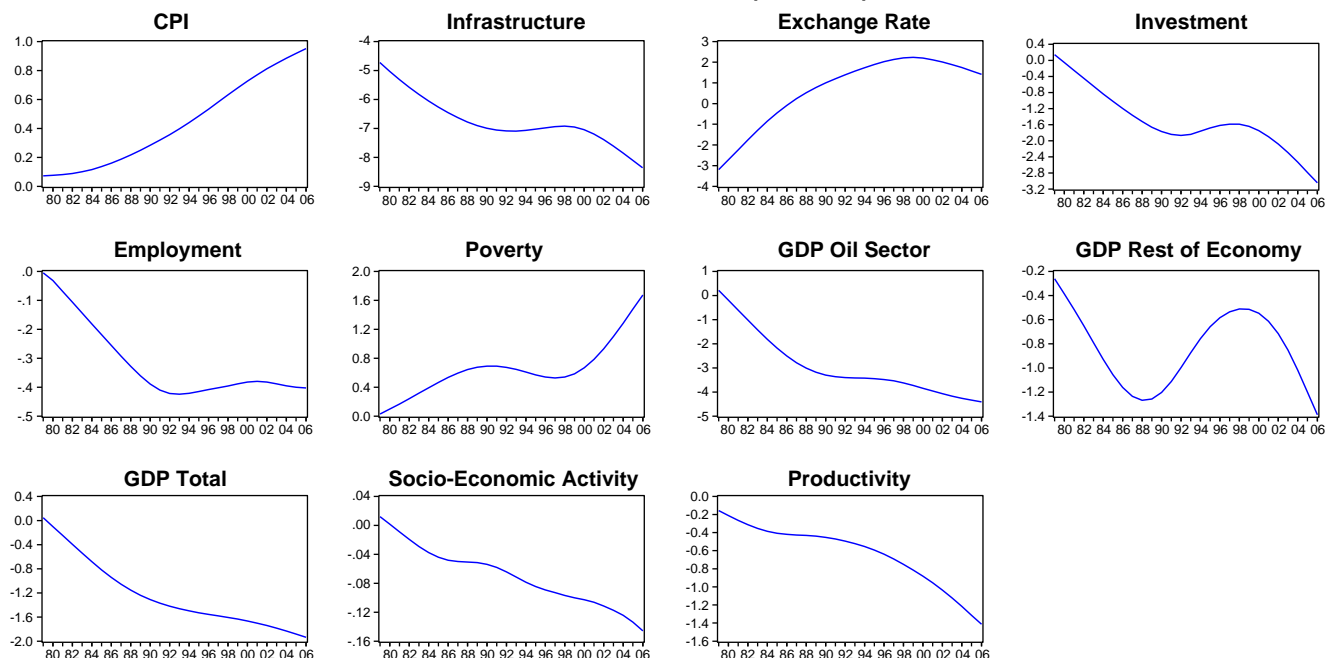
recorded over the long run, whereas growth in consumer prices also dropped drastically when compared to Model A.

Despite rising government expenditure over the years in Nigeria, it has not significantly impacted on the general economic situation. The annual growth of the economy has not been impressive and has not translated into rising employment that could have improved the socio-economic conditions of the general populace. This is well revealed in Model A indicating some structural constraints which serves as a good representative of the Nigerian economy.

4.6.2. World oil price shock

An oil price shock is generally viewed as a major external shock that should affect the real variables of any economy directly. The

