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CHAPTER 1

BACKGROUND AND INTRODUCTION

1.1 INTRODUCTION

Macroeconometric modelling is an important part of the discipline of economics. Its empirical ability to explain the actual economy has over the years aided modellers and policy makers in their decision making; its value in formulating sound macroeconomic policies also deserves more emphasis. Sound policy decisions in a country should be based on a well-developed and explicit macroeconomic model. Macroeconometric models generally reflect the major features and structural inadequacies of an economy. It is a necessary and useful tool in any policy environment for analyzing the structure of an economy, making future predictions of the major macroeconomic indicators, and also analyzing the impact of any policy scenarios.

The objective of the Millennium Development Goals (MDG) is to reduce poverty in developing and poor economies. This may not 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.

Developing countries find it difficult to develop sound macroeconometric models due to structural instability and the lack of inadequate data. Therefore, a reliable statistical database is necessary to develop a macroeconometric model that can be used for forecasting and policy analysis. These constraints are significant limitations of this study which are expected to be taken into consideration.

The main objective of this study is to develop a set of operational full-sector macroeconometric models for the Nigerian economy. These models will be used to generate a long-term solution for

the persistent growth-poverty divergence in the country. It is also able to capture the complexities of the economy and the unfavourable socio-economic conditions of the Nigerian economy within a consistent framework. The models use the available data and where data are not available; it develops an acceptable technique to generate the necessary data. The models also comply with an improved analytical framework and relevant economic theory.

1.2 PROBLEM STATEMENT

Structural inadequacies have been the primary obstacle to the achievement of the developmental objectives in the Nigerian economy. Over the past four decades various forms of macroeconomic instabilities constrained the performance of the economy. Many of these structural inadequacies may be attributed to persistently poor governance. Poor political leadership, political instability, corruption and the mismanagement of the oil resources precluded economic policies that might have alleviated poverty.

The country is faced with some fundamental issues; to address these would require an appropriate framework that will serve as a point of reference and that will also be an accurate representation of the economy. Knowledge of the underlying structure of the economy is necessary to determine the various sets of policy interventions that will correct the socio-economic imbalances and that will also generate sustainable pro-poor economic growth.

It is important to model the macroeconomy of Nigeria. This study is also unique in the sense that most structural equations do not adhere to conventional economic theory. The reason for this is that many of the relationships predicted by economic theory rely on structural factors and an institutional framework that are absent in developing economies. (Matlanyane, 2005).

The models developed in this study provide both the theoretical and practical structure to address most of the fundamental socio-economic problems of the Nigerian economy.

1.3 OBJECTIVES OF THE STUDY

The main objective of this study is to develop and estimate full-sector macroeconometric model for the Nigerian economy. These may provide a long-term solution for the major socio-economic problems facing the country. The framework developed in this study is based on underlying economic theory but also aims to incorporate the unique structural factors of the economy. Subsequently, the models are subjected to various policy shocks to determine the different impacts on the major macroeconomic variables in the economy. These shocks are used to detect numerous policy implications and relevant policy recommendations needed for sustainable development.

However, the models developed in this study are specifically applied to:

- Testing the hypothesis of existing structural supply constraints versus demand-side constraints impeding the growth and development of the country

- Analyse different policy simulations to detect the optimal policy options for the country

1.4 RESEARCH METHODOLOGY

The study develops two separate models using the Engle-Granger (1987) two-step estimation technique:

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 an impediment to the growth and development of the country. In this type of economy the limited capacity to absorb labour in the system will result 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 constraints. In this model the 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.

The models capture both the short-run and the long-run dynamic 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, the production function (depicted in Model A) is modelled according to the following principles:

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

ii. The Kalman filter estimation technique is applied to the production function specification to make the technological progress time variant.

iii. The production function is disaggregated into two functional forms:

- The oil sector
- The rest of the economy

The study uses annual time series data covering the period from 1970 to 2006.

1.5 OUTLINE OF THE STUDY

The rest of the study is organised as follows:

Chapter 2 deals with the fundamental literature on growth and poverty. It analyse the various theoretical growth models, the pro-poor growth models, and the empirical evidence on growth and poverty.

Chapter 3 evaluates the growth and poverty performance of the Nigerian economy over the years, with special emphasis on the socio-economic constraints hindering the country's productive capacity. This chapter further analyses the growth accounting exercise and the challenges of the high and sticky level of poverty in the economy.

Chapter 4 specifies the models developed in this study and provides the theoretical framework used in estimating the various equations used in the models. It also presents the techniques used in estimating the equations.

Chapter 5 provides the empirical analysis by presenting the results (long and short-run) of the various behavioural equations in the system. It describes the model closures of the two macro models and also provides the results of the long-run response properties due to the various exogenous shocks applied to the systems.

Chapter 6 concludes the study and provides policy recommendations.

CHAPTER 2

THEORETICAL ANALYSIS: GROWTH AND POVERTY

2.1 INTRODUCTION

The past 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. However, few macroeconometric models have been developed specifically for developing countries. It is surprising that, given the importance of these models in making sound economic policy, models designed to address the issue of poverty–a common feature of these economies has been rare in the literature. Macro-poverty linkages have been analysed in the literature, often with Computable General Equilibrium (CGE) models.

This chapter specifically analyses the theoretical literature and empirical evidence on growth and poverty, and is divided into five sections. The second section analyses the major theoretical growth models and their implications for developing economies. The third section analyses the literature related to poverty trap models. In the fourth section, the empirical evidence on pro-poor growth models is analysed, while the fifth section concludes the chapter.

2.2 THEORETICAL GROWTH MODEL ANALYSIS

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. The neoclassical growth model (also known as the exogenous growth model) was an extension of the Harrod-Domar model, which included productivity growth as a major contributing factor. The major conclusion of the Harrod-Domar model, i.e that steady-state growth was unstable (meaning that any deviation from the long-run path will lead to further deviation from the path) was contested by Solow (1956) and Swan (1956). They refined the exogenous capital-output ratio assumed in the Harrod-Domar model and proposed a model in which the capital-output ratio acts as the adjusting variable which brings the system back to its steady-state growth path. Their work was

seen as a major contribution to the growth theories, which became known as the neoclassical growth model.

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 like 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.

Modification of the neoclassical growth model can be attributed to the lines of thought of Ramsey (1928), Cass (1965), and Koopmans (1965), which are all centred on social planning problems (not market outcomes) that use dynamic optimization analyses of household's savings behaviour (which is taken as constant fraction of income by Solow). Their basic assumptions are that agents in the community are identical and that they live forever.

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 criticisms on the assumptions made in neoclassical theory. These tend to discard the assumption of constant returns to scale, replacing it with an increasing return to scale and thus determining growth by mainly endogenous variables. Technology and human capital are regarded as endogenous, unlike the neoclassical model that assumed these to be exogenous. However, the main emphasis on 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 & 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 using increasing returns that are only external to the firm, this problem was circumvented, as was first seen in 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). However, 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, acceleration in economic growth may not necessarily be sustainable or 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).

2.3 THEORETICAL PRO-POOR GROWTH (POVERTY TRAP) MODEL ANALYSIS

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 level of poverty. But this is not the case especially from the experiences of most developing countries where increases in the growth rates have not translated into a reduction in poverty. The Nigerian situation is an example, where good economic performance in terms of GDP growth over a few years has not improved the living standards of its citizens. However, this occurrence may be as a result of a lack of persistence or insufficient rate of growth experienced by most developing economies. (World Bank, 2006:103).

Evidence from literature has confirmed that if a country is able to maintain a sustainable increase in its growth rate over an extended period of time, this should translate into a higher increase in

the per capita income[1]. But the reality is that most developing countries are still trapped in poverty. A critical link between growth and poverty is necessary, given the disappointing socio-economic performance of these countries.

The link between growth and poverty has been an important aspect towards the process of achieving the developmental objectives of any country. There is a controversy over whether a country should focus on achieving growth and thereafter ensure that the pattern of its growth is pro-poor, or rather focus on reducing poverty, while ensuring that poverty alleviation will lead to faster economic growth. However, poverty can be viewed as a barrier to growth in the sense that a country will not grow if its citizens are poor. This thought has opened the door to the idea of a so-called poverty trap where poverty and growth interact in a vicious spiral: a high poverty level will lead to low growth and vice versa (World Bank, 2006:104).

Poverty traps are explained by Matsuyama (not dated) as self-perpetuating conditions where an economy is caught in a vicious cycle and suffers from persistent underdevelopment. A similar definition follows in Azariadis & Stachurski (2005) as a self-reinforced mechanism, which causes poverty to persist. Furthermore, they pointed out that this mechanism (which reinforces poverty), might occur at any scale of social and spatial aggregation, from individuals to families, communities, regions, and countries–not only across geographical location such as national boundaries.

It is therefore imperative for any economy experiencing a poverty trap to implement a focused strategic macroeconomic policy that would rely either on pro-growth or pro-poor principles, since there is a bidirectional 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 developmental height can be viewed from two perspectives:

[1] This could indicate a reduction in poverty in a relatively equal society.

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. If these constraints are not favourable to growth, poverty levels will rise. The traditional view sees these constraints as exogenous, in other words that they are not determined by the system (World Bank, 2006).

The poverty trap view 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 unfavorable 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 equilibria, depending on their initial positions.

The reasons for poor economies not performing well as rich economies and for the benefits of good policies failing to materialized in poor economies are all embedded in the poverty trap models (Azariadis & Stachurski, 2005; World Bank, 2006).

The presence of external economies (strategic complementarities) has been seen as a common characteristic of most poverty trap models in literature. Learning by doing (which is very difficult to disintegrate from R&D models) has been seen as a way out of poverty traps to sustained economic growth for most developing countries. Stockey (1988) developed a general equilibrium model in which the introduction of new and better products is an integral part of sustainable economic growth. This has been absent in the neoclassical models which concentrate wholly on increases in the production of the same goods. Stockey concluded that if the set of goods produced changes in a systematic way over time, so that goods of higher quality enter each period and those of lower quality drop out, improvement in productivity will not be limited to a specific industry. Under these circumstances, the poverty trap can be avoided since

production will be shifting constantly from one industry to another, and as the existing industries mature new ones will erupt.

Brezis, Krugman and Tsiddon (1993) gave an extensive analysis of how a country can use the advantages of a technological change to get out of the poverty trap. However, the mechanism they suggest involves major technological breakthrough, which may deter most advanced countries from adopting it. The might be because new technologies may not initially be perceived as an improvement by these countries given their extensive experience with older technologies, and also given the fact that human nature does not welcome change easily. However, new technologies may well have more potential for improvement and adaptation than the existing one. Less developed countries have little experience with the old technology, and new technology may allow them to enter the market. They may therefore be more willing to adopt new technology. Furthermore, this may lead to 'leapfrogging' of leadership if the new technology proves to be more productive than the old.

Positive externality through trade liberalisation has also been seen as one of the ways for an economy to achieve higher steady-state equilibrium. As put forward by Matsuyama, the difficulty of searching for trade partners may discourage many from entering an industry, making it even more difficult for others to get trade partners. Yet, when the number of potential trading partners increases, trade will be easier and there will be positive feedback in terms of more profitable production. The control variables affecting trading opportunities are search intensity, advertising and a good reputation for offering good deals. Once these are optimized, profitability will continue to rise by the availability of more potential trading partners (Diamond; 1982).

Azariadis and Drazen (1990) followed Lucas's endogenous growth model (based on the accumulation of human capital) to show how poverty traps can exist, especially when human capital is subject to threshold externalities. Their prediction is based on the fact that an economy will experience multiple steady-states if it is characterised by a sharply different dynamics for different parameter values. This may result from the technical features of the accumulation of physical and human capital in that economy. This means that countries with initial capital

endowment below the steady-state per capita will converge to a steady-state in which capital, consumption, and income per head remain relatively low.

The existence of threshold externalities is also suggested by Ciccone and Matsuyama (1996) as factor that may help in achieving economic development. They show how an economy that inherits a small range of specialised inputs can be trapped into a lower stage of development. That is to say that economic growth can be achieved by means of greater specialisation in the economy. The idea is that developed economies are more exposed to the variety of specialised inputs associated with more advanced technologies. Developing economies have limited availability of these specialised inputs thereby forcing their industries to rely on labour intensive technology. This in turn leads to a limited incentive to found new firms and introduce new goods. In this case the economy is caught in a trap as a result of the limited division of labour and market size. Ciccone and Matsuyama explain further that, when the economy is below the threshold level, it may be impossible for specialised firms to enter and push the economy above the threshold, enabling it to break free from the development trap–the reason being that the start-up cost might be a major constraint making the entry of firms unprofitable, since it requires reallocation of resources from production.

Saint-Paul (1992) shows how a poor financial market can trap an economy in poverty and underdevelopment. He stresses the idea that productivity growth can be achieved through a greater division of labour and that the financial market will play an important role by putting increasingly specialised resources at a greater risk. The intuition behind the Saint-Paul paper is that, when financial markets are underdeveloped, there will be less specialization and people will choose poorly productive, yet flexible technologies associated with less risk. This may result in a poor state of development. A poor country will therefore remain at a low steady-state equilibrium with underdeveloped financial markets and little division of labour while a rich country on the other hand, will have higher steady-state equilibrium with greater division of labour and developed financial markets. Acemoglu and Zilibotti (1997) also present a theory of development that links capital accumulation to the extent to which financial markets are developed. They indicate that well diversified opportunities and a more productive use of funds may lead to a process of development and poverty alleviation. They further argue that the desire

to avoid high-risk investments may slow down the accumulation of capital, which in turn will lead to development patterns consisting of a long period of primitive accumulation. However, policies promoting financial development may have different implications depending on the initial condition of the economy, in the sense that multiple steady-state equilibria may exist. One of these equilibria may lead to a poverty trap which in turn may lead to economic stagnation and the disappearance of the financial sector (Berthelemy &Varoudakis: 1997).

As discussed earlier, an economy grows when it experiences an increase in per capita income. But this is not really the case in some developing and underdeveloped economies. The theory of the low level equilibrium trap (poverty trap) was first developed by Nelson (1956) by building a framework that analyses the problems of stagnant (underdeveloped) economies. Based on his realistic assumptions, he shows that an economy could still escape the poverty trap if the socio-political environment is favourable, even when there is no improvement in the techniques of production and the absence of a crash investment program. The model provides means for underdeveloped economies to escape the trap. This has been achieved historically by simultaneously changing the social as well as the political structure of the economy. Also, an economy can be free from the low equilibrium trap as mention by Nelson, if income and capital increase, which can be achieved through funds, obtained from abroad and a decrease in population through emigration. However, an economy can be caught in a poverty trap when there is a high population associated with low human capital and when there is a high persistent labour force participation rate generated by the elderly (Becker et al, 1990; Matsuyama, 2000).

Moreover, as explicitly explained earlier, an economy operating at a lower steady-state equilibrium is regarded to have been trapped in poverty. But is there any self-reinforcing mechanism causing poverty to persist? Azariadis & Stachurski (2005:328) explain that poverty will disappear if agents can coordinate to maintain a higher level of equilibrium. They also emphasise the role history has to play in determining this equilibrium. They explain this by deviating from the assumption of perfect information and rationality. This means that, in a rational environment with limited information, outcomes will be driven by norms, institutions and convention. Furthermore, these factors will play a major role in a country's successful coordination to a higher equilibrium. Therefore, historical accident as put forward by Azariadis

and Stachurski may lock an economy in a suboptimal equilibrium (poverty trap) from which it will prove to be almost impossible to break free.

2.4 GROWTH AND POVERTY EMPIRICS

Empirical testing of long-term growth in macroeconomic literature became very popular from the late 1980s onwards. Some of the few empirical studies that were done prior to this period are focused on the time required for an economy to revert to its long-run equilibrium position. In recent years, most empirical studies on economic growth have been tilted to a cross-country regression in which a country specific effect can be determined from the analysis. Few empirical studies in the area of pro-poor growth have been carried out in literature. Empirical linkages between growth and poverty should be critically investigated, as most developing countries are trapped in poverty.

Table 2.1 Summary of empirical literature related to pro-poor growth model

	Title	Authors (Date)	Aggregation & Period	Methodology	Key Findings
1	Economic Growth	Barro, R.J. and Sala-i-Martin, X.			
2	Economic Growth and Convergence across the United States	Barro, R.J. and Sala-i-Martin, X. (1990)	Panel of 48 states over the period 1963 to 1986	Panel estimation techniques, using a standard neoclassical growth model	Existence of convergence across U.S. states.
3	Economic Growth in a Cross Section of Countries	Barro, R.J. (1991)	Panel of 98 countries between 1960 and 1985	Panel estimation techniques, using a standard endogenous growth model with human capital.	Existence of convergence if poor countries have high human capital per person.
4	Is Growth Exogenous?	Bernanke, B.S. & Gurkaynak, R.S. (2001).	Panel of 98 non-oil producing countries, 75 intermediate countries, and 22 OECD countries between 1960 and 1995.	Extended framework of MRW (1992) to test the Solow growth model.	Long-run growth is significantly correlated with behavioural variables such as savings rate which is not easily explained in models of exogenous growth.

5	Long-Term Growth in Developing Countries and its determinants: An Empirical Analysis	Otani and Villanueva (1990)	Annual averages of 55 developing countries.	Cross-country regression technique	Models incorporating the savings rate, exports performance, and expenditures on human capital development explain the growth performance of developing countries remarkably well.
6	Macro Policies, External Forces, and Economic Growth in Sub-Saharan Africa	Ghura (1995a)	Panel data for 33 African countries covering the period 1970 to 1990.		Confirms the important roles of physical and human capital, inflation, government consumption ratio, export growth, macroeconomic stability, and political stability in determining long-term growth.
7	Determinants of Long-Term Growth: Some African Results	Ojo and Oshikoya (1995)	Panel data for 17 African countries covering the period 1970 to 1991		Reveals the importance of some additional explanatory variables (i.e population growth) in influencing the long-run economic growth of these African countries.
8	The Augmented Solow Model and the African Growth Debate	Hoeffler (2000)		Panel data estimation technique using a Generalised Method of Moment (GMM)	Confirms that the augmented Solow model can fully account for sub-Saharan Africa's low growth performance.
9	Galton's Fallacy and Test of the Convergence Hypothesis	Quah Danny (1993)	Panel of 41 countries covering the periods between 1960 and 1985. Derived from Summer and Heston (1991).	Uses a dynamic version of Galton's Fallacy. Estimation follows Gaussian Kernel, with bandwidth selected automatically.	Reveals a tendency for divergence, rather than convergence, of cross-country income.
10	Empirical Cross-Section Dynamics in Economic Growth	Quah Danny (1993)	Panel of 118 countries covering 1962 to 1985.	Two approaches: Standard Cross-Section OLS estimation and a Dynamic Evolving	Suggests that countries with low incomes have a greater tendency to remain poorer,

				Distributions which follows a Markov Process.	while high income economies will persist to remain the richest.
11	Geography and Poverty Traps	Bloom, Canning, and Sevilla. (2003)	Cross-Section of 152 countries, using 1985 data.	Estimation follows a maximum likelihood approach and testing follows a Monte Carlo methods.	Finds evidence of the existence of a poverty trap with a high level equilibrium that is similar for all countries, but differences in geographical conditions could lift up a country to higher equilibrium.
12	Poverty Traps, Aid, and Growth	Kraay and Raddatz (2006)	Not Applicable	Calibration: Using Solow growth model to illustrate a saving-based and technology-based poverty trap.	Not much evidence in support of the idea that the two approaches used are empirically relevant. The results also question the popular idea that large scale-up of aid to the poorest countries could bring them to a higher level of equilibrium.

Table 2.1 outlines the major empirical models on growth and poverty that are available in the literature to summarise the important differences in their methodologies. As mentioned earlier, the major feature of these studies are that they are carried out using a cross-section/panel regression technique.

One of the major predictions of the neoclassical growth models is based on conditional convergence. Barro and Sala-i-Martin (2004:462) distinguish between two concepts of convergence.

First, the income level of poor countries will tend to catch up with the income level of rich countries. Empirical evidence on the average since the 1950s has reflected otherwise in that developed countries have been growing faster than developing countries. A few exceptions to

this observation were found in Asian countries (notably Japan) which appear to have converged with or even exceeded the rich countries of the Western world.

The second concept is concerned with cross-sectional dispersion. This means that convergence occurs if the standard deviation of the logarithm of per capita income across a group of countries or regions declines over time. Therefore, the convergence of countries or regions towards their steady-state level of income will depend mainly on the different characteristics, such as the institutional arrangement, market structures and trade policies of these individual countries or regions.

The neoclassical prediction that poor countries will tend to grow faster than rich countries has been a subject of debate in many of the empirical studies in the literature. Closer investigation of convergence among the U.S. states, regions and a few other countries was conducted by Barro and Sala-i-Martin (1990, 1991 and 1992). Their findings were mostly in favour of convergence, especially among the U.S. states and regions of Western Europe. However, the rate of convergence for poorer states or regions to catch-up with the richer was found to be not too rapid, growing roughly at about 2 per cent per year. This in fact, is in accordance with the neoclassical view, if diminishing capital returns is taken into consideration as the economy develops. Evidence of convergence was not found among the sample of different countries except on a conditional basis. This means that variables like initial school enrolment rates and the ratio of government consumption to GDP are held constant. These are seen as proxies for the steady-state value of output per effective worker and rate of technical progress.

The question whether or not long-run economic growth is exogenous was addressed in Bernanke and Gurkaynak (2001). They adopted the empirical framework of Mankiw et al. (1992) and used it to re-evaluate both the exogenous and endogenous growth models. Their results revealed strong evidence against the basic Solow model in the sense that the long-run growth is significantly correlated with behavioural variables. In order words, their results show that a country's rate of investment in physical capital is strongly correlated with its long-run productivity growth rate. It further indicates that rate of human capital accumulation and population growth was found to be correlated with the rate of economic growth. As explained by

Bernanke and Gurkaynak, these correlations are not accepted in the exogenous growth models and they therefore suggest that future empirical studies should focus on models of endogenous growth instead.

Empirical studies addressing the long-term growth in the developing countries and Sub-Saharan African countries have also been explored in literature. Otani and Villanueva (1990) provided empirical evidence on the determinants of long-term economic growth in a sample of 55 developing countries grouped by income level. Their theoretical model was consistent with the endogenous growth theories in which variables such as savings rates, export growth, expenditure on human capital development and population growth are included as determinant of long-term equilibrium growth rates. Evidence from their model reveals that incorporating these variables helps to explain the growth performance of these countries considerably. It also identifies the major contributing factors, such as the development of human capital, which contributes about 1 per cent annually to the average per capita growth rate of output in these countries. Their estimates also reveal that a once-off increase in the domestic saving rate of 10 per cent would raise the long-term growth rate of output by 1 or 2 per cent annually in many of the high income countries who have passed through the take-off stage, and about 3 to 4 per cent in many countries who are still in the take-off stage of economic development.

The effects of macro policies in sub-Saharan African countries on their economic growth were investigated by Ghura (1995a). His empirical model was in line with the endogenous growth theories where external forces, human capital, political instability and other factors can affect long-term economic growth. These variables (especially the macro and trade policies) provide strong evidence of a significant effect on long-run economic growth in sub-Saharan Africa. Similar studies were found in Ojo and Oshikoya (1995) while investigating the factors dictating the long-run economic growth of some African countries. To see the effect of these factors clearly they sub-divided the countries (into oil exporters, low income, and middle income) and the periods (1970-74, 1975-79, 1980-84 and 1985-1991) into three and four groups respectively. However, measuring human capital still remains a huge limitation to these studies. The African growth performance as analysed by Hoeffler (2000) using an augmented Solow model contrasted with the commonly–found result in literature that basic growth models cannot explain the growth

performance in Africa. The use of the GMM estimator adopted in the study boosted the robustness of the results since the unobserved country specific effects and the endogeneity of the regressors in the estimation have been accounted for.

The benefit of long-term economic growth should be the general improvement in the standard of living of a nation's citizens. Pro-poor growth and the idea of a poverty trap have become popular phenomena among development economists and policy makers in recent years. Empirical evidence on self-reinforcing mechanisms (explained by the poverty trap models) in which poor countries are likely to remain poor and stay at a low level of equilibrium for a long time has not been explored thoroughly in the literature. A focus on the pattern of growth that will bring most of the developing countries out of a poverty trap is deemed necessary to achieve the set objectives of the Millennium Development Goals.

Empirical evidence in support of the poverty trap was explored by Quah (1993a and 1993b) and Bloom, Canning and Sevilla (2003). These studies criticized the standard cross-section regression tests of the convergence hypothesis. The threshold level of income from which a country starts plays an important role in achieving its developmental objectives. The probability of a poor country remaining poor and of a rich country remaining rich is found to be very high. This revealed the reality of a world with economies that tends (in the long-run) towards either the very rich or the very poor. Empirical relevance of the poverty trap view of underdevelopment, which can arise due to either low saving or low technology, has also been examined by Kraay and Raddatz (2006). Based on these specific mechanisms, little evidence of a poverty trap was found.

The above empirical review of the growth and poverty trap models is mainly based on cross-sectional distribution of income, which may conceal certain important country-specific characteristics. Cross-sectional and panel data regressions on long-run growth may not reveal the dynamics of the entire distribution, since it only captures the behaviour on a conditional average (Quah, 1997). Country-specific investigation of pro-poor growth may afford better ways to showcase the empirical relevance of the poverty trap model. Time-series explanation of the

growth-poverty linkages could help release most of the developing countries that are trap in poverty. These investigations are still very rare in the literature, however.

In this study, a time-series macro-econometric model is adopted to explain the high and sticky level of poverty in Nigeria. This approach is validated through the economic preference analysis developed in the study. The study maintains a focus on structural (supply) constraints, which have been the major impediments to a sustained growth and development of the country.

2.5 CONCLUSION

This chapter has analysed the most important theoretical and empirical models on growth and poverty. A sound policy intervention and a suitable economic environment have been identified as a catalyst that may lead to pro-poor long-term growth. Most of the pro-poor growth (poverty trap) models have been able to explain why some countries remain poor and why others remain rich. It is evident that an economy able to sustain long-term growth is more likely to achieve a significant reduction in its level of poverty in the long-run. The threshold level of equilibrium that an economy starts from is crucial in achieving its developmental objectives. An economy operating at lower steady-state equilibrium (due to capacity constraints) is likely to be trapped in poverty. Structural inadequacies may also have caused the low equilibrium state. It is, however, necessary to design a framework which complies with the requirements of theoretical consistency.

CHAPTER 3

EVALUATING THE GROWTH AND POVERTY PERFORMANCE OF NIGERIA

3.1 INTRODUCTION

This chapter investigates the growth and poverty profile of the Nigerian economy since 1960. It focuses on detecting the productive capacity of the Nigerian economy over the years and also reveals the oil dependency and other structural constraints embedded in the economy. The chapter is divided into two main sections. The first section highlights the general performance of the Nigerian economy by explaining the paradox of an economy with abundant resource wealth such as Nigeria and its lacklustre economic performance over the years. It also analyses the sources of economic growth over the years by using the growth accounting exercise. The second section analyses the poverty profile and highlights the strategies that have been put in place over the years to reduce poverty. It also analyses the various challenges of poverty and gives reasons as to why poverty is still as pronounced among the Nigerian populace.

3.2 NIGERIAN ECONOMIC GROWTH PERFORMANCE

3.2.1 Wealth of the Nigerian economy

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 richest 50 countries in the early- 1970s.

As one of the largest exporters of crude oil in the world and the largest in Sub-Saharan Africa, Nigeria produces on the average about 2 million barrels of oil per day. Oil production alone

accounts for over 90 per cent of the country's export revenue. The average prices of crude oil in the world market between the late 1980s and 2006, ranges from US$20 to US$60 per barrel, which has a strong bearing on the Nigerian economy's wealth.

Table 3.1 Nigeria Selected Petroleum Statistics, 2000-2006 (Millions of barrels)

Year	Production	Export	Domestic consumption
2000	797,880,000	688,080,000	109,800,000
2001	817,150,000	674,930,000	142,220,000
2002	655,060,000	490,810,000	164,250,000
2003	655,060,000	490,810,000	164,250,000
2004	900,600,000	736,400,000	164,200,000
2005	919,285,000	846,179,700	73,105,900
2006	813,950,000	656,090,000	164,200,000

Source: Central Bank of Nigeria (CBN)

Table 3.2 Total exports of selected African countries, 2006 (Values in current US$)

Country	Exports (US$ million)	Population (million)	Exports per capita ($)
Angola	23669.5	15.9414	1484.782
Ethiopia	882.817	77.4307	11.40138
Ghana	2520	22.1128	113.9611
Kenya	3292.85	34.2557	96.12561
Nigeria	42276.9	131.53	321.424
South Africa	51625.7	47.4318	1088.42
Uganda	821.36	28.8162	28.50341
Zambia	1720	11.6685	147.4054

Source: IMF; IFS Data

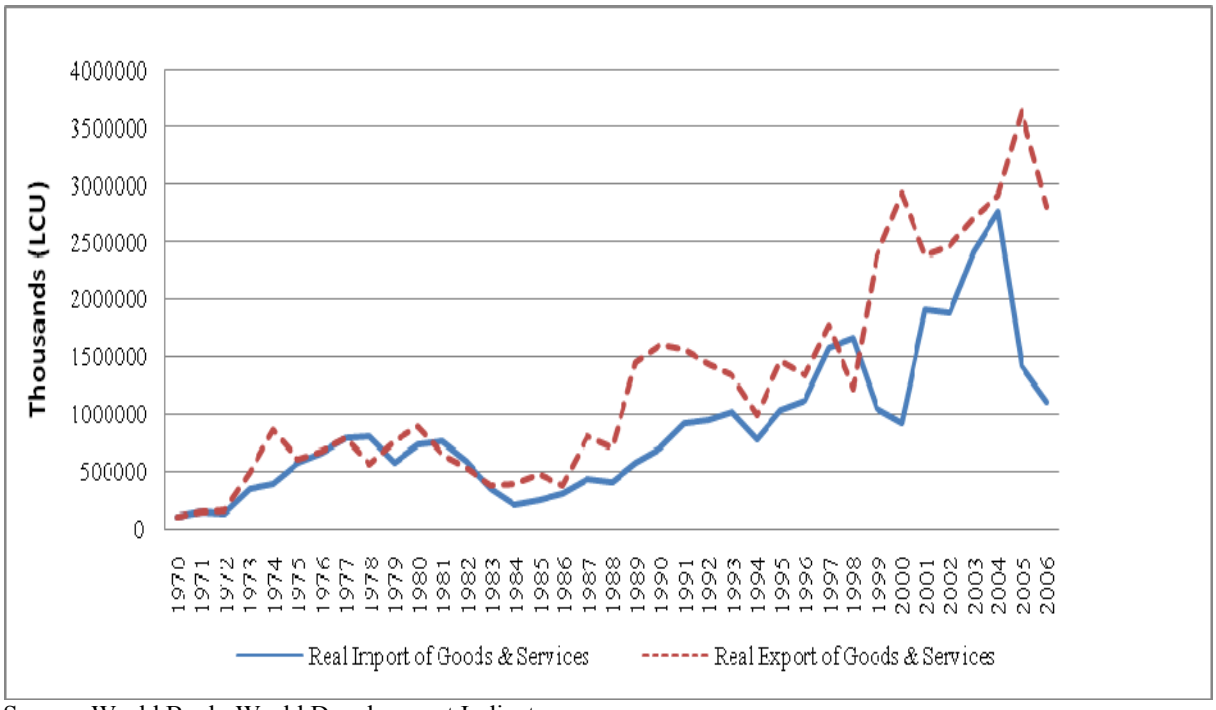
Before the discovery of oil in 1956, the main export earnings of the Nigerian economy were generated by agricultural products. On average, over 80 per cent of the total crude oil production was exported between 2000 and 2006 (table 3.1). Domestic consumption has been low over the years due to inadequate capacity to transform the crude oil into refined products. Presently, Nigeria still imports a large portion of refined petroleum products despite its huge supply of crude oil.

With the exception of South Africa, Nigeria earns the largest export income per annum among all Sub-Saharan African countries. This may also indicate the country to be the second largest economy in this region. In fact, had other mineral resources been developed to it full capacity, it

would have placed Nigeria as the top export income earner in Africa. In 2006, Nigeria earned about US$42 billion whereas South Africa earned about US$52 billion. Angola and Kenya earned about US$24 billion and US$3.2 billion respectively (table 3.2).

Despite the large population of Nigeria (more than one-sixth of the whole African population) its exports per capita of about US$322 still remain only the third largest in Sub-Saharan Africa after Angola and South Africa (with about US$1500 and US$1100 respectively).

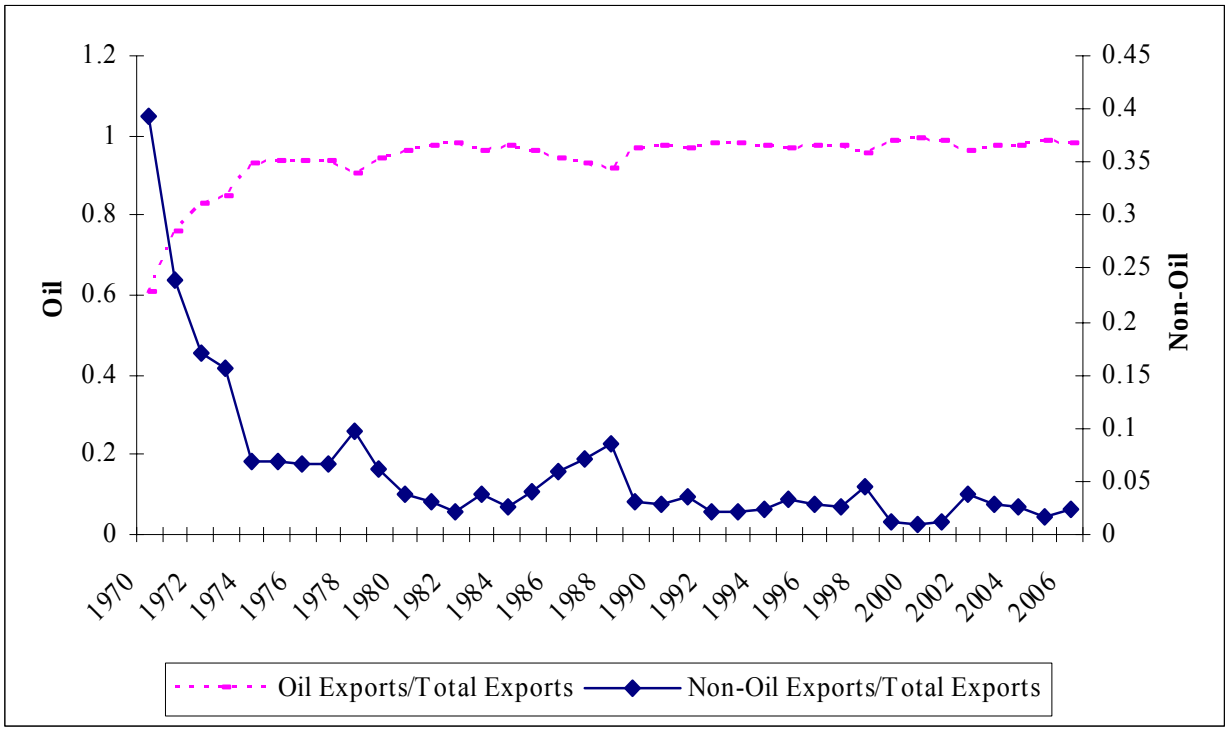
Figure 3.1 Nigeria Trade Account (1970-2006)



Source: World Bank, World Development Indicators

Despite the low productive capacity of the country, the trade account also reveals the wealth of the Nigerian economy. The country has experienced a robust trade surplus over the last few decades. Figure 3.1 shows the significant surpluses recorded between 1983 and 1997 as well as from 1999 when the country returned to a democratic dispensation. Despite the considerable import component of domestic consumption, the country's exports (mainly from crude oil) are still significantly higher than its imports. This explains the considerable amounts of foreign exchange earnings that the government receives from crude oil exports.

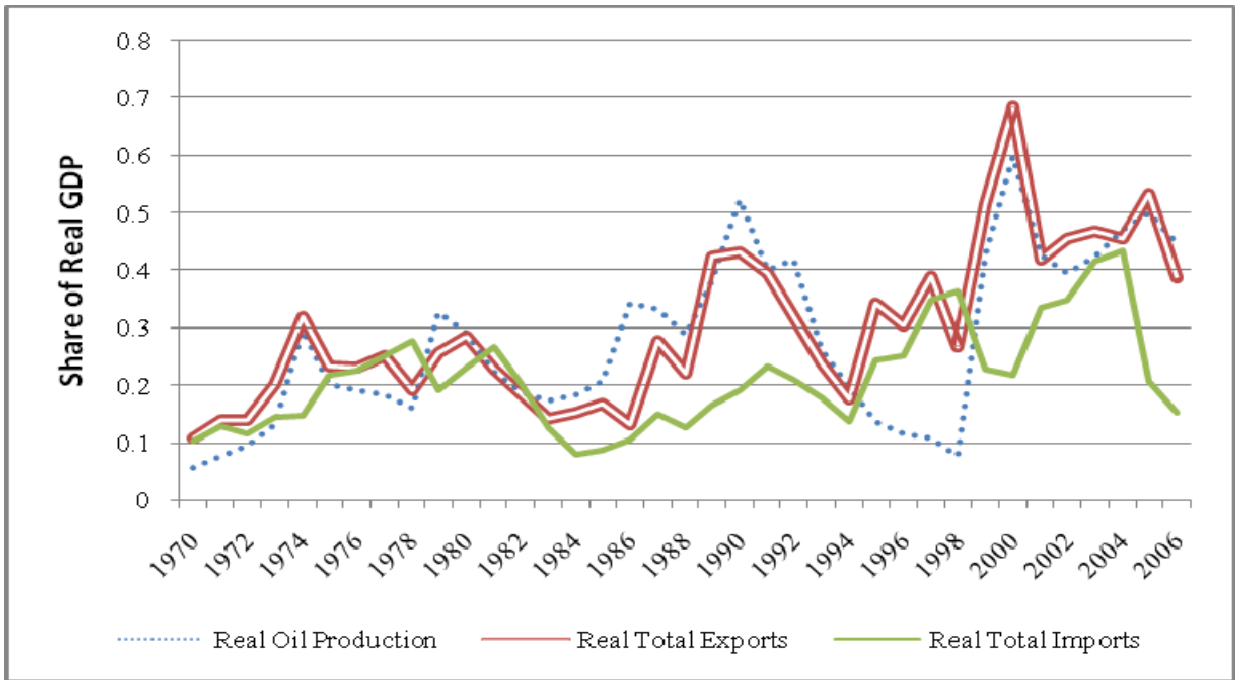
Figure 3.2: Divergence of Oil and Non-Oil Exports in Nigeria



Source: World Bank, World Development Indicators

Oil exports have been on the increase and this has dominated overall export earnings with oil export revenue on average comprising about 95 per cent of total exports over the years. Figure 3.2 shows the divergence between oil and non-oil exports in Nigeria over the past three and half decades. The ratio of non-oil exports to total exports has been on an increasingly 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.

Figure 3.3 Oil Production, Total Exports, Total Imports as a Share of GDP



Source: World Bank, World Development Indicators

Against this background, it is evident that the role played by the oil sector in the Nigerian production function can not be underemphasised. 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 per cent recorded between 1999 and 2000, and about 30 per cent 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 per cent respectively recorded on the 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 may eventually reduce the high level of poverty over the long run.

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

3.2.2 The evolution of the Nigerian economy

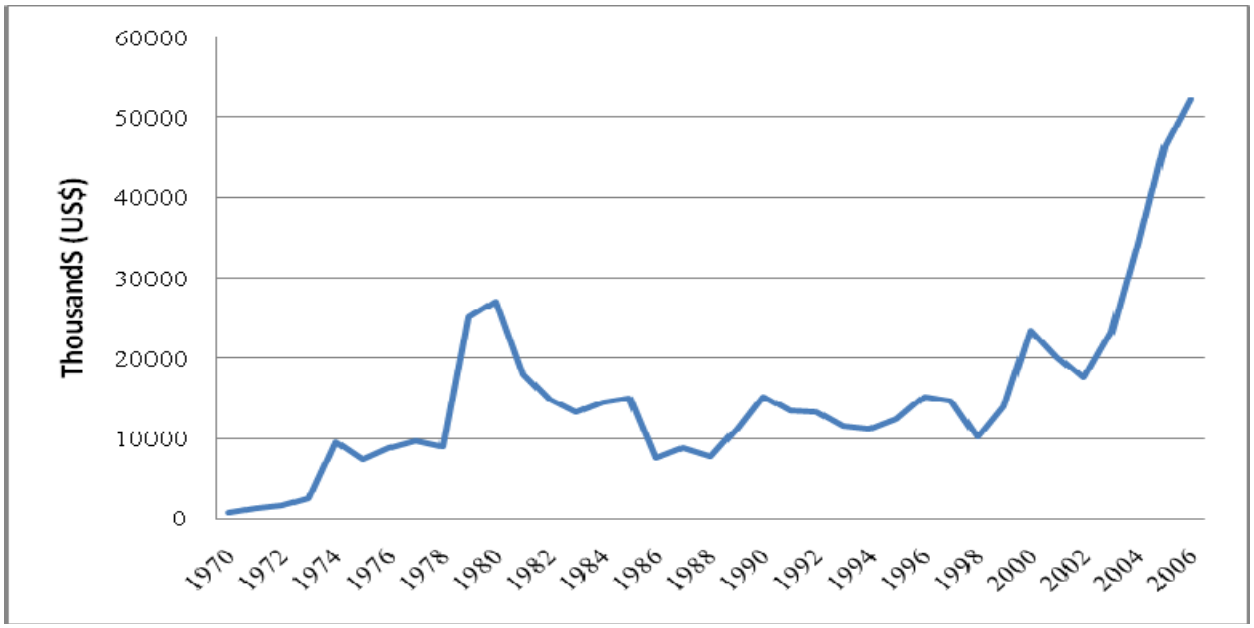
The general performance of the Nigerian economy has had a truncated history and could be analysed over four distinct periods since 1970.

- The pre-Structural Adjustment Programme (SAP)
- The SAP era
- The period of deregulation
- The return to democratic dispensation

3.2.2.1 The pre-Structural Adjustment Programme (SAP)

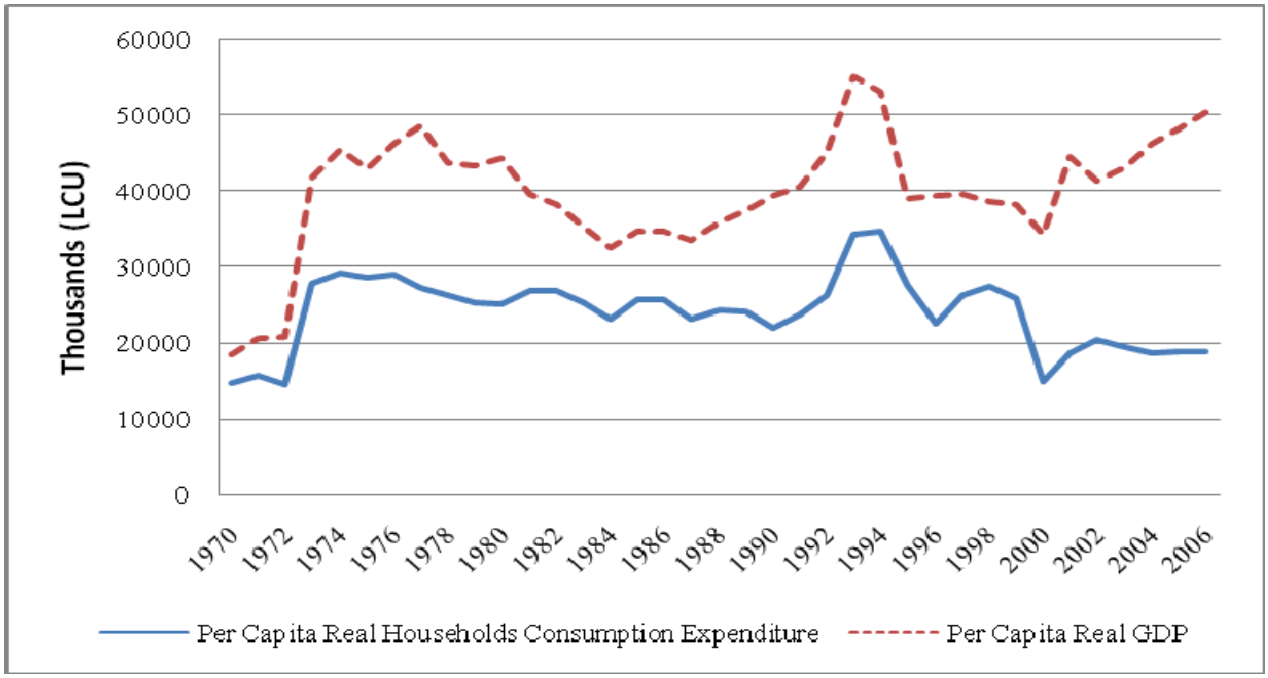
The period between 1970 and 1984 has witnessed many important events that affected the general economy and the total well-being of the Nigerian populace. Most significant of all were the mismanagement of the huge oil revenue recorded during this period. The oil shock of 1973 and 1979 serve to boost the country's oil revenue to an average of about 80 per cent of total revenue, which has also led to an improvement in the country's terms of trade in this period (Figure 3.4). The oil revenue was spent unproductively as if the shock in oil prices would continue unabatedly. As a result, real per capita GDP grew by about 7 per cent while per capita household consumption expenditure grew at a lesser rate of about 5 per cent between 1970 and 1984 (including the 1973 value, which grew by about 91 per cent and 100 per cent in household expenditure and GDP respectively). This indicates that the oil revenue boom did not reflect much on household expenditure patterns (Figure 3.5).

Figure 3.4 Total Value of Oil Production in Nigeria (1970-2006)



Source: Central Bank of Nigeria (CBN), Statistical Bulletin

Figure 3.5 Real per capita GDP and Household Consumption Expenditure (1970-2006)



Source: World Bank, World Development Indicators

The huge decline of the oil revenue in 1980 resulted in a large drop in real per capita GDP. The real per capita household consumption expenditure, which has previously been fairly stable, also dropped precipitously. Although there had been a considerable expansion in the social and economic infrastructure during this period of oil boom, but it was inadequate given the large population of Nigeria. Coupled with these above attempts to address the socio-economic needs, there was also a substantial investment in education and health care services. However, the fact remained that a large portion of oil revenue was still mismanaged and this funds failed to benefit the majority of the population at grassroots level. The significant need for an economy driven by the private sector, but could not materialise due to highly inadequate infrastructural facilities.

Prior to the oil revenue boom of the 1970s, the agricultural sector had been the main sector in which the bulk of the population earned their living. The economy of the time depended solely on the exports of commodities such as cocoa, palm oil, rubber, cotton and groundnut for its revenues, and about 60 per cent of the labour force earned their livelihood from farming. During the oil boom agricultural exports fell drastically by about 50 per cent both in value and in volume, and the naira experienced an appreciation at the same time (Canagarajah S. and Thomas S. 2001). It recovered partially in 1984 after the 1983 drought, followed by the harvest boom of 1985 (Collier;1988). The oil boom experienced rising government expenditure which diverted labour from agriculture to non-agricultural activities, as well as a steady migration from rural to urban areas. The enormous expansion of the oil revenue benefited the poor very little (if at all) since the poverty level has not shown a significant improvement during this period (Jamal V. and Weeks J. 1988).

However, the period between 1970 and 1984 not only saw a boom but also some decline in economic activities, especially during the early 1980s when there was a sharp decreases in the world oil price. While real GDP grew on average of about 1.84 per cent per year during this period (table 3.3), a negative growth of -5.2, -5.8, -13.1, -5.3, -0.24, and -4.8 per cent occurred in 1975, 1978, 1981, 1982, 1983, and 1984 respectively. The economy saw constant positive growth until 1977 (except for 1975) averaging about 7 per cent per year. In 1979 a growth rate of about 7 per cent was recorded.

Household consumption expenditure and inflation grew during this period at an average of about 3.8 and 16 per cent respectively. The periods experiencing a negative GDP growth rate corresponded to a positive growth in household consumption expenditure. Inflation rates during this same period were also significantly high. This indicated deterioration in Nigeria's terms of trade, which pushed up the general price level. However, the exchange rate (naira/dollar) was still highly-valued averaging about 0.66 to the U.S Dollar (table 3.3).

3.2.2.2: The SAP era (1985-1993)

The Structural Adjustment Programme (SAP) was introduced to reverse the worsening economic depression of declining growth, galloping inflation and high unemployment, as well as high level of poverty and increasing unsustainable fiscal deficit that was experienced in the period 1970 to 1984. The main emphasis of the programme was the reliance on market forces and the private sector in dealing with the fundamental problems of the economy (NCEMA; Not Dated).

Some of the main objectives of SAP were:

- To restructure and diversify the productive base of the economy to reduce dependency on the oil sector and imports;
- To promote non-inflationary economic growth; and
- To achieve fiscal and balance of payments viability over the medium term.

Table 3.3: Major Economic Indicators

Indicators	1971-84	1985-93	1994-98
Real growth rates(%)	1.837047	5.187456	2.295888
Real H.H consumption expenditure growth rates (%)	3.834572	-2.80524	12.79287
Inflation rates (%)	15.98718	27.94959	35.53246
Unemployment rate(%)		4.54	2.94
Exchange Rate (Naira/US Dollars)	0.655212	8.430846	21.90954

Source: CBN Statistical Bulletin and World Bank, World Development Indicators

The SAP also featured some reforms in exchange rate regimes. A floating market determined exchange rate was adopted, replacing the fixed official exchange rate regime. Because of this approach, there was a depreciation of the exchange rate on the average to about N8.4/$1 between 1985 and 1993. The beginning of 1986 saw the exchange rate at N1/$1 and by the end of that same year it moved to N3.2/$1 (Canagarajah S. and Thomas S., 2001). Real GDP grew at an average of 5.2 per cent during this period and inflation was about 28 per cent on average. The economy superseded its growth objectives for 1987-88, and where real GDP was expected to grow by 3 to 4 per cent, about 10 per cent growth was recorded. Although, the inflation objective of about 9 per cent reduction per year was not achieved, instead inflation rose from about 11 to 55 per cent in 1988 (Figure 3.6). The real household consumption expenditure declined on average by about 3 per cent. The unemployment rate averaged to about 5 per cent during the SAP era (table 3.3)[3].

The various policy measures incorporated in the SAP gave rise to the establishment of some programmes that should have helped to provide relief to people. Some of these programmes included the National Directorate of Employment (NDE) of 1986, the Directorate of Food, Road and Rural Infrastructure (DFRRI) in 1986, the Urban Mass Transit Programme in 1988, the SAP relief package in 1989 and the People's Banks and Community Banks in 1989/90. There were records of mixed performance from these programmes, but the major gain from the introduction of SAP in Nigeria was the reversal of the negative trend in GDP growth and an improvement in agricultural production.

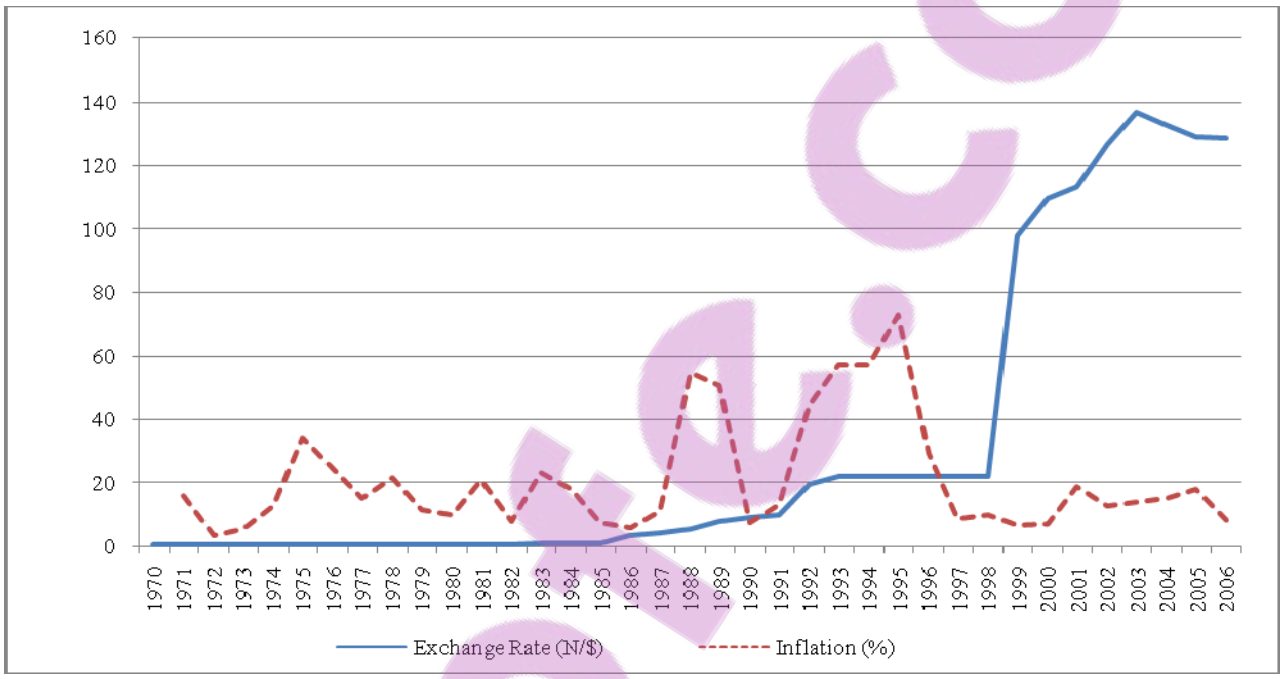
3.2.2.3: The period of guided deregulation

The period between 1994 and 1998 can be termed as the era of guided deregulation in Nigeria. The review of the SAP (intended as a long-term programme) dominated this period. Due to the hasty implementation and lack of focus, an immediate review of the SAP was seen to be vital to reverse the endemic inflation, shortage of foreign exchange and to alleviate the poverty situation in the country.

[3] There are many criticisms in the literature about the unemployment figures being underestimated.

The guided deregulation introduced a dual exchange rate regime in an attempt to address the continued depreciation of the country's currency. The main purpose of this regime, namely the stability of the Naira, was achieved during this period, as can be seen in Figure 3.6. To achieve this, the Central Bank of Nigeria intervened in the operation of the autonomous market in 1996 to ensure that adequate funds were available.

Figure 3.6 Exchange Rate and Inflation Rate 1970-2006



Source: World Bank, World Development Indicators

Some of the positive changes the SAP era brought were eroded away in the period of deregulation. The Nigerian economy again experienced a decline due to the reversal of some policies which had contributed to the growth and poverty reduction during the SAP period. The real GDP growth rate between 1994 and 1998 was on average about 2.3 per cent compared to about 5.2 per cent during the SAP era (table 3.3). The highest growth rate recorded in this period was 4.3 per cent in 1996, followed by 2.7, 2.5, 1.9, and 0.1 per cent in 1997, 1995, 1998 and 1994 respectively. Inflation rose on average from about 30 per cent during the SAP era to about 36 per cent in the era of deregulation. Inflation rose to its highest mark in the history of the country in 1995: about 73 per cent from 57 per cent in 1994. However, it reduced again to about 8 per cent in 1997, and then rose marginally to about 10 per cent in 1998.

The improvement experienced in 1997 and 1998 may be due to the demand management strategy adopted by the government of the time, where the payment of poverty wages and salaries were used to reduce demand. It may also be attributed to the general reduction of government expenditure. Although the published unemployment rate between 1994 and 1998 was on average 2.94 per cent, the general consensus among economists and various social commentators was that the true rate of unemployment was far higher than the one published.

3.2.2.4: The return to democratic dispensation

The return to a democratic system in 1999 brought about a lot of economic reforms (consistent with IMF recommendations) both in the public and private sectors of the Nigerian economy. After about 40 years of political independence from the British colony, the country is just beginning to find it right path to a sustainable economic progress.

Average real GDP growth between 1999 and 2006 was about 5 per cent, rising from about 1.1 per cent in 1999 to about 6.9 per cent in 2006 (table 3.4). The highest rate of growth was recorded in 2003 (about 11 per cent), which can be attributed mainly to the positive oil shock in that year. There was a huge surge in the growth rate of private consumption expenditure, rising from 1.09 per cent in 1999 to 19.04 per cent in 2006[4].

Table 3.4: Economic Performance 1999-2005

Indicators	1999	2006
Real GDP Growth Rate	1.1	6.9
Private Consumption Expenditure Growth Rate	1.09	19.04
Inflation Rate	4.76	13.51
Employment (Millions)	40.99	48.39
External Reserves (Billion US$)	5.6	43.8

Source: National Bureau of Statistic and CBN

There are also some improvements in other major macroeconomic variables. The average inflation rate during this period was about 13 per cent compared to the previous period of galloping inflation. In 1999, inflation was about 7 per cent but rose to about 18 per cent in 2005

[4] This is different from Household Consumption Expenditure discussed previously.

before returning to about 8 per cent in 2006. These were still more favourable compared to the high levels of about 36 per cent experienced during the deregulation period. Social indicators also show an increase in employment of 7.4 per cent between 1999 and 2006. The country's external reserve experienced an enormous surplus of about US$5.6 billion and US$43.8 billion in 1999 and 2006 respectively. This can be attributed to relatively prudent management of the country's resources and also the recent upsurge of world oil prices that is favourable to the country.

The current democratic dispensation has shown impressive positive outcomes especially in some major sectors of the economy since 1999.

Table 3.5: Sectoral Growth Rate

Sectors	1999	2005
Agriculture	5.28	6.81
Solid Minerals	3.79	9.5
Telecommunication & Post	5.39	28.96
Manufacturing	3.44	9.41
Wholesale & Retail Trade	2.5	12.32
Others	3.7	7.94

Source: CBN, Statistical Bulletin

One of the greatest achievements of the present democratic dispensation in Nigeria was the introduction of the Global System of Mobile-Telecommunication (GSM) in 2001. The telecommunication sector has experienced tremendous growth between 1999 and 2005, recording about 5.39 per cent growth in 1999 and about 29 per cent growth in 2005−the highest growing sector in the economy since 1999. Telecommunication was followed by wholesale & retail trade, rising from about 2.5 per cent growth in 1999 to about 12.3 per cent in 2005. Manufacturing and solid minerals also recorded a high growth of about 3.4 per cent and 3.8 per cent respectively in 1999 and about 9.4 per cent and 9.5 per cent respectively in 2005 (table 3.5). The agricultural sector, which has been suffering from extremely low productivity over the years, improved slightly with a growth rate of about 5.28 per cent in 1999 and about 6.8 per cent in 2005 attributed to this sector. Other sectors grew from 3.7 per cent to 7.94 per cent between 1999 and 2005.

3.2.3 Sources of Economic Growth (Growth Accounting)

The unimpressive historical economic and political performance of the Nigerian economy since its Independence in 1960 has not allowed a serious transmission into substantial differences in income of its average citizens. The basic determinant of a country's economic performance and living standards is mainly its capacity to produce goods and services with the available quantity of inputs (factors of production). However, a nation's output of goods and services do not only depend on the availability of its inputs (capital and labour) but also on the productivity of these inputs.

Empirical investigation of the various developed and the newly industrialised economies on their sources of economic growth over a long period of time have shown explicitly how much the tangible inputs and their productivity have contributed to long-term growth (Kim and Lau (1994), Lau and Park (2003), Tahari, et al. (2004), Senhadji (2000), and Dike (1995)). In the case of Nigeria, no studies exist on the sources of economic growth, except for Dike (1995).

In an attempt to identify the structural changes that occurred in the Nigerian economy over the years, it is imperative to decompose the growth performance into its primary sources. The sources of the Nigerian economic growth from 1960 to 2006 ae calculated according to the effectiveness with which capital and labour were used in the production process.

Following Solow (1956), a Cobb-Douglas production function using a constant return to scale technique was adopted in performing the simple growth accounting exercise.

To experience economic growth under the assumption of constant returns to scale, there must be growth in the accumulation of capital, labour, and total factor productivity. The growth accounting equation states that output growth is equal to the weighted sum of capital and labour growth, plus the growth in total factor productivity or technology. The growth accounting equation is presented as:

$$\frac{\Delta Y}{Y} = \frac{\Delta A}{A} + \alpha \frac{\Delta K}{K} + \beta \frac{\Delta L}{L}$$

where $\frac{\Delta A}{A}$ is the contribution of total factor productivity to output growth, $\alpha \frac{\Delta K}{K}$ is the contribution of capital to output growth and $\beta \frac{\Delta L}{L}$ is the contribution of labour to the growth in output. The contribution of total factor productivity to output growth can be derived from the equation since the growth rate of output, capital and labour is known. These are also called the Solow residuals, which is that portion of growth left unaccounted for by increases in capital and labour[5].

By applying the growth accounting equation to decompose the sources of economic growth in Nigeria from 1960 to 2006, table 2.6 presents the results of this analysis in four different periods:

- The pre-Structural Adjustment Programme (SAP) [1960-1984]
- The SAP era [1985-1993]
- The period of deregulation [1994-1998]
- The return to democratic dispensation [1999-2006]

[5] Detailed exposition of all the variables used can found in the appendix.

Table 3.6: Sources of Economic Growth in Nigeria (per cent per year)

	1960-1984	1985-1993	1994-1998	1999-2006	1960-2006
Sources of Growth					
Labour	2.4	2.3	2.5	2.4	2.4
Capital	1.6	-0.1	-0.2	0.1	0.9
Total input	4.0	2.2	2.3	2.5	3.3
TFP	-0.8	3.0	0	2.0	0.4
Total Output	3.2	5.2	2.3	4.5	3.7

Table 3.6 provides a summary of the findings of what growth accounting indicates about the sources of Nigeria economic growth. Over the period 1960 to 2006, the country's total output grew at an average rate of about 3.7 per cent per year. The contribution of labour to total output growth accounted for about 2.4 per cent per year. This may be due to the large population of the country and the fact that more than one-third of the population are active in the labour force. The large informal sector participation rate in the country may have contributed to labour taking a high share of economic activities[6]. Since capital stock is more pronounced in the formal sector (which weak in Nigeria because the economy is not driven by the private sector) one would expect the contribution of capital to economic growth to be very small. However, the contribution of capital stock to output growth during this period is accounted to be 0.9 per cent per year. Therefore, the contribution of labour and capital combined gives a total input of 3.3 per cent per year. The difference between the total output growth (3.7 per cent) and the contribution of total inputs (3.3 per cent) is 0.4 per cent, which represents the total factor productivity (TFP) per year. These results are similar to the findings of Dike (1995) and Senhadji (2000).

The breakdown of data into the 4 different periods above explains in more detail how long-run sources of growth were achieved in Nigeria. Columns (3) and (4) represent the SAP (1985 to 1993) and the Deregulation (1994 to 1998) periods in Nigeria respectively and the contribution of capital stock to the total output growth during these periods is negative. These periods are associated with a continuous military rule associated with mismanagement and corrupt

[6] The high informal sector participation in the country may be the result of the low unemployment figures that has been released in the past years.

government officials preventing much capital investment (capital expenditures) to be made into the economy. The return to a democratic system in 1999 has improved the country's economic performance, and the contribution of capital stock to economic growth has increased by about 0.3 per cent from the previous period.

The period between 1960 and 1984 recorded about 3.2 per cent growth in total output per year. This was accompanied by a slow-down in productivity during this period, which, after two decades of political independence, came as no surprise, since empirical evidence also shows that most countries (especially the U.S) experienced a slow-down in productivity in almost the same period. Although no one can be certain of the cause of the slow-down, but many empirical studies related to the U.S. economy such as in (Baily & Gordon (1988), Denison (1985), Bishop (1989), Nordhaus (1982), Baily (1982), Jorgenson (1990), Greenwood & Yorukoglu (1997), and Hobijn & Jovanovic (2001)) have suggested some alternatives associated with measurement error, legal and human environment, technological depletion and slow commercial adaptation, oil price, and the beginning of a new industrial revolution. Some of these explanations can also be attributed to Nigeria, and one cannot debunk the possibility of these causes of slow-down in productivity, one should rather have the opinion that many factors have contributed to it.

The long-run sources of economic growth indicate that productivity from labour and capital has been very low over the years. This gives an indication why poverty has been on its increase in Nigeria since the rate of productivity growth (if very low) could have an adverse effect on the future real wages, the standard of living and the social security system of an economy (Abel & Bernanke, 2005:215). Despite increased economic growth since 1999, real per capita income as at 2005 was about N1800 (local currency unit) which is similar to the 1970s level (Figure 2.3). This is a significant indication that the country is breaking free from its past economic bondage of corruption and mismanagement, although still facing the problem of severe poverty among its people. Statistics from the Federal Office of Statistics of Nigeria indicate that the number of poor in Nigeria has been rising over the years from about 18.5 million in 1980 to about 36 million in 1985, 40 million in 1992 and about 71 million in 1996. By the end of 2005, estimated poor rose to 94.7 million.

The next section of this study, dwells on the performance of poverty in Nigeria over the years, despite success associated with economic growth in certain periods.

3.3 NIGERIA POVERTY PERFORMANCE

3.3.1 Measurement of Poverty

Throughout history, many researchers and organisations across the world have attempted to measure poverty. Because of the different views about the concept of poverty it is evident that there exists no uniform measure for measuring poverty. It is furthermore difficult to find a definitive and universally-accepted way to measure poverty, because it is a phenomenon that affects many aspects of human condition, including physical, moral and psychological. Poverty is defined by the World Bank (1990) as the inability to maintain a minimum standard of living and this has been analysed in 'absolute' and 'relative' terms. Although there is a vast body of literature debating whether poverty is relative or absolute, the view that poverty is relative is now widely accepted. Since resource requirements for many basic functioning are relative, the poverty line or measurement must be put at a higher level in rich countries than in poor countries (Marx and Bosch, not dated).

Most of the analyses about poverty have followed the conventional view of insufficient income for securing basic goods and services. Others view poverty as a function of education, health, life expectancy, and child mortality etc. Tomori et al. (2005) specify two type of poverty namely income poverty and basic needs poverty (a lack of food, education, health care etc). They further linked poverty in developed countries to be income-determined, while in the case of developing countries poverty can be attributed to the deprivation and lack of access to basic services. The poor has also been identified by their low levels of consumption and expenditures on goods and services, which have also been generally used in conceptualizing poverty and the construction of poverty lines (Blackwood and Lynch 1994). There is increasing emphasis on the multidimensionality of poverty and social exclusion, and on the need to incorporate indicators relating to dimensions other than income (Soede, 2007).

According to the "vicious cycle" hypothesis of the orthodox Western views on poverty, a person is poor because he is poor, and will remain poor forever unless that person's income level increases significantly enough to pull that person from poverty. To the classical school of thought, such improvement can only be real and sustained if the population growth is controlled and the economic growth impediments are eliminated. Others also believe that the explanation for poverty can be linked to the person's apparent lack of response to normal monetary incentives for hard work. This means that a poor person is the cause of his/her own poverty.

3.3.2 Profile of poverty in Nigeria

Poverty in Nigeria has been seen as a serious problem that seems to be almost unsolvable. An estimated 70 per cent of the population live under US$1 a day between 1994 and 2002. Despite the huge natural resources (oil, gas, solid minerals etc.), Nigeria has been endow with, the country is still rated among the poorest in the world (World Bank; 2004).

Table 3.7: Nigerian Human Development and Poverty Index.

	Life expectancy at birth (Years)	**Combined primary, secondary, and tertiary gross enrolment ratio (%)**	**GDP per capita (PPP US$)**	**Probability of not surviving past age 40 (%)**	**People without access to an improved water source (%)**	**Children underweight (% ages 0-5)**
Human Development Index	46.6	52.5	1,852			
Human Poverty Index				39	53	29

Source: UNDP, Human Development Report 2008.

The Human Development Indicators (HDI) 2008, which use a wider definition of well-being, ranked Nigeria as the 154th out of 177 countries, based on available data. It measures human development in three dimensions, as indicated in table 3.7. In the case of Nigeria life expectancy at birth is about 46.6 years, the general school enrolment ratio is about 53 per cent and the GDP

per capita is about US$1,852 (PPP). These indicators tend to provide a rough picture of the country's socio-economic development.

The Human Poverty Index (HPI) focuses on the proportion of people below a threshold in the same dimension of human development and represents a multi-dimensional alternative to the US$1 a day poverty measure (HDI, 2008). The HPI (37 per cent) ranked Nigeria as the 111th of 135 developing countries from which the index was calculated. The indicators show that Nigerians have about 39 per cent chance of not living past the age of 40 whereas people with no access to an improved water source average about 53 per cent of its population. The proportion of children under the age of 5 years who are underweight is about 29 per cent (table 3.7).

The level of poverty in Nigeria has also been surveyed by the Federal Office of Statistics (FOS) of Nigeria over the years. This was through the National Consumer Survey conducted in 1980, 1985, 1992 and 1996. In the absence of an official definition, the poverty line was obtained by calculating two-thirds of the mean per capita household expenditure. Table 3.8 shows the profile of poverty based on the surveys conducted in these years[7].

Table 3.8: Nigerian Poverty Profile 1980 to 1996 (% Population)

	1980	1985	1992	1996
National	27	46	42	67
Sectors:				
Urban	17	38	37	59
Rural	28	51	46	71
Zones:				
North East	36	55	54	67
North West	38	52	37	68
North Central	32	51	46	66
South East	12	30	41	68
South West	13	39	43	67
South-South	13	46	41	67
Household Head:				
Male	27	47	43	68
Female	29	39	40	60
Occupation:				
Professional/Tech.	17	36	35	28

[7] The criteria used by the FOS in measuring these indices may be different from the UNDP.

Administration	45	25	22	6
Clerical	10	29	34	35
Sales worker	15	36	33	30
Services	21	38	38	34
Agriculture	31	53	48	73
Production/Transportation	23	46	41	47
Manufacture	12	31	33	26
Apprentice/Student	2	37	42	33
Others	15	40	43	24
Occupation:				
Farming	31	53	48	73
Non-Farming	16	37	36	58
Education:				
None	30	51	46	74
Primary	25	50	43	61
Secondary	19	41	30	54
Post Secondary	21	26	26	48
Household Size				
1	0.2	2.5	2.8	13
2-4	9	27	19	52
5-9	30	59	45	75
10-14	48	75	63	88
15-19	61	84	81	94
20 and above	81	75	93	95

Source: Federal Office of Statistics (FOS) and Ogwumike(2003)

In 1980, about 27 per cent of the population lived below the poverty line. It increased dramatically to 46 per cent in 1985 (an increase of about 70 per cent). This could be attributed to the negative economic growth and the positive population growth rates (which amounted to an increase of about 10 million) experienced in this period. The period between 1985 and 1992 saw a decline in national poverty by about 4 percentage points. However, this was not readily appreciated by most Nigerians because it did not compensate them for the rapid increase in income between the early 70s till 1980 when income starts falling (Ajayi, 1992). The high population growth also resulted in an increase of about 7 million in the poor population between 1985 and 1992. The post-SAP era recorded another upsurge in poverty level among Nigerian

populace of about 67 per cent in 1996. This is more or less a to about 60 per cent increase compared to the 1992 estimate[8].

Studies on the severity of poverty in Nigeria have found that poverty was more pronounced among the rural than the urban population (World Bank 1996; Canagarajah et.al, 1997). Poverty in the urban areas has also increased over the years, from about 17 per cent in 1980 to about 59 per cent in 1996. There was no serious decline in poverty in urban areas between 1985 and 1996 when the national poverty declined to about 42 per cent, as much of this was felt in the rural areas where the poverty level declined from 51 per cent to 46 per cent. This could be linked to the massive rural-urban migration experienced during this period and the collapse of the oil revenue, which led to a massive importation of food to augment the declining production capacity in the agricultural and industrial sectors (Ogwumike, 2003). On the whole, however, rural poverty has been higher than urban poverty over the years, rising from about 28 per cent to about 71 per cent between 1980 and 1996.

Looking at the severity of poverty among the six geo-political zones of Nigeria, the three northern zones of the country (North East, West and Central) were found to be seriously embedded in poverty, especially between 1980 and 1985. The average level of poverty in the northern zones ranged between about 35.3 per cent in 1980 and about 52.5 per cent in 1985. Comparing this to the poverty levels in the southern zones (South-South, East, and West), which averaged about 12.7 per cent in 1980 and about 38.3 per cent in 1985, one can deduce that poverty grew progressively higher from the south to the north of the country. The wide gap in poverty between the north and the south started shrinking after 1985, and by 1992 the average poverty rate in the northern zones was about 45.6 per cent as opposed to about 41.7 per cent in the southern zones. This increased to about 67 per cent in the northern zones and 67.3 per cent in

[8] Updated data on national poverty survey is not readily available. According to recent World Bank research, the developing world is poorer than previously thought, but not less successful in the fight against poverty. Poverty has been more widespread over the past 25 years than previously estimated, but there has also been strong overall progress toward reducing poverty (Chen and Ravallion, 2008).

the southern zones in 1996, which indicate a 0.3 per cent higher level of poverty in the southern part of the country.

Gender poverty has been increasing over the years from about 27 per cent of males and about 29 per cent of females in 1980 to about 68 per cent of males and 60 per cent of females in 1996. Male poverty levels over the years have been higher than female levels, except for 1980 when female poverty was 2 per cent higher than male poverty. Male poverty level declined at the same rate (4 per cent) as that of the national poverty level between 1985 and 1992. But there seems to be no great change in female poverty level during this period; instead there was a slight increase by about 1 per cent.

Occupational classification of poverty in Nigeria has shown that poverty is more pronounced in the agricultural sector (farming) with about 31 per cent in 1980, 53 per cent in 1985, and down to 47 per cent in 1992. it picked up drastically to about 73 per cent in 1996. The non-farming occupation on the average experienced a slight fall in poverty by 1 per cent between 1985 and 1992. The poverty level within this occupation rose in general from 16 per cent in 1980 to about 58 per cent in 1996, which is about 15 per cent below that of the farming population.

Analysing the Nigerian poverty profile in terms of the level of education, it is obvious from table 3.8 that the higher the level of education the lower will be the per centage of people living in poverty. The highest poverty rate has been recorded when the population had very little education, whereas the lowest when the population had been in a post-secondary phase. About 30 per cent of the population with no education and 21 per cent in the post-secondary level were living in poverty in 1980, while in 1996 this rose to about 74 per cent and 48 per cent of the population with no education and those at the post secondary level, respectively. This is an indication of how important the educational sector is in alleviating poverty in Nigeria.

The aggregate picture on poverty rates by household size shows that there has been a general increase in the severity of poverty among the different household sizes and it tends to increase as

the household size increases. Between 1985 and 1992 the rate of poverty among the different households declined, except for household sizes of above 20[9].

3.3.3 Poverty reduction strategies in Nigeria

Many macroeconomic policies have been introduced in Nigeria to reduce the level of poverty among its population. These policies were targeted towards rural development and improvement in the agricultural sector, which were perceived to have contained most of the population living in poverty. The World Bank (1996) analysed the aspect of poverty in Nigeria to be concentrated in communities that lack basic services such as roads, potable water supply, safe sanitation and access to health and education services. These are characteristics of people living in rural communities and their main occupation is subsistence farming which goes with large household sizes.

About four development plans have been prepared and executed since political independence in 1960. Although poverty reduction was not the direct focus of these development plans, it will undoubtedly have alleviated poverty if the objectives were achieved accordingly. The first National Development Plan (NDP), 1962 to 1968, stated that:

'The basic objective of planning in Nigeria is not merely to accelerate the rate of economic growth and the rate at which the level of the population can be raised; it is also to give her an increasing measure of control over her own destiny'.[10]

The main objective of the plan was the achievement and maintenance of the highest rate of increase in the standard of living and the creation of the necessary conditions to this end, including public support and awareness of both the potentialities that exist and the sacrifices that will be required.[11]

[9] A breakdown of the current poverty profile data similar to table 3.8 is not available.
[10] NDP 1962-68 (Federal Ministry of Economic Development, Lagos), p.3.
[11] Ibid., p.46

The second NDP was a build up on the first NDP, and it claims that national planning should be aimed at the transformation of the whole society (Ekundare,1971). The plan stated that:

'the present plan…recognizes explicitly the possibilities of using planning as a deliberate weapon of social change by correcting defects in existing social relations in various spheres of production, distribution and exchange.'[12]

The fundamental objective of the plan was to establish Nigeria firmly as

- A united, strong and self-reliant nation;
- A great and dynamic economy;
- A just and egalitarian society;
- A land of bright and full opportunities for all citizens; and
- A free and democratic society.[13]

Nigeria's third NDP 1975 to 1980 suggested that the fastest and most effective ways to achieve development were to make judicious use of then oil revenue to build the social and economic infrastructures and rapidly transform the nature of economic activities. The goals listed in the third NDP were economic growth and development, price stability, and social change.[14] This was to be achieved by given top priority to the manufacturing sector in the belief that a solid industrial base was the firmest foundation for self-sustained growth (Wolgin,1978).

The major objective of the fourth NDP (1981 to 85) major objective was to bring about improvement in the living condition of the Nigerian populace, in addition to the three policy goals inherited from the third NDP. This objective appeared to be directed at fighting poverty,

[12] Second NDP 1970-74 (Federal Ministry of Information, Lagos), p.37.
[13] Ibid., p.32.
[14] Central Planning Office, Federation of Nigeria, Third NDP, 1975-80, p. 30-1.

since its main emphases were to raise the real income of an average Nigerian and also to close the huge inequality gap among it population.

During the eras of national development plans, there were many poverty-related government programmes that sprang up in support of the attainment of the various objectives specified in the plans. These were the River Basin Development Authority (RBDA), the Agricultural Development Bank (ADB), the Agricultural Credit Guarantee Scheme (ACGS), and the Rural Electrification Scheme (RES). Other programmes just before the advent of SAP included Operation Feed the Nation (OFN), Free and Compulsory Primary Education (FCPE), Green Revolution, and the Low Cost Housing Scheme. Although these programmes were designed to directly or indirectly solve the problem of poverty in Nigeria, they were not entirely successful as most of them were not sustainable due to a lack of focus.

The worsening state of the Nigerian economy, characterised by a collapse of social and economic infrastructure, high external and domestic debt, real sector dominated by primary production, high level of poverty, dysfunctional education system, and high rate of unemployment has led to the introduction of National Economic Empowerment and Development Strategy (NEEDS). This program covered the period 2004 to 2007 and served as a medium-term plan for economic recovery, growth and development of the nation. The main goals of NEEDS were to reduce poverty, create wealth, and generate employment in the society and to re-orientate the citizens about their value system. The overall performance of NEEDS between 2004 and 2007 was hailed by the IMF Country Report as remarkable. In fact, many aspects of the economy, such as the macroeconomic environment, civil service reforms and due process, banking consolidation/emergence of mega banks, privatisation and liberalisation, have surpassed its expectations. However, there are weaknesses in a few areas such as monitoring and evaluation, and effective coordination and implementation which still need to be tackled, while poverty reduction, employment generation and power supply have still not yet reached the stage where it should be (IMF: 2007).

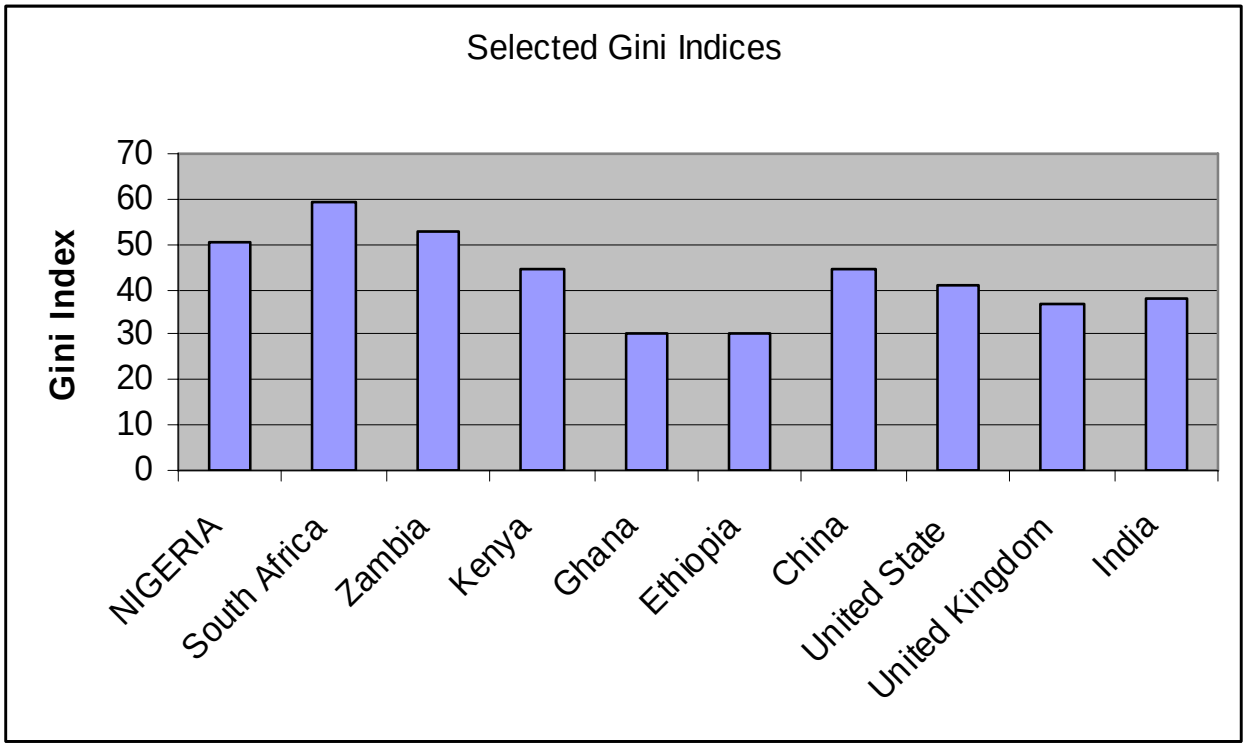
3.2.4: Challenges to poverty alleviation in Nigeria

The high level of poverty in Nigeria is related to the profile of social indicators discussed earlier. The concurrent political instability, woefully poor governance and the high level of corrupt practices can be pointed out as the key factors accounting for the staggering level of poverty. The lack of good governance and the long history of political unrest have also contributed greatly to the problem of poverty in Nigeria. The misuse of public funds by political leadership has led to a massive decline in the quality of public services. The provision of basic infrastructure (i.e roads, electricity, water, etc) is still at its lowest level and this has led to inadequate inflow of private investment into the country. Lack of enforcement of the rule of law has given the political leadership an opportunity to direct public funds to other component of government expenditure where corrupt practices are more visible. These have had severe negative impacts on the wellbeing of the Nigerian citizens.

The current state of the Nigerian economy appears to have been trapped in poverty. The return to democratic dispensation is a highly welcome development and although there has been some encouraging progress, the basic problem of lack of good governance, corruption, and among many the lack of attention to basic human needs are still the country's key poverty challenges.

In addition, these challenges have created a huge inequality of income within Nigerian society. This is also a sign of poor governance performances that are entrenched in the system. Unequal opportunities among the Nigerian populace make it more difficult to achieve the Millennium Development Goals (MDG), since economic potentials remain unutilised. The absence of better developed infrastructures, high quality of human capital and institutions prevent the country from participating in the global financial market. Over the years the widening inequality has been the one factor responsible for poor growth in developing countries. The large growth-poverty gaps that exist in developing countries are results of the increasing income inequalities in these countries (WESS, 2006).

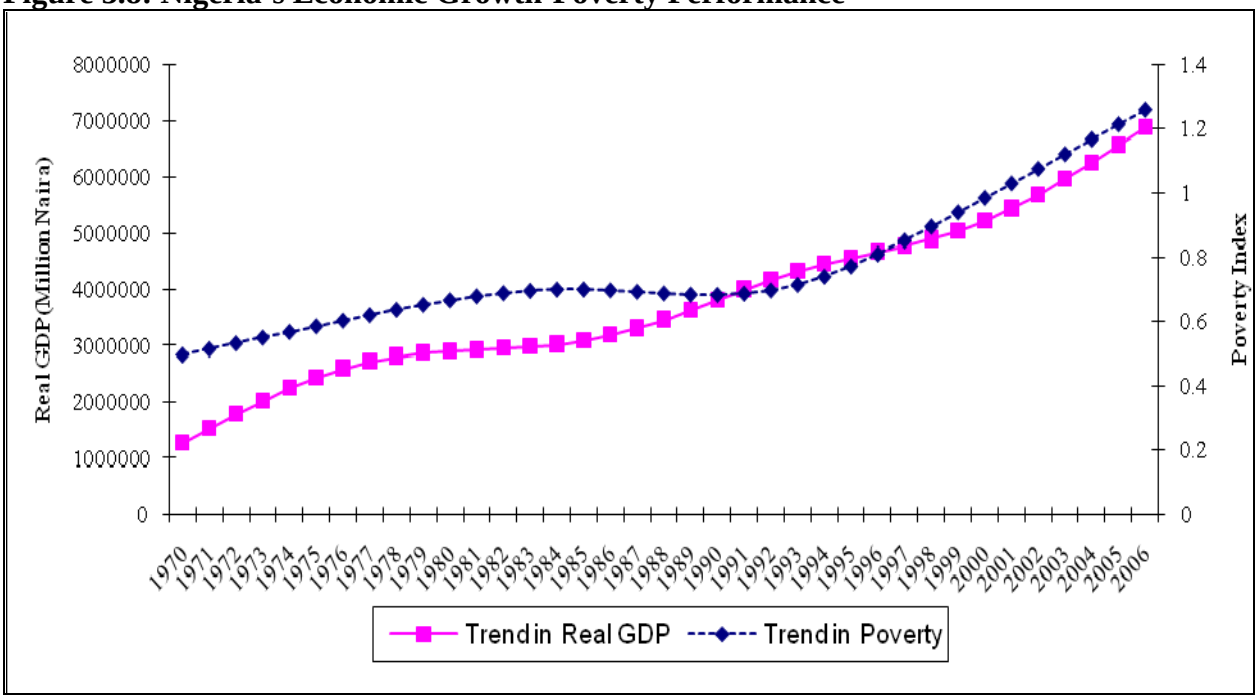
Figure 3.7: Nigeria Inequality Relative to other Countries



Source: UNDP, Human Development Report 2008.

The skewed distribution of income in Nigeria shown in figure 3.7 compared to other African, developing and developed economies put the country among the top unequal societies in the world. As a result, embedded economic inefficiencies and common social unrest in Nigeria can be attributed to the high income inequality. According to the World Bank Development Indicators, Nigeria has a Gini index of 0.51, which means that about half of the population of Nigeria does not benefit from generated income. This is a major challenge to the country—to provide for a better life for the majority of citizens, the Nigerian Government and civil society must empower that section of the population not benefiting from the immense wealth Nigeria is endowed with.

Figure 3.8: Nigeria's Economic Growth-Poverty Performance



Source: World Bank; World Development Indicators

As discussed earlier, the growth of an economy is expected to translate to improvement in welfare conditions of the general populace. Increases in GDP that will lead to a significant reduction in the level of poverty through increased domestic investment which will generate significant employment in the economy should be the major focus within the policy environment.

However, a rise in real GDP should be pro-poor leading to employment generation that will translate into a reduction in poverty over the long run. Figure 3.8 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. Therefore, there is need to investigate further the cause of the existing gap between economic growth and the level of poverty in the country. This will lead us to first delve into the various theories of growth and poverty that existed in the literature.

3.4 CONCLUSION

This chapter reviewed and analysed major economic development in the history of Nigeria's economy. It revealed the impressive and unimpressive economic situations faced by the country over the years, as well as how these transformed and improved the socio-economic condition of its people.

Despite its resource endowment (human and oil resources), the country is still far from reaching its full potential of sustained economic growth and employment generation expected to alleviate the country's high level of poverty. The historical performance of the country reveals significant socio-economic constraints as predominant impediments to a high and sticky level of poverty in the economy. Sources of economic growth show the importance of an increasing domestic investment that will kick-start the economy, as well as the urgent need to break the structural impediments constraining the economy. This analysis has shed light on the macroeconomic environment of Nigeria. The next chapter develops a framework for analysing the growth-poverty divergence of the country.

CHAPTER 4

MODEL SPECIFICATION AND ESTIMATION TECHNIQUES

4.1 INTRODUCTION

One of the deficiencies of the Keynesian demand-side macro models is the failure to simultaneously address the two fundamental problems associated with stagflation. In achieving a stable macroeconomic environment that will lead to an improvement in both the economic growth rate and the living standard of the people, a policy must be targeted that will lead to low inflation and low unemployment. The previous chapter has identified the failure of any government intervention in achieving a pro-poor economic growth in an economy characterised by huge supply constraints. The review of the historical performance of the Nigerian economy presents significant socio-economic constraints as the primary impediment to achieving the developmental objective of poverty alleviation. These constraints prompted the development of a useful macroeconomic model that will address the long-term equilibrium outcomes of output, employment, inflation and poverty.

However, it is crucial to develop a macro-econometric model for the Nigerian economy that will provide a useful policy analysis to alleviate poverty, with major focus on capturing the specific features and uniqueness of the country. The important implication of this model is to address the divergence between growth and poverty. The purpose of this chapter is therefore to present a macro-econometric model that is constructed and estimated for the Nigerian economy.

The chapter is divided into five sections. The second section identifies the different models developed in the study, while the third section presents the core structural equations estimated in the models. Estimation techniques and methodology used in the study are presented in the fourth section. The fifth section concludes the chapter.