A. Shock on Government Effectiveness; Worse Governance (Model A)



B. Shock on Government Effectiveness; Worse Governance (Model B)

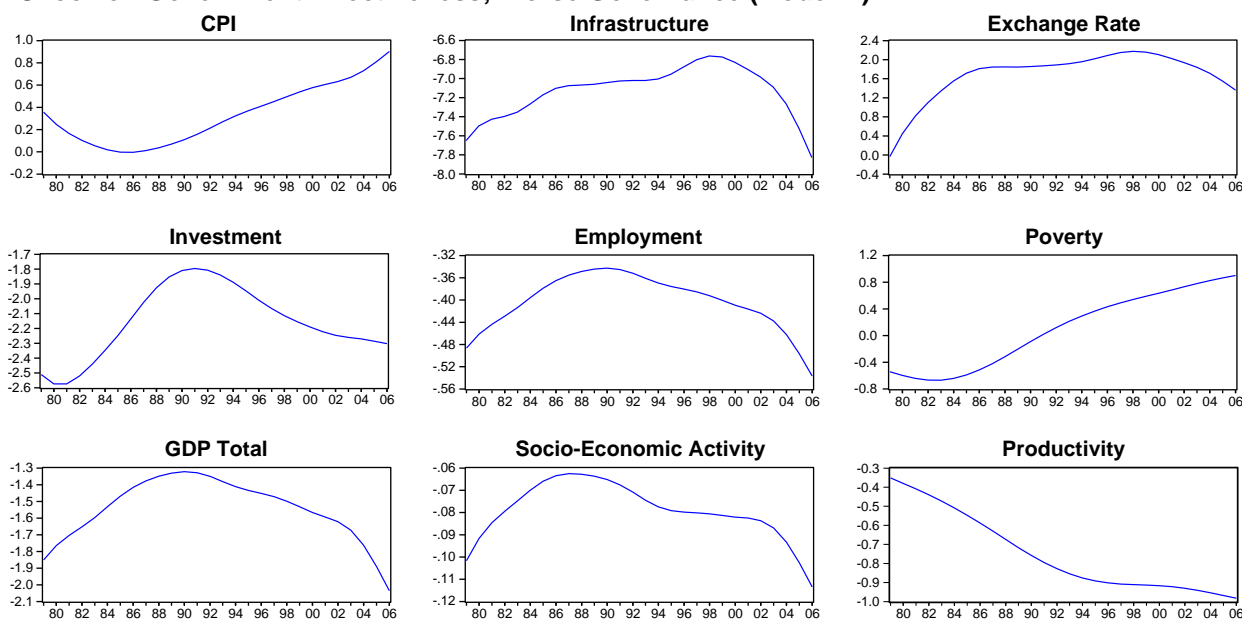


Fig. 10. A. shock on government effectiveness; worse governance (model A). B. shock on government effectiveness; worse governance (model B).

impact of an oil price shock is expected to be more acutely experienced by a country like Nigeria, whose main source of revenue comes from crude oil exportation. It is expected that a rise in the oil price should increase the productive capacity and also improve the general living standard in the country. But over the years the revenue from the oil price increases has not been translated into significant economic growth that is pro-poor. Model B reveals a positive impact on the economy as a result of a 10% rise in the oil price while in Model A negative impact on the economy is revealed.

Except for the oil sector GDP, growth in total GDP and the rest of the economy in Model A was negative in all the periods with a more

severe impact on the rest of the economy's GDP. Irrespective of any structural constraints, the oil sector GDP still recorded a positive increase, reaching a high of about 2.4%. Through this effect, domestic investment and the level of infrastructural development fell by about 1% each over the same period. This resulted in a decrease in employment and productivity but a marginal and insignificant rise in socio-economic activity. This in turn led to a rise in the level of poverty, which reached a high of about 0.4%. Consumer prices also grew on a high of about 1.2% with a depreciating exchange rate throughout the period. The constraints preventing the spread of the oil revenue to increased levels of other production and an improvement in welfare can be attributed to high import volumes of refined

petroleum products which had a direct impact on production prices.¹⁶ This trend still continues in Nigeria.

A positive impact of an oil price shock on the entire economy is shown in Model B. Growth in total GDP was positive over the period, reaching a high of about 2.2%. This led to an increase in domestic investment and infrastructural development. Poverty decreased due to a rising level of employment, socio-economic activity and productivity in the country. The effect of the shock on production prices is not significant in this economic environment and caused decreases in consumer prices over the period, coupled with an appreciating exchange rate.

4.6.3. World income shock

A 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's exchange rate as a result of a rise in world income should lead to an additional improvement in the country's export demand. But, since the country is not competitive in the global environment and the exchange rate impacts negatively on consumer prices, the level of poverty is deemed to rise over the years. The negative impact of the exchange rate on consumer prices can be attributed to the large import component of the country's consumption pattern. This again, is indicative of an economy with structural constraints.

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

The shock on world income increased total GDP in Model B throughout the entire period, reaching a high of about 3.5%. Domestic investment and the level of infrastructural development also received a boost with a high of about 5%. These changes translated into improved employment and socio-economic activity, reaching highs of about 0.9% and 0.2%, respectively. Productivity worsened over the period, simply because of an inflationary effect of the shock.

Growth in total GDP was negative throughout the period in Model A with a severe impact on the oil sector GDP.¹⁷ Domestic investment and infrastructural development also recorded declines with a low of about 3% each over the period leading to falls in employment, socio-economic activity and productivity.

4.6.4. Governance shock

Good governance was the central focus of the 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 an absence of a political will in the leadership structure. The extent to which a country's governance can impact on the socio-economic environment and productive capacity cannot be over emphasised.

The Nigerian governance structures have been in a poor state for many years and this has been a serious challenge in achieving the set developmental objectives. The model indicates a significant impact of good governance on domestic investment and the level of infrastructure in the economy. The poor effectiveness of government and the re-occurrence of political unrest had a seriously negative impact on the growth and development of Nigeria.

Irrespective of the kind of economic environment, good governance plays a crucial role in the economy. Shocks on both political instability and government effectiveness in Models A and B confirmed this. Negative and similar impacts of poor governance were recorded

in the two economic environments.¹⁸ The two models revealed negative growth in total GDP throughout the period. 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 came to the fore.

5. Conclusions and policy recommendations

This study developed explicit and robust macro-econometric models that analysed the persistence in the growth-poverty divergence in Nigeria. The historic performance of the economy identified the existence of socio-economic constraints that serve as impediments to the high and sticky level of poverty in the country. The models were, however, applied to test the hypothesis of existing structural supply constraints versus demand-side constraints impeding the growth and development of the country. Different policy simulations were applied in order to detect optimal policy options for the government.