4.2 MODEL SPECIFICATION

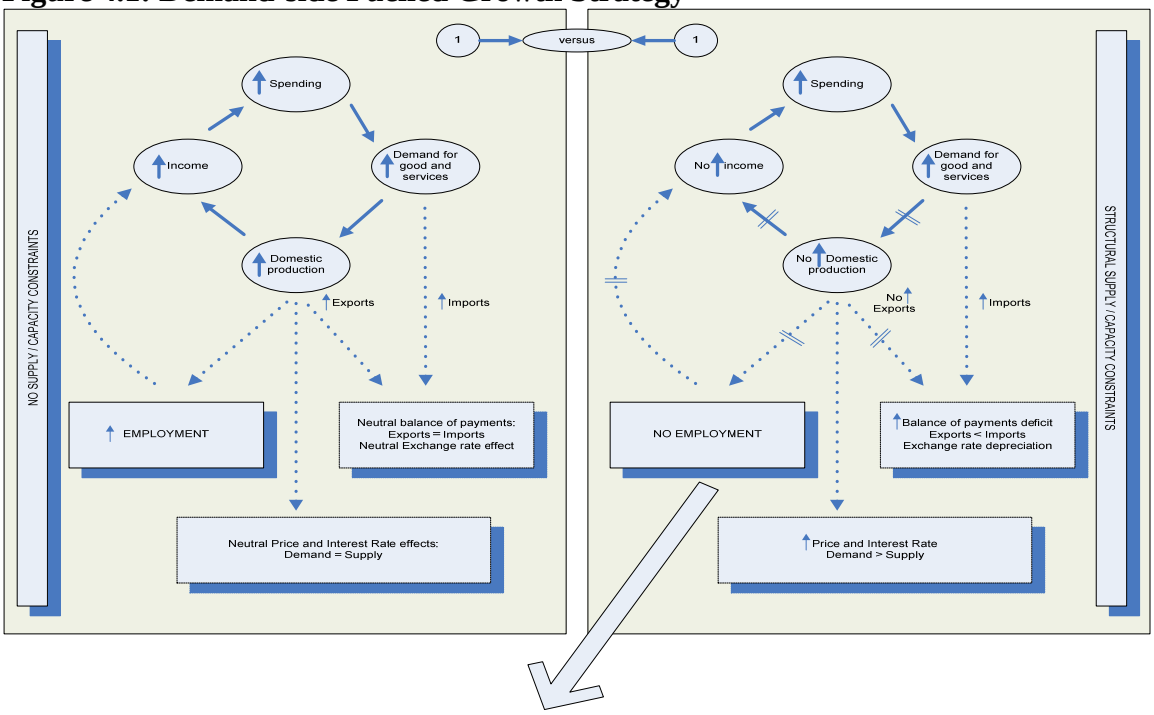
As mention earlier, the focus of the structural macro-econometric model developed in this study is to:

- Test the hypothesis of existing structural supply constraints versus demand-side constraints impeding the growth and development of the country

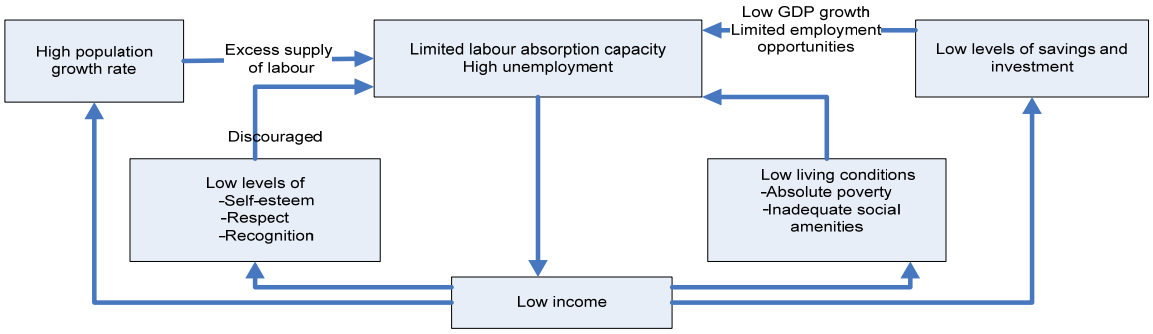
- Analyze different policy simulations in order to determine the optimal policy options for the country

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 figure 4.1 below:

Figure 4.1: Demand-side Fuelled Growth Strategy



Poverty Trap



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

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 faced 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 will 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 rising unemployment 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 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 which requires an innovative intervention targeted at eliminating the significant structural impediments (Focus, 2007).

Against these backgrounds, the study develops two separate models[15]:

Model A

Supply-side orientated (Demand-side marginalized) 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 an impediment to the growth and development of the country. In this type of economy the limited capacity to absorb labour in the system will result 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 constraints. In this model, GDP is generated following the Keynesian

[15] The empirical analysis gives detailed analysis on how these models have been constructed and closed.

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 give solid support to the hypothesis that the Nigerian economy has been faced with huge socio-economic constraints impeding the development of the country.

4.3 CORE STRUCTURAL EQUATIONS

As mentioned earlier, the study captures both the short-run and long-run dynamic properties of the economy. Four sectors of the economy were captured and include the real sector, the external sector, the monetary sector, and the Government (public) sector. The long-run core structural equations estimated from the four sectors of the economy are presented as follows:

4.3.1 The real sector

This sector 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.

4.3.1.1 Aggregate supply

Modelling the Nigerian production function

High unemployment and poverty, low levels of productivity, and inadequate real investment has been major features of the Nigerian economy over the years. The endogenous growth models (i.e. Romer, 1990) which are concerned with endogenising technological progress became popular in the literature in recent decades. These models see technological progress as an engine

for growth in any economy. This is against the neoclassical assumption that growth occurs due to the exogenous improvement in technology.

The structure of any economy's production function determines the degree to which its level of poverty and unemployment can be reduced. The oil sector comprises the most important component of the production structure of the Nigerian economy, since over 90 per cent of the country's total revenue is generated by this sector. However, it has not been possible to translate into an employment generating sector. The labour absorption rate in the Nigerian oil sector is negligible. This may be due to the capital intensive nature of the production function. Against this background, the Nigerian production function is modelled based on the following principles:

(i) Adopting the idea of the endogenous growth theories by endogenising the technological progress;

(ii) Appling 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 economy.

Ample empirical evidence in the area of the neoclassical growth model has dominated the literature in the recent past. Its main assumption (which could also be regarded as the main limitation to the model) is the hypothesis that technological progress grows at a constant rate over time. The new growth theories strongly argue against this mechanism by explaining technological progress in terms of the role played by human capital.

An attempt is made to model the Nigerian production function by employing the state-space model (Kalman filter) to determine the evolution of the Solow residual that is estimated from a simple Cobb-Douglas production function. The state-space model regained its popularity in economic literature during the 1980s (i.e. Lawson, 1980; Harvey *et al*., 1987). The development of these models was first witnessed in Wiener (1949) and Kalman (1960) who were control

engineers in radar and aircraft technology. The application of the state-space model with stochastically time-varying parameters (coefficient of the technological progress is allowed to vary over time) is adopted in this study to model the Nigerian production structure. An extensive econometrics application of the state-space models can be found in Hamilton (1994: 372 to 408).

The dynamic representation of the state-space model of a *(n×1)* vector y_t, is given by the following system of equations:

$$y_t = a(x_t) + [H(x_t)]'\xi_t + w_t \qquad (4.1)$$

$$\xi_{t+1} = F(x_t)\xi_t + v_{t+1} \qquad (4.2)$$

where $a(x_t)$ describes an *(n×1)* vector-value function, $H(x_t)$ an *(r×n)* matrix-value function, and $F(x_t)$ denotes a *(r×r)* matrix whose elements are function of x_t. ξ_t is a *(r×1)* vector of unobserved state variables (i.e state vector). The *(n×1)* and *(r×1)* disturbance vectors w_t and v_t are assumed to be independent white noise. The first equation is known as the observation (or measurement) equation and the second is known as the state (or transition) equation. Detailed description of the state-space representation of a dynamic system can be found in Hamilton (1994: 372) and has also been adopted by Du Toit *et al*. (2008).

Following the Kalman filter representation above, the Nigerian production function is modelled as follows:

$$Y_t = \xi_t K_t^{\alpha} N_t^{\beta} e^{w_t} \qquad 0<\alpha<1;\ 0<\beta<1 \qquad (4.3)$$

$$\xi_t = \xi_{t-1} + v_t \qquad v_t \sim N(0,Q) \qquad (4.4)$$

where

Y_t = Real GDP in period t

K_t = Real capital stock in period t

N_t = Total employment in period t

w_t, v_t = Stochastic disturbance terms

ξ_t = The time varying constant, representing technological progress.

Specifically, the Nigerian production structure remained a difficult phenomenon to analyse. The benefits of oil production over the years have not really sunk down to the rest of the economy where the majority of the population still suffers from poverty and high unemployment. The Nigerian populace can therefore be regarded as living in two different economies: the first economy, which is the oil sector, and the second economy, which is the rest of the economy. The first economy comprises less than five per cent of the population, but controls over 90 per cent of the country's resources. The second economy on the other hand, comprises more than 95 per cent of the population, is highly marginalised, consists of a large numbers of poor and unemployed and does not benefit from the abundant oil resources of the country.

As a result, the study disaggregates the production function into two groups to measure the real effects of any policy measure or exogenous shock on the targeted (poor) population:

(i) The oil sector, and

(ii) The rest of the economy

Domestic investment (Real gross capital formation)

The aggregate capital stock at the end of period *t*, is referred to as the net capital stock, assuming a constant depreciation rate (δ). This is expressed as:

$$K_t = (1-\delta)K_{t-1} + I_t \qquad (4.5)$$

where K_t and K_{t-1} are the capital stocks at the end of the current and previous period respectively, δ is the rate of depreciation and I_t is the gross investment. δK_{t-1} is the

replacement investment, and net investment ($K_t - K_{t-1}$) equals total investment, minus replacement investment ($I_t - \delta K_{t-1}$). Therefore, the following identity holds for gross investment:

Gross investment = replacement investment + net investment

The theories of investment behaviour mostly relate the demand for new plant and equipment to the gap between the desired or optimal amount of capital and the actual amount of capital (Du Toit, 1999:81). Combining these two aspects of investment behaviour, the gross investment can be expressed as:

$$I_t = \lambda_t (K_t^* - K_{t-1}) + \delta K_{t-1} = \lambda_t K_t^* + (\delta - \lambda_t) K_{t-1} \qquad (4.6)$$

where λ_t is the speed of adjustment between K_t^* and K_{t-1}, and K_t^* is the desired or optimal capital at the end of the current time period (see Du Toit, 1999: 81 for a detailed exposition).

Different approaches, such as the Keynesian model, cash flow model, and the neoclassical model (Jorgenson approach) have been used in modelling 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 minimising and profit maximising decision making processes by firms. This approach has also been adopted in Du Toit (1999), Du Toit and Moolman (2004) and Pretorius (1998).

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 has been analysed in many theoretical and empirical studies varying from country to country, i.e. Pehkonen, (1992), Darby and Wren-Lewis, (1991), Appelbaum and Schettkat, (1995), and Disney and Kiang, (1990). These studies focus on economic variables (such as output, labour productivity and labour cost) as the major

determinant of employment. The socio-economic impact on labour demand has not been explored thoroughly in literature. Chletsos (2005) 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 utilised in this study also incorporates the socio-economic activity as a determinant factor and this is specified as:

$$N_t^d = f(rw_t, Y_t, SE_t) \qquad (4.7)$$

where N_t^d is the labour demand, rw_t is the real wage rate defined in terms of consumer prices, Y_t is the level of output or GDP, and SE_t is socio-economic activity. The last mentioned variable is discussed in paragraph 4.3.5.

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

$$rw_t = f(labprod_t) \qquad (4.8)$$

where $labprod_t$ is the labour productivity[16]. Labour productivity is expected to influence the real wage rate since the prospect of a rise in real wages will be an incentive for workers to increase their productivity. Therefore, labour productivity will have a positive influence on real wages. Labour productivity is also disaggregated into two components (oil and the rest of the economy) and these will also depend on the total economy's labour productivity.

Technological progress (total factor productivity)

Endogenising technological progress has not been very popular in economic literature over the years. There is a large body of empirical literature that tends to explain the process of growth in a single or cross-country setting, but very little evidence has been found in respect of total factor

[16] The rate of unemployment is excluded from the specification due to data limitation.

productivity (Senhadji, 2000). In line with the endogenous growth theory, the problem of how best to represent technological progress was investigated by Budd and Hobbis (1989) who applied their analysis to the UK production function. Two main sources of technological advances were identified in their paper, namely through domestic research effort or by importing new technology from abroad. The macro determinants of total factor productivity in Pakistan were also investigated in Khan (2006). These determinants are broadly categorised into macroeconomic stability, openness of economy, human resource development and financial sector development[17].

Against this background (which are in line with new growth theories) technological progress (ξ) can be defined as:

$$\zeta_t = f(ms_t, hd_t, fd_t) \qquad (4.9)$$

where ms_t is a form of macroeconomic stability (proxied by consumer prices), hd_t is the human development variable (proxied by poverty level), and fd_t represents the level of financial development proxied by financial constraints. These variables are expected to influence the growth of technology in Nigeria since the developing economies are characterised by these factors.

4.3.1.2 Aggregate demand

Household real consumption expenditure

The theoretical underpinning of the household real consumption expenditure follows the permanent income and life-cycle hypothesis. The specification of the household consumption expenditure follows the notion that liquidity-constrained consumers make consumption choices based only on their disposable income and that their rate of time preference is equal to their rate of return. On the other hand, the unconstrained consumers base their decision on total lifetime

[17] There is a closer similarity between the Pakistan economy and the Nigerian economy than the UK economy.

resources with the marginal propensity to consume fluctuating over time to capture consumption smoothing (Pauly, 2004). Therefore, the long-run household consumption is a function of real disposable income, real wealth and the real interest rate. This is specified as:

$$hh\_rcon\exp_t = f(hh\_dis\_inc_t, rwealth_t, r\,\mathrm{int}_t) \tag{4.10}$$

where $hh\_rcon\exp_t$ is household real consumption expenditure, $hh\_dis\_inc_t$ is household real disposable income, $rwealth_t$ is real wealth, and $r\,\mathrm{int}_t$ is the real rate of interest.

4.3.1.3 Prices

Consumer and producer prices

The price system helps to achieve a good coordination and communication system in a pure 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. In a neoclassical profit-maximising framework with imperfect market competition, prices are set by firms as a mark-up on their marginal cost of production proxied by average or unit costs (Layard and Nickell, 1986: 142). This is illustrated as

$$P^p = m * AC \text{ and } m = \frac{1}{1 - 1/\eta} >;\ m' \geq 0 \tag{4.11}$$

where P^p is the production prices, m is the mark-up factor, AC is the average or unit cost of production and η is the price elasticity of demand. The mark-up factor can be specified in terms of a demand pressure variable such as expected demand relative to actual output, since this depends on the price elasticity of demand and the short-run demand position (Du Toit, 1999: 150).

Following Layard and Nickell, production prices can be specified as

$$P_t^p = f(w_t, cu_t, ucc_t) \tag{4.12}$$

where w_t is the nominal wage rate, cu_t is the capacity utilisation, and ucc_t is the nominal user cost of capital.

Consumer prices are directly related to production prices and can be specified as

$$C_t^p = f(P_t^p, imp_t^p, excessd_t, exch_t) \tag{4.13}$$

where C_t^p is the consumer price, imp_t^p is the import price of consumption goods, $excessd_t$ is the excess demand, and $exch_t$ is the nominal exchange rate (expressed in terms of domestic to foreign currency).

4.3.2 The external sector

The external sector identifies 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/ U.S. 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 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[18]. Fluctuations in world oil prices are

[18] In the case of Nigeria, 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 Nigeria economy and the fact that over 90 percent of its exports/foreign exchange earnings comes from oil.

therefore expected to have a significant impact on the Nigeria's exports. The Nigerian real exports function is therefore specified as

$$r\exp_t = f(wY_t, relp_t, oil\_p_t) \quad (4.14)$$

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

Real imports of goods and services

The long-run demand for real imports of goods and services is mainly driven by the level of domestic income and relative prices of goods and services. The fluctuations in the exchange rate are also expected to have 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

$$rimp_t = f(Y_t, relp_t, exch_t) \quad (4.15)$$

Nominal exchange rate

The underlining theory behind the specification of the nominal exchange rate equation follows Dornbusch (1976 and 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 the long-run Purchasing Power Parity (PPP). Against this background, the nominal exchange rate is specified as follows

$$exch_t = f(relY_t, relMs_t, relp_t) \quad (4.16)$$

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

4.3.3 Monetary sector

The essence of modelling the monetary sector in this study is to elicit information regarding the extent to which monetary variables feed the rest of the economy[19]. 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 monetary authority does not directly control interest rates. The monetary policy instrument 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 can be derived from the money demand equation as:

$$RMs_t = f(Y_t, \text{int}_t) \Rightarrow \text{int}_t = f(RMs_t, Y_t) \tag{4.17}$$

where RMs_t is the real monetary aggregate and int_t is the nominal interest rate (lending rate).

4.3.4 The government sector

In this study, the government sector is assumed to be exogenously determined. 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 some 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.

[19] However, the role of monetary policy in Nigeria has over the years been quite insignificant. This may be due to the fact that the country's financial system has still not yet been integrated into the domestic and global environment.

Government revenue is excluded in the study, since more than over 90 per cent of revenue comes from oil production, which has been captured extensively in the study. Tax revenue plays an insignificant role in the economy.

4.3.5 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.

Socio-economic activity

GDP has popularly been used in the literature as a measure of a country's socio-economic progress, neglecting other aspects of development such as education and health. The value of a nation's economic activity is expected to be reflected positively in the well-being of its citizens. That is to say that those who produce the resources should see how it is channelled to appropriate ends. This should be determined by the producers rather than being spent on debt service, exporting to safer havens, or used to build prestigious facilities of little use which are mostly the dominant features of GDP (Lind, 1993). Therefore, an appropriate indicator for socio-economic development will be a broader measure which includes other social aspects of life that provide a decent living.

Since socio-economic progress is expected to translate into a good state of well-being of the people, socio-economic activity can therefore be specified as

$$SE_t = f(hh\_dis\_inc_t, govt\exp_t, fr_t) \tag{4.18}$$

where $hh\_dis\_inc_t$ is household real disposable income, $govt\exp_t$ is a form of government expenditure 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.

Household disposable income

Disposable income is directly related to real wages and can be specified as

$$hh\_dis\_inc_t = f(rw_t, transfer_t) \tag{4.19}$$

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

Poverty

The economy-wide Computable General Equilibrium (CGE) models have in recent years dominated the literature in analysing poverty. The Social Accounting Matrix (SAM) provides both the database and logical framework for the CGE models to gain its strength in literature (Robinson and Lofgren, 2005). Other recent extensions of CGE models have incorporated financial sectors and these models can differ in terms of the kind of policy issues they address[20].

Analyses of macro-poverty linkages have gained substantial ground among policy makers over the last few years. The impacts of specific macroeconomic policies (i.e. fiscal policy, inflation, and financial liberalisation) on poverty have recently started dominating literature[21]. This study attempt to explain poverty using some important macroeconomic variables and this can be specified as

$$poverty_t = f(C_t^p, hh\_dis\_inc_t, govt\exp_t, fr_t, agricprod_t) \tag{4.20}$$

where $poverty_t$ is the level of poverty, $agricprod_t$ is the level of agricultural production.

[20] See Robinson and Lofgren (2005); Willey (1992); and Agenor (2004) for more comprehensive treatment of CGE models.
[21] Gunter et al (2005) summarises some important macro-poverty debates that have just recently emerged.

Agricultural production

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

$$agricprod_t = f(land_t, ec_t, p_t^p, fr_t) \tag{4.21}$$

where $land_t$ is the availability of land for agricultural production, and ec_t is an environmental condition such as rainfall. These variables are expected to influence agricultural production significantly.

Provision of infrastructure

The role of adequate infrastructure in economic development cannot be overemphasised. Capital stock provides the public goods and services which have various positive effects on economic activities and the living standard of households (Yoshino and Nakahigashi, 2000). Empirical studies (i.e Mitsui and Inoue, 1995) have identified infrastructure as one of the main driving forces of production and this has also been investigated in the economic growth theory, for example, Barro (1997) and Easterly and Rebelo (1993)[22].

The level of a country's infrastructural development will increase the production activities and improve the standard of living of its citizens. Likewise, the increase in the level of production activities will in turn necessitate more infrastructural expansion. Therefore, the effect of infrastructure in this study is twofold:

(i) It increases the level of GDP

(ii) It serves as a catalyst in reducing poverty

[22] See Ayogu (2007) for a survey of theoretical literature on infrastructure and growth.

This means that infrastructure plays a dual role in the Growth-Poverty linkage. The challenge of long-term development is to design economic policies that are geared towards investment in infrastructure. Lack of basic infrastructural expansion and misappropriation of government expenditure earmarked for infrastructural development have been major features of the Nigerian economy over the years 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 activities and the level of government effectiveness (good governance). This can be represented as:

$$fr_t = f(Y_t, ge_t) \tag{4.22}$$

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

4.4 ESTIMATION TECHNIQUES

In view of the above discussion, the production function and other behavioural equations are estimated using Engle and Granger (1987) techniques. 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. As laid out in Enders (2004:335), Engle and Granger proposed a four-step procedure to determine whether two I(1) variables are cointegrated:

Step 1: The variables are tested for their order of integration. Cointegration requires that two variables be integrated of the same order and if these variables are all stationary, then it is not necessary to proceed since the standard OLS regression can be applied to stationary variables. The Augmented Dickey-Fuller test is used to establish the order of integration of the data. Since the actual data generating process is not known, it is better to test the hypothesis γ=0 using the general model:

$$\Delta y_t = a_0 + \gamma y_{t-1} + a_2 t + \sum_{i=2}^{p} \beta_i \Delta y_{t-i+1} + \varepsilon_t \qquad (4.23)$$

The testing procedure suggested by Dolado *et al*. (1990) as also briefly laid out in Enders (2004:213) is adopted in testing for the unit root of all the series. All variables are in natural logarithmic form except for variables that may contain negative values.

The maximum lag structure that is used follows Said and Dickey (1984) who suggested a lag order equal to $T^{1/3}$ with T the number of observations. Therefore, the maximum lag structure of 4 is used in the testing procedure. Nevertheless, there is no strict specification on the number of lags to be used in the testing regressions. Perron (1989) suggests starting with eight lags at a 10 per cent level of significance. This procedure will result in low power of the test but may not affect the size of the test.

Step 2: After determining the order of integration of the variables in the equation and they are found to be non-stationary. The next step is to estimate the long-run equilibrium relationship of the variables in the equation. To determine if the variables have a long-run relationship (cointegrated), the residuals of the estimated equation are tested for stationarity. If the residuals displayed stationarity, one can conclude that there is a long-run relationship among the variables in the equation. Enders (2004:337) suggested the use of critical values for Engle-Granger cointegration test when estimating a cointegrating equation. This follows the MacKinnon (1991) response surface values.

Enders (2004:336) also suggested considering the estimation of the autoregression of the residuals without intercept.

$$\Delta \hat{e}_t = a_1 \hat{e}_{t-1} + \varepsilon_t \qquad (4.24)$$

where $\hat{e}_t$ are the residuals of the estimated regression. The null hypothesis is $a_1=0$. Therefore, the stability condition suggests that $-2<a_1<0$ before one can conclude that the residuals are stationary.

Step 3: After a suitable long-run estimation is found and if all the variables are found to be cointegrated, then an error-correction model can be estimated using the residuals from the long-run regression. Engle and Granger proposed the following procedure in estimating the error-correction model:

$$\Delta y_t = \alpha_1 + \alpha_y \hat{e}_{t-1} + \sum_{i=1} \alpha_{11}(i)\Delta y_{t-1} + \sum_{i=1} \alpha_{12}(i)\Delta z_{t-1} + \varepsilon_{yt} \qquad (4.25)$$

where Δ is the first difference operator of a variable, $\hat{e}_{t-1}$ is the lagged residuals from the long-run equation, α_y is the speed of adjustment coefficient and y_{t-1} and z_{t-1} is the lagged dependent variable and all other variables that may have transitory effects on output. Given that equation (4.25) contains only stationary variables (first differenced), all the test statistics used in the traditional OLS regressions can be applied.

Step 4: This step is performed to assess the appropriateness of the error-correction model. This is done by first performing the diagnostic test to detect if the residuals of the error-correction equation are stationary. In the situation where the residuals are found to be non-stationary, Enders (2004:338) suggests that the model should be re-estimated by adjusting the lag length until it produces stationary residuals. Secondly, check the speed of adjustment coefficient α_y which shows an important implication for the dynamics of the system. The coefficient is expected to be negative and the absolute value must not be too large to enable the system to speedily return to equilibrium.

4.5 CONCLUSION

Following the Engle-Granger (1987) estimation techniques, this chapter has explained the explicit specifications of the macro-econometric model developed in this study. The specifications have been inferred from both the theoretical fundamentals and the underlying structure of the Nigerian economy analyzed in the previous chapters. Two separate models testing the hypothesis of existing structural supply constraints versus demand-side constraints. The Nigerian production function has been specified in two folds using a Kalman filter approach. The oil sector belongs to the first economy and the rest of the economy is regarded as the second economy. The majority of the poor also form part of the second economy. The model identified four major sectors in the economy which are: the real sector, the external sector, the monetary sector and the government sector. Other behavioural equations are also specified and estimated in order to explicitly determine the feedback of a policy change on the entire system. The empirical analysis and results of the various estimations are discussed in the next chapter.

CHAPTER 5

EMPIRICAL ANALYSIS

5.1 INTRODUCTION

Based on the theoretical underpinnings of the various equations discussed in the previous chapter, this chapter provides the empirical analysis. First, it estimates and analyses the results of the production functions and all other structural equations in the models. Second, it creates a fully dynamic system model by combining the production functions and all other structural equations. This enables a link between the endogenous variables in the system. Last, the dynamic response characteristics are analysed by applying the various exogenous and policy shocks to some selected variables.

As discussed earlier, the models developed in this study seek to test the hypothesis of existing structural supply constraints versus demand-side constraints impeding the growth and development of Nigeria. However, the two models have different closures but some of the equations estimated are different[23]. The Engle-Granger estimation technique is also adopted in this study. Since the analysis of growth and poverty are generally based on long-term perspectives, major emphases are placed on the long-run equations of the model.

Detailed descriptions of all the data (their sources and calculations) used in the study and their order of integration are presented in Appendix 1 and 2. All the estimated long-run and short-run equations outputs, their simulation path and statistical properties (i.e cointegration residuals and diagnostic tests) are presented in Appendix 3 to 5.

[23] More detail distinction between the two models is presented in Section 5.3.

5.2 ESTIMATION RESULTS (MODEL A): SUPPLY-SIDE ORIENTATED

As discussed earlier, this model represents a typical economy (such as Nigeria) with structural supply constraints. In this model the demand-side of the economy is being marginalised based on the assumption that the productive capacity of the economy is being impeded by some socio-economic constraints facing the country. The oil sector is the dominant driver in the nation's production function and therefore prompts an estimation of a separate oil sector production function. In this model the major macroeconomic variables detected to be a determinants factor in explaining some stochastic equations used the rest of the economy variables (disaggregated variables) where poverty and unemployment is prevalent.

The price blocks serve as a linkage between the demand-side and the supply-side of the economy through capacity utilisation and the excess demand variables included in the production price and consumer price equations respectively[24]. The results of the various estimations are presented inline with the four major sectors discussed in chapter four.

5.2.1 The real sector

5.2.1.1 Aggregate supply

Production function for the Nigerian economy

The aggregate production function for the total economy and oil sector is estimated using the Kalman Filter specification[25]. The unknown parameters of the system are estimated along with the state vectors which are assumed to follow an autoregressive process that evolved over time. All variables are in natural logarithm and are integrated of order 1 (see Appendix 2).

The observation equations of the production functions are first estimated. A time-varying parameter representing technological progress is allowed for in the aggregate production function for the total economy. In order to capture well the production function in the oil sector

[24] The definition of these variables can be seen in Appendix 5.
[25] The rest of the economy production function is calculated from the identity rgdp_rest = rgdp – rgdp_oil.

all the parameters are allowed to be time-variant[26]. Constant returns to scale are enforced and the long-run results of the production functions are presented as:

Total economy:

$$\ln\_rgdp_t = 0.18 \ln\_rk\_stock2_t + (1-0.18) \ln\_labor\_f_t + sv\_tfp\_tot_t \quad (5.1)$$

Oil Sector

$$\ln\_rgdp\_oil_t = sv\_rk\_stock2\_oil1_t * \ln\_rk\_stock2_t + (1 - sv\_rk\_stock2\_oil1_t) * \ln\_labor\_f_t + sv\_tfp\_oil1_t + sv\_dum\_oil1_t * dum_t \quad (5.2)$$

0.7 (Final Value)

The long-run results from the Kalman filter estimation for the total economy production function shows that the estimate of the elasticity of output with respect to capital is about 0.2 which means that the elasticity of output with respect to labour will be 0.8. This result reflects the minimal use of capital stock in the production structure of the Nigerian economy. These estimates are in line with the growth accounting exercise presented in Chapter 3 and also similar to the findings of Du Toit (1999) when estimating a production function for the South African economy[27]. The time varying technology as explained in Section 5.2.5 is found to have similar trend with the result of the growth accounting exercise presented in Chapter 3.

Kalman filter estimation for the oil sector production function reflects the intensity of capital stock that is used in the production process. Since this parameter is allowed to vary over time, the final value of the estimate of the elasticity of output with respect to capital is 0.7 and the

[26] The Eviews estimation outputs for all the equations in the model (long-run and short-run) are presented in Appendix 3

[27] The t-statistics in long-run equation can be ignored and the use of this in performing the significance tests in the cointegrating equation should be avoided (Enders, 2004:339).

average estimate over the period is 0.8. This means that the elasticity of output with respect to labour will be 0.3 and 0.2 in the final state and on the overall average respectively. It is found necessary to include a dummy variable in the long-run equation of the oil sector production function to capture periods of oil price shocks. The time varying technology as explained in the previous section is found to increase for most of the period.

The cointegration tests on the production functions were carried out by testing for stationarity in the residuals and the results revealed stationary residuals. This implies that the variables are cointegrated.

The Error Correction Model (ECM) captures the short-run dynamics of the Nigerian production structures. Apart from the long-run variables, real wages and consumer inflation are found to play a significant role in the short-run adjustment process in both the total economy and oil sector production functions. Oil prices also have a significant impact on the oil sector in the short-run. The coefficients of the lagged residual from the long-run are negative and significant, showing the dynamic adjustment towards the long-run equilibrium path. This shows that about 14 per cent and 30 per cent of any disequilibrium is corrected for every year in the total economy and the oil sector respectively. The short-run equations passed all the required diagnostic tests; thus confirming that the equations are well-specified and do not violate the Gaussian or classical linear regression assumptions.

The dynamic simulation of the long-run and short-run equations reveals a very good fit of the estimated model (Appendix 4).

Domestic investment (real gross capital formation)

As discussed in the previous chapter, the investment function of the Nigerian economy is estimated using the neoclassical approach. This approach is seen to be consistent with a supply-side model since it incorporates the cost-minimising and profit-maximising decisions of firms. Based on the neoclassical theory of investment, the level of interest rates, output, cost of capital and tax policies are the main driving forces that optimise a firm's capital stock.

The link between investment and capital stock can be captured empirically by either 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 modelled as a function of output, user cost of capital, capacity utilisation, and the level of political instability (governance indicator). The long-run result is presented below as:

$$\ln\_gcf_t = 0.97\ln\_rgdp_t - 0.1\ln\_ucc_t + 0.32\,pi_t + 0.5\ln\_cu\_tot_t - 0.35dummy\_m_t - 0.5dum_t \quad (5.3)$$

The long-run equation is consistent with a priori expectation and the residuals from the regression were tested for stationarity and the null hypothesis of no cointegration was rejected. The results show that 1 per cent increases in output and capacity utilisation are associated with an increase of about 0.97 per cent and 0.5 per cent in domestic investment respectively, while a rise in the user cost of capital by 1 per cent causes domestic investment to decline by about 0.1 per cent. Political instability is also included in the estimation as a measure of governance. The result reveals that a more stable political environment will attract more foreign direct investment into the country. This result is not surprising since political instability has been one of the dominant features of the Nigerian economy over the years and also a source of the decline in domestic investment[28]. Dummy variables are also included in the estimation to capture the periods of military rule and oil price shocks.

Estimates from the ECM capture the short-run dynamic properties. The dynamic adjustment towards the long-run equilibrium path is shown by the coefficient of the lagged residuals from the long-run which is negative and significant. This shows that about 54 per cent of any disequilibrium is corrected for every year. The oil prices, capital flows, exchange rates, and producer inflation play a major role in the short-run adjustment processes of the Nigerian investment function. In order to determine whether the ECM is well-specified, the required

[28] Political instability is not in its natural logarithms due to negative values in the series (see data description for more details).

diagnostic tests were carried out and the results revealed no violation of the Gaussian or classical linear regression assumptions.

The dynamic simulation of the long-run and short-run equations reveal a very good fit of the estimated model (Appendix 4).

Labour demand and real wage determination

The role played by labour in the Nigerian production function also warrants proper investigation. With a large population of about 140 million currently, the country's economically active population constitutes more than 50 per cent of the total population of which about 70 per cent are in the labour force. This is an indication that there is still a considerable number who are unemployed/not employable.

The labour demand which is a function of output and real wage is estimated by augmenting it with socio-economic activity as discussed in the previous chapter. Since wage and employment data for Nigeria are not available, the labour force is however used as a proxy for employment. The socio-economic index is used as a proxy for socio-economic activity which follows Lind (1993)[29]. Two dummy variables capturing periods of military rule and oil price shocks are included as additional explanatory variables. As discussed earlier, since the rest of the economy constitute the majority of the poor and unemployed, the GDP in the rest of the economy is used in the estimated labour demand function. The long-run result is however, presented as:

$$\ln\_labor\_f_t = 0.7\ln\_rgdp\_rest_t - 0.6\ln\_rwage\_lf_t + 0.9\ln\_se\_index\_b_t - 0.1dum_t - 0.2dummy\_m_t \quad (5.4)$$

The estimation result is consistent with the expected sign and it reveals that a 1 per cent rise in real wages will influence employment negatively by about 0.6 per cent while output and socio-economic activity will have a positive influence on employment. The socio-economic activity is found to be very significant economically in explaining the labour demand in Nigeria. This

[29] Detailed description and calculation of all the data are presented in Appendix 1.

reveals that an increase in socio-economic activity by one per cent will result in about 0.9 per cent increase in labour employment. The residual from the long-run equation was tested for stationarity and the null hypothesis of no cointegration was rejected[30].

The short-run dynamics of labour demand in Nigeria is revealed by using the Error Correction Model (ECM). Capital stock, government expenditure on social development, consumer inflation, import prices and exchange rate are found to play a significant role in the short-run adjustment process. The coefficient of the lagged residual in the long-run is negative and significant, showing the dynamic adjustment towards the long-run equilibrium path. The short-run equation passed all the required diagnostic tests which has confirmed the equation as well-specified and that it does not violate the Gaussian or classical linear regression assumptions[31].

The dynamic simulations of the long-run and short-run equations reveal a very good fit of the estimated model (Appendix 4).

The real wage equation for the Nigerian economy is expected to be driven by labour productivity. Again, labour productivity in the rest of the economy is used in the long-run equation. The long-run result of the real wage equation is therefore presented as:

$$\ln\_rwage\_lf_t = 0.75\ln\_labprod\_rest_t - 0.2dummy\_m_t + 0.1dum_t + 3.2 \qquad (5.5)$$

The result shows that the labour productivity in the rest of the economy has a positive impact on the real wages. This means that a 1 per cent increase in the labour productivity in the rest of the economy causes real wages to rise by about 0.8 per cent. The residual from the long-run equation was tested for stationarity and the null hypothesis of no cointegration was rejected.

Capturing the short-run dynamics of the real wage equation, the coefficient of the lagged residuals from the long-run are negative and significant, indicating the dynamic adjustment towards the long-run equilibrium path. About 18 per cent of any disequilibrium is corrected for

[30] Due to the softness of the data most of the long-run equations in the model passed the Engle-Granger cointegration test at nearly 10 percent.
[31] All the diagnostic tests are reported in the ECM estimation output presented in the Appendix.

every year. Apart from the long-run explanatory variables socio-economic activity, government transfers, level of openness of the economy also influence the short-run adjustment process significantly. The ECM passed all the required diagnostic tests confirming a well-specified equation.

The estimated long-run and short-run equations are simulated together and the fitness of the model revealed very robust parameter estimates (Appendix 4).

Technological progress (total factor productivity)

The role played by technology in the growth process of a nation cannot be overemphasised. Technology was the primary catalyst to any nation's economy transformation. The assumption that technological progress occurs at constant rate is very common in the growth literature (especially the exogenous growth theories). This may not be a very realistic assumption. A time-varying technological progress that is adopted in this study using the Kalman filter procedure reveals the weakness of this assumption. It clearly shows the upward and downward trend in the evolution of technology in Nigeria. The method follows a similar trend with the technology from the growth accounting exercise calculated for each period as explained in the previous chapter.

Technology in the oil sector (as represented by the generated series) of the Nigerian economy has experienced an upward trend especially between the mid-1970s and early 1990s. This is not surprising since oil is the main source of export revenue to Nigeria which also requires a high level of technology and innovations in extracting it. The downward trend experienced from the mid-1990s can be attributed to the social unrest in the Niger-Delta that disrupted the production of oil.

Based on the above background, technological progress in the total economy and the oil sector is modelled following the theoretical specification presented in the previous chapter.

Total economy:

Total factor productivity for the total economy is modelled as a function of the level of poverty which also captured the human development component of the economy. The level of financial development is captured by the level of financial constraints (financing of domestic investment) and the domestic investment in the country. The long-run result is presented as:

$$\ln\_tfp\_tot_t = -0.28\ln\_povertyd\_index_t + 0.13\ln\_gcfgdp_t + 0.03\ln\_finconstr_t + 0.41dum\_tfp_t - 4.5dumtfp_t + 9.4 \quad (5.6)$$

The result shows the important role played by the human development variables in the long-run technological progress in Nigeria. An increase in the level of poverty by 1 per cent causes a 0.3 per cent decline in total factor productivity. The ratio of domestic investment to GDP and the level of financial constraints will have a positive influence on technology of about 0.1 per cent and 0.03 per cent respectively. The two dummy variables captured the structural break found in the total factor productivity series. These were also significant for determining the long-run technological process. The long-run equation was tested for cointegration and the null hypothesis of no cointegration was rejected.

Capturing the short-run dynamics the ECM passed all the diagnostic tests which suggests that no assumption of the classical regression model has been violated. The dynamic adjustment towards the long-run equilibrium path is found to be negative and significant showing that about 25 per cent of any disequilibrium is corrected for every year. Socio-economic activity is found to play an important role in the short-run adjustment process.

The dynamic simulation of the long-run and short-run equations reveals a very good fit of the estimated model (Appendix 4).

Oil sector:

Since the oil sector is characterised as the first economy, the human development variable plays an insignificant role in determining its long-run technological progress. A major difficulty is however encountered in modelling the technological progress in the oil sector. The financial development sector and oil prices are expected to have a big influence on this aspect of the economy. The oil sector total factor productivity is modelled as a function of certain financial variables. The availability of domestic credit, the level of foreign direct investment and oil prices are seen as major forces driving technology in the oil sector. The long-run result is presented as:

$$\ln\_tfp\_oil_t = 0.95\ln\_dcredit_t + 0.05\ln\_fdi_t + 0.3\ln\_oil\_p_t + 2.6dummy\_m_t - 13.1 \qquad (5.7)$$

The long-run equation is consistent with a priori expectation and the residuals of the regression were tested for stationarity and the null hypothesis of no cointegration was rejected. The results show that a rise of domestic credit by 1 per cent will cause total productivity in the oil sector to rise by about 0.95 per cent and as the foreign direct investment increases by 1 per cent total productivity rises by about 0.05 per cent. Oil prices are expected to have a positive impact on the technology in the oil sector with about a 0.3 per cent increase when the oil price rises by one per cent. The dummy variable capturing the oil price shocks is found to be significant in the long-run equation[32].

The short-run dynamic properties are also shown from the Error Correction Model (ECM). Capital stock, socio-economic activity, some form of government expenditure, and capacity utilisation in the oil sector are found to be significant in the short-run adjustment process. The coefficient of the lagged residual from the long-run is negative and significant, showing that about 32 per cent of any disequilibrium is corrected for every year. The short-run equation passed all the required diagnostic tests which have revealed that the equation is well-specified and does not violate the Gaussian or classical linear regression assumptions.

[32] The rest of the economy total productivity function is calculated from the identity tfp_rest=tfp_tot-tfp_oil.

The dynamic simulation of the long-run and short-run equations reveals a very good fit of the estimated model (Appendix 4).

5.2.1.2 Aggregate demand

Household real consumption expenditure

The long-run relationship of the household consumption in Nigeria is captured by the level of household disposable income, real wealth (proxied by real M2) and the real interest rate. These variables are expected to influence the consumption pattern of households positively. The real interest rate coefficient is positive and significant, conforming to theory. This is in contrast with most empirical studies applied to the developing countries. The long-run result is presented as:

$$\ln\_hh\_rconexp_t = 0.97\ln\_hh\_rgdp\_rest + 0.004\ln\_rm2_t + 0.01r\,int_t + 0.14dummy\_m_t + 0.18dum_t \quad (5.8)$$

The result conforms to theory and the inclusion of the two dummy variables tends to capture the periods of military rule and oil price shocks. The result shows that a 1 per cent increase in household disposable income and real money supply will lead to about 0.97 per cent and 0.004 per cent increase in household consumption expenditure while a 1 unit rise in the real rate of interest will lead to about 0.01 per cent increase in household consumption. The stationarity test on the residual from the long-run equation was carried out and the null hypothesis of no cointegration was rejected.

Capturing the short-run dynamics of the consumption function, the coefficient of the lagged residuals from the long-run is negative and significant, showing the dynamic adjustment towards the long-run equilibrium path. About 91 per cent of any disequilibrium is corrected for every year. Apart from the long-run variables the lagged value of the household consumption expenditure also play an important role in the short-run. The ECM passed the entire diagnostic test revealing a well-specified model.

The dynamic simulation of the long-run and short-run equations reveals a very good fit of the estimated model (Appendix 4).

5.2.1.3 Prices

Consumer and producer prices

Price settings are seen as a key decision for firms operating under a profit-maximising or cost-minimising framework. The pricing structure links together the various sectors in the economy and also provides an additional advantage to be able to explain the high inflationary pressure that the country has been experiencing since 1970. As discussed in the previous chapter, models of production and consumption prices are estimated.

The Nigerian consumer price index is expected to be influenced by production prices, import prices and the exchange rate, which are captured by the producer price index, import price index and Naira per U.S dollar nominal exchange rate respectively. The level of excess demand in the economy is also found to have a long-run impact on the consumer prices. The long-run result is presented as:

$$\ln\_cpi_t = 0.96\ln\_ppi_t + 0.8\ln\_imp\_p_t + 0.9\ln\_exch_t + 0.2\ln\_excessd + 0.5dummy\_m_t - 0.3dum\_oil_t - 7.4 \quad (5.9)$$

Most importantly is the magnitude of the coefficients of the producer prices and exchange rate which indicate about 0.9 per cent increase in consumer prices when the two variables rise by 1 per cent each. The results confirmed the economic significance that production prices, import prices and exchange rate has on the consumer prices in Nigeria. The depreciation of the Naira is expected to put pressure on consumer prices, likewise an increase in the production prices and import prices. Dummy variables capturing the military rule and the oil sector are found to be significant in explaining consumer prices. The stationarity test on the residual from the long-run equation was carried out and the null hypothesis of no cointegration was rejected.

Capturing the short-run adjustment process as revealed from the ECM. Apart from the long-run variables nominal wage, GDP, capital flows, and government transfers are found to have been significant in the short-run. The dynamic adjustment towards the long-run equilibrium path is found to be negative and significant revealing that about 5 per cent of any disequilibrium is corrected for every year. The diagnostic tests carried out from the ECM shows that the model is well-specified and has not violated any of the assumptions of the classical linear regression model.

The dynamic simulation of the long-run and short-run equations of the Nigerian consumer prices confirms a very good fit of the estimated model (Appendix 4).

However, it is assumed that the producer prices are influenced by nominal wages and the cost of capital (proxy by interest rate). Oil price and the level of capacity utilisation have also significantly affected the Nigerian production prices in the long-run. All these variables have a positive influence on the production prices. The long-run result is presented as:

$$\ln\_ppi_t = 0.01\ln\_wage_t + 0.1\ln\_oil\_p_t + 0.5\ln\_cu\_tot_t + 0.2\ln\_\text{int}_t + 4.5 \qquad (5.10)$$

The result shows that the level of capacity utilisation has a slightly higher impact on production prices than other variables in the long-run. The stationarity test on the residual from the long-run equation was carried out and the null hypothesis of no cointegration was rejected.

The dynamic adjustment towards the long-run equilibrium path is found to be negative and significant, revealing that about 29 per cent of any disequilibrium is corrected for every year. The ECM passed all the diagnostic tests and no assumption of the classical linear regression model has been violated.

The dynamic simulation of the long-run and short-run equations of the Nigerian producer prices reveals a good fit of the estimated model (Appendix 4).

5.2.2 The external sector

Real export of goods and services

The long-run real export demand is estimated as a function of world income, relative prices and the fluctuations in the level of oil prices. As mentioned earlier, the exchange rate which measures the level of competitiveness in the economy does not have any long-run relationship in the Nigerian export demand function, instead oil prices plays a significant role in the long-run. The long-run result is presented as:

$$\ln\_r\exp_t = 0.75\ln\_rgdpus_t - 0.20\ln\_relcpi_t + 0.34\ln\_oil\_p_t \quad (5.11)$$

The result conforms to theoretical specification. A 1 per cent increase in world income and oil prices will lead to about 0.8 per cent and 0.3 per cent increase in real exports while a 1 per cent rise in relative prices is expected to reduce real exports by about 0.2 per cent. World income and oil prices are found to have a greater impact on the export function than relative prices. This is expected since U.S. is the major trading partner of Nigeria especially in the export of crude oil. A rise in the domestic prices relative to U.S prices will lead to a fall in the country's export demand. Stationarity test on the residuals from the long-run equation was carried out and the null hypothesis of no cointegration was rejected.

Capturing the short-run dynamics of the export demand function, the coefficient of the lagged residuals from the long-run is negative and significant showing the dynamic adjustment towards the long-run equilibrium path. About 55 per cent of any disequilibrium is corrected for every year. The nominal exchange rate is however, found to play a significant role in the short-run dynamics of the Nigerian export demand. In addition, the level of production prices also has a significant influence on export in the short-run. The ECM passed the entire diagnostic test revealing a well-specified model.

The dynamic simulation of the long-run and short-run equations confirms a very good fit of the estimated model (Appendix 4).

Real import of goods and services

The long-run real imports demand is determined by the level of domestic income (GDP), relative prices and the nominal exchange rate. The nominal exchange rate plays a significant role in the Nigerian import demand function since imports constitute the majority of the country's consumption expenditure. The long-run result is presented as:

$$\ln\_rimp_t = 1.4\ln\_rgdp_t + 0.21\ln\_relcpi_t - 0.21\ln\_exch_t - 0.48dum_t - 0.32dummy\_m_t - 6.4 \quad (5.11)$$

The depreciation of the exchange rate by 1 per cent will lead to about 0.2 per cent decrease in imports as it becomes more expensive to purchase foreign goods, while a rise in the domestic prices relative to U.S prices by 1 per cent will increase imports by the same magnitude as the U.S goods will become cheaper. Domestic income is found to play a much greater role in the import equation indicating about 1.4 per cent rise in imports if domestic income should increase by 1 per cent. The inclusion of the two dummy variables tends to capture the periods of military rule and oil price shocks. The stationarity test on the residuals from the long-run equation was carried out and the null hypothesis of no cointegration was rejected.

The short-run dynamics of the import demand function was captured and the coefficient of the lagged residuals from the long-run was found to be negative and significant, showing the dynamic adjustment towards the long run equilibrium path. About 58 per cent of any disequilibrium is corrected for every year. Apart from the long-run variables the lagged values of the real imports, the fluctuation in oil prices play an important role in the short run. The ECM passed the entire diagnostic test revealing a well-specified model.

The dynamic simulation of the long-run and short-run equations reveals a very good fit of the estimated model (Appendix 4).

Nominal exchange rate

As analysed in the previous chapter, the long-run nominal exchange rate is estimated following the Dornbusch (1980) and Frankel (1979) methods. The relative interest rate is found not to have any significant impact in the long run. This confirms the insignificant role played by the monetary policy over the years in the Nigeria economy. The long-run result is presented as:

$$\ln\_exch_t = -1.11\ln\_relrgdp_t + 0.78\ln\_relm2_t + 0.38\ln\_relcpi_t - 0.68dum_t + 8.5 \qquad (5.12)$$

The long run result shows the sensitivity of exchange rate to both domestic and foreign income. As the level of domestic income increases by 1 per cent relative to foreign income, the Naira will appreciate by about 1.1 per cent, while an increase in relative money supply and prices by 1 per cent will lead to the depreciation of the Naira by about 0.8 per cent and 0.4 per cent respectively. The dummy variable representing the periods of oil price shocks plays a significant role in the long run specification. The stationarity test on the residuals from the long-run equation was carried out and the null hypothesis of no cointegration was rejected.

Capturing the short run dynamics, the ECM passed all the diagnostic tests and this suggests that no assumption of the classical regression model has been violated. The dynamic adjustment towards the long-run equilibrium path is found to be negative and significant, showing that about 30 per cent of any disequilibrium is corrected for every year. Apart from the long-run variables, oil prices and relative remittances from abroad also play an important role in the short-run adjustment process.

The dynamic simulation of the long-run and short-run equations displays a very good fit of the estimated model (Appendix 4).

Foreign direct investment

The long-run foreign direct investment is determined by the level of GDP (market size), price level, level of openness of the economy and the fluctuations in the nominal exchange rate. The result from the estimation is presented as:

$$\ln\_fdi_t = 0.68\ln\_rgdp_t - 0.5\ln\_cpi_t + 0.1\ln\_open_t + 0.29\ln\_exch_t + 1.17dummy\_m_t + 0.9dum_t \qquad (5.13)$$

The result revealed the significant role played by GDP in attracting foreign investment into the country and how the level of macroeconomic instability (price level) can slowdown the flow of foreign investment. A 1 per cent increase in GDP will lead to about 0.7 per cent increase in foreign direct investment and hen consumer prices increases by 1 per cent the level of foreign direct investment declines by about 0.5 per cent. The depreciation of the exchange rate by 1 per cent will lead to an increase in the flow of foreign investment by about 0.3 per cent as this will serve as a signal for a reduced cost of capital while the level of openness of the economy will also give way to more foreign investment in the country. The inclusion of the two dummy variables which represent the periods of military rule and oil price shocks plays a significant role in the long-run. The stationarity test on the residuals from the long-run equation was carried out and the null hypothesis of no cointegration was rejected.

The dynamic adjustment towards the long run equilibrium path is found to be negative and significant, revealing that about 60 per cent of any disequilibrium is corrected for every year. The lagged values of foreign direct investment and the level of domestic investment are found to have played an important role in the short-run. The ECM passed all the diagnostic tests and no assumption of the classical linear regression model has been violated.

The dynamic simulation of the long-run and short-run equations confirms a good fit of the estimated model (Appendix 4).

5.2.3 The monetary sector

Nominal interest rate

The long run nominal interest rate equation is estimated as a function of real GDP, money supply, and the discount rate. Since the discount rate is directly linked to the lending rate and has been the main monetary policy tool used by the Central Bank to determine bank lending rates it is included in the long run specification of the nominal interest rate (Pauly, 2005). The result from the long-run estimation is presented as:

$$\ln\_\text{int}_t = 0.49 \ln\_rgdp_t - 0.26 \ln\_rm2_t + 0.78 \ln\_dis\_rate_t - 7.69 \qquad (5.14)$$

The result shows that an increase in GDP by 1 per cent is associated with an increase in interest rate by about 0.5 per cent since the higher GDP will result in increased transaction demand for money. The increase in real money supply by 1 per cent will lead to a reduction in interest rate by about 0.3 per cent. The link between the discount rate and interest rate is confirmed from the positive relationship shown in the result. The stationarity test on the residuals of the long-run equation was carried out and the null hypothesis of no cointegration was rejected.

The short-run dynamics of the nominal interest rate function was captured and the coefficient of the lagged residuals from the long-run was found to be negative and significant showing the dynamic adjustment towards the long-run equilibrium path. About 72 per cent of any disequilibrium is corrected for every year. Apart from the long-run variables the lagged values of the nominal interest rate is found to play an important role in the short-run. The ECM passed the entire diagnostic test revealing a well-specified model.

The dynamic simulation of the long-run and short-run equations reveals a very good fit of the estimated model (Appendix 4).

5.2.4 Other behavioural equations in the model

Socio-economic activity

The importance of capturing the socio-economic aspect of the macroeconometric model of the Nigerian economy is to be able to see the impact of any policy scenario on the welfare of its citizens and in general the development of the nation. As specified in the previous chapter, socio-economic activity in Nigeria is influenced by the level of household disposable income, government expenditure on social development and some level of infrastructural development which is captured by electricity production per capita. These factors are expected to positively affect the social aspect of economic livelihood of Nigerian population. Again, household disposable income in the rest of the economy is used since the majority of the poor population belongs to this class. The long-run result of socio-economic activity is presented as:

$$\ln\_se\_index\_b_t = 0.03\ln\_hh\_rgdp\_rest_t + 0.03\ln\_r\exp social_t + 0.02\ln\_eleppop_t + 0.04dummy\_m_t - 0.5 \quad (5.15)$$

The results show that the household disposable income and government expenditure on social development will have similar impact on the socio-economic activity. That is to say that, a 1 per cent increase in household disposable income or government expenditure will cause socio-economic activity to rise by 0.03 per cent. Electricity production per capita is found to have slightly lower impact of about 0.02 per cent and a dummy variable capturing the military rule is found to be significant in explaining socio-economic activity in the long-run. Based on the stationarity test on the residuals from the long-run equation, the null hypothesis of no cointegration was rejected.

Capturing the short-run dynamics the ECM reveals that the model has passed all the diagnostic tests which suggest that no assumption of the classical regression model has been violated. The dynamic adjustment towards the long-run equilibrium path is found to be negative and significant, showing that about 33 per cent of any disequilibrium is corrected for every year.

Apart from the long-run variables, capital flows, GDP, and the level of poverty are some of the factors that played an important role in the short-run adjustment process.

Simulating the dynamics of the long-run and short-run equations of socio-economic activity in Nigeria shows a very good fit of the estimated model (Appendix 4).

Disposable income

Household disposable income as discussed in the previous chapter is expected to be influenced mainly by real wages and some form of government transfer payments. The long-run result is present as:

$$\ln\_hh\_rgdp\_rest_t = 0.9\ln\_rwage\_lf_t + 0.1\ln\_transfer_t + 0.1dummy\_m_t - 1.2E-07dumoil_t + 3.5 \quad (5.16)$$

The long-run equation is tested for cointegration based on stationarity of the residuals and the null hypothesis of no cointegration was rejected. The result shows that a 1 per cent increase in real wages will lead to 0.9 per cent rise in real household disposable income and if government transfer payments should increase by 1 per cent, real household disposable income will increase by 0.1 per cent.

The dynamic adjustment towards the long-run equilibrium path is shown by the coefficient of the lagged residuals from the long-run which is negative and significant. This shows that about 26 per cent of any disequilibrium is corrected for every year. Capital stock, production prices, and agricultural production are found to play an important role in the short-run adjustment process. In order to determine whether the ECM is well-specified the required diagnostic tests were carried out and the results reveal no violation of the Gaussian or classical linear regression assumptions.

The dynamic simulation of the long-run and short-run equations reveals a very good fit of the estimated model (Appendix 4).

Poverty

The explanation of poverty using a macro-econometric model is fairly rare in the literature. As mention earlier, the microeconomic literature have dominated most of the analysis on poverty and the CGE models which focus on the general economy have a strong micro-foundation. The main focus of this part of the study is to build a macroeconomic model which can explain the rising poverty levels the Nigerian economy has been plagued with over the years. The divergence between growth and poverty has been a major feature of most of the developing countries and a focus on the production structure of these economies is deeming necessary in order to alleviate the high poverty levels.

The long-run poverty function as discussed in the previous chapter is expected to be influenced by some form of macroeconomic instability, (proxy with inflation) food production, the level of household disposable income, the level of aid that flow into the country, and the level of infrastructural development. These variables with the exception of inflation are expected to have a negative relationship with the level of poverty. The long-run result is presented as:

$$\ln\_povertyd\_index_t = 0.24\ln\_cpi_t - 0.54\ln\_index\_agric_t - 0.15\ln\_hh\_rgdp\_rest_t - 0.02\ln\_aidpop_t - 0.1\ln\_eleppop_t + 3.03 \quad (5.17)$$

The result shows that an increase in consumer inflation by 1 per cent will cause poverty to rise by 0.24 per cent. The level of agricultural production is found to have the highest impact on the level of poverty with a 0.5 per cent decline in poverty when food production rises by 1 per cent. Household's disposable income and electricity production per capita are also found to be significant in determining the long-run poverty path. The level of aid per capita will lead to an improvement in the standard of living. This is inline with poverty trap view of aid reliance as a catalyst for growth and poverty reduction. Some, like Kraay and Raddatz (2006) are however sceptic of this popular notion. The residual from the long run equation was tested for stationarity and the null hypothesis of no cointegration was rejected.

Capturing the short run dynamics of the poverty equation, the coefficient of the lagged residuals in the long run is negative and significant showing the dynamic adjustment towards the long-run equilibrium path. About 10 per cent of any disequilibrium is corrected for every year. Apart from the long-run explanatory variables the level of employment and capital flows also play a major role in the short-run adjustment process. The ECM however, passed all the required diagnostic tests revealing a well-specified equation.

The estimated long-run and short-run equations are simulated together and the fitness of the model revealed very robust parameter estimates (Appendix 4).

Provision of infrastructure

As discussed earlier, the level of infrastructural development will be a catalyst to achieve economic growth and simultaneously improve the living standard of the general society. Likewise will the increasing level of economic activities calls for a need to expand existing infrastructure. There has been a decay of infrastructure in the Nigerian society over the years and this has been a major setback in achieving the potential level of economic growth and developmental objectives.

Substantial investment in infrastructure, especially in the power sector and road is essential at this stage in the Nigerian economy. Electricity generation and distribution remains a serious aspect of infrastructural building that is impeding development in Nigeria and government performs a significant role in this sector. The long run infrastructural function as a proxy for electricity production is expected to be influenced by the level of output and some form of good governance (government effectiveness). These variables are expected to have a positive influence on the level of infrastructural development. The long-run result as presented in Appendix 3 (Table 27) can be shown as:

$$\ln\_elep_t = 1.4 \ln\_rgdp_t + 0.9 ge_t + 0.4 dum_t - 13.6 \qquad (5.18)$$

The results shows that an increase in economic activities (output) by 1 per cent will require an expansion of infrastructure by 1.4 per cent, while an improvement in government efficiency by 1 unit will cause a 0.9 per cent rise in the level of infrastructure[33]. The residual from the long-run equation was tested for stationarity and the null hypothesis of no cointegration was rejected.

The dynamic adjustment towards the long-run equilibrium path was found to be negative and significant, revealing that about 36 per cent of any disequilibrium is corrected for every year. Cost of capital and socio-economic activities are some of the additional variables that played important roles in the short-run adjustment process. The ECM passed all the diagnostic tests and no assumption of the classical linear regression model was violated.

The estimated long run and short run equations were simulated simultaneously and the fitness of the model revealed a very robust parameter estimate (Appendix 4).

Agricultural production

As discussed in the previous chapter, agricultural production in Nigeria is expected to be influenced by the availability of natural resources (i.e. land), environmental condition (i.e. rainfall) and some form of production price in the economy. Due to a lack of available data on environmental conditions the long-run agricultural production function is captured by production prices, the availability of land for farming and the level of infrastructural development. These variables are expected to have a significant influence on agricultural production. The long-run result is presented as:

$$\ln\_index\_agric_t = -0.14\ln\_ppi_t + 0.58\ln\_land_t + 0.4\ln\_elep_t - 0.56dum_t - 0.17dummy\_m_t \qquad (5.19)$$

The residual from the long-run equation was tested for stationarity and the null hypothesis of no cointegration was rejected. The results revealed that a 1 per cent rise in production prices will add to the cost of producing food and this will lead to a fall in food production by about 0.14 per

[33] Government Effectiveness is not in its natural logarithms due to negative values in the series (see data description for more details).

cent. The rise in the availability of arable land for farming will have a positive and greater impact on food production by about 0.6 per cent likewise will the level of infrastructural development boost food production by about 0.4 per cent.

Capturing the short-run dynamics of the agricultural production equation, the coefficient of the lagged residuals from the long run is negative and significant, showing a dynamic adjustment towards the long run equilibrium path. About 19 per cent of any disequilibrium is corrected for every year. Apart from the long-run explanatory variable the level of capital stock, openness of the economy, political instability and some form of aid also play a major role in the short run adjustment process. The ECM however, passed all the required diagnostic tests, revealing a well-specified equation.

The estimated long-run and short-run equations are simulated together and the fitness of the model revealed a very robust parameter estimate (Appendix 4).

5.3 ESTIMATION RESULTS (MODEL B): DEMAND-SIDE ORIENTATED

In this model an economy with limited or no structural supply constraints is presented. The notion is that the supply-side of the economy is being marginalised based on the assumption that the productive capacity of the economy is not being impeded by socio-economic constraints.

The core distinction between this model (Model B) and the previous model (Model A) is that the Gross Domestic Product (GDP) is generated following the Keynesian demand identity. Therefore, it does not call for a need to disaggregate the production function into the oil sector and the rest of economy. This means that some major macroeconomic variables detected to be determinant factors in explaining some stochastic equations are not disaggregated. The model however re-estimated the equations where the rest of economy macro variables are present. The results of these equations are presented below. All other equations are the same as in Model A.

Labour demand and real wage determination

The labour demand equation is re-estimated as a function of total GDP, real wages, and socio-economic activities. The long-run result is presented as:

$$\ln\_labor\_f_t = 0.8\ln\_rgdp_t - 0.8\ln\_rwage\_lf_t + 0.1\ln\_se\_index\_b_t \qquad (5.20)$$

Using the total economy's output (GDP) the impact of socio-economic activity on labour employment is much lower than when output is disaggregated revealing about 0.1 per cent rise in employment when economic activities increases by 1 per cent. But real wages in this model have a slightly greater impact than in Model A recording about 0.8 per cent decline in employment when real wages rises by 1 per cent. The residual from the long-run equation were tested for stationarity and the null hypothesis of no cointegration rejected.

Capturing the short term dynamics, capital stock, government expenditure on social development, consumer inflation, import prices, and exchange rate are also found to play a major role in the short-run adjustment process. The coefficient of the lagged residual from the long run is negative and significant, showing the dynamic adjustment towards the long-run equilibrium path. The short run equation passed all the required diagnostic tests which have revealed that the equation is well-specified and does not violate the Gaussian or classical linear regression assumptions.

The dynamic simulation of the long and short run equations reveals a very good fit of the estimated model (Appendix 4).

The real wage equation is captured by labour productivity in the total economy and the long-run result is presented as:

$$\ln\_rwage\_lf_t = 0.98\ln\_labprod\_tot_t - 0.1dummy\_m_t + 0.1dum_t \qquad (5.21)$$

Labour productivity in the total economy seems to have a greater impact on real wages in this model than Model A showing about 0.98 per cent increase in real wages when productivity rises by 1 per cent. The residual from the long run equation was tested for stationarity and the null hypothesis of no cointegration rejected.

Capturing the short run dynamics, the coefficient of the lagged residuals from the long-run is negative and significant showing, the dynamic adjustment towards the long-run equilibrium path. Apart from long run explanatory variables, socio-economic activity, government transfers, level of openness of the economy also play a major role in the short run adjustment process. The ECM however passed all the required diagnostic tests, revealing a well-specified equation.

The dynamic simulation of the long and short run equations reveals a very good fit of the estimated model (Appendix 4).

Household real consumption expenditure

The household real consumption expenditure is re-estimated as a function of household disposable income in the total economy and real wealth (real M2). The level of the real interest rate is found not to play any role in this specification. The long-run result is presented as:

$$\ln\_hh\_rconexp_t = 0.65\ln\_hh\_rgdp_t + 0.16\ln\_rm2_t + 0.3dummy\_m_t - 1.4e-07dum_t + 2.4 \qquad (5.22)$$

The level of disposable income is found to have a less impact on household expenditure (0.7 per cent) when compared with Model A while real wealth (0.2 per cent) will have a greater impact. The dummy variables capture the period of military rule and oil price shock. The residual from the long-run equation was tested for stationarity and the null hypothesis of no cointegration rejected.

Capturing the short run dynamics, the coefficient of the lagged residuals from the long-run is negative and significant, showing the dynamic adjustment towards the long-run equilibrium path. About 76 per cent of any disequilibrium is corrected for every year. Apart from long run

variables, the lagged values of the household consumption expenditure also play an important role in the short run. The ECM passed the entire diagnostic test, revealing a well-specified model.

The dynamic simulation of the long and short run equations reveals a very good fit of the estimated model (Appendix 4).

Socio-economic activity

The long-run socio-economic activity is re-estimated as a function of household disposable income in the total economy, government expenditure on social development, and the level of infrastructural development. The long run result is presented as:

$$\ln\_se\_index\_b_t = 0.03\ln\_hh\_rgdp_t + 0.03\ln\_r\exp social_t + 0.02\ln\_eleppop_t + 0.04dummy\_m_t - 0.7 \quad (5.23)$$

This is similar to the result present in Model A. The residual from the long run was again tested for stationarity and the null of no cointegration rejected.

The short run dynamics are also captured with the same variables as in Model A and this reveals the same dynamic adjustment towards the long-run. The ECM passed all the diagnostic tests, suggesting that no assumption of the classical regression model was violated. The dynamic simulation of the long and short run equations reveals a very good fit of the estimated model (Appendix 4).

Poverty

The level of poverty is re-estimated and the long run result presented as:

$$\ln\_povertyd\_index_t = 0.21\ln\_cpi_t - 0.42\ln\_index\_agric_t - 0.004\ln\_hh\_rgdp_t - 0.01\ln\_aidpop_t - 0.1\ln\_eleppop_t \quad (5.24)$$

The impact of household disposable income (0.004 per cent) on poverty in this specification is significantly less when compared to the specification in Model A. All other variables have similar impacts as presented in Model A. The residual from the long-run was again tested for stationarity and the null of no cointegration rejected.

The short run dynamics are also captured with the same variables as in Model A, revealing the same dynamic adjustment towards the long run. The ECM passed all the diagnostic tests, suggesting that no assumption of the classical regression model has been violated. The dynamic simulation of the long and short run equations reveals a very good fit of the estimated model (Appendix 4).

Disposable income

The long run household disposable income in the total economy is estimated following the same specification as in Model A. The result is however, presented as:

$$\ln\_hh\_rgdp_t = 0.97 \ln\_rwage\_lf_t + 0.14 \ln\_transfer_t + 0.1dum_t + 2.3 \qquad (5.25)$$

The long run equation was tested for cointegration based on stationarity of the residuals and the null hypothesis of no cointegration was rejected. The result conforms to theory and revealed about 0.97 per cent increase in disposable income when real wages rises by about 1 per cent. . .

Capturing the short-run dynamics, the coefficient of the lagged residuals from the long-run is negative and significant, showing a dynamic adjustment towards the long-run equilibrium path. ECM passed the entire diagnostic test, revealing a well-specified model.

The dynamic simulation of the long and short run equations reveals a very good fit of the estimated model (Appendix 4).

5.4 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 feedback into the entire system. Therefore, 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 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 the excess demand and the capacity utilisation. This is presented as:

GDP = $f(L, K, T)$

Excess Demand = GDE / GDP

GDE = C + I + G

Capacity Utilisation = GDP / GDP_POTENTIAL

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

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 the excess demand and capacity utilisation. This is presented as:

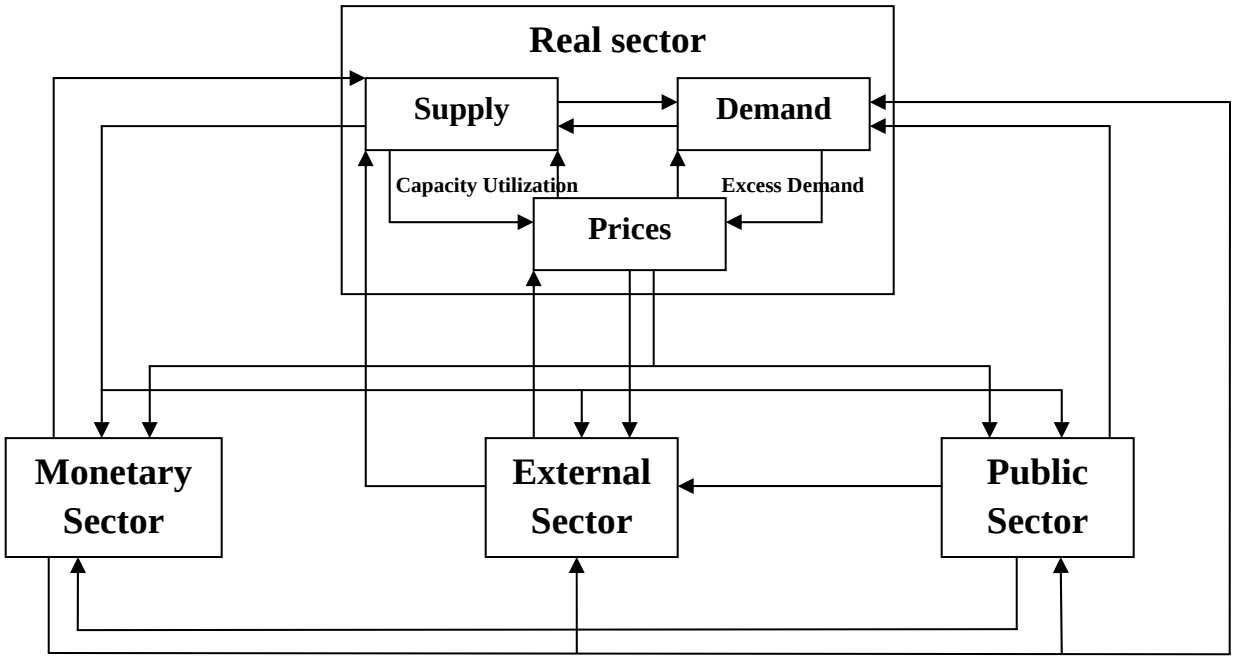
$$GDP = C + I + G + X - Z$$

$$GDE = GDP + Z - X$$

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 the flow chart in figure 5.1. The chart highlights the major contemporaneous feedback processes of the interactions between the sectors investigated in the model. Details of all structural equations have been analyzed in the previous sections.

Figure 5.1: A Flow Chart of the Model



As shown in the flow chart above, the price block serves as a major linkage between the supply-side and aggregate demand-side through capacity utilisation and excess demand. Changes in these variables cause fluctuation in price, which affects production and demand and also causes 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 the 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.

5.5. LONG-RUN 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, 1983: 135).

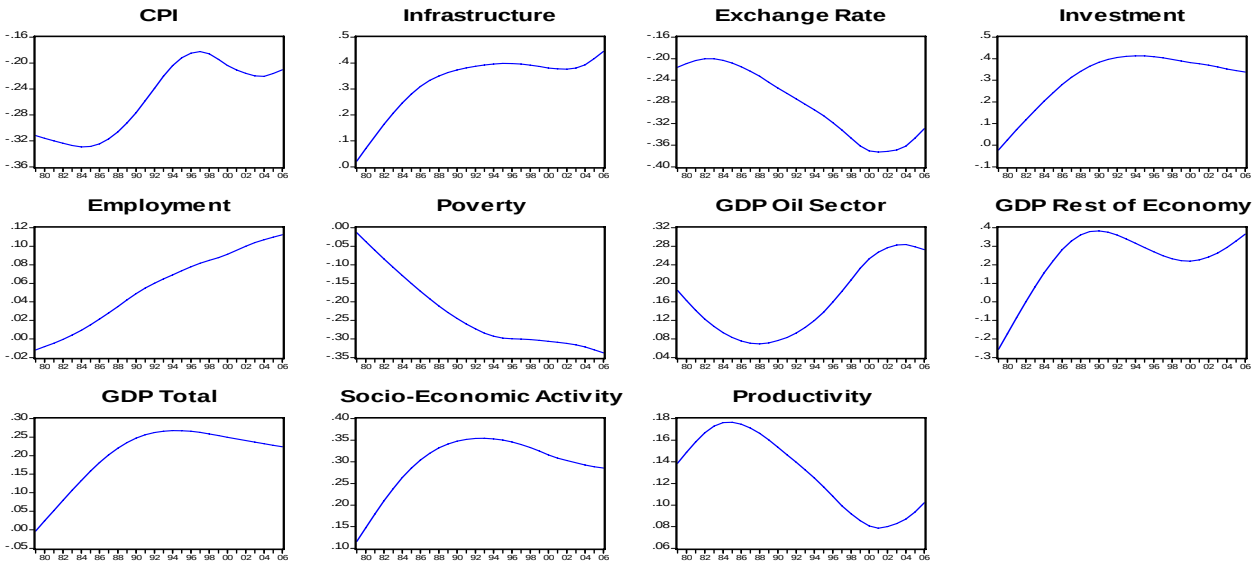
A positive shock of 10 per cent was applied to an exogenous variable from 1979 onwards to determine the shock simulation path. The model is therefore dynamically simulated and every response variable's simulation path was compared with its baseline path to determine the response elasticities. The process is 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 5.2-5. Positive shocks of 10 per cent 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.

5.5.1. Total government expenditure shock:

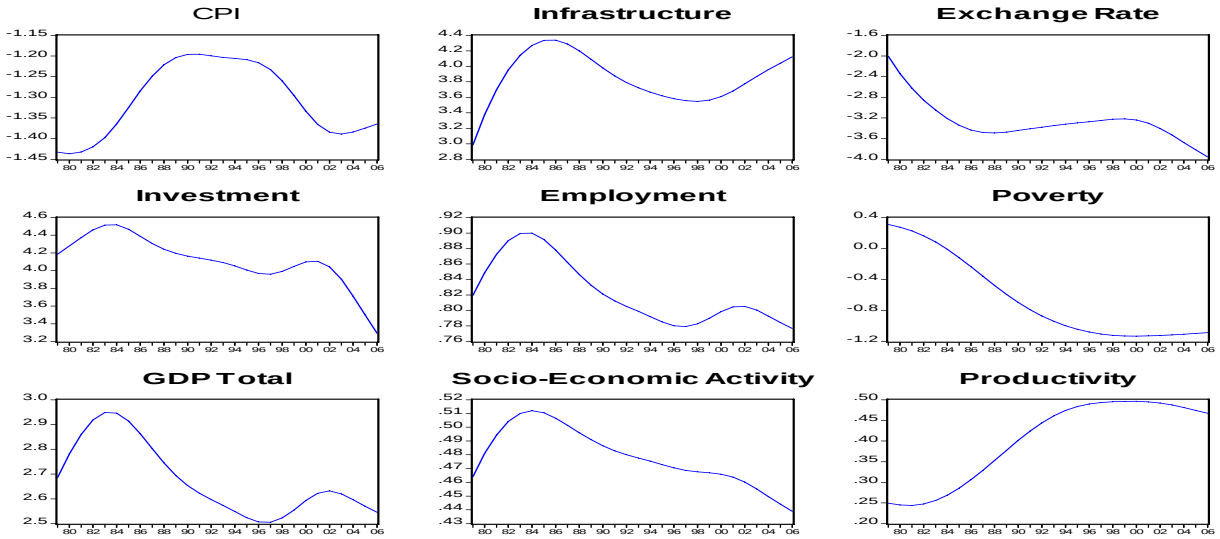
The increase in total government expenditure by 10 per cent shows a positive response on the major macroeconomic variables in both Model A and B. This impact is however more successful in an economic environment with limited supply constraints[34].

Figure 5.2A: Shock on Total Government Expenditure (Model A)



[34] The effect of a monetary shock is not analyzed due to the marginal role that monetary policy has played 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.

Figure 5.2B: Shock on Total Government Expenditure (Model B)



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 per cent. 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 has boosted domestic investment and the level of infrastructural development over these periods, reaching a high of about 0.4 per cent each. These have resulted into an increase in socio-economic activities, employment and productivity, which eventually lead to a decline in the level of poverty at a low of about 0.4 per cent. The growth in consumer prices has also been negative throughout 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 per cent. A high level of about 4.5 per cent increase was recorded for domestic investment as well as the level of infrastructural development, translating into a higher positive impact in socio-economic activities, employment and productivity and leading to a lower reduction in poverty of about 1.2 per cent. A more significant improvement in the value of the currency is recorded over the long run, whereas the growth in consumer prices has also dropped drastically when compared to Model A.

Despite the 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.

5.5.2. 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 an oil price shock should 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 prices 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 a significant economic growth that is pro-poor. Model B reveals a positive impact on the economy as a result of a 10 per cent rise in oil prices while in Model A, a negative impact on the economy is revealed.

Figure 5.3A: Shock on World Oil Prices (Model A)

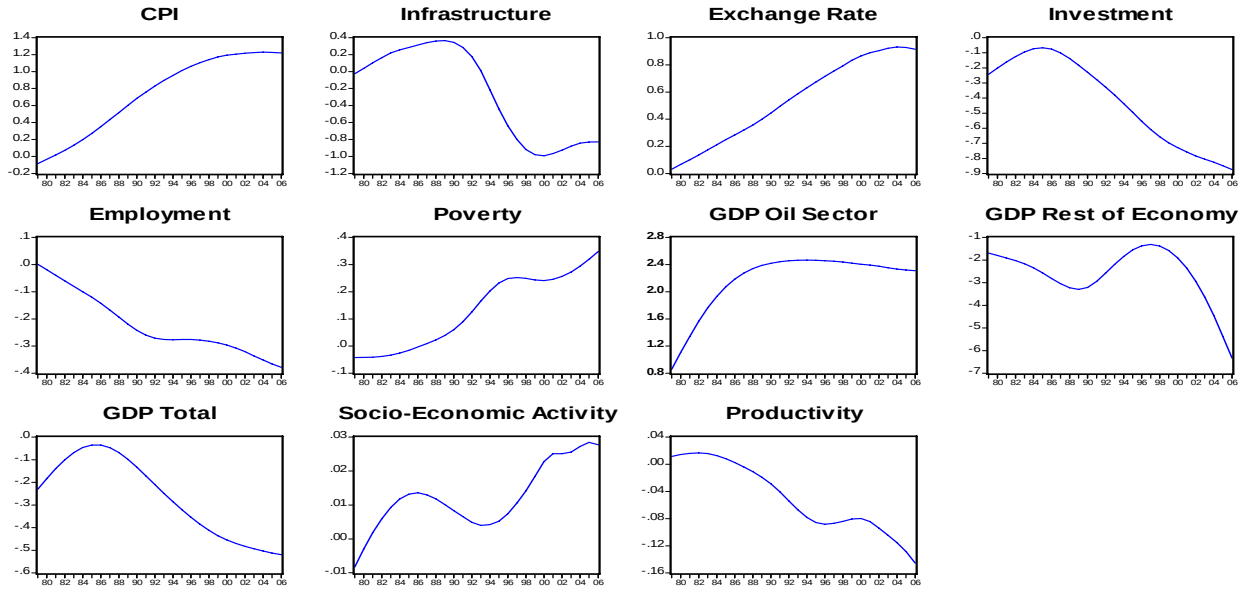
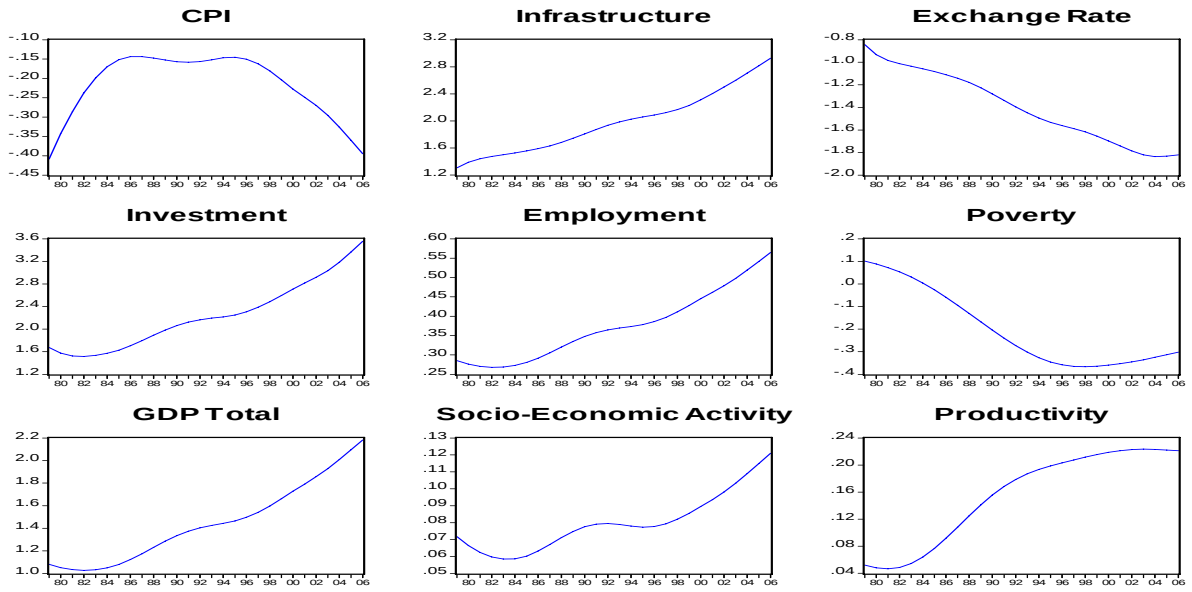


Figure 5.3B: Shock on World Oil Prices (Model B)



Except for the oil sector GDP, the growth in total GDP and the rest of the economy in Model A was 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 per cent. Through this effect, the domestic investment and level of infrastructural development fell by about 1 per cent each over the same period. These resulted in a decrease in employment and productivity but with a marginal and insignificant rise in socio-economic activities. This in turn led to a rise in the level of poverty which reached a high of about 0.4 per cent. Consumer prices also grew on a high of about 1.2 per cent with a depreciating exchange rate through out the period. The constraints preventing the spread of the oil revenue to increased levels of other production and improvement in the welfare can be attributed to the high import volumes of refined petroleum products in the country which had a direct impact on the production prices[35]. This trend still continues in Nigeria.

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 per cent. This has translated into an increase in domestic investment and infrastructural development. Poverty

[35] Note: the country is a major exporter of crude petroleum.

decreases 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 decreases in consumer prices over the period coupled with an appreciating exchange rate.

5.5.3. World income shock:

The shock on world GDP (proxied 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 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 the negative impact of the exchange rate on consumer prices, the level of poverty is deemed to rise over the years. This negative impact of the exchange rate on the consumer prices can be attributed to the large import component of the country's consumption pattern. This again revealed the feature of an economy that has structural constraints.

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 5.4A: Shock on World Income (Model A)

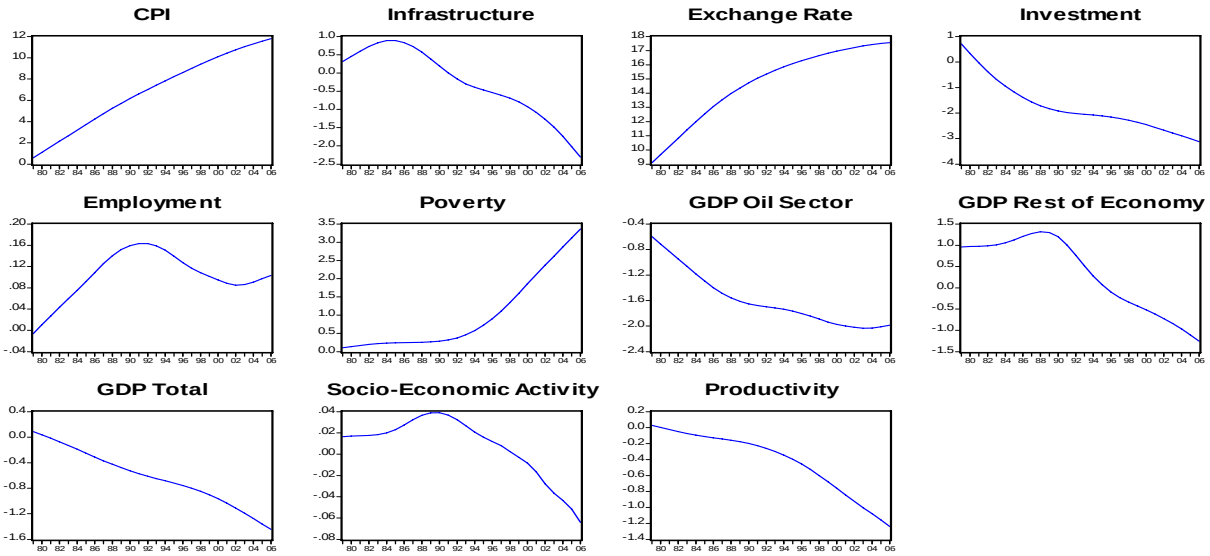
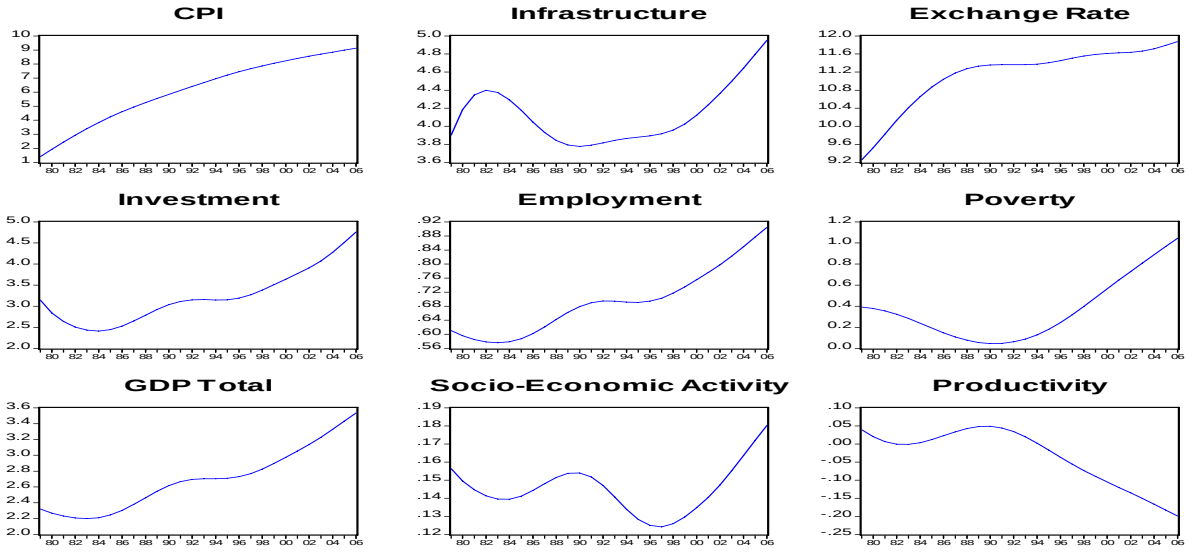


Figure 5.4B: Shock on World Income (Model B)



The shock on world income increases total GDP in Model B throughout the entire period, reaching a high of about 3.5 per cent. The domestic investment and level of infrastructural development also received a boost with a high of about 5 per cent. These changes translated into rising employment and socio-economic activity reaching a high of about 0.9 per cent and 0.2 per

cent respectively. Productivity dropped over the period simply due to the inflationary effect of the shock.

The growth in total GDP is found to be negative throughout the period in Model A with a more severe impact on the oil sector GDP[36]. Domestic investment and infrastructural development also recorded a fall with a low of about 3 per cent each over the period leading to a fall in employment, socio-economic activities, and productivity.

5.5.4. 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 the absence of the political will imbedded in the leadership structure. The extent to which a country's governance can impact on the socio-economic environment and productive capacity cannot be overemphasised. The Nigerian governance structures have been in a poor state 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 had a seriously negative impact on the economy.

[36] This may be due to the significant role the oil sector plays in the country production function.

Figure 5.5A: Shock on Government Effectiveness; Worse Governance (Model A)

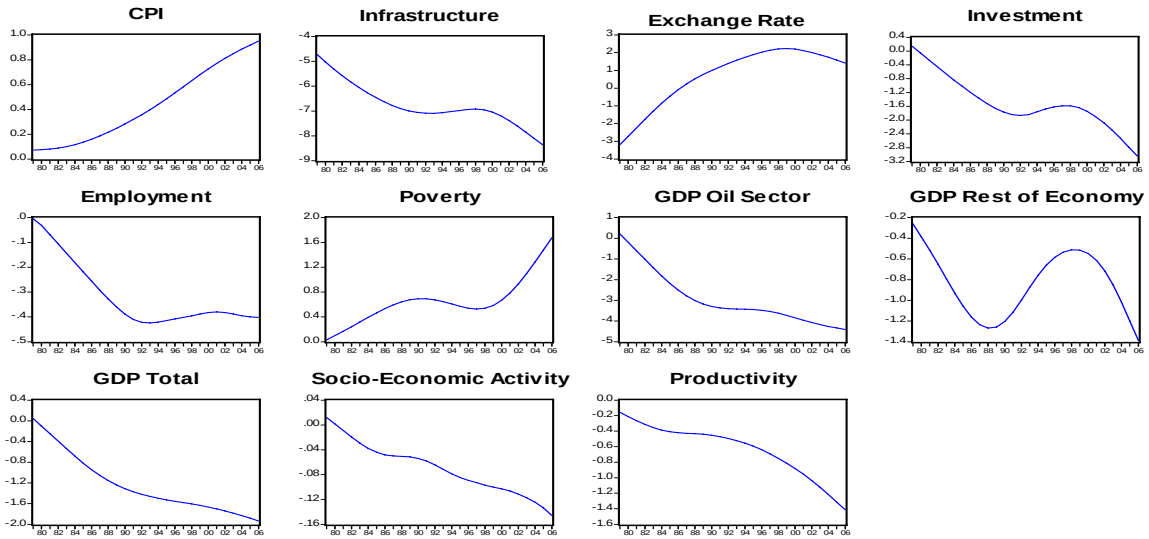
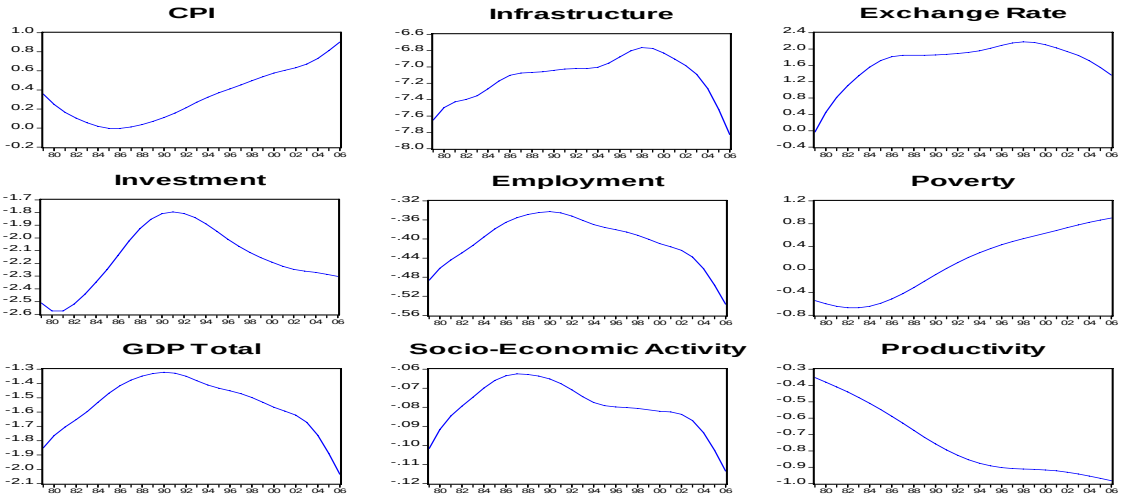


Figure 5.5B: Shock on Government Effectiveness; Worse Governance (Model B)



Irrespective of the kind of economic environment, good governance plays a crucial role in the economy. This fact is confirmed from the results in both Model A & B. A negative and similar impact of worse governance is recorded in the two economic environments[37]. 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.