The series of dynamic simulations which were performed, revealed the importance of the policy analysis of the study. Policy impacts were derived by shocking selected exogenous variables in the system in order to determine the elasticity for every endogenous variable. A 10% shock was applied to all the selected exogenous variables. The simulation with regards to fiscal policy was also evaluated. The fiscal shock involved was total government expenditure. The level of governance was also evaluated by shocking the level of government effectiveness and political instability. The external shocks which were simulated, revealed the vulnerability of the domestic economy to shocks from the global economy.

Based on the historic performance of the economy and the results from the model's simulations, the study concludes that a macro-econometric model capturing structural supply constraints (Model A) will greatly assist in devising appropriate policies to address the high and sticky level of poverty in the Nigerian economy.

Therefore, a supply-side policy intervention is required. A new paradigm for policy making has to be developed for the Nigerian policy environment. To enable the proceeds from 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 a reduction in poverty should be the primary focus of any government policy intervention. Policy intervention should aim at increasing economic growth from the supply-side by absorbing the potentially productive population which will further eradicate the structural impediments embedded in the economy.

In order to achieve the optimal objectives of a sustained economic growth and reduction in poverty, a well-structured and coordinated policy mix is needed because of the interrelationships that exist within the system. Based on the long-run response analysis and the conclusions drawn from this study, the following policy proposals are suggested in addressing the growth-poverty divergence in Nigeria.

- There should be an improvement in the quality of government spending. Fiscal policy expansion should tend towards increasing the component of government expenditure that will lead to sustainable growth and also improvements in the standard of living of the citizens.
- In order to be able to reap the benefits of a positive external shock there is an urgent need to increase the level of competitiveness and the productive capacity of the country.

¹⁶ Note: the country is a major exporter of crude petroleum.

¹⁷ This may be due to the significant role the oil sector plays in the country's production function.

¹⁸ Note: A 10 percent increase in governance reflects bad governance. See data description for more detail.

- The role of infrastructure in boosting the supply-side of the economy cannot be over emphasised. Therefore, investment in basic infrastructure, such as power and roads, is crucial at this stage of the Nigerian economy.
- Poor governance was the major feature of the Nigerian economy over the past few decades. There is an urgent need to refocus the government's role in certain critical areas of the economy. Government institutions need to be strengthened by improving the coordination that exists within the government structures. The political environment needs to be more stable to attract more private investment. The maintenance of public order, ensuring property rights and a sound regulatory structure should be prioritised by government. Creating a framework that will increase the consistent provision of public goods and services and the

maintenance of infrastructure is also urgently required to achieve the macroeconomic objectives.

Moreover, it is imperative to note the difficulties encountered in analyzing poverty using a macro-econometric model. The study, however, brought areas that need further investigation to the fore. The major limitation of this study is the unavailability of quality data for some key macroeconomic variables and this has created major problems in the estimation processes. The problem was largely circumvented through the use of generated indices and dummy variables as proxies for the unavailable data. This has also limited the scope of specification of some equations in the model. There is a need to improve and extend the database. It is also imperative to re-investigate some of the specifications adopted in this study in follow-up studies.

Appendix A

Table 1
Long-run elasticities (the real sector).

Independent variables	Dependent variables									
	Y_t tot	Y_t oil	I_t	N_t	rw_t	ζ_{oil}	ζ_t tot	hh_rcon exp_t	P_t^p	C_t^p
Y_t tot			0.97							
Y_t rest				0.7						
K_t	0.18	0.7								
N_t	0.82	0.3								
rw_t					-0.6					
P_t^p										0.96
ucc_t			-0.1						0.2	
cu_t			0.5						0.5	
pi_t			0.32							
SE_t				0.9						
$labprod_t$					0.75					
hd_t							-0.28			
fd_t							0.03			
$hh_dis_inc_t$								0.97		
$rwealth_t$								0.004		
$r\ int_t$								0.01		
w_t									0.01	
imp_t^p										0.8
$excessd_t$										0.2
$exch_t$										0.9
oil_p_t									0.1	
fdi_t						0.3				
						0.05				

$Y_tRest = Y_tTot - Y_tOil$.

Table 2
Long-run elasticities (external sector, monetary sector and other behavioural equations).

Independent variables	Dependent variables									
	$r\ exp_t$	$rimp_t$	$exch_t$	int_t	SE_t	$hh_dis_inc_t$	$poverty_t$	$agricprod_t$	fr_t	
wY_t	0.75									
$relp_t$	-0.2	0.21	0.38							
oil_p_t	0.34									
Y_t Tot				0.49						1.4
$exch_t$		-0.21								
$relY_t$			-1.1							
$relMs_t$			0.78							
RMS_t				-0.26						
$hh_dis_inc_t$					0.03		-0.15			
$govt\ exp_t$					0.03					
fr_t					0.02		-0.1	0.4		
$transfer_t$						0.1				
rw_t						0.9				
C_t^p							0.24			
aid_t							-0.02			
$agricprod_t$							-0.54			
$land_t$								0.58		
P_t^p								-0.14		
ge_t										0.9

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