[37] Note: A 10 percent increase in governance reflects bad governance. See Appendix 1 for more details.

However, the role played by the effectiveness of government in the provision of infrastructure is enormous.

5.6 CONCLUSION

Based on the above analyses of the results from the various estimated structural equations, the closing of the entire macro-economy system, and the long-run response properties of the various exogenous shocks applied. Numerous economic implications have been analysed from the results of the model as revealed by the responses of the major economic variables to shocks in some exogenous variables in the system. The model has clearly revealed the implications of a certain policy option on the long-term path to achieving sustainable economic growth and a reduction in the level of poverty in the Nigerian economy. Government effort to tackle the numerous economic challenges (i.e. increased productive capacity and ensuring good governance) that will put in place correct institutions which will improve the level of socio-economic activities is crucial to the country. The various policy decisions made by the government over the years have not transformed into a significant improvement in the socio-economic conditions of the citizens and this is reflected from the simulations performed in Model A. Therefore, Model A can be regarded as the appropriate model that represents the structure of the Nigerian economy which could be used to address the various policy challenges in the economy. The next chapter provides the summary of the study and recommends policies that will ensure sustained economic growth and an improvement in the standard of living of the Nigerian population.

CHAPTER 6

SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

6.1 INTRODUCTION

This chapter presents a summary of the study, the major conclusions and important policy recommendations. The purpose of the study was to develop an explicit and robust macro-econometric model that will analyse the persistence in the growth-poverty divergence in the Nigerian economy and to design appropriate policy remedies. This is performed through the application of the various policy simulations in order to determine their effects on the key macroeconomic variables in the economy.

6.2 SUMMARY AND MAIN FINDINGS OF THE STUDY

Analysing the Nigerian growth-poverty divergence, the study was divided into six main chapters.

Chapter one presents the introduction and background of the study by firstly trying to highlight the importance of macro-econometric modelling in making sound economic policies and the major setbacks encountered by the developing economies in designing a sound macro-econometric model. It also highlights the major problem of structural inadequacies that is evident in the Nigerian economy which are the major hindrances to the achievement of the laid down developmental objectives. The major problems of the economy are therefore regarded as supply-side constraints and which can only be tackled from the supply-side of the economy.

The literature analysis in Chapter two focuses on the theoretical and empirical growth and poverty models. The implication of the neoclassical growth model which was analysed shows that the long-run growth path will be exogenously determined and the economy can be predicted to converge towards a steady-state growth rate. This depends on the rate of technological progress and labour force growth. Criticism of the assumptions of the neoclassical growth theory surfaced as the endogenous growth theory started gaining popularity in the growth literature. The

main argument of the endogenous growth theorist about the long run growth path is that it is not dependent on exogenous factors but rather on accumulation of human capital. This led to the tremendous popularity of the endogenous growth models and leads to the perception that human capital development is the catalyst to reduce poverty. A substantial number of theoretical pro-poor growth (poverty trap) models exist, although empirical studies in this regard are limited. Most of the pro-poor growth (poverty trap) models have enabled explanations for some countries remaining poor and why others experience increases in overall welfare. It is evident that an economy that can sustain solid long-term growth is most likely to achieve a significant reduction in its level of poverty over the long term. The poverty trap models believe that the threshold level of equilibrium that an economy starts from is crucial in achieving its developmental objectives. An economy that operates at the lower steady-state equilibrium is likely to be trapped in poverty. But the use of macro-econometric models in addressing the devastating poverty level in developing economies is still fairly rare in the literature.

Chapter three commences with an analysis of the growth-poverty performance of the Nigerian economy in the last few decades. It reveals significant socio-economic constraints as the predominant impediments to high and sticky levels of poverty in the country. It also discusses the enormous resource endowment of the country and the potential it has to be the leading economy in Africa and also in eradicating poverty among its citizenry. The performance of the Nigerian economy over the last four decades is in total contrast with the given level of human and natural resources that it has. The trends in the major macroeconomic variables have not been impressive and are highly unpredictable. This is caused mainly by the mismanagement of the country's resources and the various policy regime shifts that were experienced as the economy evolved. The long-run sources of economic growth revealed by the growth accounting exercise show that productivity from labour and capital have been very low over the years. This gives an indication why the high level of poverty still persists in the country. The profile of poverty analysed shows the severity of poverty in the major parts of the country. Despite the various strategies introduced to combat poverty in Nigeria, the majority of its population is still living below the poverty line. But the basic problem of lack of good governance, corruption, and lack of attention to basic human needs are still the country's major poverty challenges.

The model specifications and estimation techniques adopted in this study were presented in Chapter 4 while Chapter 5 gives the detailed analysis of the empirical results. The production function is disaggregated into two main parts (oil sector and rest of the economy) in Model A. Model A and B consist of about 19 and 16 behavioural equations respectively, which are consistent with economic theory. The models are estimated with time series data covering the period 1970-2006 using the Engle-Granger two-step technique. The simulation process combines both the short-run and long-run versions of the equations which in turn solved from 1979 to 2006 and this is due to the various lags employed in the short-run equations.

The models covered the four sectors of the economy and the level of disaggregation adopted is considered sufficient in analysing the growth-poverty divergence and other necessary policy scenarios. But this is dictated to a large extent by the availability of data.

The series of dynamic simulations performed reveal the importance of the policy analysis of the study. Policy impacts are derived by shocking selected exogenous variables in the system in order to determine the elasticity for every endogenous variable. A 10 per cent 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. The external shocks simulated revealed the vulnerability of the domestic economy to shocks from the global economy.

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 (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 reduction in poverty should be the primary focus of any government policy intervention. Policy interventions 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.

6.3 POLICY RECOMMENDATIONS

It is evident from the results presented in Model A that the major impediments to the achievement of set developmental objectives in Nigeria are predominantly supply constraints. 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 set of interrelationships that exists within the system. Based on the long-run response analysis and the conclusions drawn from the previous sections, the following policy proposals are suggested in addressing the growth-poverty divergence in Nigeria.

- 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 sustained growth and also an improvement in the standard of living of the citizens. Expenditure on social development should be channelled correctly to areas where it can be seen as significant investment in the development of human capital and physical infrastructure which will eventually generate employment and increased economic growth. Over the years, fiscal policies in Nigeria have been subjectively decided by the political leadership (which lack consultation and transparency) and government expenditure has been tilted to those components where corruption is not visible.

- The Nigerian monetary sector is still globally uncompetitive. The country's financial system needs to be further strengthened in order to enhance the effectiveness of the interest rate as a monetary policy tool in achieving the long-run macroeconomic objectives. An effective financial system will serve as catalyst to achieving a pro-poor growth through its role as an intermediary in distributing wealth and creating domestic

credit within the economy. This will however help boost domestic investment which eventually leads to employment generation in the economy. The financial institutions need to be equipped with a stronger capital base that will enable them to provide sound and reliable credit to the public.

- In order 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. The role of infrastructure in boosting the supply-side of the economy cannot be overemphasised. Therefore, investment in basic infrastructure such as power and roads are crucial at this stage of the Nigerian economy's development. With a favourable socio-economic environment, more inflows of capital will be attracted into the country that will ensure a favourable balance of payments position and also stability in the country's currency. A revamp of the non-oil exports is very crucial at this stage of the Nigerian economy. A boost in the manufacturing base will serve as a catalyst to rising levels of employment and a reduction in poverty in the country.

- Poor governance has been the major feature of the Nigerian economy over the past few decades. This aspect serves as a major stumbling block in achieving positive outcomes from any policy intervention. The existence of bad governance can restrict the productive capacity through the level of investment and productivity in the economy. There is an urgent need to refocus the government's role in some 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 set macroeconomic objectives.

6.4 AREAS FOR FURTHER RESEARCH

It is imperative to note the difficulties encountered in analysing poverty using a macro-econometric model. The study has addressed the major objectives outlined in Chapter 1 by providing a snapshot of the Nigerian economy and the major constraints that exists therein. 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 process. This problem was circumvented through the use of generated indices and dummy variables as proxies for the unavailable data. This has also resulted in limiting the 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 specifications adopted in this study.

6.5 FINAL CONCLUSION

This study has revealed empirically that a model with structural constraints will be appropriate in addressing the persistence in growth-poverty divergence in the Nigerian economy. The demand-side fiscal and monetary policy intervention aiming at accelerating domestic production will be more effective in an economic environment with limited or no structural constraints impeding the productive capacity of the economy in absorbing labour employment. Given the past experiences of the Nigerian economy it is evident that there are socio-economic/capacity constraints contributing to the sticky and high level of poverty. Achieving a pro-poor economic growth in Nigeria means designing and implementing a policy framework that focuses on the supply-side of the economy where growth in the long run comes through a boost in capital accumulation or domestic investment which leads to employment generation.

To achieve this, the role played by institutions cannot be overemphasised. Correct institutional framework needs to be put in place through a good leadership structure. With this, an efficient and coordinated policy mix that will boost the growth and development of the country can be achieved. A conducive socio-economic environment through infrastructural development will be

a major breakthrough in boosting the productive capacity of the country at this point in the economy.

Moreover, the adoption of the structural supply constraint model as the appropriate model that can address the socio-economic problems in the country means that policy intervention by government should be geared towards boosting the supply-side of the economy.

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APPENDIX 1

AN EXPOSITION OF THE DATA UTILISED IN THE MODEL

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). Table A1 presents all the data used in the study.

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 per cent is adopted in this study since Nigeria allocates 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 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 form:

$$finconstr = gds\_nom+capflow+creserv+depr\_value$$

iii. Poverty Index

There are multiple dimensions and 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) indices as this is one of the most commonly used poverty indices in the literature[38]. 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 relates to the distance separating the poorest households from the poverty line. These indices are calculated as follows:

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

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. α = 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 as a measure of poverty gap.

iv. Capital Stock

In the model, the 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:

$$rk\_stock2 = (1 - depr)*rk\_stock2(-1) + gcf(-1)$$

[38] See Louw (2008) for detailed analyses of poverty measures and indices.

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:

$$\frac{rk\_stock2}{rgdp} + \frac{labor\_f}{rgdp} = \frac{rgdp}{rgdp} = 1$$

Therefore,

$$\frac{rk\_stock2 * \text{int}}{rgdp} + \frac{labor\_f * rwage\_lf}{rgdp} = 1$$

$labor\_f * rwage\_lf$ represents the total wage bill in the economy.

This implies,

rwage_lf = (1-(rk_stock2*int/rgdp))*(rgdp/labor_f)

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 in measuring the value of economic activities of a country. This is represented as:

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

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 = (1+int)*exch

viii. Governance Indicators

The worldwide governance indicators developed by Kaufmann et.al (1999a) was utilized in this study as a measure of governance. The indices covers a broad range of policy and institutional outcomes for large number of countries, which includes; the rule of law, corruption, government effectiveness, regulatory quality, and political instability. Since the governance indicators series are only available from 1996 onward and due to the persistence of governance over time, the average value from 1996-2006 governance scores are 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. However, 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.

Table A1: Data Description and Calculation

Series	Natural logarithms	Variable names	Data source/calculation
agric_elep	ln_agric_elep	Ratio of agricultural production to electricity production (index)	index_agric/index_elep
aid	ln_aid	Official aid (constant 2000)	(aidgcf/100)*gcf
aidgcf		Official aid as a per centage of real gross capital formation	World Bank: African Development Indicators
aidpop	ln_aidpop	Official aid per capita	aid/pop
capflow	ln_capflow	Capital flow	World Bank: World Development Indicator
cpi	ln_cpi	Consumer Price Index	World Bank: World Development Indicator
cpi_us	ln_cpi_us	Consumer Price Index (United State)	World Bank: World Development Indicator
creserv		Change in reserve	World Bank: World Development Indicator
cu_oil	ln_cu_oil	Capacity utilisation in the oil sector	rgdp_oil/potrgdp_oil
cu_tot	ln_cu_tot	Capacity utilisation in the total economy	rgdp/potrgdp
dcredit	ln_dcredit	Domestic credit	IMF: International Financial Statistics
depr		Rate of depreciation	Assumed to be 20%
depr_value	ln_depr_value	Value of depreciation	depr*gcf_nom

dis_rate	ln_dis_rate	Discount rate	IMF: International Financial Statistics
dum		Dummy: oil price shocks	n.a
dum_oil		Dummy: structural breaks for real GDP oil sector	n.a
dum_povd		Dummy: poverty index	n.a
dum_tfp		Interactive dummy: tfp_tot	n.a
dummy_m		Dummy: military rule	n.a
dumoil		Interactive dummy: structural breaks for real GDP oil sector	n.a
dumtfp		Dummy: tfp_tot	n.a
elep	ln_elep	Electricity production (kwh)	Central Bank of Nigeria Statistical Bulletin
eleppop	ln_eleppop	Electricity production per capita	elep/pop
excessd	ln_excessd	Excess demand	gne_nom/gdp
exch	ln_exch	Official exchange rate (Naira per US$, period average)	World Bank: World Development Indicators
expt		Export of goods and services (current prices)	World Bank: World Development Indicators
fdi	ln_fdi	Flow of foreign direct investment (constant 2000)	Central Bank of Nigeria Statistical Bulletin
fdigcf	ln_fdigcf	Ratio of foreign direct investment to gross capital formation	fdi/gcf
finconstr	ln_finconstr	Financial constraint: Measure of financial development	gds_nom+capflow+creserv+depr_value

gcf_nom		Gross capital formation (current prices) = Investment	World Bank: World Development Indicators
gcf	ln_gcf	Gross capital formation (constant 2000) = Investment	gcf_nom/gdp_def
gcfgdp	ln_gcfgdp	Ratio of gross capital formation to real GDP	gcf/rgdp
gcfpot		Potential gross capital formation	Hodrick-Prescott filter application
gdp	ln_gdp	Gross domestic product (current prices)	World Bank: World Development Indicators
gdp_def		Gross domestic product deflator (2000=100)	IMF: International Financial Statistics
gds_nom	ln_gds_nom	Gross domestic savings (current prices)	World Bank: World Development Indicators
ge		Governance indicator: Government effectiveness	Worldwide Governance Indicators
gne_nom	ln_gne_nom	Gross national expenditure (current prices)	World Bank: World Development Indicators
govcongdp	ln_govcongdp	Ratio of general government final consumption expenditure to real GDP.	govtcons/rgdp
govtcons	ln_govtcons	General government final consumption expenditure (Constant 2000)	World Bank: World Development Indicators
hh_rconexp	ln_hh_rconexp	Household real consumption expenditure	World Bank: World Development Indicators
hh_rgdp	ln_hh_rgdp	Household real disposable income (total economy)	rgdp(1-taxr)
hh_rgdp_rest	ln_hh_rgdp_rest	Household real disposable income (rest of the economy)	rgdp_rest(1-taxr)

imp		Import of goods and services (current prices)	World Bank: World Development Indicators
imp_p	ln_imp_p	Import price index	World Bank: World Development Indicators
index_agric	ln_index_agric	Index of agricultural production	Central Bank of Nigeria Statistical Bulletin
index_elep	ln_index_elep	Index of electricity production	(elep/1738.3)*100; 1738.3=year 2000 value
int	ln_int	Lending rate = Interest rate	IMF: International Financial Statistics
labor_f	ln_labor_f	Labour force = Employment	World Bank: World Development Indicators
labor_pot	ln_labor_pot	Potential employment	Hodrick-Prescott filter application
labprod_rest	ln_labprod_rest	Labour productivity in the rest of the economy	rgdp_rest/labor_f
labprod_tot	ln_labprod_tot	Labour productivity in the total economy	rgdp/labor_f
land	ln_land	Agricultural land (% of land area)	World Bank: World Development Indicators
m2	ln_m2	Monetary aggregate 2 (current prices)	IMF: International Financial Statistics
m2_us	ln_m2_us	Monetary aggregate 2;United State (current prices)	IMF: International Financial Statistics
oil_p	ln_oil_p	Crude oil prices	IMF: International Financial Statistics
open	ln_open	Openness of the economy	(rexp+rimp)/rgdp
pi		Governance indicator: Political instability	Worldwide Governance Indicators

pop	ln_pop	Total population	World Bank: World Development Indicators
potrgdp		Potential real GDP in the total economy	See estimation
potrgdp_oil		Potential real GDP in the oil sector	Hodrick-Prescott filter application
povertyd_index	ln_povertyd_index	Poverty index	FGT Index
ppi	ln_ppi	Industrial production index (2000=100) = Production price index	IMF: International Financial Statistics
relcpi	ln_relcpi	Relative prices	cpi/cpi_us
relrgdp	ln_relrgdp	Relative gross domestic product	rgdp/rgdpus
relm2	ln_relm2	Relative money supply	m2/m2_us
rexp	ln_rexp	Export of goods and services (constant 2000)	expt/gdp_def
rexpsocial	ln_rexpsocial	Government expenditure on social development (constant 2000)	Central Bank of Nigeria Statistical Bulletin
rgdp	ln_rgdp	Gross domestic product (constant 2000)	gdp/gdp_def
rgdp_oil	ln_rgdp_oil	Crude oil production (constant 2000): Proxy for GDP oil sector	Central Bank of Nigeria Statistical Bulletin
rgdp_rest	ln_rgdp_rest	Gross domestic product rest of the economy (constant 2000)	rgdp-rgdp_oil
rgdpus	ln_rgdpus	Gross domestic product; United States (constant 2000)	IMF: International Financial Statistics
rimp	ln_rimp	Import of goods and services (constant 2000)	imp/gdp_def
rk_stock2	ln_rk_stock2	Capital stock (constant 2000)	rk_stock2 = (1 - depr)*rk_stock2(-1) + gcf(-1)

rk_stock2pot	ln_rk_stock2pot	Potential capital stock	rk_stock2pot = (1 - depr)*rk_stock2pot(-1) + gcfpot(-1)
rm2	ln_rm2	Real monetary aggregate 2	m2/gdp_def
rwage_lf	ln_rwage_lf	Real wages (constant 2000)	(1-(rk_stock2*int/rgdp))*(rgdp/labor_f)
se_index_b	ln_se_index_b	Socio-economic index (2000=100)	See Lind (1993)
sv_dum_oil1		Time varying coefficient for dum_oil	Kalman Filter application
sv_rk_stock2_oil		Time varying coefficient for capital stock	Kalman Filter application
taxr		Tax rate	Non_oil revenue/gdp
tfp_oil	ln_tfp_oil	Total factor productivity in the oil sector	Kalman Filter application
tfp_rest	ln_tfp_rest	Total factor productivity in the rest of the economy	tfp_tot-tfp_oil
tfp_tot	ln_tfp_tot	Total factor productivity in the total economy	Kalmer Filter application
tfp_totpot	ln_tfp_totpot	Potential total factor productivity in the total economy	Hodrick-Prescott filter application
totgovexp	ln_totgovexp	Total government expenditure	Central Bank of Nigeria Statistical Bulletin
tran_pubexp_ratio	ln_tran_pubexp_ratio	Ratio of transfer to public expenditure	transfer/rpubexp
transfer	ln_transfer	Government transfer payments	Central Bank of Nigeria Statistical Bulletin

ucc	ln_ucc	User cost of capital	(1+int)*exch
wage_labor	ln_wage_labor	Ratio of real wages to employment	rwage_lf/labor_f
wage_lf	ln_wage_lf	Wages (current prices)	rwage_lf*gdp_def
wagelfucc	ln_wagelfucc	Ratio of nominal wage to user cost of capital	wage_lf/ucc

APPENDIX 2

ORDER OF INTEGRATION

As discussed in Chapter 4 the univariate characteristics of the data was analysed using the Augmented Dickey-Fuller tests to establish the order of integration since the actual data generating process is not known.

The maximum lag structure that is used follows Said and Dickey (1984) who suggested a lag order equal to $T^{1/3}$ with T the number of observations, which in this case is 37 (years 1970 to 2006). Therefore, the maximum lag structure of 4 is used in the testing procedure.

The test is implemented through the usual t-statistic of γ denoted as τ_τ. Under the null hypothesis, τ_τ will not follow the standard t-distribution and the adjusted critical values computed by MacKinnon (1991) are used for evaluation. If τ_τ is significant, the null of non-stationarity is rejected and the data series is stationary.

If τ_τ is insignificant, the joint null hypothesis of $a_2 = \gamma = 0$, using the F-statistic denoted as ϕ_3 is tested (Equation 4.18). The relevant critical values from Dickey and Fuller are used to evaluate the test statistic ϕ_3. If ϕ_3 is significant, the unit root test is repeated, now using the critical values of the standard t-distribution.

If the trend is not significant in the model, the next step is to estimate Equation 4.18 without a trend ($a_2 = 0$). The unit root test is carried out denoting the t-statistic of γ as τ_μ and using the relevant critical values from MacKinnon. If the null hypothesis is rejected, the series is stationary.

If the null hypothesis of non-stationarity is not rejected, the joint null hypothesis of $a_0 = \gamma = 0$, using the F-statistic denoted as ϕ_1 is tested and the critical values reported by Dickey and Fuller are used. If ϕ_1 is significant, the unit root test is repeated using the standard normal distribution.

If ϕ_1 is insignificant, the Dickey-Fuller τ test is carried out without a constant and trend in the testing equation, testing the joint hypothesis of $a_0 = a_2 = 0$. If the test statistic (τ) is less than the MacKinnon critical value, the null hypothesis of non-stationarity is rejected and the series is stationary.

Moreover, if we have concluded that the variables in level form are non-stationary, we would need to go ahead and repeat the process for the first difference form. But if we concluded that most of the variables in level are stationary (trend stationary), then there is no need to perform a unit root test for the first difference. Hence, we conclude that these series are stationary or I(0) series.

The results of the ADF-tests for all the variables used in the estimations are reported in Table A2.1 and Table A2.2. The first column shows the list of all the variables that are tested. The second column (model) shows whether the equation that is estimated for the testing purpose involves a trend and a constant (Tend), or a constant only (Constant), or neither a constant nor trend (None). The third column shows the number of lags that are used for each model and they are significant at 10 per cent level. The fourth column is the ADF t-statistic, called τ_τ (for Trend and a Constant), τ_μ (for only Constant), and τ (for neither Trend nor Constant). The last column is the F-statistic ϕ_3 (ϕ_1), testing whether the trend (constant) is significant under the null hypothesis of no unit root.

From the result in Table A2 it is clear that most of the variables are non-stationary in level form. However, there are a couple of variables that seem to be stationary in level form, but since the testing of a unit root is associated with problems and inference guidelines, it is obvious that these variables are not stationary in level form (Du Toit, 1999: A108). The results of the stationarity tests in first difference form are presented in Table A2.2 and this reveals a stationary series.

Table A2.1: Augmented Dickey-Fuller tests for non-stationarity, levels, 1970-2006

Series	Model	Lags	τ_τ, τ_μ, τ	ϕ_3, ϕ_1
ln_aid	Trend	0	-1.39	2.23
	Constant	0	0.07	0.01
	None	0	1.16	
ln_capflow	Trend	1	-2.57	2.73
	Constant	0	-0.37	0.13
	None	0	2.14	
ln_cpi	Trend	1	-2.51	7.50**
	Constant	1	-0.30	7.02*
	None	1	0.67	
ln_cpi_us	Trend	8	-5.99***	39.93***
	Constant	2	-4.60***	49.15***
	None	2	1.73	
creserv	Trend	3	2.50	4.55
	Constant	3	3.61	5.89**
	None	3	4.04	
ln_dcredit	Trend	1	-2.71	2.73
	Constant	0	-0.96	0.92
	None	0	2.28	
ln_elep	Trend	0	-3.05	5.34
	Constant	0	-2.01	4.05
	None	0	1.64	
ln_exch	Trend	0	-2.40	3.37
	Constant	0	0.21	0.04
	None	0	1.71	
ln_fdi	Trend	1	-2.18	9.19**
	Constant	1	-1.29	11.23***
	None	1	-0.41	

*(**)[***] Significant at a 10(5)[1]% level.

a At a 10(5)[1]% significance level, the MacKinnon critical values are -3.18(-3.50)[-4.15] when a trend and a constant are included (τ_τ), and -2.60(-2.93)[-3.58] when only a constant is included (τ_μ), and -1.61(-1.95)[-2.62] when neither is included (τ). The standard normal critical value is -1.697(-2.04)[-2.75].

b At a 10(5)[1]% significance level, the Dickey-Fuller critical values are 5.91(7.24)[10.61] when a trend and a constant are included (ϕ_3) and 4.12(5.18)[7.88] when only a constant is included (ϕ_1).

Table A2.1 (cont.): Augmented Dickey-Fuller tests for non-stationarity, levels, 1970-2006

Series	Model	Lags	τ_τ, τ_μ, τ	ϕ_3, ϕ_1
ln_gcf	Trend	0	-2.82	4.39
	Constant	0	-2.63*	6.93**
	None	0	1.17	
ln_gdp	Trend	1	-1.81	2.62
	Constant	1	0.41	1.94
	None	1	3.32	
ln_gds_nom	Trend	0	-1.70	1.86
	Constant	0	0.34	0.11
	None	0	3.01	
ge	Trend	0	-1.43	1.78
	Constant	0	-0.03	0.00
	None	0	-1.34	

ln_gne_nom	Trend	1	-1.91	3.61
	Constant	1	0.11	3.21
	None	1	2.90	
ln_govtcons	Trend	2	-4.16***	4.92
	Constant	0	-1.88	3.55
	None	0	1.87	
ln_hh_rconexp	Trend	0	-4.05**	8.31**
	Constant	0	-3.62***	13.09***
	None	0	0.44	
ln_imp_p	Trend	1	-1.55	2.65
	Constant	1	-1.50	3.94
	None	1	0.71	
ln_index_agric	Trend	0	-2.83	5.12
	Constant	0	0.10	0.01
	None	0	1.47	
ln_int	Trend	0	-1.11	0.91
	Constant	0	-1.21	1.45
	None	0	-1.29	

*(**)[***] Significant at a 10(5)[1]% level.

a At a 10(5)[1]% significance level, the MacKinnon critical values are -3.18(-3.50)[-4.15] when a trend and a constant are included (τ_τ), and -2.60(-2.93)[-3.58] when only a constant is included (τ_μ), and -1.61(-1.95)[-2.62] when neither is included (τ). The standard normal critical value is -1.697(-2.04)[-2.75].

b At a 10(5)[1]% significance level, the Dickey-Fuller critical values are 5.91(7.24)[10.61] when a trend and a constant are included (ϕ_3) and 4.12(5.18)[7.88] when only a constant is included (ϕ_1).

Table A2.1 (cont.): Augmented Dickey-Fuller tests for non-stationarity, levels, 1970-2006

Series	Model	Lags	τ_τ, τ_μ, τ	ϕ_3, ϕ_1
ln_labor_f	Trend	2	-2.95	3.35
	Constant	0	0.70	0.49
	None	0	12.97	
ln_land	Trend	4	-3.89**	5.47
	Constant	1	-0.93	5.53**
	None	1	1.04	
ln_m2	Trend	1	-1.78	2.06
	Constant	1	-1.60	2.80
	None	0	1.76	
ln_m2_us	Trend	4	-3.50**	9.79***
	Constant	1	-1.73	16.64***
	None	1	2.28	
ln_oil_p	Trend	0	-3.38*	5.72
	Constant	0	-0.37	0.13
	None	0	2.87	
pi	Trend	1	-2.77	3.31
	Constant	1	-2.94	5.09
	None	0	0.22	
ln_pop	Trend	3	0.54	2692.4***
	Constant	3	-4.86***	3442.49***
	None	4	-0.21	
ln_ppi	Trend	0	-3.85**	10.23**
	Constant	0	-3.47**	12.03***

	None	0	2.34	
ln_rexpsocial	Trend	0	-4.83***	14.85***
	Constant	0	-5.53***	30.60***
	None	0	1.03	

*(**)[***] Significant at a 10(5)[1]% level.
a At a 10(5)[1]% significance level, the MacKinnon critical values are -3.18(-3.50)[-4.15] when a trend and a constant are included (τ_τ), and -2.60(-2.93)[-3.58] when only a constant is included (τ_μ), and -1.61(-1.95)[-2.62] when neither is included (τ). The standard normal critical value is -1.697(-2.04)[-2.75].
b At a 10(5)[1]% significance level, the Dickey-Fuller critical values are 5.91(7.24)[10.61] when a trend and a constant are included (ϕ_3) and 4.12(5.18)[7.88] when only a constant is included (ϕ_1).

Table A2.1 (cont.): Augmented Dickey-Fuller tests for non-stationarity, levels, 1970-2006

Series	Model	Lags	τ_τ, τ_μ, τ	ϕ_3, ϕ_1
ln_rgdp	Trend	0	-3.33*	6.17*
	Constant	0	-2.41	5.81**
	None	0	2.15	
ln_rgdp_oil	Trend	0	-3.10	5.25
	Constant	0	-2.68*	7.21**
	None	0	1.32	
ln_rgdp_rest	Trend	0	-3.28*	5.61
	Constant	0	-2.67*	7.10**
	None	0	0.99	
ln_rgdpus	Trend	8	-4.03**	3.28
	Constant	0	-0.49	0.24
	None	0	9.49	
ln_rk_stock2	Trend	1	-3.40*	13.80***
	Constant	1	-2.11	14.58***
	None	1	1.50	
ln_rpubexp	Trend	2	-4.52***	5.88
	Constant	0	-2.17	4.73*
	None	0	1.66	
ln_totgovexp	Trend	0	-1.83	1.68
	Constant	0	-1.06	1.12
	None	0	1.96	
ln_transfer	Trend	0	-3.18*	5.07
	Constant	0	-0.44	0.20
	None	0	2.59	

*(**)[***] Significant at a 10(5)[1]% level.
a At a 10(5)[1]% significance level, the MacKinnon critical values are -3.18(-3.50)[-4.15] when a trend and a constant are included (τ_τ), and -2.60(-2.93)[-3.58] when only a constant is included (τ_μ), and -1.61(-1.95)[-2.62] when neither is included (τ). The standard normal critical value is -1.697(-2.04)[-2.75].
b At a 10(5)[1]% significance level, the Dickey-Fuller critical values are 5.91(7.24)[10.61] when a trend and a constant are included (ϕ_3) and 4.12(5.18)[7.88] when only a constant is included (ϕ_1).

Table A2.2: Augmented Dickey-Fuller tests for non-stationarity, first differences, 1970-2006

Series	Model	Lags	τ_τ, τ_μ, τ	ϕ_3, ϕ_1
Δ ln_aid	Trend	0	-6.06***	18.37***

	Constant	0	-5.59***	31.26***
	None	0	-5.52***	
Δ ln_capflow	Trend	0	-4.73***	11.2***
	Constant	0	-4.77***	22.77***
	None	0	-4.35***	
Δ ln_cpi	Trend	0	-2.98	4.49
	Constant	0	-3.04**	9.25***
	None	0	-1.75*	
Δ ln_cpi_us	Trend	1	-5.02***	10.12**
	Constant	1	-2.68***	5.16**
	None	0	-1.02	
Δ creserv	Trend	2	-3.68**	8.54***
	Constant	0	-4.34***	18.84***
	None	0	-4.25***	
Δ ln_dcredit	Trend	0	-5.18***	13.51***
	Constant	0	-5.20***	27.05***
	None	0	-4.52***	
Δ ln_elep	Trend	0	-7.95***	31.59***
	Constant	0	-7.77***	60.39***
	None	0	-7.02***	
Δ ln_exch	Trend	0	-5.30***	14.08***
	Constant	0	-5.31***	28.18***
	None	0	-4.57***	
Δ ln_fdi	Trend	0	-11.76***	69.26***
	Constant	0	-11.86***	140.66***
	None	0	-12.02***	

*(**)[***] Significant at a 10(5)[1]% level.

a At a 10(5)[1]% significance level, the MacKinnon critical values are -3.18(-3.50)[-4.15] when a trend and a constant are included (τ_τ), and -2.60(-2.93)[-3.58] when only a constant is included (τ_μ), and -1.61(-1.95)[-2.62] when neither is included (τ). The standard normal critical value is -1.697(-2.04)[-2.75].

b At a 10(5)[1]% significance level, the Dickey-Fuller critical values are 5.91(7.24)[10.61] when a trend and a constant are included (ϕ_3) and 4.12(5.18)[7.88] when only a constant is included (ϕ_1).

Table A2.2 (cont.): Augmented Dickey-Fuller tests for non-stationarity, first differences, 1970-2006

Series	Model	Lags	τ_τ, τ_μ, τ	ϕ_3, ϕ_1
Δ ln_gcf	Trend	0	-5.29***	14.00***
	Constant	0	-5.33***	28.45***
	None	0	-5.27***	
Δ ln_gdp	Trend	0	-4.16***	8.66**
	Constant	0	-4.13***	17.03***
	None	0	-2.12**	
Δ ln_gds_nom	Trend	0	-5.12***	13.09***
	Constant	0	-5.13***	26.33***
	None	0	-4.23***	
Δ ge	Trend	0	-5.74***	16.56***
	Constant	0	-5.59***	31.24***
	None	0	-5.39***	
Δ ln_gne_nom	Trend	0	-3.71***	6.89*
	Constant	0	-3.73***	13.92***
	None	0	-1.96**	

Δ ln_govtcons	Trend Constant None	0 0 0	-5.38*** -5.42*** -5.05***	14.46*** 29.37***
Δ ln_hh_rconexp	Trend Constant None	0 0 0	-7.54*** -7.61*** -7.66***	28.5*** 57.96***
Δ ln_imp_p	Trend Constant None	0 0 0	-3.91** -4.00*** -3.93***	7.81** 16.01***
Δ ln_index_agric	Trend Constant None	0 0 0	-4.68*** -4.77*** -4.52***	11.49*** 22.79***
Δ ln_int	Trend Constant None	0 0 0	-5.49*** -5.46*** -5.39***	15.09*** 29.85***

*(**)[***] Significant at a 10(5)[1]% level.

a At a 10(5)[1]% significance level, the MacKinnon critical values are -3.18(-3.50)[-4.15] when a trend and a constant are included (τ_τ), and -2.60(-2.93)[-3.58] when only a constant is included (τ_μ), and -1.61(-1.95)[-2.62] when neither is included (τ). The standard normal critical value is -1.697(-2.04)[-2.75].

b At a 10(5)[1]% significance level, the Dickey-Fuller critical values are 5.91(7.24)[10.61] when a trend and a constant are included (ϕ_3) and 4.12(5.18)[7.88] when only a constant is included (ϕ_1).

Table A2.2 (cont.): Augmented Dickey-Fuller tests for non-stationarity, first differences, 1970-2006

Series	**Model**	**Lags**	τ_τ, τ_μ, τ	ϕ_3, ϕ_1
Δ ln_labor_f	Trend Constant None	2 2 1	-1.36 -1.91 0.74	3.62 4.81*
Δ ln_land	Trend Constant None	0 0 0	-3.26* -3.14** -2.98***	5.42 9.88***
Δ ln_m2	Trend Constant None	0 0 0	-4.28*** -4.35*** -4.05***	9.16** 18.89***
Δ ln_m2_us	Trend Constant None	0 0 1	-3.18* -2.89* -1.55	5.24 8.39***
Δ ln_oil_p	Trend Constant None	0 0 0	-6.29*** -6.39*** -4.74***	19.77*** 40.78***
Δ pi	Trend Constant None	1 1 1	-5.02*** -4.94*** -4.98***	8.98** 12.91***
Δ ln_pop	Trend Constant None	2 3 3	-2.45 -0.20 -1.15	409.70*** 314.78***
Δ ln_ppi	Trend Constant None	0 0 0	-6.20*** -6.05*** -5.49***	19.53*** 36.65***
Δ ln_rexpsocial	Trend Constant	0 0	-5.38*** -5.25***	14.63*** 27.58***

	None	0	-5.20***	

*(**)[***] Significant at a 10(5)[1]% level.
a At a 10(5)[1]% significance level, the MacKinnon critical values are -3.18(-3.50)[-4.15] when a trend and a constant are included (τ_τ), and -2.60(-2.93)[-3.58] when only a constant is included (τ_μ), and -1.61(-1.95)[-2.62] when neither is included (τ). The standard normal critical value is -1.697(-2.04)[-2.75].
b At a 10(5)[1]% significance level, the Dickey-Fuller critical values are 5.91(7.24)[10.61] when a trend and a constant are included (ϕ_3) and 4.12(5.18)[7.88] when only a constant is included (ϕ_1).

Table A2.2 (cont.): Augmented Dickey-Fuller tests for non-stationarity, first differences, 1970-2006

Series	Model	Lags	τ_τ, τ_μ, τ	ϕ_3, ϕ_1
Δ ln_rgdp	Trend	0	-5.63***	15.89***
	Constant	0	-5.60***	31.36***
	None	0	-5.10***	
Δ ln_rgdp_oil	Trend	0	-5.21***	13.57***
	Constant	0	-5.23***	27.37***
	None	0	-5.09***	
Δ ln_rgdp_rest	Trend	0	-6.26***	19.65***
	Constant	0	-6.30***	39.74***
	None	0	-6.21***	
Δ ln_rgdpus	Trend	0	-4.68***	10.95***
	Constant	0	-4.74***	22.49***
	None	0	-2.13**	
Δ ln_rk_stock2	Trend	0	-3.01	4.77
	Constant	0	-3.04**	9.24**
	None	0	-2.58**	
Δ ln_rpubexp	Trend	0	-5.35***	14.29***
	Constant	0	-5.34***	28.50***
	None	0	-5.04***	
Δ ln_totgovexp	Trend	0	-6.01***	18.07***
	Constant	0	-6.10***	37.25***
	None	0	-5.60***	
Δ ln_transfer	Trend	0	-7.61***	28.97***
	Constant	0	-7.73***	59.68***
	None	0	-6.15***	

*(**)[***] Significant at a 10(5)[1]% level.
a At a 10(5)[1]% significance level, the MacKinnon critical values are -3.18(-3.50)[-4.15] when a trend and a constant are included (τ_τ), and -2.60(-2.93)[-3.58] when only a constant is included (τ_μ), and -1.61(-1.95)[-2.62] when neither is included (τ). The standard normal critical value is -1.697(-2.04)[-2.75].
b At a 10(5)[1]% significance level, the Dickey-Fuller critical values are 5.91(7.24)[10.61] when a trend and a constant are included (ϕ_3) and 4.12(5.18)[7.88] when only a constant is included (ϕ_1).

APPENDIX 3

ESTIMATIONS OUTPUTS

Table A3.1: Model A

Long-Run (Cointegration Equation)

Production Function (Total Economy)

Dependent Variable: LN_RGDP

Method: Maximum likelihood (Marquardt)

Sample: 1970 2005

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.176113	0.191056	0.921790	0.3566
C(7)	-5.448819	0.218887	-24.89335	0.0000

	Final State	Root MSE	z-Statistic	Prob.
SV1	9.781871	0.083425	117.2531	0.0000

Log likelihood	16.82217	Akaike info criterion	-0.956269
Parameters	2	Schwarz criterion	-0.863753
Diffuse priors	1	Hannan-Quinn criter.	-0.926111

ln_rgdp=c(1)*ln_rk_stock2+(1-c(1))*ln_labor_f+sv1+[var=exp(c(7))]
sv1=sv1(-1)+[var=exp(c(7))]
sv1 = Time varying coefficient representing technology
c(7) = Variances of the error terms of the observation and state equations

Short-Run (Error Correction Model)

Production Function (Total Economy)

Dependent Variable: D_LN_RGDP

Method: Least Squares

Sample (adjusted): 1973 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESIDUAL_RGDP_TOT1_1	-0.138877	0.050737	-2.737181	0.0106
D_LN_RK_STOCK2	0.118594	0.048330	2.453826	0.0206
D_LN_RWAGE_LF	0.820447	0.031845	25.76381	0.0000
D_LN_LABOR_F	0.568914	0.275354	2.066115	0.0482
D_LN_CPI(-2)	-0.077556	0.028170	-2.753128	0.0102
C	0.021167	0.010923	1.937845	0.0628

R-squared	0.983101	F-statistic	325.7824
Adjusted R-squared	0.980083	Prob(F-statistic)	0.000000
Durbin-Watson stat	2.046571		

Diagnostic Tests:

Normality	3.810792	0.148764
Serial Correlation	0.151497	0.8602
Hetroschedasticity	1.733360	0.1597
Stability	0.166626	0.6863

Production Function (Oil Sector)

Dependent Variable:LN_RGDP_OIL
Method: Maximum likelihood (Marquardt)
Sample: 1970 2006

	Coefficient	Std. Error	z-Statistic	Prob.
C(17)	-34.94872	7.02E-10	-4.98E+10	0.0000
C(18)	0.915696	9.80E-15	9.34E+13	0.0000
C(19)	-0.085844	1.96E-19	-4.38E+17	0.0000
C(20)	-34.31234	2.92E-12	-1.18E+13	0.0000
C(21)	-0.395280	4.81E-13	-8.23E+11	0.0000
C(22)	-0.021711	2.18E-13	-9.96E+10	0.0000
C(23)	-29.85372	2.72E-12	-1.10E+13	0.0000

	Final State	Root MSE	z-Statistic	Prob.
SV1	2.887169	3.39E-06	850878.7	0.0000
SV2	0.667849	2.93E-07	2276086.	0.0000
SV3	-0.457963	3.37E-07	-1357898.	0.0000

Log likelihood	-1.8E+308	Akaike info criterion	9.7E+306
Parameters	7	Schwarz criterion	9.7E+306
Diffuse priors	3	Hannan-Quinn criter.	9.7E+306

ln_rgdp_oil=sv2*ln_rk_stock2+(1-sv2)*ln_labor_f+sv1+sv3*dum
sv1=sv1(-1)+[var=exp(c(17))]
sv2 = c(18)+C(19)*SV1(-1) + [var=exp(C(20))]
sv3 = c(21)+C(22)*SV1(-1) + [var=exp(C(23))]

sv1, sv2, and sv3 = Time varying coefficients representing technology, capital stock, and dummy variable respectively.
c(17) to c(23) = Variances of the error terms of the observation and state equations.

Production Function (Oil Sector)

Dependent Variable: D_LN_RGDP_OIL
Method: Least Squares
Sample (adjusted): 1972 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESIDUAL_RGDP_OIL_1	-0.307895	0.111819	-2.753513	0.0104
D_LN_CAPFLOW(-1)	-0.101167	0.028136	-3.595620	0.0013
D_LN_CPI	-0.873676	0.148722	-5.874543	0.0000
D_LN_OIL_P	0.911629	0.051352	17.75242	0.0000
D_LN_RWAGE_LF(-1)	-0.536847	0.142383	-3.770437	0.0008
D_LN_RM2	0.403761	0.115772	3.487548	0.0017
DUMMY_M	0.089220	0.045784	1.948715	0.0618
DUM	-0.120577	0.045960	-2.623496	0.0141

R-squared	0.943671	Durbin-Watson stat	1.727258
Adjusted R-squared	0.929067		

Diagnostic Tests:

Normality	1.827985	0.400920
Serial Correlation	0.246996	0.7830
Hetroschedasticity	1.725249	0.1984
Stability	0.001506	0.9693

Labour Demand

Dependent Variable: LN_LABOR_F
Method: Least Squares
Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_RGDP_REST	0.687782	0.087082	7.898115	0.0000
LN_RWAGE_LF	-0.569611	0.112231	-5.075331	0.0000
LN_SE_INDEX_B	0.911231	0.435405	2.092834	0.0444
DUM	-0.129847	0.059362	-2.187356	0.0361
DUMMY_M	-0.220239	0.052431	-4.200554	0.0002

R-squared	0.791798
Adjusted R-squared	0.765773

Labour Demand

Dependent Variable: D_LN_LABOR_F
Method: Least Squares
Sample (adjusted): 1979 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_LABOR_1	-0.020519	0.009030	-2.272434	0.0382
D_LN_RGDP_REST(-3)	0.016037	0.007698	2.083176	0.0548
D_LN_RWAGE_LF(-3)	0.163101	0.047578	3.428082	0.0037
D_LN_LABOR_F(-3)	-0.930285	0.248504	-3.743545	0.0020

Durbin-Watson stat	0.745603

D_LN_AGRIC_ELEP(-2)	0.026870	0.005483	4.900618	0.0002
D_LN_CPI(-5)	-0.066981	0.009341	-7.171014	0.0000
D_LN_SE_INDEX_B(-8)	0.246130	0.037022	6.648119	0.0000
D_LN_CU_TOT(-3)	-0.254760	0.053642	-4.749221	0.0003
D_LN_EXCH(-7)	0.015652	0.004207	3.720596	0.0021
D_LN_IMP_P(-3)	0.015746	0.006893	2.284420	0.0373
D_LN_RK_STOCK2	-0.049325	0.019326	-2.552333	0.0221
D_LN_REXPSOCIAL(-6)	0.005301	0.001913	2.771545	0.0143
C	0.064965	0.007176	9.053556	0.0000

R-squared	0.939495	F-statistic	19.40939
Adjusted R-squared	0.891091	Prob(F-statistic)	0.000001
Durbin-Watson stat	2.243828		

Diagnostic Tests:

Normality	3.097046	0.212562
Serial Correlation	0.376732	0.6934
Hetroschedasticity	0.796760	0.3806
Stability	0.176826	0.6964

Real Wages

Dependent Variable: LN_RWAGE_LF

Method: Least Squares

Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_LABPROD_REST	0.745313	0.098439	7.571336	0.0000
DUMMY_M	-0.172642	0.054389	-3.174192	0.0032
DUM_OIL	0.132359	0.051444	2.572863	0.0148
C	3.150154	1.104874	2.851143	0.0075

R-squared	0.647728	F-statistic	20.22588
Adjusted R-squared	0.615703	Prob(F-statistic)	0.000000
Durbin-Watson stat	0.998292		

Real Wages

Dependent Variable: D_LN_RWAGE_LF
Method: Least Squares
Sample (adjusted): 1973 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_RWAGE_NEW_1	-0.179116	0.064551	-2.774823	0.0101
D_LN_CPI	-0.112168	0.044423	-2.524975	0.0180
D_LN_LABPROD_REST	0.284137	0.095117	2.987247	0.0061
D_LN_OIL_P	0.090183	0.030867	2.921635	0.0071
D_LN_SE_INDEX_B	3.891884	0.649320	5.993785	0.0000
D_LN_TRAN_PUBEXP_RATIO(-2)	0.062086	0.019923	3.116349	0.0044
D_LN_OPEN(-2)	-0.085002	0.039787	-2.136447	0.0422
DUM	-0.039482	0.018483	-2.136177	0.0422

R-squared	0.940203
Adjusted R-squared	0.924104
Durbin-Watson stat	1.863386

Diagnostic Tests:

Normality	1.221375	0.542977
Serial Correlation	1.509162	0.2413
Hetroschedasticity	0.130737	0.7201
Stability	1.925155	0.1775

Investment

Dependent Variable: LN_GCF

Method: Least Squares

Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_RGDP	0.972006	0.022691	42.83754	0.0000
LN_UCC	-0.074014	0.022144	-3.342452	0.0022
PI	0.323701	0.184370	1.755716	0.0890
LN_CU_TOT	0.496816	0.144981	3.426761	0.0017
DUMMY_M	-0.349581	0.084671	-4.128723	0.0003
DUM	-0.540648	0.095111	-5.684395	0.0000

R-squared	0.907419	Durbin-Watson stat	1.516507
Adjusted R-squared	0.892486		

Investment

Dependent Variable: D_LN_GCF

Method: Least Squares

Sample (adjusted): 1975 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_INV_1	-0.537726	0.115013	-4.675368	0.0001
D_LN_RGDP	1.146649	0.181015	6.334558	0.0000
D_LN_OIL_P	-0.324343	0.062818	-5.163247	0.0000
D_LN_CAPFLOW(-2)	0.111214	0.022017	5.051308	0.0001
D_LN_EXCH	0.166503	0.080438	2.069957	0.0510
D_LN_PPI(-1)	0.883835	0.210097	4.206796	0.0004
D_LN_RWAGE_LF(-2)	1.226132	0.526766	2.327660	0.0300
D_LN_OPEN(-3)	-0.368711	0.077496	-4.757822	0.0001
D_LN_GCF(-1)	0.420187	0.087073	4.825694	0.0001
D_LN_CU_TOT(-2)	-1.094030	0.606676	-1.803317	0.0857
D_LN_HH_RGDP(-4)	-0.291696	0.109062	-2.674576	0.0142

R-squared	0.930124	Durbin-Watson stat	1.856226
Adjusted R-squared	0.896850		

Diagnostic Tests:

Normality	0.238388	0.887635
Serial Correlation	2.314055	0.1174
Hetroschedasticity	0.003339	0.9543
Stability	1.343907	0.2624

Total Factor Productivity (Total Economy)

Dependent Variable: LN_TFP_TOT1

Method: Least Squares

Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.

Total Factor Productivity (Total Economy)

Dependent Variable: D_LN_TFP_TOT1

Method: Least Squares

Sample (adjusted): 1971 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.

LN_POVERTYD_INDEX	-0.276592	0.110935	-2.493287	0.0182
LN_GCFGDP	0.127461	0.052271	2.438464	0.0207
LN_FINCONSTR	0.034384	0.010420	3.299905	0.0024
DUM_TFP	0.411404	0.159645	2.576984	0.0149
DUMTFP	-4.496443	1.737189	-2.588344	0.0146
C	9.394842	0.188032	49.96396	0.0000

R-squared	0.659579	F-statistic	12.01277
Adjusted R-squared	0.604673	Prob(F-statistic)	0.000002
Durbin-Watson stat	0.707632		

RESID_TFP_TOT_1	-0.245419	0.112779	-2.176096	0.0373
D_LN_POVERTYD_INDEX	-0.346988	0.156297	-2.220059	0.0339
D_LN_SE_INDEX_B	1.142799	0.231909	4.927789	0.0000
DUM_TFP	0.214239	0.075179	2.849741	0.0077
DUMTFP	-2.319164	0.817755	-2.836011	0.0080

R-squared	0.675749	Durbin-Watson stat	1.510620
Adjusted R-squared	0.633910		

Diagnostic Tests:

Normality	0.213131	0.898916
Serial Correlation	2.040171	0.1443
Hetroschedasticity	0.792371	0.3815
Stability	1.929841	0.1801

Total Factor Productivity (Oil Sector)

Dependent Variable: LN_TFP_OIL
Method: Least Squares
Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_DCREDIT	0.951431	0.403558	2.357606	0.0247
LN_FDI	0.045328	0.393016	0.115333	0.9089
LN_OIL_P	0.295148	0.407195	0.724831	0.4738
DUMMY_M	2.590847	0.821094	3.155359	0.0035
C	-13.05096	4.961980	-2.630191	0.0130

R-squared	0.717969	Durbin-Watson stat	0.335480
Adjusted R-squared	0.682715		
F-statistic	20.36566		
Prob(F-statistic)	0.000000		

Total Factor Productivity (Oil Sector)

Dependent Variable: D_LN_TFP_OIL
Method: Least Squares
Sample (adjusted): 1974 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_TFP_OIL_1	-0.315440	0.045736	-6.896991	0.0000
D_LN_DCREDIT	0.584360	0.176632	3.308353	0.0039
D_LN_TFP_OIL(-1)	0.323899	0.090021	3.598039	0.0021
D_LN_TFP_OIL(-3)	0.440375	0.106569	4.132301	0.0006
D_LN_RK_STOCK2	-4.282490	1.252265	-3.419796	0.0031
D_LN_SE_INDEX_B(-1)	-29.12714	7.885989	-3.693531	0.0017
D_LN_REXPSOCIAL	-0.762298	0.152465	-4.999832	0.0001
D_LN_RM2	-1.145366	0.477742	-2.397456	0.0276
D_LN_CU_TOT(-1)	8.580464	2.045029	4.195766	0.0005
D_LN_GCF(-2)	0.742166	0.247618	2.997225	0.0077
D_LN_HH_RGDP(-3)	2.778251	0.725042	3.831846	0.0012
DUMMY_M	-0.146373	0.078995	-1.852943	0.0804
D_LN_FDI(-3)	0.198044	0.077096	2.568817	0.0193

R-squared	0.929789	Mean dependent var	0.125944
Adjusted R-squared	0.875180	S.D. dependent var	0.785058
S.E. of regression	0.277360	Akaike info criterion	0.575952
Sum squared resid	1.384711	Schwarz criterion	1.256183
Log likelihood	5.496790	Hannan-Quinn criter.	0.804829
Durbin-Watson stat	1.421533		

Diagnostic Tests:

Normality	1.049380	0.591739
Serial Correlation	1.525458	0.2459
Hetroschedasticity		

	0.231905	0.6336
Stability	0.012487	0.9123

Consumer Prices

Dependent Variable: LN_CPI

Method: Least Squares

Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_PPI	0.964454	0.405104	2.380754	0.0238
LN_IMP_P	0.791153	0.251889	3.140883	0.0038
LN_EXCH	0.893697	0.075618	11.81861	0.0000
LN_EXCESSD	0.179694	0.947616	0.189627	0.8509
DUMMY_M	0.453542	0.245543	1.847096	0.0746
DUM_OIL	-0.247312	0.154180	-1.604045	0.1192
C	-7.455257	1.441331	-5.172481	0.0000

R-squared	0.968336	F-statistic	152.9104
Adjusted R-squared	0.962004	Prob(F-statistic)	0.000000
Durbin-Watson stat	0.756745		

Consumer Prices

Dependent Variable: D_LN_CPI

Method: Least Squares

Sample (adjusted): 1975 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_CPI_1	-0.054380	0.010049	-5.411374	0.0000
D_LN_CPI(-1)	0.061703	0.033613	1.835679	0.0821
D_LN_EXCESSD	-0.149378	0.053229	-2.806320	0.0113
D_LN_IMP_P(-4)	0.039443	0.021199	1.860606	0.0783
D_LN_PPI	-0.164863	0.050941	-3.236362	0.0043
D_LN_WAGE_LF	0.938521	0.034026	27.58232	0.0000
D_LN_INT(-4)	-0.062425	0.026563	-2.350051	0.0297
D_LN_TRANSFER(-3)	0.033780	0.008949	3.774837	0.0013
D_LN_RGDP	-1.140638	0.054789	-20.81885	0.0000
D_LN_EXCH	0.060282	0.011384	5.295320	0.0000
D_LN_ELEPPOP(-4)	0.078148	0.031026	2.518755	0.0209
D_LN_CAPFLOW(-2)	0.028130	0.006917	4.066715	0.0007
C	0.012813	0.007924	1.617078	0.1223

R-squared	0.989372	F-statistic	147.3999
Adjusted R-squared	0.982660	Prob(F-statistic)	0.000000
Durbin-Watson stat	1.739353		

Diagnostic Tests:

Normality	2.561184	0.277873
Serial Correlation	0.665996	0.5267
Hetroschedasticity	1.045902	0.3149
Stability	0.952172	0.3421

Producer Prices

Dependent Variable: LN_PPI

Method: Least Squares

Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_WAGE_LF	0.007109	0.039112	0.181762	0.8569
LN_OIL_P	0.076239	0.035855	2.126325	0.0413
LN_CU_TOT	0.484784	0.094025	5.155923	0.0000
LN_INT	0.197271	0.072017	2.739219	0.0100
C	4.466082	0.298851	14.94419	0.0000

R-squared	0.921229	F-statistic	93.55980
Adjusted R-squared	0.911382	Prob(F-statistic)	0.000000
Durbin-Watson stat	0.998865		

Producer Prices

Dependent Variable: D_LN_PPI
Method: Least Squares
Sample (adjusted): 1977 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_PPI_1	-0.288706	0.074891	-3.855031	0.0014
D_LN_INT	0.179374	0.041582	4.313717	0.0005
D_LN_CU_TOT	0.179187	0.037589	4.767034	0.0002
D_LN_WAGE_LF	0.243482	0.036182	6.729386	0.0000
D_LN_GCF	0.233823	0.040797	5.731339	0.0000
D_LN_PPI(-3)	0.449360	0.089123	5.042045	0.0001
D_LN_RGDP	-0.647062	0.128723	-5.026792	0.0001
D_LN_ELEPPOP(-6)	0.257701	0.059774	4.311280	0.0005
D_LN_GCFGDP(-1)	0.174178	0.036120	4.822217	0.0002
D_LN_FINCONSTR	0.089649	0.013710	6.539002	0.0000
D_LN_EXCESSD(-3)	0.152510	0.078472	1.943490	0.0698
D_LN_WAGE_LF(-6)	0.057629	0.021247	2.712304	0.0154
D_LN_GCF(-2)	-0.077860	0.023541	-3.307456	0.0044
D_LN_RGDP_REST(-6)	-0.122511	0.053777	-2.278133	0.0368

R-squared	0.933281		
Adjusted R-squared	0.879071		
Durbin-Watson stat	2.266264		
Diagnostic Tests:			
Normality		0.587906	0.745311
Serial Correlation		0.335602	0.7205
Hetroschedasticity		0.014766	0.9042
Stability		0.947065	0.3459

Socio-Economic Activity

Dependent Variable: LN_SE_INDEX_B
Method: Least Squares
Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_HH_RGDP_REST	0.030940	0.016507	1.874366	0.0700
LN_REXPSOCIAL	0.032528	0.004763	6.829768	0.0000
LN_ELEPPOP	0.022355	0.011749	1.902763	0.0661
DUMMY_M	0.037452	0.010102	3.707218	0.0008
C	-0.543475	0.325743	-1.668418	0.1050

R-squared	0.829443	Durbin-Watson stat	1.170655
Adjusted R-squared	0.808123		
F-statistic	38.90500		
Prob(F-statistic)	0.000000		

Socio-Economic Activity

Dependent Variable: D_LN_SE_INDEX_B
Method: Least Squares
Sample (adjusted): 1973 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_SE_REST_1	-0.329734	0.057513	-5.733180	0.0000
D_LN_CAPFLOW	-0.006750	0.001518	-4.445621	0.0002
D_LN_REXPSOCIAL	0.011303	0.002195	5.149289	0.0000
D_LN_RGDP(-2)	0.047847	0.007557	6.331458	0.0000
D_LN_HH_RGDP	0.134396	0.008260	16.27146	0.0000
D_LN_ELEPPOP	-0.010816	0.005214	-2.074412	0.0489
D_LN_EXCESSD(-1)	-0.053352	0.012159	-4.387941	0.0002
D_LN_POVERTYD_INDEX(-1)	-0.074722	0.027936	-2.674739	0.0133
DUM	0.009144	0.002391	3.824671	0.0008
DUMOIL	-5.47E-09	1.13E-09	-4.848493	0.0001

R-squared	0.970915		
Adjusted R-squared	0.960009		
Durbin-Watson stat	2.351897		
Diagnostic Tests:			
Normality		0.654540	0.720889
Serial Correlation		0.719718	0.4980
Hetroschedasticity		0.096717	0.7579
Stability		1.725422	0.2013

Disposable Income (Rest of Economy)

Dependent Variable: LN_HH_RGDP_REST
Method: Least Squares
Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_RWAGE_LF	0.876241	0.120386	7.278594	0.0000
LN_TRANSFER	0.110486	0.013818	7.995734	0.0000
DUMMY_M	0.115174	0.064841	1.776251	0.0852
DUMOIL	-1.19E-07	3.52E-08	-3.378026	0.0019
C	3.476751	1.364878	2.547298	0.0159

R-squared	0.828022	Durbin-Watson stat	1.387012
Adjusted R-squared	0.806525		
F-statistic	38.51767		
Prob(F-statistic)	0.000000		

Disposable Income (Rest of Economy)

Dependent Variable: D_LN_HH_RGDP_REST
Method: Least Squares
Sample (adjusted): 1975 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_HH_REST_1	-0.263604	0.121832	-2.163666	0.0416
D_LN_RWAGE_LF	1.012605	0.131858	7.679484	0.0000
D_LN_CAPFLOW(-4)	-0.045298	0.019722	-2.296806	0.0315
D_LN_TRANSFER(-3)	0.166261	0.034884	4.766105	0.0001
D_LN_RK_STOCK2(-4)	0.390019	0.172500	2.260988	0.0340
D_LN_FINCONSTR	-0.125216	0.038293	-3.269971	0.0035
D_LN_CU_TOT(-4)	0.175539	0.097390	1.802429	0.0852
D_LN_PPI	-0.381874	0.204526	-1.867121	0.0753
D_LN_INDEX_AGRIC(-2)	0.968760	0.207588	4.666739	0.0001
DUMOIL	-3.66E-08	1.97E-08	-1.854812	0.0771

R-squared	0.894303	Durbin-Watson stat	1.552035
Adjusted R-squared	0.851064		
Diagnostic Tests:			
Normality		1.651074	0.438000
Serial Correlation		0.882692	0.4300
Hetroschedasticity		0.861965	0.3609
Stability		0.251604	0.6214

Poverty

Dependent Variable: LN_POVERTYD_INDEX

Method: Least Squares

Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_CPI	0.237591	0.040575	5.855542	0.0000
LN_INDEX_AGRIC	-0.541746	0.184387	-2.938089	0.0062
LN_HH_RGDP_REST	-0.151928	0.068281	-2.225043	0.0335
LN_AIDPOP	-0.002034	0.024612	-0.082640	0.9347
LN_ELEPPOP	-0.073436	0.064789	-1.133462	0.2657
C	3.028525	1.542574	1.963293	0.0586

R-squared	0.866594	F-statistic	40.27474
Adjusted R-squared	0.845077	Prob(F-statistic)	0.000000
Durbin-Watson stat	0.420307		

Poverty

Dependent Variable: D_LN_POVERTYD_INDEX

Method: Least Squares

Sample (adjusted): 1975 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_POVERTYD_NEW1_1	-0.093114	0.041593	-2.238701	0.0356
D_LN_WAGE_LABOR(-2)	0.045429	0.016574	2.740952	0.0119
D_LN_POVERTYD_INDEX(-1)	0.742858	0.074000	10.03864	0.0000
D_LN_CPI(-1)	0.066169	0.025902	2.554574	0.0181
D_LN_LABOR_F	0.559386	0.208033	2.688929	0.0134
D_LN_LABOR_F(-3)	-0.806361	0.261309	-3.085857	0.0054
D_LN_CAPFLOW(-2)	-0.014158	0.003853	-3.674003	0.0013
D_LN_ELEPPOP(-2)	0.023840	0.012336	1.932658	0.0663
DUM_POVD	0.004247	0.001908	2.226074	0.0366
D_LN_AIDPOP(-4)	-0.026275	0.006917	-3.798492	0.0010

R-squared	0.900523	Durbin-Watson stat	1.889975
Adjusted R-squared	0.859829		

Diagnostic Tests:

Normality	0.204793	0.902671
Serial Correlation	0.461347	0.6391
Hetroschedasticity	0.470891	0.4980
Stability	0.006292	0.9378

Agricultural Production

Dependent Variable: LN_INDEX_AGRIC
Method: Least Squares
Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_PPI	-0.137146	0.255780	-0.536189	0.5955

Agricultural Production

Dependent Variable: D_LN_INDEX_AGRIC
Method: Least Squares
Sample (adjusted): 1975 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_AGRIC_1	-0.190114	0.041999	-4.526639	0.0002

LN_ELEP	0.400086	0.116814	3.424985	0.0017
LN_LAND	0.580866	0.111595	5.205121	0.0000
DUM	-0.556776	0.080179	-6.944134	0.0000
DUMMY_M	-0.165237	0.075582	-2.186186	0.0362

R-squared	0.833988
Adjusted R-squared	0.813237
Durbin-Watson stat	1.016386

D_LN_CPI	0.187988	0.040180	4.678665	0.0001
D_LN_RK_STOCK2(-1)	-0.697646	0.094154	-7.409635	0.0000
D_LN_LAND(-4)	-4.701944	0.904099	-5.200698	0.0000
D_LN_AID(-2)	-0.033844	0.016108	-2.101111	0.0479
D_LN_UCC(-3)	0.107544	0.020942	5.135263	0.0000
D_PI(-4)	-0.322952	0.058495	-5.520980	0.0000
D_LN_INDEX_AGRIC(-1)	0.181145	0.087838	2.062251	0.0518
D_LN_OPEN(-4)	0.123404	0.030306	4.071859	0.0005
D_LN_PPI	0.151371	0.070958	2.133254	0.0449
D_LN_ELEP(-1)	-0.104568	0.027112	-3.856829	0.0009

R-squared	0.879103
Adjusted R-squared	0.821533
Durbin-Watson stat	1.423088

Diagnostic Tests:

Normality	2.351871	0.308530
Serial Correlation	1.672980	0.2129
Hetroschedasticity	0.913922	0.3470
Stability	0.266558	0.6110

Infrastructure

Dependent Variable: LN_ELEP
Method: Least Squares
Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_RGDP	1.430276	0.164295	8.705542	0.0000
GE	0.845762	0.448987	1.883712	0.0684
DUM	0.404438	0.149918	2.697728	0.0109
C	-13.57408	2.847999	-4.766181	0.0000

R-squared	0.823067	Durbin-Watson stat	0.832361
Adjusted R-squared	0.806982		
F-statistic	51.17032		
Prob(F-statistic)	0.000000		

Infrastructure

Dependent Variable: D_LN_ELEP
Method: Least Squares
Sample (adjusted): 1975 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_ELEP_1	-0.354742	0.075172	-4.719048	0.0001
D_GE	1.520223	0.454856	3.342206	0.0025
D_LN_ELEP(-4)	0.394435	0.157986	2.496649	0.0192
D_LN_RGDP_REST(-3)	-0.444890	0.138632	-3.209132	0.0035
D_LN_UCC(-4)	0.324727	0.062449	5.199857	0.0000
D_LN_SE_INDEX_B(-3)	1.982076	1.106360	1.791529	0.0849

R-squared	0.841910	Durbin-Watson stat	2.084017
Adjusted R-squared	0.811508		

Diagnostic Tests:

Normality	1.057963	0.589205
Serial Correlation	0.011305	0.9888
Hetroschedasticity		

			0.076137	0.7846
			Stability	0.995962	0.3297

Household Consumption Expenditure

Dependent Variable: LN_HH_RCONEXP
Method: Least Squares
Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_HH_RGDP_REST	0.972615	0.081643	11.91300	0.0000
LN_RM2	0.004293	0.086403	0.049685	0.9607
RINT	0.007445	0.217317	0.034257	0.9729
DUMMY_M	0.142686	0.087794	1.625236	0.1139
DUM	0.184128	0.082003	2.245369	0.0318

R-squared	0.818465	Durbin-Watson stat	2.140756
Adjusted R-squared	0.795773		

Household Consumption Expenditure

Dependent Variable: D_LN_HH_RCONEXP
Method: Least Squares
Sample (adjusted): 1975 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_CONS_1	-0.916454	0.149502	-6.130052	0.0000
D_LN_HH_RGDP_REST	1.294527	0.137080	9.443605	0.0000
D_RINT(-3)	-0.004270	0.001607	-2.657629	0.0129
D_LN_HH_RCONEXP(-4)	-0.211070	0.069695	-3.028496	0.0052

R-squared	0.876526	Durbin-Watson stat	2.358821
Adjusted R-squared	0.863296		

Diagnostic Tests:

Normality	1.157963	0.389205
Serial Correlation	1.016767	0.375700
Hetroschedasticity	0.176137	0.4846
Stability	1.466505	0.249193

Exports

Dependent Variable: LN_REXP
Method: Least Squares
Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_RGDPUS	0.749785	0.041429	18.09791	0.0000
LN_OIL_P	0.338712	0.087149	3.886571	0.0004
LN_RELCPI	-0.203701	0.123205	-1.653351	0.1075

Exports

Dependent Variable: D_LN_REXP
Method: Least Squares
Sample (adjusted): 1975 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_EXP_1	-0.552230	0.123824	-4.459792	0.0001
D_LN_OIL_P	0.306532	0.084548	3.625534	0.0012
D_LN_RGDPUS(-4)	2.462485	1.429793	1.722268	0.0969
D_LN_EXCH(-2)	-0.275570	0.109583	-2.514709	0.0184

R-squared	0.824577	Durbin-Watson stat	0.665997
Adjusted R-squared	0.814258		

DUM	-0.224912	0.085258	-2.638008	0.0139
D_LN_PPI	1.032138	0.406294	2.540373	0.0174

R-squared	0.695505	Durbin-Watson stat	2.593351
Adjusted R-squared	0.636949		

Diagnostic Tests:

Normality	0.700557	0.704492
Serial Correlation	2.212771	0.100771
Hetroschedasticity	0.655355	0.762070
Stability	1.782459	0.178600

Imports

Dependent Variable: LN_RIMP

Method: Least Squares

Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_RGDP	1.390517	0.214155	6.493052	0.0000
LN_RELCPI	0.213230	0.132165	1.613361	0.1168
LN_EXCH	-0.206131	0.100828	-2.044387	0.0495
DUM	-0.478356	0.158213	-3.023486	0.0050
DUMMY_M	-0.321161	0.139370	-2.304366	0.0281
C	-6.396372	3.353126	-1.907585	0.0657

R-squared	0.863437	F-statistic	39.20041
Adjusted R-squared	0.841411	Prob(F-statistic)	0.000000
Durbin-Watson stat	1.148905		

Imports

Dependent Variable: D_LN_RIMP

Method: Least Squares

Sample (adjusted): 1973 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_IMP_1	-0.581142	0.187438	-3.100444	0.0043
D_LN_RGDP	1.231038	0.270035	4.558807	0.0001
D_LN_RIMP(-1)	0.401320	0.147816	2.714999	0.0110
D_LN_OIL_P	-0.176863	0.093238	-1.896902	0.0678
D_LN_INT(-2)	0.474030	0.294296	1.610726	0.1181

R-squared	0.543925	Durbin-Watson stat	1.861622
Adjusted R-squared	0.481018		

Diagnostic Tests:

Normality	1.805803	0.405392
Serial Correlation	0.097716	0.907226
Hetroschedasticity	0.430651	0.916330
Stability	0.095489	0.961845

Interest Rate

Dependent Variable: LN_INT

Method: Least Squares

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Sample: 1970 2006

Included observations: 37

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_RGDP	0.489271	0.087215	5.609922	0.0000
LN_RM2	-0.256578	0.055728	-4.604146	0.0001
LN_DIS_RATE	0.777294	0.041146	18.89114	0.0000
C	-7.693613	0.779270	-9.872851	0.0000

R-squared	0.964472	F-statistic	298.6167
Adjusted R-squared	0.961242	Prob(F-statistic)	0.000000
Durbin-Watson stat	1.858574		

Interest Rate

Dependent Variable: D_LN_INT

Method: Least Squares

Sample (adjusted): 1974 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_INT_1	-0.718833	0.147979	-4.857677	0.0000
D_LN_DIS_RATE	0.550220	0.068943	7.980770	0.0000
D_LN_INT(-3)	0.243390	0.098365	2.474357	0.0192

R-squared	0.737095	Durbin-Watson stat	1.608142
Adjusted R-squared	0.719568		

Diagnostic Tests:

Normality	0.820171	0.663594
Serial Correlation	1.060172	0.359893
Hetroschedasticity	0.879971	0.523205
Stability	0.672593	0.518437

Exchange Rate

Dependent Variable: LN_EXCH

Method: Least Squares

Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_RELRGDP	-1.111410	0.579148	-1.919043	0.0639
LN_RELM2	0.781134	0.465380	1.678485	0.1030
LN_RELCPI	0.375075	0.479249	0.782632	0.4396
DUM	-0.683912	0.295259	-2.316314	0.0271
C	8.498273	2.698539	3.149212	0.0035

R-squared	0.946120	F-statistic	140.4770

Exchange Rate

Dependent Variable: D_LN_EXCH

Method: Least Squares

Sample (adjusted): 1973 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_EXCH_1	-0.294147	0.069126	-4.255230	0.0003
D_LN_RELCPI	0.925168	0.200107	4.623356	0.0001
D_LN_OIL_P	0.717931	0.063274	11.34641	0.0000
D_LN_RELINT	0.379537	0.102486	3.703311	0.0011
D_LN_GCF	0.781741	0.129814	6.022016	0.0000
D_LN_RELRGDP	-0.737525	0.243273	-3.031679	0.0058
D_LN_AID(-2)	0.152819	0.062702	2.437234	0.0226

Adjusted R-squared	0.939385	Prob(F-statistic)	0.000000
Durbin-Watson stat	0.672903		

D_LN_RELREMIT	-0.096521	0.032830	-2.940050	0.0072
D_LN_M2_US	-3.373332	0.671654	-5.022421	0.0000
DUM	0.230886	0.067560	3.417507	0.0023

R-squared	0.870187	Durbin-Watson stat	2.033036
Adjusted R-squared	0.821507		

Diagnostic Tests:

Normality	0.683645	0.710474
Serial Correlation	0.083990	0.919734
Hetroschedasticity	1.488649	0.226296
Stability	0.872594	0.568433

Foreign Direct Investment

Dependent Variable: LN_FDI

Method: Least Squares

Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_RGDP	0.681613	0.029886	22.80747	0.0000
LN_CPI	-0.496629	0.218464	-2.273274	0.0301
LN_OPEN	0.075962	0.439911	0.172677	0.8640
LN_EXCH	0.288011	0.228836	1.258591	0.2176
DUMMY_M	1.168249	0.320932	3.640174	0.0010
DUM	0.978211	0.400298	2.443708	0.0204

R-squared	0.621662	Durbin-Watson stat	2.152807
Adjusted R-squared	0.560640		

Foreign Direct Investment

Dependent Variable: D_LN_FDI

Method: Least Squares

Sample (adjusted): 1974 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_FDI_1	-0.590600	0.235782	-2.504858	0.0183
D_LN_FDI(-1)	-0.373373	0.145780	-2.561209	0.0161
D_LN_FDI(-3)	0.217317	0.106820	2.034415	0.0515
D_LN_GCF(-3)	-0.792694	0.362943	-2.184073	0.0375
D_LN_OPEN(-3)	0.665368	0.398410	1.670058	0.1061

R-squared	0.697786	Durbin-Watson stat	1.965139
Adjusted R-squared	0.654613		

Diagnostic Tests:

Normality	0.022571	0.988778
Serial Correlation	0.321537	0.727876
Hetroschedasticity	1.122641	0.389563
Stability	1.876953	0.173214

Table A3.2: Model B

Labour Demand

Dependent Variable: LN_LABOR_F

Method: Least Squares

Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_RGDP	0.831114	0.012311	67.50851	0.0000
LN_RWAGE_LF	-0.790810	0.016080	-49.18101	0.0000
LN_SE_INDEX_B	0.088369	0.075262	1.174145	0.2485

R-squared	0.993518	Durbin-Watson stat	0.859577
Adjusted R-squared	0.993137		

Labour Demand

Dependent Variable: D_LN_LABOR_F

Method: Least Squares

Sample (adjusted): 1979 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_LABOR_1	-0.123946	0.051508	2.406351	0.0286
D_LN_RGDP(-1)	-0.027298	0.011727	-2.327725	0.0334
D_LN_RWAGE_LF(-3)	0.221453	0.049104	4.509851	0.0004
D_LN_LABOR_F(-3)	-0.259916	0.222787	-1.166657	0.2604
D_LN_AGRIC_ELEP(-2)	0.023013	0.005651	4.072247	0.0009
D_LN_CPI(-5)	-0.065162	0.010865	-5.997158	0.0000
D_LN_SE_INDEX_B(-8)	0.264947	0.040923	6.474235	0.0000
D_LN_CU_TOT(-3)	-0.300010	0.061788	-4.855470	0.0002
D_LN_EXCH(-7)	0.015525	0.004703	3.301418	0.0045
D_LN_IMP_P(-3)	0.015016	0.007485	2.006038	0.0621
D_LN_REXPSOCIAL(-6)	0.005680	0.002167	2.621457	0.0185
C	0.046328	0.006314	7.337186	0.0000

R-squared	0.917644	F-statistic	16.20706
Adjusted R-squared	0.861024	Prob(F-statistic)	0.000001
Durbin-Watson stat	2.144370		

Diagnostic Tests:

Normality	3.147047	0.312567
Serial Correlation	0.267672	0.5449
Hetroschedasticity	0.987610	0.53806
Stability	0.136821	0.47964

Real Wages

Dependent Variable: LN_RWAGE_LF

Method: Least Squares

Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.

Real Wages

Dependent Variable: D_LN_RWAGE_LF

Method: Least Squares

Sample (adjusted): 1973 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.

LN_LABPROD_TOT	0.984090	0.001466	671.4456	0.0000
DUMMY_M	0.056499	0.019175	2.946473	0.0058
DUM	0.049768	0.021904	2.272108	0.0295

R-squared	0.951400	Durbin-Watson stat	0.412683
Adjusted R-squared	0.948541		

RESID_RWAGE_1	-0.179116	0.064551	-2.774823	0.0101
D_LN_CPI	-0.112168	0.044423	-2.524975	0.0180
D_LN_LABPROD_REST	0.284137	0.095117	2.987247	0.0061
D_LN_OIL_P	0.090183	0.030867	2.921635	0.0071
D_LN_SE_INDEX_B	3.891884	0.649320	5.993785	0.0000
D_LN_TRAN_PUBEXP_RATIO(-2)	0.062086	0.019923	3.116349	0.0044
D_LN_OPEN(-2)	-0.085002	0.039787	-2.136447	0.0422
DUM	-0.039482	0.018483	-2.136177	0.0422

R-squared	0.940203	Durbin-Watson stat	1.863386
Adjusted R-squared	0.924104		

Diagnostic Tests:

Normality	1.321575	0.442979
Serial Correlation	1.719163	0.3013
Hetroschedasticity	0.310740	0.8401
Stability	1.955160	0.2785

Socio-Economic Activity

Dependent Variable: LN_SE_INDEX_B

Method: Least Squares

Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_HH_RGDP	0.033612	0.018544	1.812510	0.0793
LN_REXPSOCIAL	0.031832	0.004963	6.413442	0.0000
LN_ELEPPOP	0.016514	0.013962	1.182830	0.2456
DUMMY_M	0.042125	0.009833	4.284199	0.0002
C	-0.655900	0.391973	-1.673328	0.1040

R-squared	0.828340	F-statistic	38.60380
Adjusted R-squared	0.806883	Prob(F-statistic)	0.000000
Durbin-Watson stat	1.140892		

Socio-Economic Activity

Dependent Variable: D_LN_SE_INDEX_B

Method: Least Squares

Sample (adjusted): 1973 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_SE_TOT_1	-0.337387	0.059553	-5.665315	0.0000
D_LN_CAPFLOW	-0.006572	0.001524	-4.312964	0.0002
D_LN_REXPSOCIAL	0.010968	0.002194	4.999692	0.0000
D_LN_RGDP(-2)	0.045796	0.007602	6.024204	0.0000
D_LN_HH_RGDP	0.132844	0.008477	15.67056	0.0000
D_LN_ELEPPOP	-0.012664	0.005283	-2.396820	0.0247
D_LN_EXCESSD(-1)	-0.043506	0.012429	-3.500407	0.0018
D_LN_POVERTYD_INDEX(-1)	-0.056549	0.027131	-2.084292	0.0479
DUM	0.010223	0.002496	4.096116	0.0004
DUMOIL	-5.97E-09	1.13E-09	-5.274068	0.0000

R-squared	0.970514	Durbin-Watson stat	2.375418

	Adjusted R-squared 0.959457 **Diagnostic Tests:** Normality 0.554564 0.731898 Serial Correlation 0.735719 0.5080 Hetroschedasticity 0.106712 0.6589 Stability 1.473421 0.2117

Poverty

Dependent Variable: LN_POVERTYD_INDEX

Method: Least Squares

Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_CPI	0.205810	0.039710	5.182826	0.0000
LN_INDEX_AGRIC	-0.421465	0.179931	-2.342372	0.0255
LN_HH_RGDP	-0.003912	0.041696	-0.093814	0.9258
LN_AIDPOP	-0.014419	0.023295	-0.618968	0.5403
LN_ELEPPOP	-0.097905	0.063607	-1.539218	0.1336

R-squared	0.845099	Durbin-Watson stat	0.256567
Adjusted R-squared	0.825737		

Poverty

Dependent Variable: D_LN_POVERTYD_INDEX

Method: Least Squares

Sample (adjusted): 1974 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_POVERTYD_NEW1_1	-0.092791	0.036299	-2.556272	0.0180
D_LN_WAGE_LABOR(-2)	0.049153	0.015822	3.106674	0.0051
D_LN_AIDPOP(-2)	-0.010651	0.006016	-1.770473	0.0905
D_LN_POVERTYD_INDEX(-1)	0.630599	0.070281	8.972565	0.0000
D_LN_CPI(-1)	0.063179	0.024464	2.582521	0.0170
D_LN_LABOR_F	0.373708	0.154627	2.416828	0.0244
D_LN_CAPFLOW(-2)	-0.014798	0.003682	-4.018639	0.0006
D_LN_EXCESSD(-3)	0.067526	0.028774	2.346764	0.0283
D_LN_REXPSOCIAL(-2)	0.010650	0.004613	2.308421	0.0308
DUM_POVD	0.006822	0.001838	3.711841	0.0012
DUMMY_M	-0.022579	0.005778	-3.907861	0.0008

R-squared	0.913777	Durbin-Watson stat	2.421918
Adjusted R-squared	0.874584		
Diagnostic Tests:			
Normality		0.214891	0.924673
Serial Correlation		0.516137	0.3319
Hetroschedasticity		0.571891	0.7984
Stability		0.016292	0.5375

Disposable Income (Total Economy)

Dependent Variable: LN_HH_RGDP

Method: Least Squares

Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_RWAGE_LF	0.979738	0.042600	22.99854	0.0000
LN_TRANSFER	0.144799	0.004440	32.61527	0.0000
DUM	0.092152	0.024877	3.704261	0.0008
C	2.297017	0.482710	4.758582	0.0000

R-squared	0.984526	F-statistic	699.8866
Adjusted R-squared	0.983120	Prob(F-statistic)	0.000000
Durbin-Watson stat	1.828508		

Disposable Income (Total Economy)

Dependent Variable: D_LN_HH_RGDP

Method: Least Squares

Sample (adjusted): 1971 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_HH_TOT_1	-0.245771	0.114452	-2.147366	0.0392
D_LN_RWAGE_LF	0.869462	0.039113	22.22951	0.0000
C	0.030977	0.006511	4.757665	0.0000

R-squared	0.937430	F-statistic	247.2047
Adjusted R-squared	0.933638	Prob(F-statistic)	0.000000
Durbin-Watson stat	2.341542		

Diagnostic Tests:

Normality	1.341171	0.216024
Serial Correlation	0.802762	0.4471
Hetroschedasticity	0.762965	0.3819
Stability	0.261604	0.6514

Household Consumption Expenditure

Dependent Variable: LN_HH_RCONEXP

Method: Least Squares

Sample: 1970 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_HH_RGDP	0.654117	0.219981	2.973521	0.0056
LN_RM2	0.154979	0.158868	0.975524	0.3366
DUMMY_M	0.296432	0.112627	2.631978	0.0130
DUMOIL	-1.43E-07	5.61E-08	-2.545232	0.0159
C	2.409168	1.817799	1.325321	0.1944

R-squared	0.646445	F-statistic	14.62729
Adjusted R-squared	0.602250	Prob(F-statistic)	0.000001
Durbin-Watson stat	1.821887		

Household Consumption Expenditure

Dependent Variable: D_LN_HH_RCONEXP

Method: Least Squares

Sample (adjusted): 1975 2006

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_CONS_1	-0.761895	0.190059	-4.008736	0.0005
D_RINT(-3)	-0.008939	0.003046	-2.935000	0.0069
D_LN_RM2	0.697276	0.296747	2.349732	0.0267
D_LN_HH_RCONEXP(-4)	-0.331278	0.127381	-2.600698	0.0151
DUMOIL	-2.14E-07	5.81E-08	-3.678653	0.0011
C	0.118381	0.059289	1.996668	0.0564

R-squared	0.660811	F-statistic	10.13067
Adjusted R-squared	0.595582	Prob(F-statistic)	0.000018

Durbin-Watson stat	1.624581		
Diagnostic Tests:			
Normality		1.103913	0.200215
Serial Correlation		0.916768	0.175711
Hetroschedasticity		0.096197	0.1546
Stability		1.114515	0.104190

Figure A3.1: Long-Run Residuals (Model A)

FIGURE 1: RESIDUALS RGDP TOTAL ECONOMY

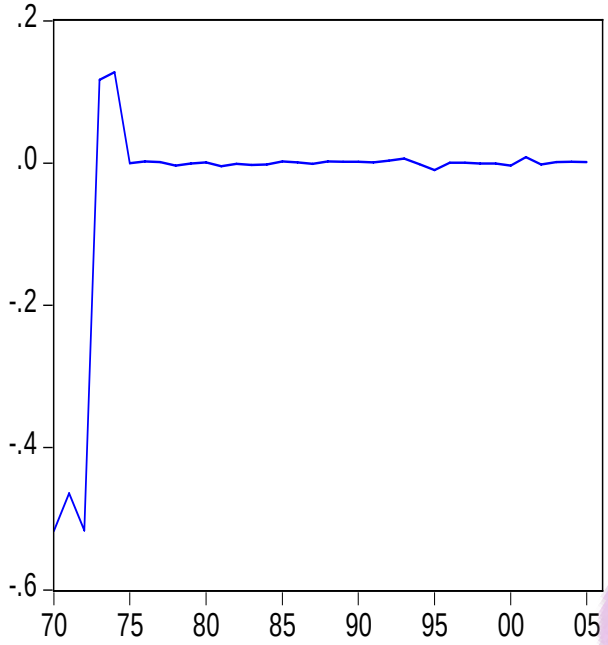


FIGURE 2: RESIDUALS RGDP OIL SECTOR

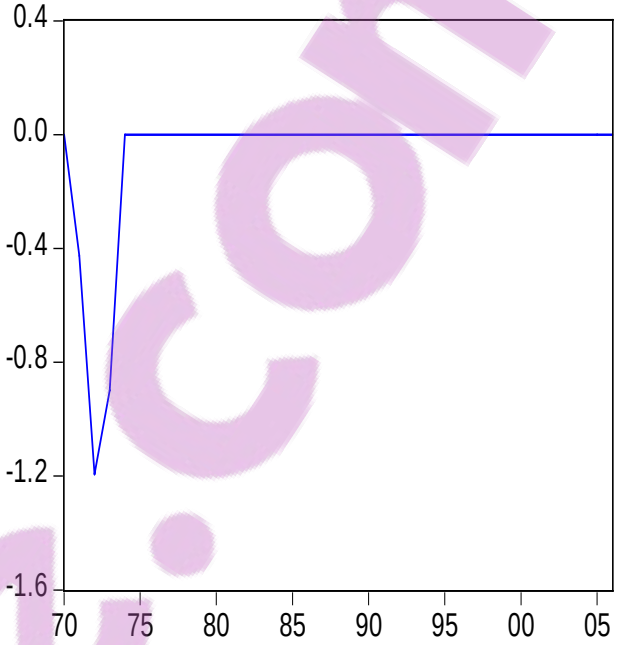


FIGURE 3: RESIDUALS LABOUR DEMAND

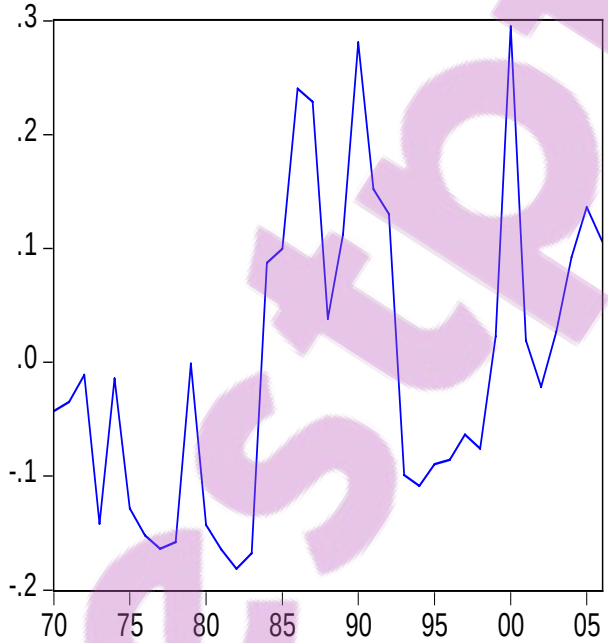


FIGURE 4: RESIDUALS REAL WAGE

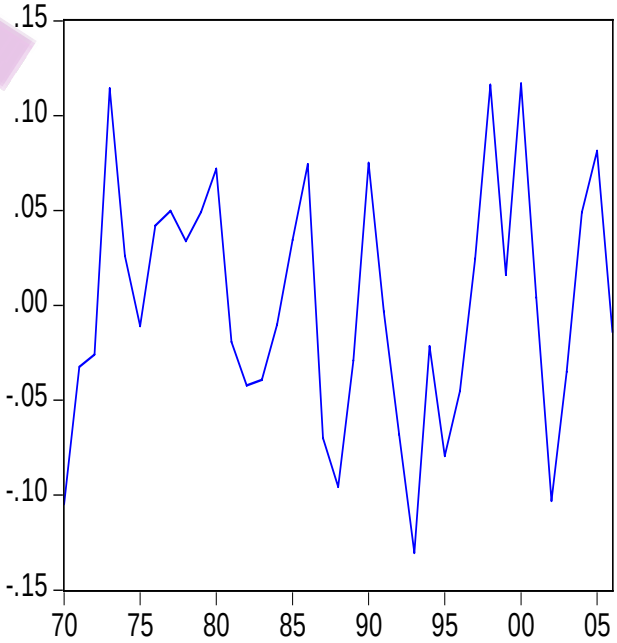


FIGURE 5: RESIDUALS INVESTMENT

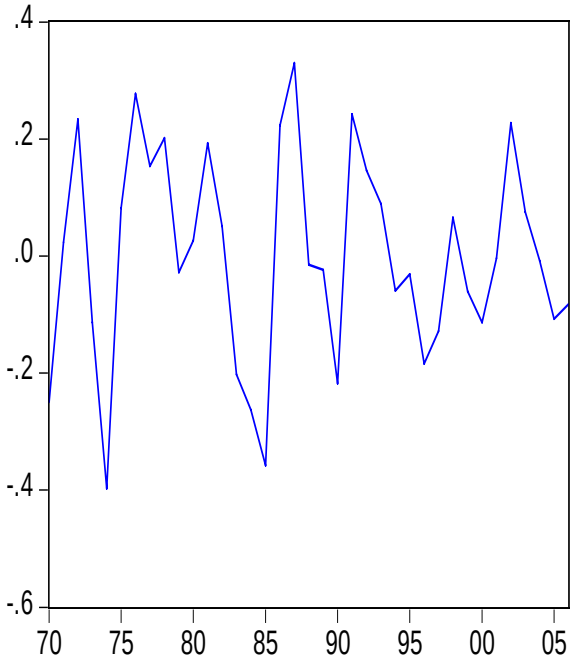


FIGURE 6: RESIDUALS TFP TOTAL ECONOMY

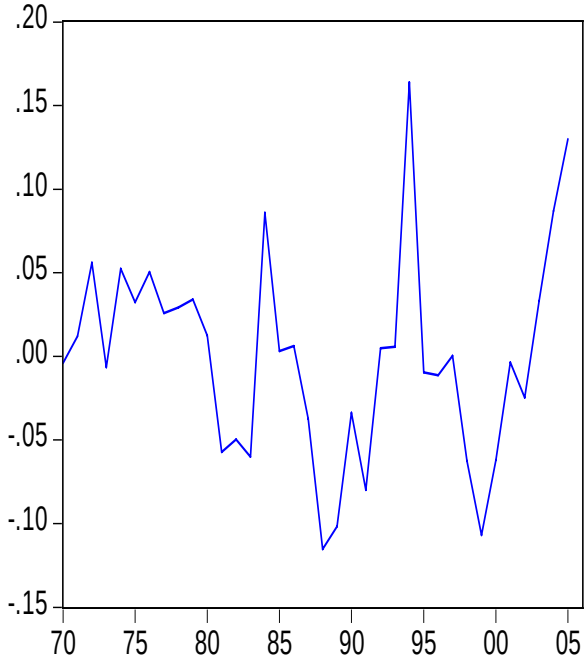


FIGURE 7: RESIDUALS TFP OIL SECTOR

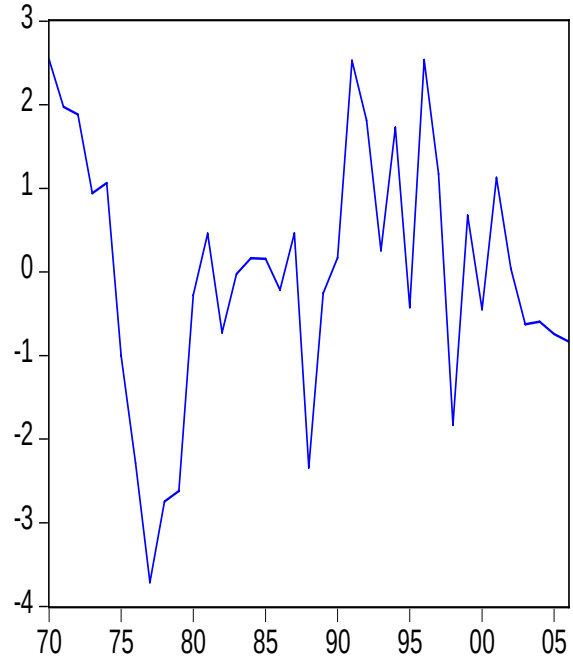


FIGURE 8: RESIDUALS CPI

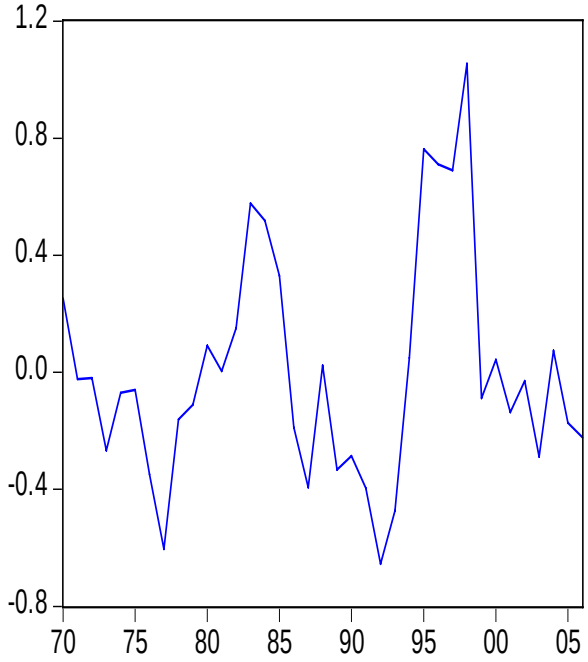


FIGURE 9: RESIDUALS PPI

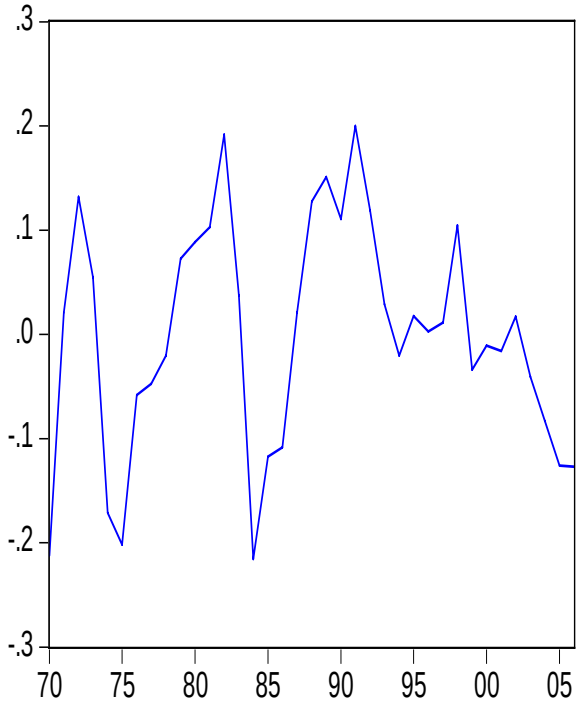


FIGURE 10: RESIDUALS SOCIO-ECONOMIC ACTIVITY

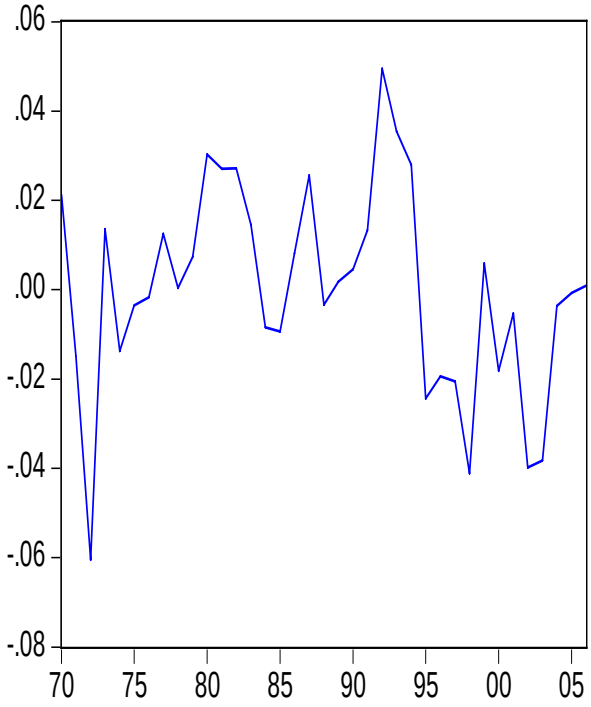


FIGURE 11: RESIDUALS HOUSEHOLD DISPOSABLE INCOME

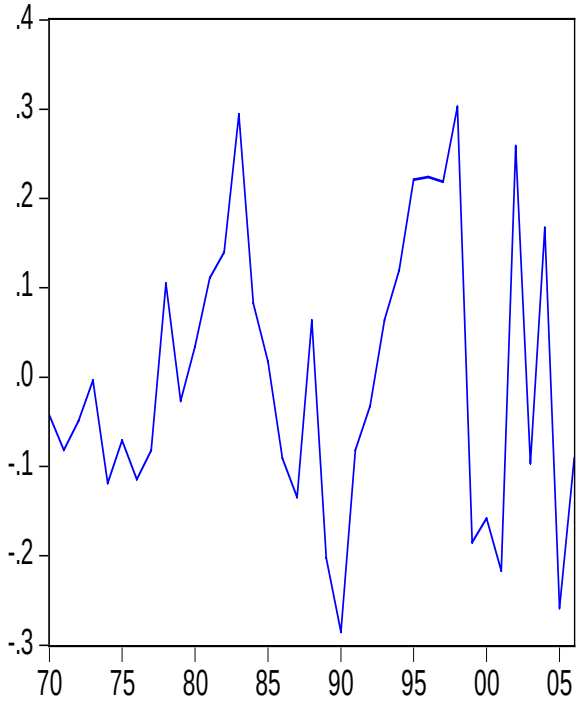


FIGURE 12: RESIDUALS POVERTY

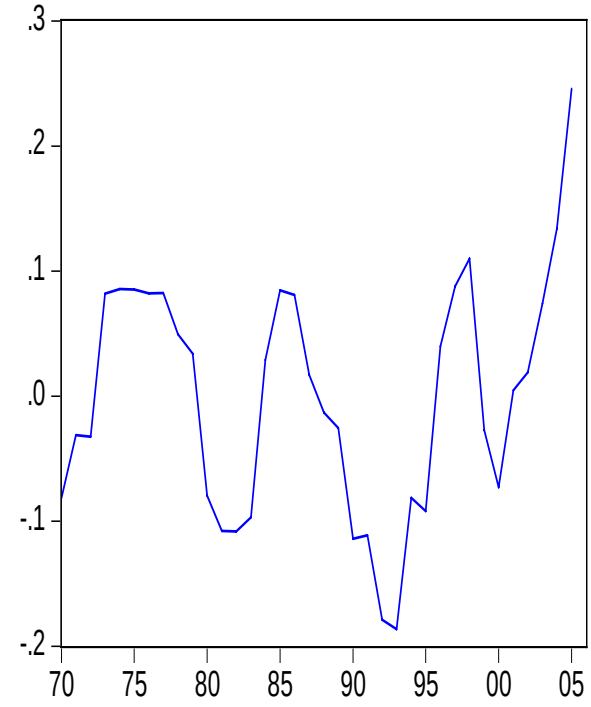


Figure 13: Residuals Agricultural Production

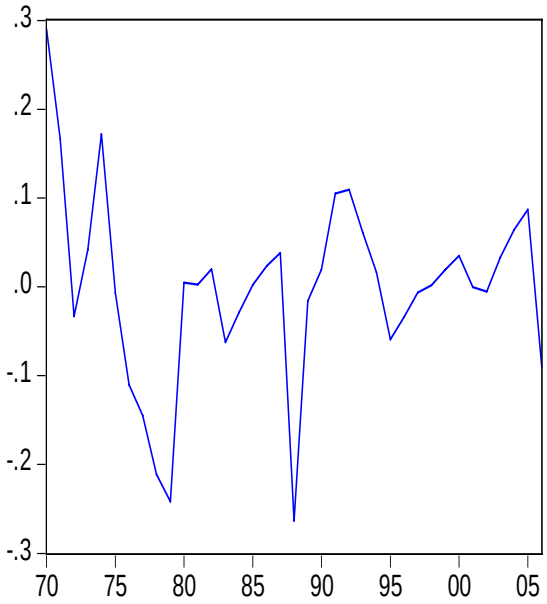


Figure 14: Residuals Infrastructure

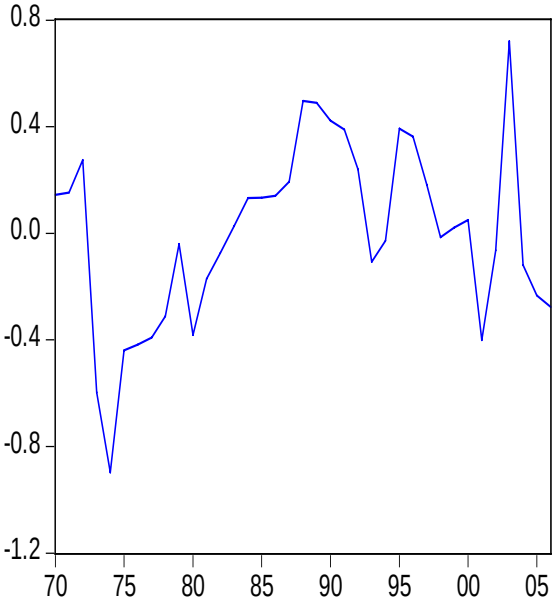


Figure 15: Residuals Exchange Rate

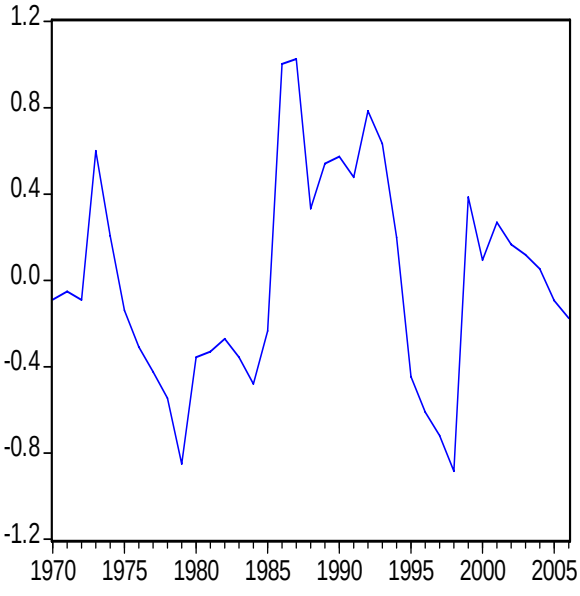


Figure 16: Residuals Interest Rate

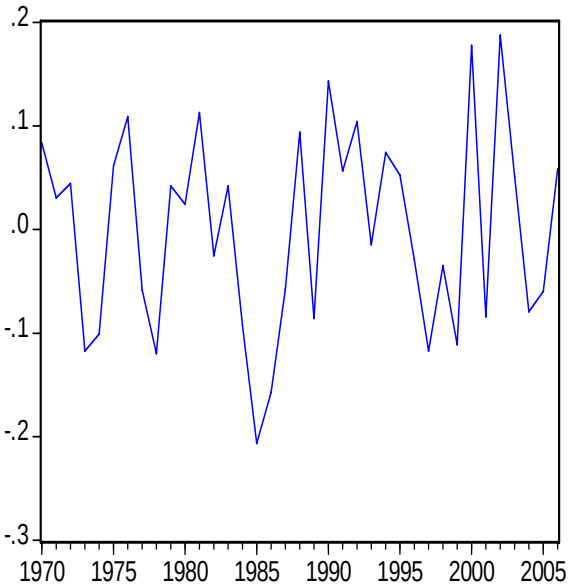


Figure 17: Residuals Exports

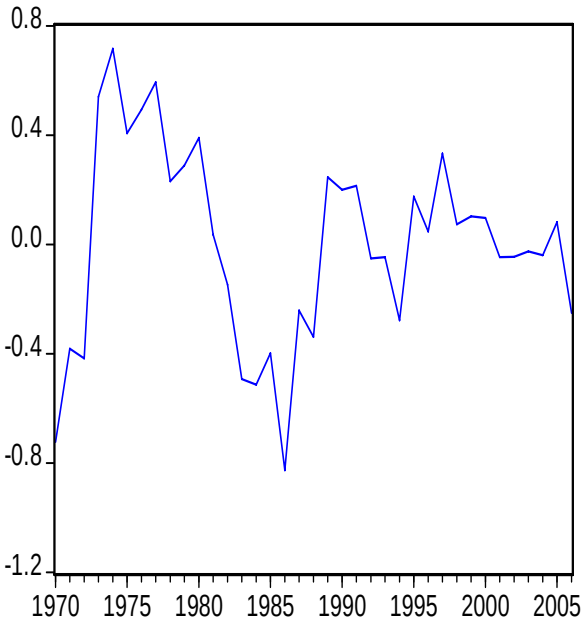


Figure 18: Residuals Imports

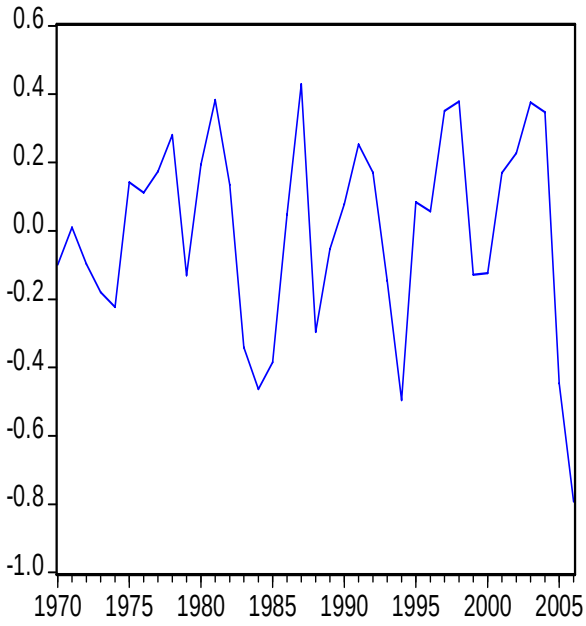


Figure 19: Residuals Consumption

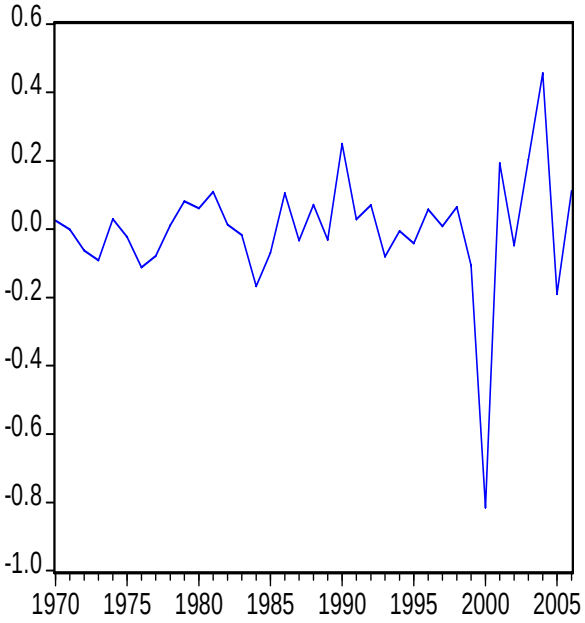


Figure 20: Residuals FDI

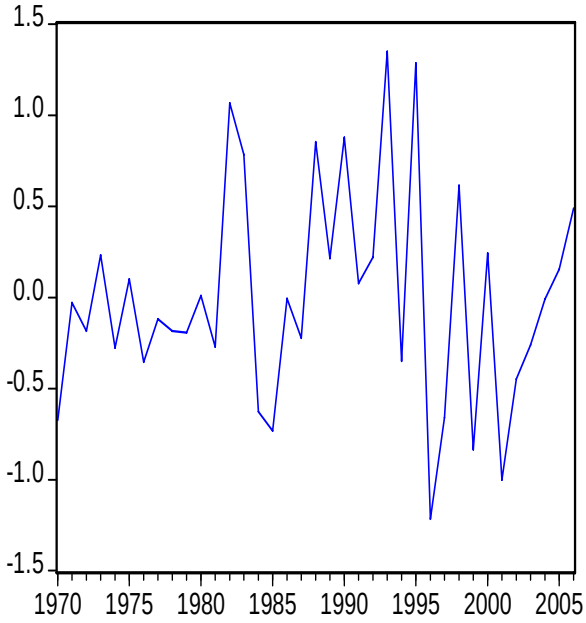


Figure A3.2: Long-Run Residuals (Model B)

Figure 1: Residuals Socio-economic Activity

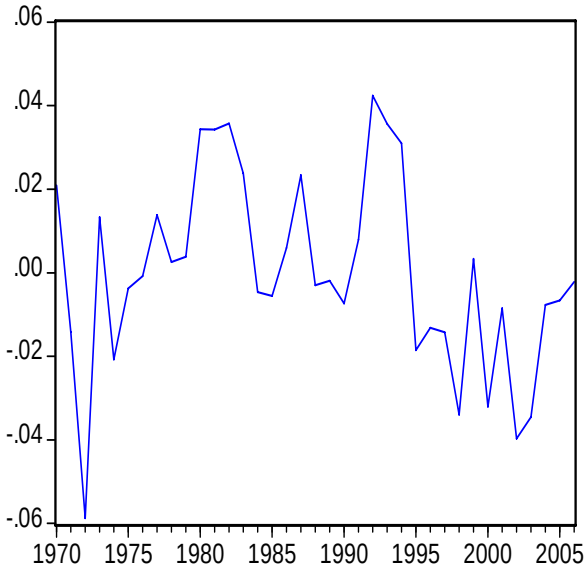


Figure 2: Residuals Poverty

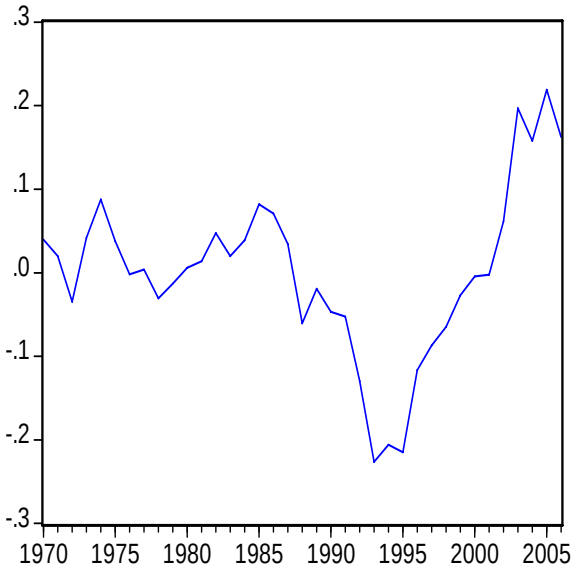


Figure 3: Residuals Disposable Income

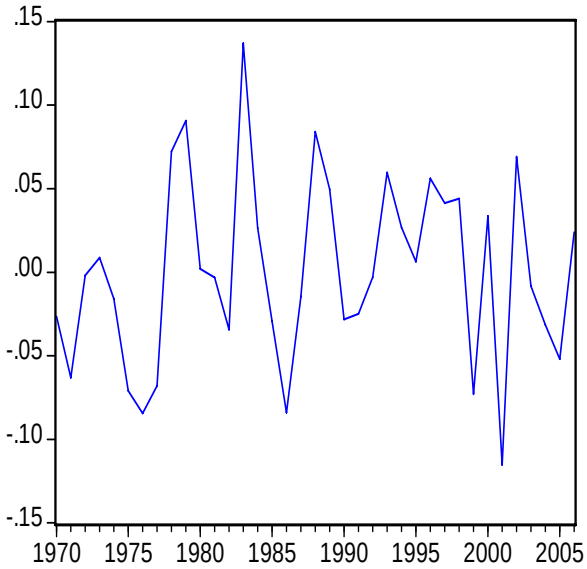
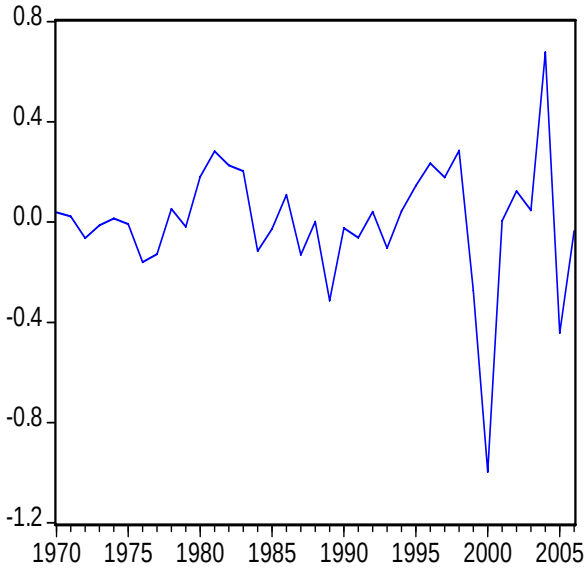


Figure 4: Residuals Consumption



APPENDIX 4

MODEL SIMULATIONS: ACTUAL AND FITTED VALUES

Figure A4.1: Model A

Figure 1: ln_rgdp

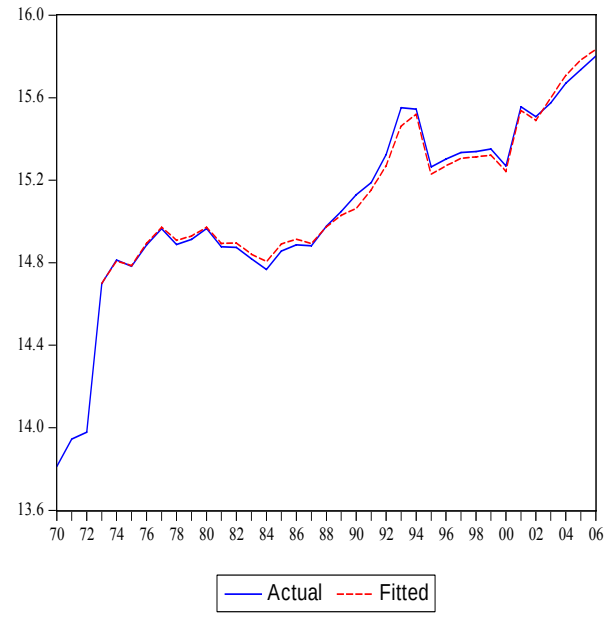


Figure 2: ln_rgdp_oil

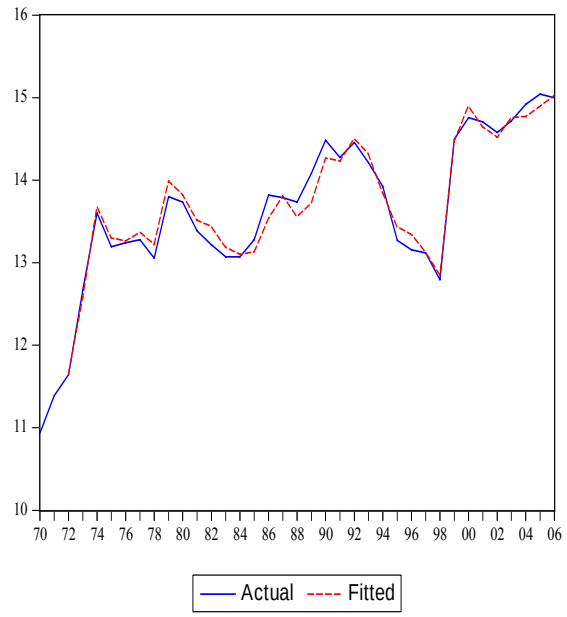


Figure 3: ln_labor_f

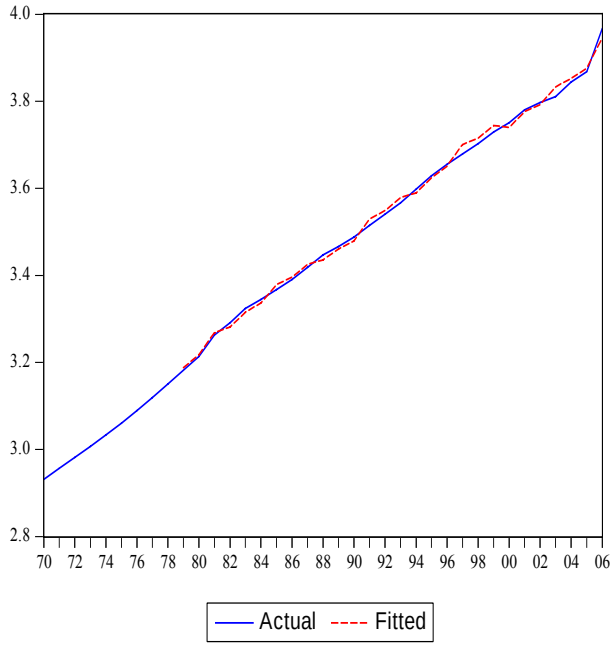


Figure 4: ln_rwage_lf

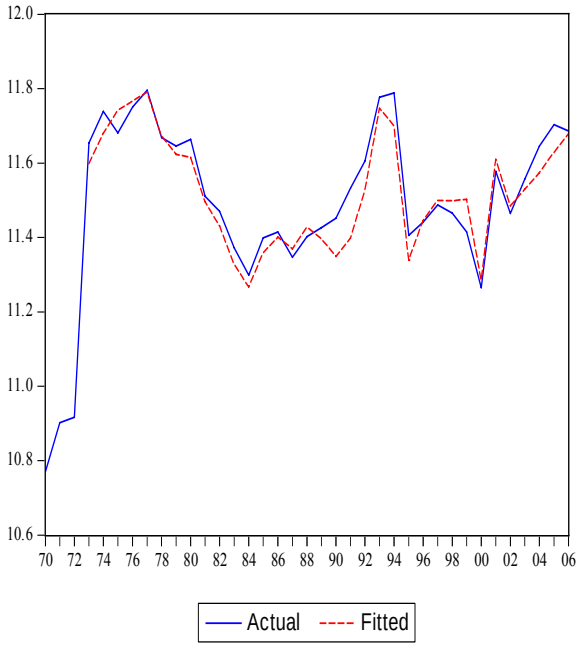


Figure 5: ln_gcf

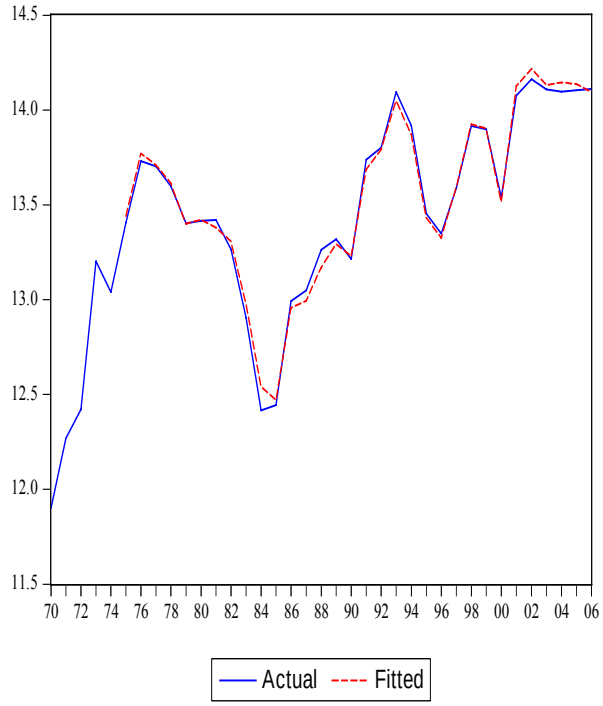


Figure 6: ln_tfp_tot

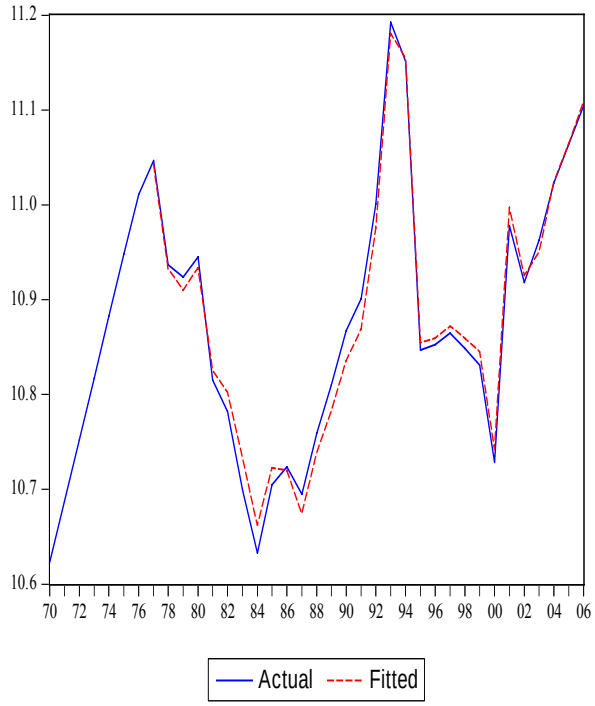


Figure 7: ln_tfp_oil

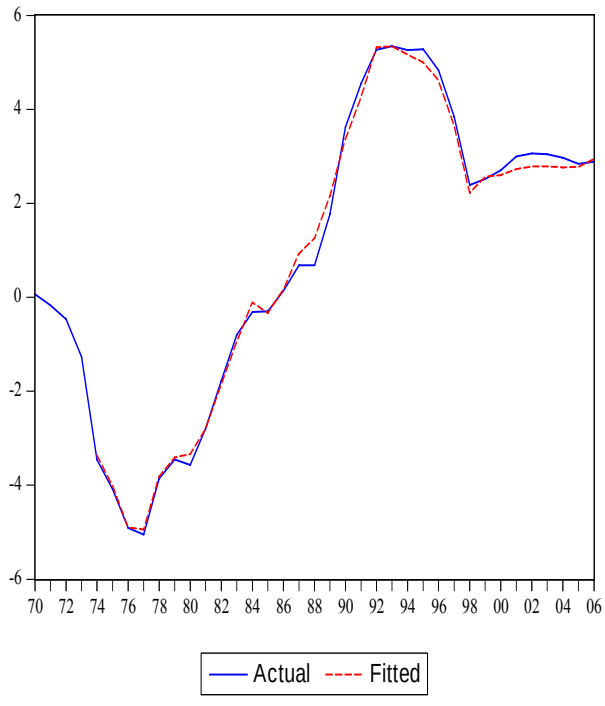


Figure 8: ln_cpi

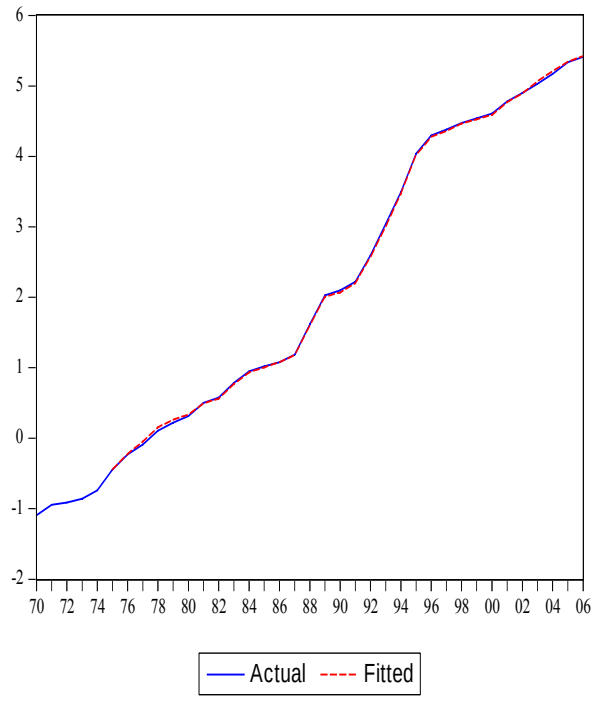


Figure 9: ln_ppi

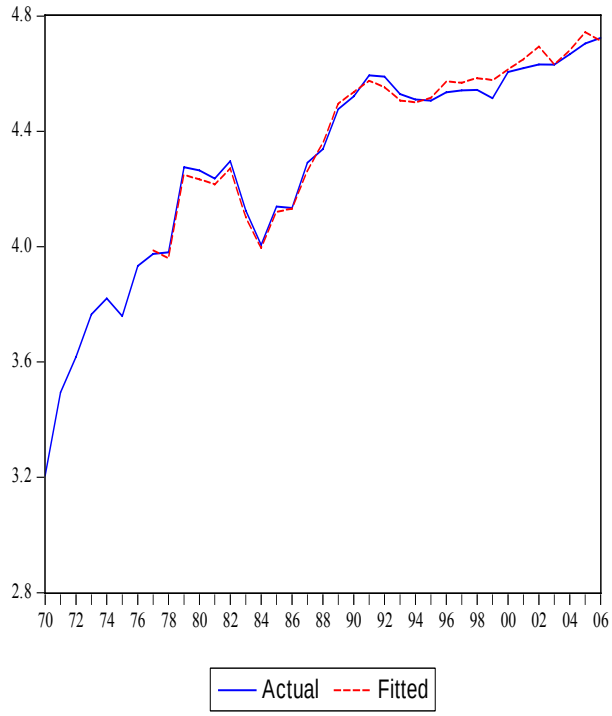


Figure 10: ln_se_index_b

Figure 11: ln_hh_rgdp_rest

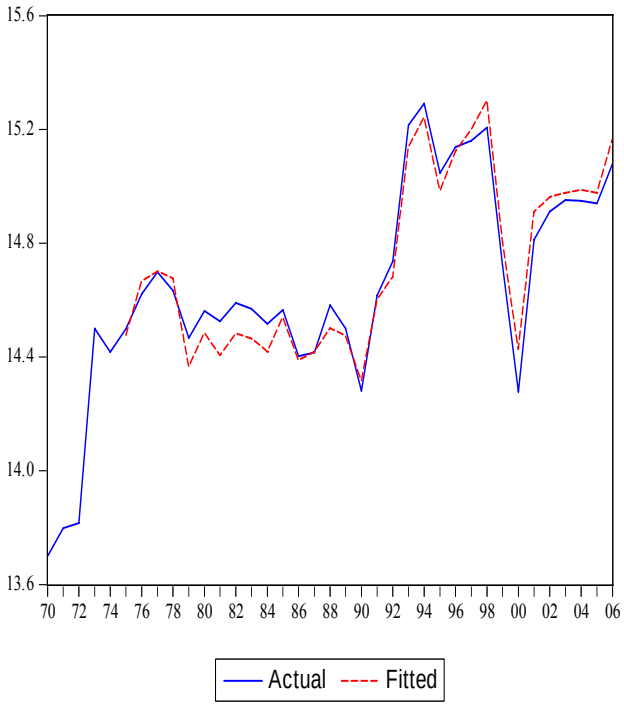


Figure 12: Ln_povertyd_index

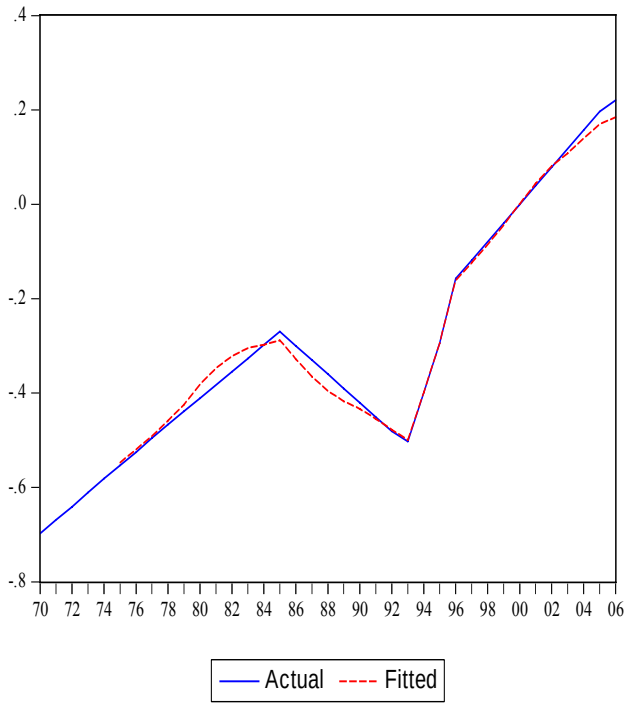


Figure 13: ln_elep

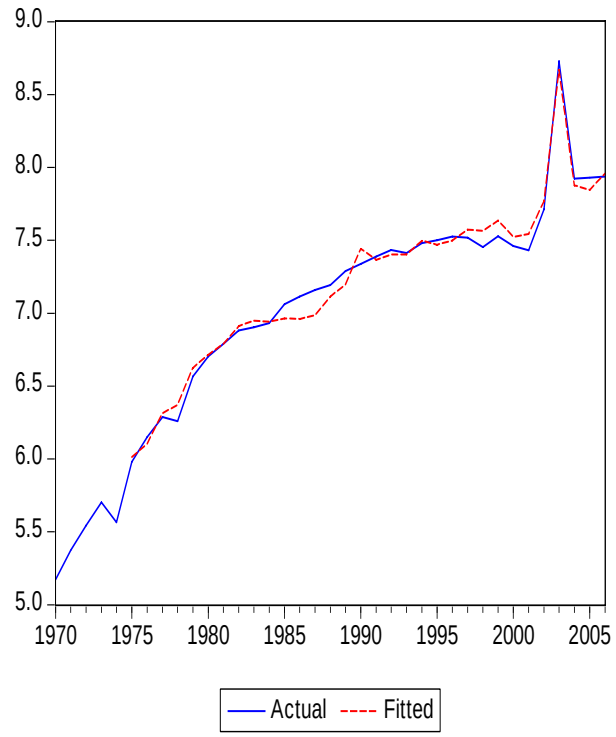


Figure 14: ln_index_agric

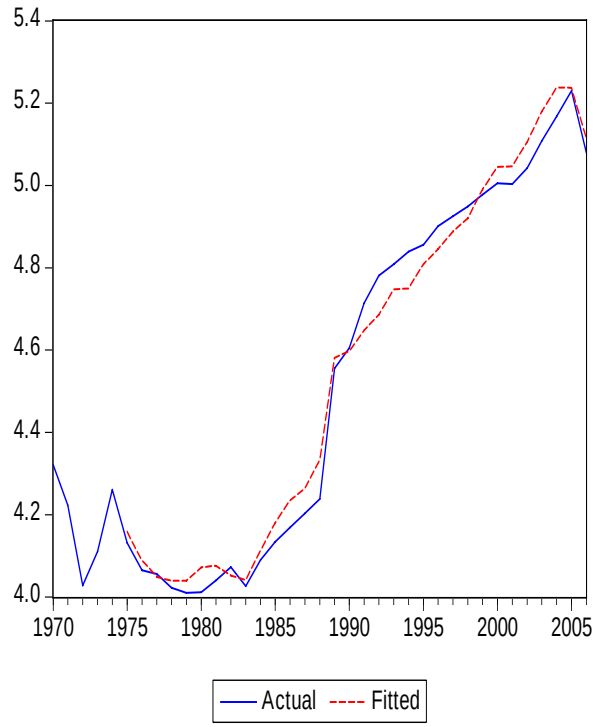


Figure 15: ln_exch

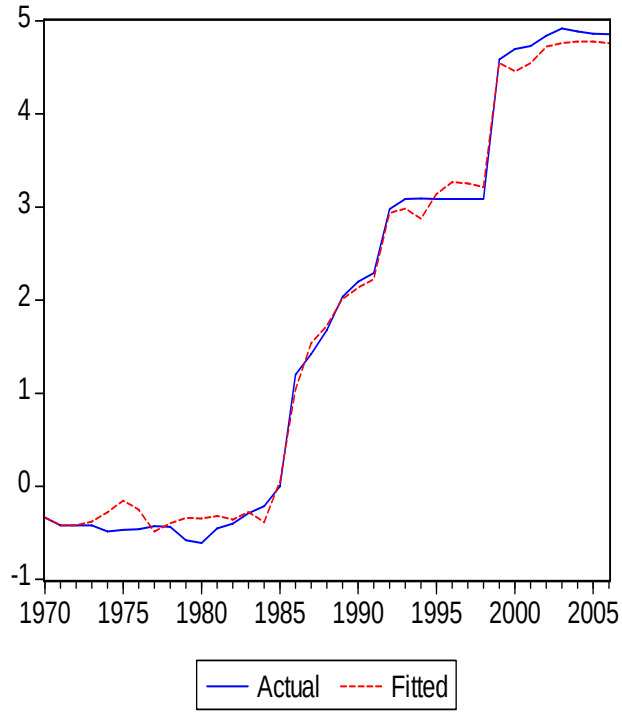


Figure 16: ln_rexp

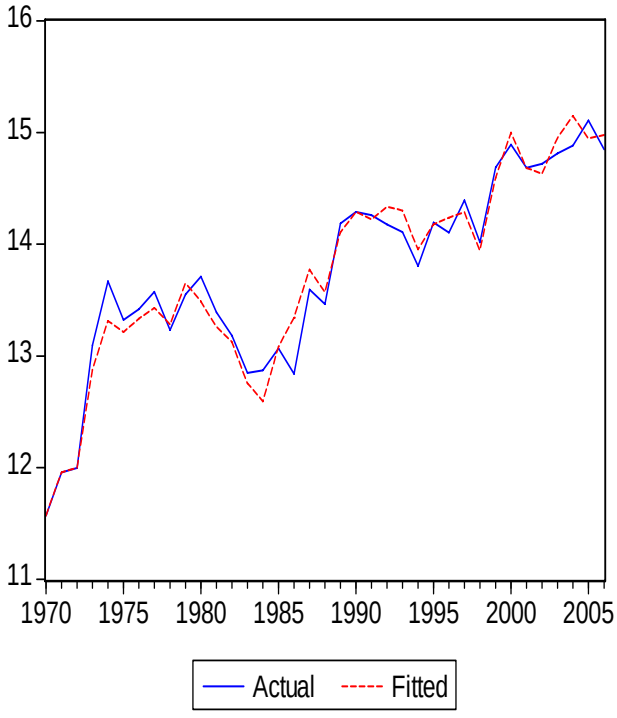


Figure 17: ln_rimp

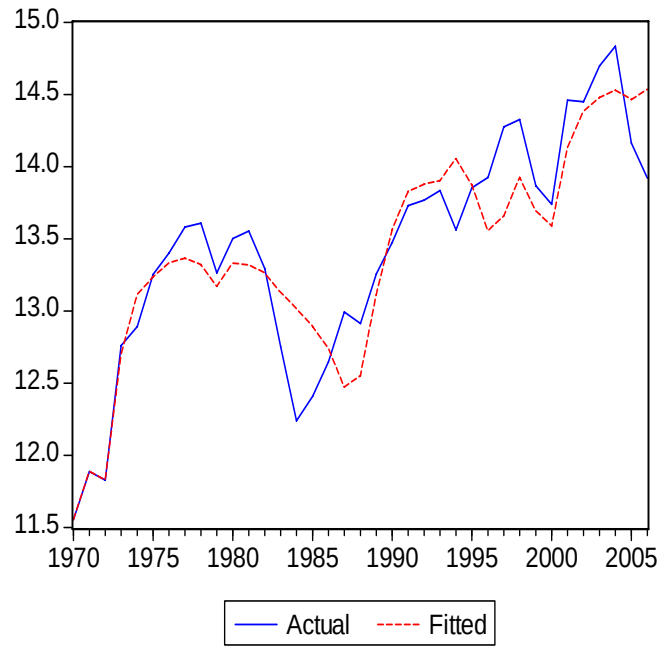


Figure 18: ln_int

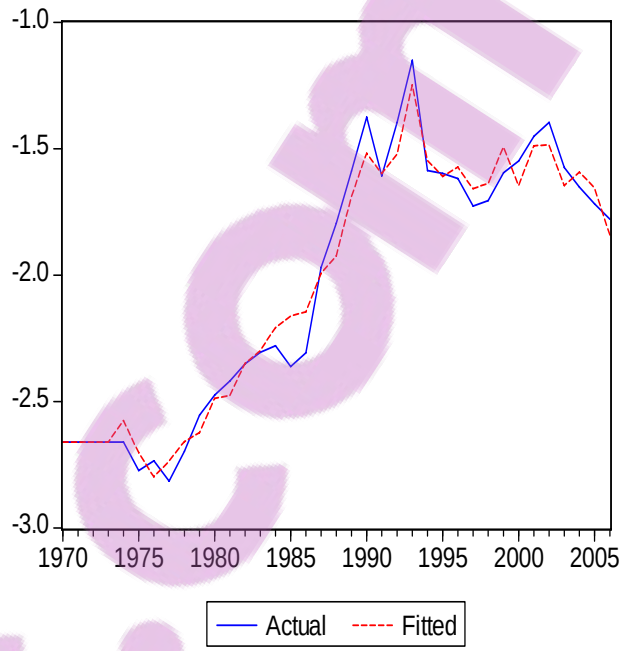


Figure 19: ln_hh_rconexp

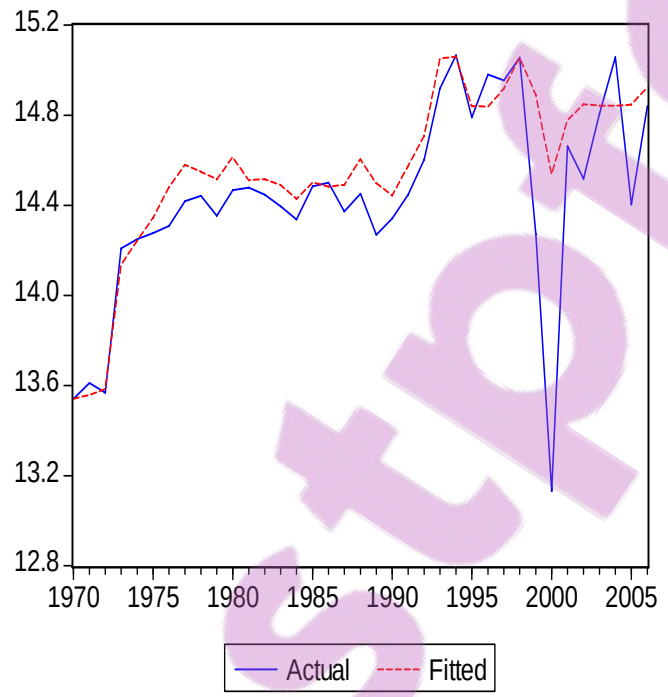


Figure 20: ln_fdi

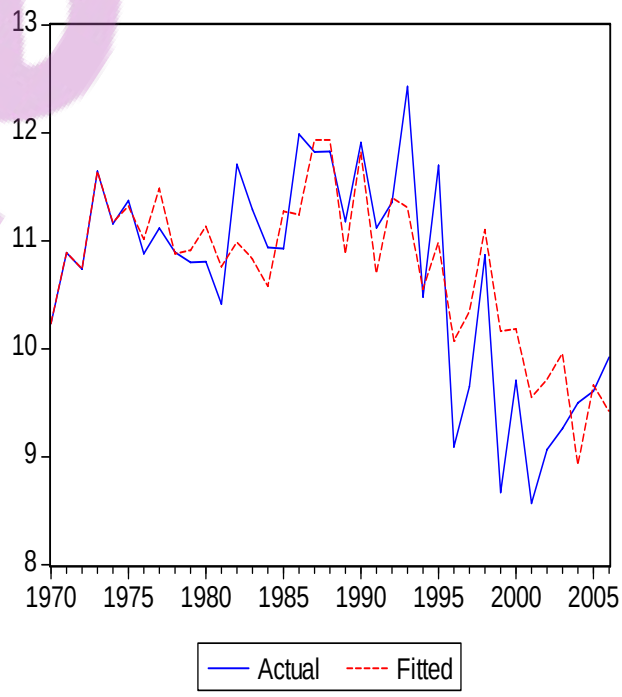


Figure A4.2: Model B

Figure 1: ln_se_index_b

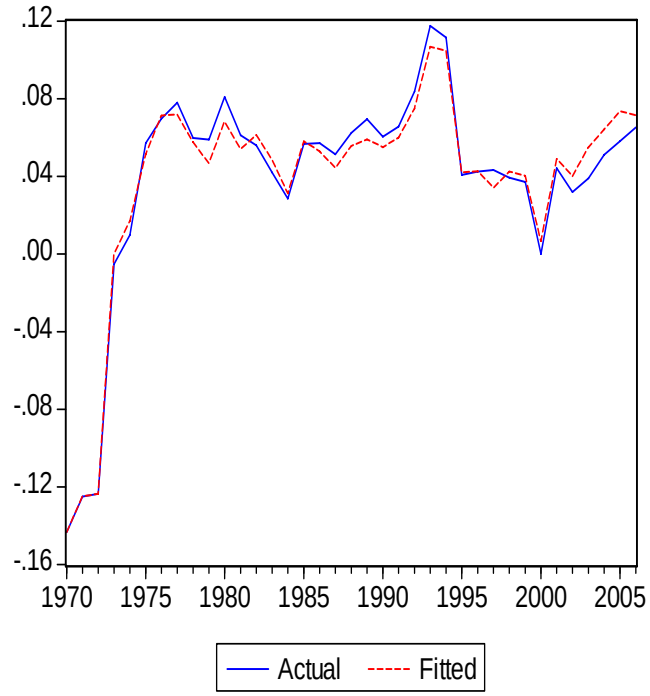


Figure 2 : ln_povertyd_index

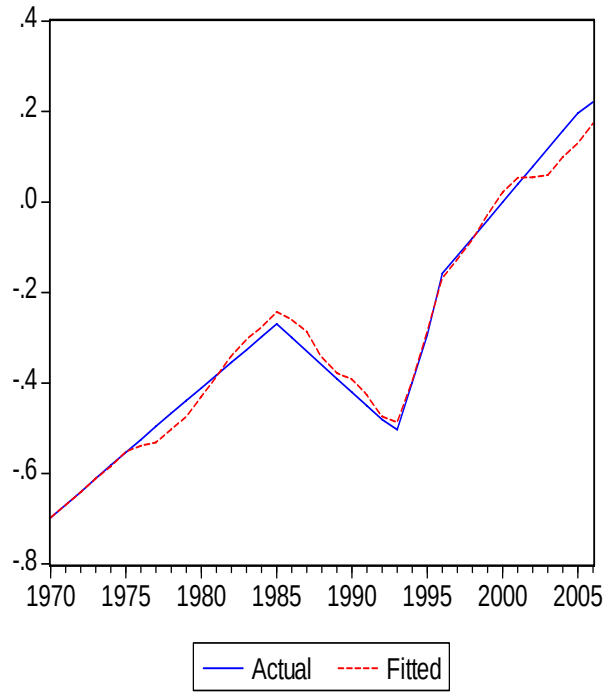


Figure 3 : ln_hh_rgdp

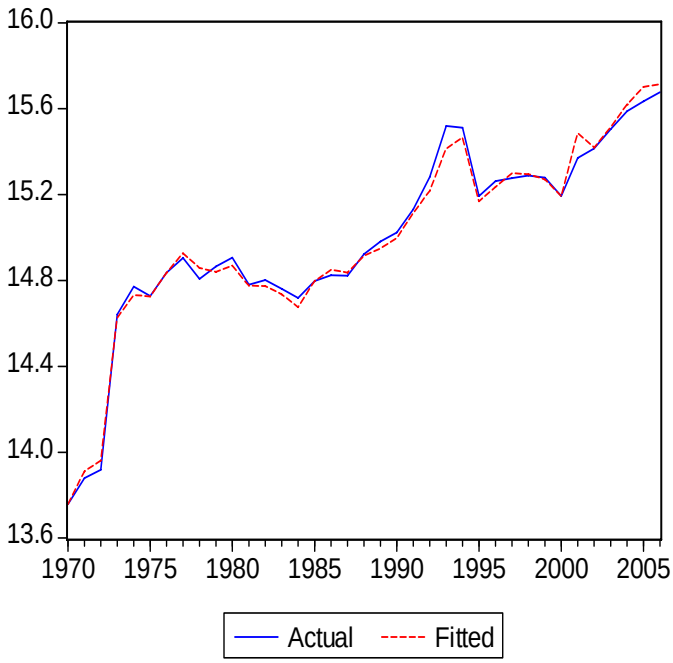


Figure 4 : ln_hh_rconexp

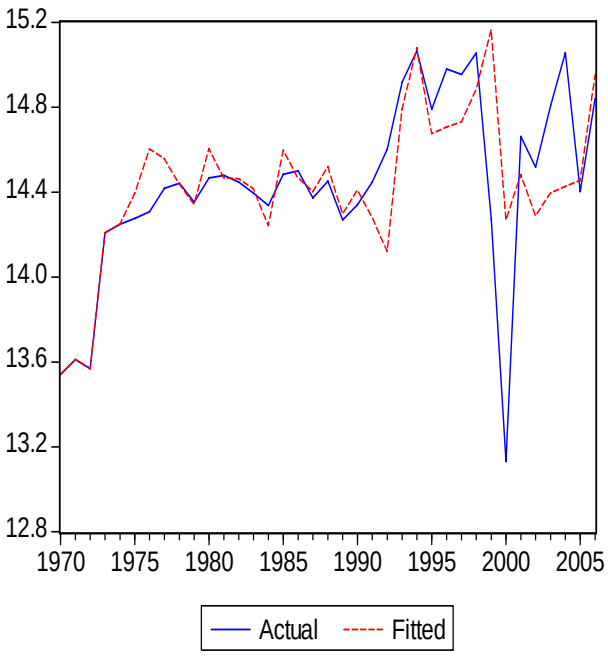


Figure 5 : ln_labor_f

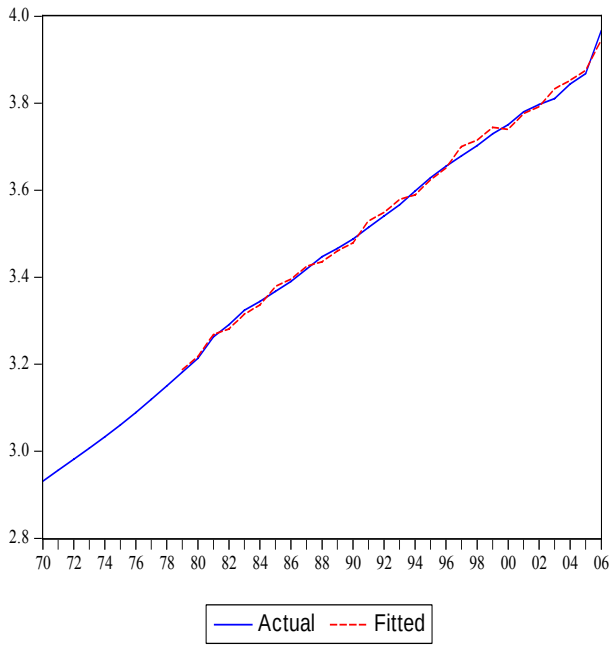
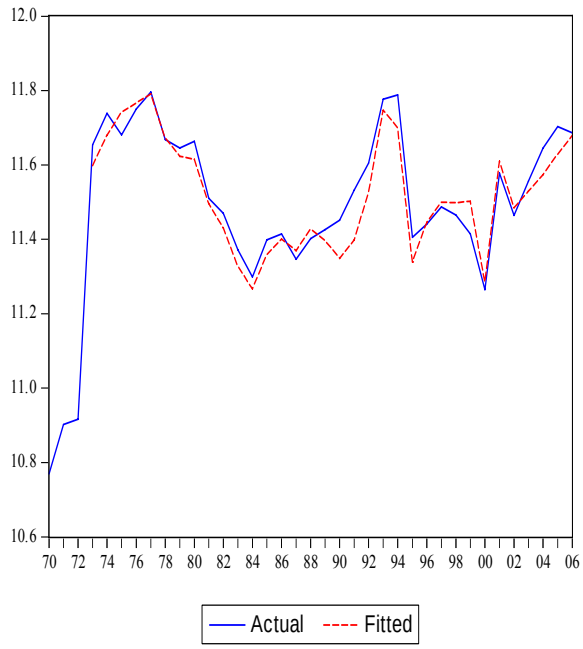


Figure 6 : ln_rwage_lf



APPENDIX 5

EQUATIONS, IDENTITIES, AND ESTIMATED PARAMETERS OF THE FULL SYSTEM

Model A

AGGREGATE SUPPLY

Production Function: Total Economy

residual_rgdp_tot1_1 = ln_rgdp(-1) - (0.179113 * ln_rk_stock2(-1) + (1 - 0.179113) * ln_labor_f(-1) + ln_tfp_tot1(-1))

LN_RGDP = - 0.138877 * RESIDUAL_RGDP_TOT1_1 + 0.118594 * (LN_RK_STOCK2 - ln_rk_stock2(-1)) + 0.820447 * (LN_RWAGE_LF - ln_rwage_lf(-1)) + 0.568914 * (LN_LABOR_F - ln_labor_f(-1)) - 0.077556 * (LN_CPI(-2) - ln_cpi(-3)) + 0.021167 + ln_rgdp(-1)

rgdp = exp(ln_rgdp)

Production Function: Oil Sector

residual_rgdp_oil_1 = ln_rgdp_oil(-1) - (sv_rk_stock2_oil1(-1) * ln_rk_stock2(-1) + (1 - sv_rk_stock2_oil1(-1)) * ln_labor_f(-1) + ln_tfp_oil(-1) + sv_dum_oil1(-1) * dum(-1))

ln_rgdp_oil = - 0.307895 * residual_rgdp_oil_1 - 0.101167 * (ln_capflow(-1) - ln_capflow(-2)) - 0.873676 * (ln_cpi - ln_cpi(-1)) + 0.911629 * (ln_oil_p - ln_oil_p(-1)) - 0.536847 * (ln_rwage_lf(-1) - ln_rwage_lf(-2)) + 0.403761 * (ln_rm2 - ln_rm2(-1)) + 0.089220 * dummy_m - 0.120577 * dum + ln_rgdp_oil(-1)

rgdp_oil = exp(ln_rgdp_oil)

Total Factor Productivity:

Total Economy

resid_tfp_tot_1 = LN_TFP_TOT1(-1) - (-0.276592 * LN_POVERTYD_INDEX(-1) + 0.127461 * LN_GCFGDP(-1) + 0.034384 * LN_FINCONSTR(-1) + 0.411404 * DUM_TFP(-1) - 4.496443 * DUMTFP(-1) + 9.394842)

LN_TFP_TOT1 = - 0.245419 * RESID_TFP_TOT_1 - 0.346988 * (LN_POVERTYD_INDEX - ln_povertyd_index(-1)) + 1.142799 * (LN_SE_INDEX_B - ln_se_index_b(-1)) + 0.214239 * DUM_TFP - 2.319164 * DUMTFP + ln_tfp_tot1(-1)

tfp_tot1 = exp(ln_tfp_tot1)

Oil Sector

LN_TFP_OIL = 0.951431 * LN_DCREDIT + 0.045328 * LN_FDI + 0.295148 * LN_OIL_P - 13.050955 + 2.590847 * DUMMY_M

tfp_oil = exp(ln_tfp_oil)

Labor Demand

resid_labor_1 = ln_labor_f(-1) - (0.687782 * ln_rgdp_rest(-1) - 0.569611 * ln_rwage_lf(-1) + 0.911231 * ln_se_index_b(-1) - 0.129847 * dum(-1) - 0.220239 * dummy_m(-1))

ln_labor_f = - 0.020519 * resid_labor_1 + 0.016037 * (ln_rgdp_rest(-3) - ln_rgdp_rest(-4)) + 0.163101 * (ln_rwage_lf(-3) - ln_rwage_lf(-4)) - 0.930285 * (ln_labor_f(-3) - ln_labor_f(-4)) + 0.026870 * (ln_agric_elep(-2) - ln_agric_elep(-3)) - 0.066981 * (ln_cpi(-5) - ln_cpi(-6)) + 0.246130 * (ln_se_index_b(-8) - ln_se_index_b(-9)) - 0.254760 * (ln_cu_tot(-3) - ln_cu_tot(-4)) + 0.015652 * (ln_exch(-7) - ln_exch(-8)) + 0.015746 * (ln_imp_p(-3) - ln_imp_p(-4)) - 0.049325 * (ln_rk_stock2 - ln_rk_stock2(-1)) + 0.005301 * (ln_rexpsocial(-6) - ln_rexpsocial(-7)) + 0.064965 + ln_labor_f(-1)

labor_f = exp(ln_labor_f)

Investment

resid_inv_1 = ln_gcf(-1) - (0.972006 * ln_rgdp(-1) - 0.074014 * ln_ucc(-1) + 0.323701 * pi(-1) + 0.496816 * ln_cu_tot(-1) - 0.349581 * dummy_m(-1) - 0.540648 * dum(-1))

LN_GCF = - 0.537726 * RESID_INV_1 + 1.146649 * (LN_RGDP - ln_rgdp(-1)) - 0.324343 * (LN_OIL_P - ln_oil_p(-1)) + 0.111214 * (LN_CAPFLOW(-2) - ln_capflow(-3)) + 0.166503 * (LN_EXCH - ln_exch(-1)) + 0.883835 * (LN_PPI(-1) - ln_ppi(-2)) + 1.226132 * (LN_RWAGE_LF(-2) - ln_rwage_lf(-3)) - 0.368711 * (LN_OPEN(-3) - ln_open(-4)) + 0.420187 * (LN_GCF(-1) - ln_gcf(-2)) - 1.094030 * (LN_CU_TOT(-2) - ln_cu_tot(-3)) - 0.291696 * (LN_HH_RGDP(-4) - ln_hh_rgdp(-5)) + ln_gcf(-1)

gcf = exp(ln_gcf)

Real Wage

LN_RWAGE_LF = 0.745313057 * LN_LABPROD_REST - 0.1726417349 * DUMMY_M + 0.1323589493 * DUM_OIL + 3.150153779

'LN_WAGE_LF = 1.027616393 * LN_CPI + 0.6054227737 * LN_LABPROD_REST

rwage_lf = exp(ln_rwage_lf)

AGGREGATE DEMAND

Consumption

resid_cons_1 = LN_HH_RCONEXP(-1) - (0.972615 * LN_HH_RGDP_REST(-1) + 0.004293 * LN_RM2(-1) + 0.007445 * RINT(-1) + 0.142686 * DUMMY_M(-1) + 0.184128 * DUM(-1))

LN_HH_RCONEXP = - 0.916454 * RESID_CONS_1 + 1.294527 * (LN_HH_RGDP_REST - ln_hh_rgdp_rest(-1)) - 0.004270 * (RINT(-3) - rint(-4)) - 0.211070 * (LN_HH_RCONEXP(-4) - ln_hh_rconexp(-5)) + ln_hh_rconexp(-1)

HH_RCONEXP = EXP(LN_HH_RCONEXP)

Export

resid_exp_1 = LN_REXP(-1) - (0.749785 * LN_RGDPUS(-1) + 0.338712 * LN_OIL_P(-1) - 0.203701 * LN_RELCPI(-1))

LN_REXP = - 0.552230 * RESID_EXP_1 + 0.306532 * (LN_OIL_P - ln_oil_p(-1)) - 0.275570 * (LN_EXCH(-2) - ln_exch(-3)) + 1.032138 * (LN_PPI - ln_ppi(-1)) + 2.462485 * (LN_RGDPUS(-4) - ln_rgdpus(-5)) - 0.224912 * DUM + ln_rexp(-1)

rexp = exp(ln_rexp)

Import

RESID_IMP_1 = LN_RIMP(-1) - (1.39051741 * LN_RGDP(-1) + 0.2132304288 * LN_RELCPI(-1) - 0.2061312587 * LN_EXCH(-1) - 0.4783556955 * DUM(-1) - 0.3211606128 * DUMMY_M(-1) - 6.396371801)

LN_RIMP = - 0.5811416067 * RESID_IMP_1 + 1.231037876 * (LN_RGDP - LN_RGDP(-1)) + 0.4013195261 * (LN_RIMP(-1) - LN_RIMP(-2)) - 0.1768633126 * (LN_OIL_P - LN_OIL_P(-1)) + 0.4740304797 * (LN_INT(-2) - LN_INT(-3)) + LN_RIMP(-1)

RIMP = EXP(LN_RIMP)

Interest Rate

RESID_INT_1 = LN_INT(-1) - (0.4892709087 * LN_RGDP(-1) - 0.2565779837 * LN_RM2(-1) + 0.7772942446 * LN_DIS_RATE(-1) - 7.693613293)

LN_INT = - 0.7188328105 * RESID_INT_1 + 0.5502197726 * (LN_DIS_RATE - LN_DIS_RATE(-1)) + 0.2433899603 * (LN_INT(-3) - LN_INT(-4)) + LN_INT(-1)

INT = EXP(LN_INT)

Exchange Rate

resid_exch_1 = LN_EXCH(-1) - (- 1.111410 * LN_RELRGDP(-1) + 0.781134 * LN_RELM2(-1) + 0.375075 * LN_RELCPI(-1) - 0.683912 * DUM(-1) + 8.498273)

LN_EXCH = - 0.294147 * RESID_EXCH_1 + 0.925168 * (LN_RELCPI - ln_relcpi(-1)) + 0.717931 * (LN_OIL_P - ln_oil_p(-1)) + 0.379537 * (LN_RELINT - ln_relint(-1)) + 0.781741 * (LN_GCF - ln_gcf(-1)) - 0.73753 * (LN_RELRGDP - ln_relrgdp(-1)) + 0.152819 * (LN_AID(-2) - ln_aid(-3)) - 0.096521 * (LN_RELREMIT - ln_relremit(-1)) - 3.373332 * (LN_M2_US - ln_m2_us(-1)) + 0.230886 * DUM + ln_exch(-1)

exch = exp(ln_exch)

PRICES

'

'Consumer Price Index

resid_cpi_1 = ln_cpi(-1) - (0.964454 * ln_ppi(-1) + 0.791153 * ln_imp_p(-1) + 0.893697 * ln_exch(-1) + 0.179694 * ln_excessd(-1) + 0.453542 * dummy_m(-1) - 0.247312 * dum_oil(-1) - 7.455257)

ln_cpi = - 0.054380 * resid_cpi_1 + 0.061703 * (ln_cpi(-1) - ln_cpi(-2)) - 0.149378 * (ln_excessd - ln_excessd(-1)) + 0.039443 * (ln_imp_p(-4) - ln_imp_p(-5)) - 0.164863 * (ln_ppi - ln_ppi(-1)) + 0.938521 * (ln_wage_lf - ln_wage_lf(-1)) - 0.062425 * (ln_int(-4) - ln_int(-5)) + 0.033780 * (ln_transfer(-3) - ln_transfer(-4)) - 1.140638 * (ln_rgdp - ln_rgdp(-1)) + 0.060282 * (ln_exch - ln_exch(-1)) + 0.078148 * (ln_eleppop(-4) - ln_eleppop(-5)) + 0.028130 * (ln_capflow(-2) - ln_capflow(-3)) + 0.012813 + ln_cpi(-1)

cpi = exp(ln_cpi)

Producer Price Index

LN_PPI = 0.007109 * LN_WAGE_LF + 0.076239 * LN_OIL_P + 0.484784 * LN_CU_TOT + 0.197271 * LN_INT + 4.466082

ppi = exp(ln_ppi)

OTHER BEHAVIOURAL EQUATIONS

Socio-Economic Activity

resid_se_rest_1 = ln_se_index_b(-1) - (0.030940 * ln_hh_rgdp_rest(-1) + 0.032528 * ln_rexpsocial(-1) + 0.022355 * ln_eleppop(-1) + 0.037452 * dummy_m(-1) - 0.543475)

ln_se_index_b = - 0.329734 * resid_se_rest_1 - 0.006750 * (ln_capflow - ln_capflow(-1)) + 0.011303 * (ln_rexpsocial - ln_rexpsocial(-1)) + 0.047847 * (ln_rgdp(-2) - ln_rgdp(-3)) + 0.134396 * (ln_hh_rgdp - ln_hh_rgdp(-1)) - 0.010816 * (ln_eleppop - ln_eleppop(-1)) - 0.053352 * (ln_excessd(-1) - ln_excessd(-2)) - 0.074722 * (ln_povertyd_index(-1) - ln_povertyd_index(-2)) + 0.009144 * dum - 5.47E-09 * dumoil + ln_se_index_b(-1)

se_index_b = exp(ln_se_index_b)

Infrastrucure

resid_elep_1 = ln_elep(-1) - (1.430276 * ln_rgdp(-1) + 0.845762 * ge(-1) + 0.404438 * dum(-1) - 13.57408)

LN_ELEP = - 0.354742 * RESID_ELEP_1 + 1.520223 * (GE - ge(-1)) + 0.394435 * (LN_ELEP(-4) - ln_elep(-5)) - 0.444890 * (LN_RGDP_REST(-3) - ln_rgdp_rest(-4)) + 0.324727 * (LN_UCC(-4) - ln_ucc(-5)) + 1.982076 * (LN_SE_INDEX_B(-3) - ln_se_index_b(-4)) + ln_elep(-1)

elep = exp(ln_elep)

Poverty

resid_povertyd_new1_1 = LN_POVERTYD_INDEX(-1) - (0.237591 * LN_CPI(-1) - 0.541746 * LN_INDEX_AGRIC(-1) - 0.151928 * LN_HH_RGDP_REST(-1) - 0.002034 * LN_AIDPOP(-1) - 0.073436 * LN_ELEPPOP(-1) + 3.028525)

LN_POVERTYD_INDEX = - 0.093114 * RESID_POVERTYD_NEW1_1 + 0.045429 * (LN_WAGE_LABOR(-2) - ln_wage_labor(-3)) + 0.742858 * (LN_POVERTYD_INDEX(-1) - ln_povertyd_index(-2)) + 0.066169 * (LN_CPI(-1) - ln_cpi(-2)) + 0.559386 * (LN_LABOR_F - ln_labor_f(-1)) - 0.806361 * (LN_LABOR_F(-3) - ln_labor_f(-4)) - 0.014158 * (LN_CAPFLOW(-2) - ln_capflow(-3)) + 0.023840 * (LN_ELEPPOP(-2) -

ln_eleppop(-3)) + 0.004247 * DUM_POVD - 0.026275 * (LN_AIDPOP(-4) - ln_aidpop(-5)) + ln_povertyd_index(-1)

povertyd_index = exp(ln_povertyd_index)

Agric Production

RESID_AGRIC1_1 = LN_INDEX_AGRIC(-1) - (- 0.137146446709 * LN_PPI(-1) + 0.400086304569 * LN_ELEP(-1) + 0.580866145411 * LN_LAND(-1) - 0.556776445008 * DUM(-1) - 0.165236631234 * DUMMY_M(-1))

LN_INDEX_AGRIC = - 0.190114100061 * RESID_AGRIC1_1 + 0.187988440706 * (LN_CPI - ln_cpi(-1)) - 0.697645588961 * (LN_RK_STOCK2(-1) - ln_rk_stock2(-2)) - 4.70194380403 * (LN_LAND(-4) - ln_land(-5)) - 0.033844484003 * (LN_AID(-2) - ln_aid(-3)) + 0.10754425889 * (LN_UCC(-3) - ln_ucc(-4)) - 0.322952206752 * (PI(-4) - pi(-5)) + 0.181144701167 * (LN_INDEX_AGRIC(-1) - ln_index_agric(-2)) + 0.123403670113 * (LN_OPEN(-4) - ln_open(-5)) + 0.151371328198 * (LN_PPI - ln_ppi(-1)) - 0.104567508704 * (LN_ELEP(-1) - ln_elep(-2)) + ln_index_agric(-1)

index_agric = exp(ln_index_agric)

Disposable Income

resid_hh_rest_1 = ln_hh_rgdp_rest(-1) - (0.876241 * ln_rwage_lf(-1) + 0.110486 * ln_transfer(-1) + 0.115174 * dummy_m(-1) - 1.19E-07 * dumoil(-1) + 3.476751)

LN_HH_RGDP_REST = - 0.263604 * RESID_HH_REST_1 + 1.012605 * (LN_RWAGE_LF - ln_rwage_lf(-1)) - 0.045298 * (LN_CAPFLOW(-4) - ln_capflow(-5)) + 0.166261 * (LN_TRANSFER(-3) - ln_transfer(-4)) + 0.390019 * (LN_RK_STOCK2(-4) - ln_rk_stock2(-5)) - 0.125216 * (LN_FINCONSTR - ln_finconstr(-1)) + 0.175539 * (LN_CU_TOT(-4) - ln_cu_tot(-5)) - 0.381874 * (LN_PPI - ln_ppi(-1)) + 0.968760 * (LN_INDEX_AGRIC(-2) - ln_index_agric(-3)) - 3.66e-08 * DUMOIL + ln_hh_rgdp_rest(-1)

hh_rgdp_rest = exp(ln_hh_rgdp_rest)

Foriegn Direct Investment

RESID_FDI_1 = LN_FDI(-1) - (0.6816131507 * LN_RGDP(-1) - 0.4966291681 * LN_CPI(-1) + 0.07596241635 * LN_OPEN(-1) + 0.2880109528 * LN_EXCH(-1) + 1.16824926 * DUMMY_M(-1) + 0.978210767 * DUM(-1))

LN_FDI = - 0.5906001952 * RESID_FDI_1 - 0.3733726592 * (LN_FDI(-1) - LN_FDI(-2)) + 0.2173172107 * (LN_FDI(-3) - LN_FDI(-4)) - 0.7926940282 * (LN_GCF(-3) - LN_GCF(-4)) + 0.6653683842 * (LN_OPEN(-3) - LN_OPEN(-4)) + LN_FDI(-1)

FDI = EXP(LN_FDI)

IDENTITIES AND DEFINITIONS

rgdp_rest = rgdp - rgdp_oil

ln_rgdp_rest = log(rgdp_rest)

tfp_rest = tfp_tot1 - tfp_oil

ln_tfp_rest = log(tfp_rest)

rk_stock2 = (1 - depr) * rk_stock2(-1) + gcf(-1)

ln_rk_stock2 = log(rk_stock2)

total_govexp = rexpsocial + transfer + other_govexp

ln_total_govexp = log(total_govexp)

ln_other_govexp = log(other_govexp)

ln_capflow = log(capflow)

ln_oil_p = log(oil_p)

gcfgdp = gcf / rgdp

ln_gcfgdp = log(gcfgdp)

finconstr = gds_nom + capflow + creserv + depr_value

ln_gds_nom = log(gds_nom)

ln_depr_value = log(depr_value)

ln_finconstr = log(finconstr)

cu_tot = rgdp / potrgdp

ln_cu_tot = log(cu_tot)

ln_aid = log(aid)

ln_pop = log(pop)

ln_rexpsocial = log(rexpsocial)

ln_dcredit = log(dcredit)

govcongdp = govtcons / rgdp

ln_govtcons = log(govtcons)

ln_govcongdp = log(govcongdp)

agric_elep = index_agric / index_elep

index_elep = (elep / 1738.3) * 100

ln_index_elep = log(index_elep)

ln_agric_elep = log(agric_elep)

open = (rexp + rimp) / rgdp

ln_open = log(open)

RINT = INT - INF

INF = ((CPI - CPI(-1)) / CPI(-1))

relcpi = cpi / cpi_us

ln_cpi_us = log(cpi_us)

ln_relcpi = log(relcpi)

relrgdp = rgdp / rgdpus

ln_rgdpus = log(rgdpus)

ln_relrgdp = log(relrgdp)

relm2 = m2 / m2_us

ln_m2_us = log(m2_us)

ln_m2 = log(m2)

```
rm2  = m2  / gdp_def

ln_rm2  = log(rm2)

ln_relm2  = log(relm2)

relint  = int  / int_us

ln_int_us  = log(int_us)

ln_relint  = log(relint)

relremit  = remit  / remit_us

ln_remit  = log(remit)

ln_remit_us  = log(remit_us)

ln_relremit  = log(relremit)

LN_DIS_RATE  = LOG(DIS_RATE)

ln_imp_p  = log(imp_p)

wage_lf  = rwage_lf  * gdp_def

ln_wage_lf  = log(wage_lf)

wagelfucc  = wage_lf  / ucc

ucc  = (1  + int)  * exch

ln_ucc  = log(ucc)

ln_wagelfucc  = log(wagelfucc)

eleppop  = elep  / pop

ln_eleppop  = log(eleppop)

hh_rgdp  = (1  - taxr)  * rgdp

ln_hh_rgdp  = log(hh_rgdp)
```

gdp = rgdp * gdp_def

excessd = gne_nom / gdp

gne_nom = (hh_rconexp + gcf + total_govexp) * gdp_def

ln_gdp = log(gdp)

ln_gne_nom = log(gne_nom)

ln_excessd = log(excessd)

wage_labor = rwage_lf / labor_f

ln_wage_labor = log(wage_labor)

ln_transfer = log(transfer)

ln_land = log(land)

cad = rexp - rimp

labprod_tot = rgdp / labor_f

ln_labprod_tot = log(labprod_tot)

aidpop = aid / pop

ln_aidpop = log(aidpop)

MODEL B

AGGREGATE SUPPLY

Production Function: Total Economy

ln_potrgdp = 0.179113 * ln_rk_stock2pot + (1 - 0.179113) * ln_pop_active + ln_tfp_totpot

potrgdp = exp(ln_potrgdp)

Labour Demand

LN_LABOR_F = 0.831114 * LN_RGDP - 0.790810 * LN_RWAGE_LF + 0.088369 * LN_SE_INDEX_B

labor_f = exp(ln_labor_f)

Investment

resid_inv_1 = ln_gcf(-1) - (0.972006 * ln_rgdp(-1) - 0.074014 * ln_ucc(-1) + 0.323701 * pi(-1) + 0.496816 * ln_cu_tot(-1) - 0.349581 * dummy_m(-1) - 0.540648 * dum(-1))

LN_GCF = - 0.537726 * RESID_INV_1 + 1.146649 * (LN_RGDP - ln_rgdp(-1)) - 0.324343 * (LN_OIL_P - ln_oil_p(-1)) + 0.111214 * (LN_CAPFLOW(-2) - ln_capflow(-3)) + 0.166503 * (LN_EXCH - ln_exch(-1)) + 0.883835 * (LN_PPI(-1) - ln_ppi(-2)) + 1.226132 * (LN_RWAGE_LF(-2) - ln_rwage_lf(-3)) - 0.368711 * (LN_OPEN(-3) - ln_open(-4)) + 0.420187 * (LN_GCF(-1) - ln_gcf(-2)) - 1.094030 * (LN_CU_TOT(-2) - ln_cu_tot(-3)) - 0.291696 * (LN_HH_RGDP(-4) - ln_hh_rgdp(-5)) + ln_gcf(-1)

gcf = exp(ln_gcf)

Total Factor Productivity:Total Economy

resid_tfp_tot_1 = LN_TFP_TOT1(-1) - (-0.276592 * LN_POVERTYD_INDEX(-1) + 0.127461 * LN_GCFGDP(-1) + 0.034384 * LN_FINCONSTR(-1) + 0.411404 * DUM_TFP(-1) - 4.496443 * DUMTFP(-1) + 9.394842)

LN_TFP_TOT1 = - 0.245419 * RESID_TFP_TOT_1 - 0.346988 * (LN_POVERTYD_INDEX - ln_povertyd_index(-1)) + 1.142799 * (LN_SE_INDEX_B - ln_se_index_b(-1)) + 0.214239 * DUM_TFP - 2.319164 * DUMTFP + ln_tfp_tot1(-1)

tfp_tot1 = exp(ln_tfp_tot1)

Real Wage

LN_RWAGE_LF = 0.984090 * LN_LABPROD_TOT + 0.056499 * DUMMY_M + 0.049768 * DUM

rwage_lf = exp(ln_rwage_lf)

AGGREGATE DEMAND

Consumption

resid_cons_1 = LN_HH_RCONEXP(-1) - (0.654117 * LN_HH_RGDP(-1) + 0.154979 * LN_RM2(-1) + 0.296432 * DUMMY_M(-1) - 1.43e-07 * DUMOIL(-1) + 2.409168)

LN_HH_RCONEXP = - 0.761895 * RESID_CONS_1 - 0.008939 * (RINT(-3) - rint(-4)) + 0.697276 * (LN_RM2 - ln_rm2(-1)) - 0.331278 * (LN_HH_RCONEXP(-4) - ln_hh_rconexp(-5)) - 2.14e-07 * DUMOIL + 0.118381 + ln_hh_rconexp(-1)

hh_rconexp = exp(ln_hh_rconexp)

Export

resid_exp_1 = LN_REXP(-1) - (0.749785 * LN_RGDPUS(-1) + 0.338712 * LN_OIL_P(-1) - 0.203701 * LN_RELCPI(-1))

LN_REXP = - 0.552230 * RESID_EXP_1 + 0.306532 * (LN_OIL_P - ln_oil_p(-1)) - 0.275570 * (LN_EXCH(-2) - ln_exch(-3)) + 1.032138 * (LN_PPI - ln_ppi(-1)) + 2.462485 * (LN_RGDPUS(-4) - ln_rgdpus(-5)) - 0.224912 * DUM + ln_rexp(-1)

rexp = exp(ln_rexp)

Import

RESID_IMP_1 = LN_RIMP(-1) - (1.39051741 * LN_RGDP(-1) + 0.2132304288 * LN_RELCPI(-1) - 0.2061312587 * LN_EXCH(-1) - 0.4783556955 * DUM(-1) - 0.3211606128 * DUMMY_M(-1) - 6.396371801)

LN_RIMP = - 0.5811416067 * RESID_IMP_1 + 1.231037876 * (LN_RGDP - LN_RGDP(-1)) + 0.4013195261 * (LN_RIMP(-1) - LN_RIMP(-2)) - 0.1768633126 * (LN_OIL_P - LN_OIL_P(-1)) + 0.4740304797 * (LN_INT(-2) - LN_INT(-3)) + LN_RIMP(-1)

RIMP = EXP(LN_RIMP)

Interest Rate

RESID_INT_1 = LN_INT(-1) - (0.4892709087 * LN_RGDP(-1) - 0.2565779837 * LN_RM2(-1) + 0.7772942446 * LN_DIS_RATE(-1) - 7.693613293)

LN_INT = - 0.7188328105 * RESID_INT_1 + 0.5502197726 * (LN_DIS_RATE - LN_DIS_RATE(-1)) + 0.2433899603 * (LN_INT(-3) - LN_INT(-4)) + LN_INT(-1)

INT = EXP(LN_INT)

Exchange Rate

resid_exch_1 = LN_EXCH(-1) - (- 1.111410 * LN_RELRGDP(-1) + 0.781134 * LN_RELM2(-1) + 0.375075 * LN_RELCPI(-1) - 0.683912 * DUM(-1) + 8.498273)

LN_EXCH = - 0.294147 * RESID_EXCH_1 + 0.925168 * (LN_RELCPI - ln_relcpi(-1)) + 0.717931 * (LN_OIL_P - ln_oil_p(-1)) + 0.379537 * (LN_RELINT - ln_relint(-1)) + 0.781741 * (LN_GCF - ln_gcf(-1)) - 0.73753 * (LN_RELRGDP - ln_relrgdp(-1)) + 0.152819 * (LN_AID(-2) - ln_aid(-3)) - 0.096521 * (LN_RELREMIT - ln_relremit(-1)) - 3.373332 * (LN_M2_US - ln_m2_us(-1)) + 0.230886 * DUM + ln_exch(-1)

exch = exp(ln_exch)

PRICES

Consumer Price Index

resid_cpi_1 = ln_cpi(-1) - (0.964454 * ln_ppi(-1) + 0.791153 * ln_imp_p(-1) + 0.893697 * ln_exch(-1) + 0.179694 * ln_excessd(-1) + 0.453542 * dummy_m(-1) - 0.247312 * dum_oil(-1) - 7.455257)

ln_cpi = - 0.054380 * resid_cpi_1 + 0.061703 * (ln_cpi(-1) - ln_cpi(-2)) - 0.149378 * (ln_excessd - ln_excessd(-1)) + 0.039443 * (ln_imp_p(-4) - ln_imp_p(-5)) - 0.164863 * (ln_ppi - ln_ppi(-1)) + 0.938521 * (ln_wage_lf - ln_wage_lf(-1)) - 0.062425 * (ln_int(-4) - ln_int(-5)) + 0.033780 * (ln_transfer(-3) - ln_transfer(-4)) - 1.140638 * (ln_rgdp - ln_rgdp(-1)) + 0.060282 * (ln_exch - ln_exch(-1)) + 0.078148 * (ln_eleppop(-4) - ln_eleppop(-5)) + 0.028130 * (ln_capflow(-2) - ln_capflow(-3)) + 0.012813 + ln_cpi(-1)

cpi = exp(ln_cpi)

Producer Price Index

LN_PPI = 0.007109 * LN_WAGE_LF + 0.076239 * LN_OIL_P + 0.484784 * LN_CU_TOT + 0.197271 * LN_INT + 4.466082

ppi = exp(ln_ppi)

OTHER BEHAVIOURAL EQUATION

Socio-Economic Activity

resid_se_tot_1 = LN_SE_INDEX_B(-1) - (0.033612 * LN_HH_RGDP(-1) + 0.031832 * LN_REXPSOCIAL(-1) + 0.016514 * LN_ELEPPOP(-1) + 0.042125 * DUMMY_M(-1) - 0.655900)

LN_SE_INDEX_B = - 0.337387 * RESID_SE_TOT_1 - 0.006572 * (LN_CAPFLOW - ln_capflow(-1)) + 0.010968 * (LN_REXPSOCIAL - ln_rexpsocial(-1)) + 0.045796 * (LN_RGDP(-2) - ln_rgdp(-3)) + 0.132844 * (LN_HH_RGDP - ln_hh_rgdp(-1)) - 0.012664 * (LN_ELEPPOP - ln_eleppop(-1)) - 0.043506 * (LN_EXCESSD(-1) - ln_excessd(-2)) - 0.056549 * (LN_POVERTYD_INDEX(-1) - ln_povertyd_index(-2)) + 0.010223 * DUM - 5.97e-09 * DUMOIL + ln_se_index_b(-1)

se_index_b = exp(ln_se_index_b)

Infrastructure

resid_elep_1 = ln_elep(-1) - (1.430276 * ln_rgdp(-1) + 0.845762 * ge(-1) + 0.404438 * dum(-1) - 13.57408)

LN_ELEP = - 0.447038 * RESID_ELEP_1 + 1.857681 * (GE - ge(-1)) + 0.445765 * (LN_ELEP(-4) - ln_elep(-5)) + 0.392417 * (LN_UCC(-4) - ln_ucc(-5)) - 0.045568 + ln_elep(-1)

elep = exp(ln_elep)

Poverty

resid_povertyd_new1_1 = LN_POVERTYD_INDEX(-1) - (0.205810 * LN_CPI(-1) - 0.421465 * LN_INDEX_AGRIC(-1) - 0.003912 * LN_HH_RGDP(-1) - 0.014419 * LN_AIDPOP(-1) - 0.097905 * LN_ELEPPOP(-1))

LN_POVERTYD_INDEX = - 0.092791 * RESID_POVERTYD_NEW1_1 + 0.049153 * (LN_WAGE_LABOR(-2) - ln_wage_labor(-3)) - 0.010651 * (LN_AIDPOP(-2) - ln_aidpop(-3)) + 0.630599 * (LN_POVERTYD_INDEX(-1) - ln_povertyd_index(-2)) + 0.063179 * (LN_CPI(-1) - ln_cpi(-2)) + 0.373708 * (LN_LABOR_F - ln_labor_f(-1)) - 0.014798 * (LN_CAPFLOW(-2) - ln_capflow(-3)) + 0.067526 * (LN_EXCESSD(-3) - ln_excessd(-4)) + 0.010650 * (LN_REXPSOCIAL(-2) - ln_rexpsocial(-3)) + 0.006822 * DUM_POVD - 0.022579 * DUMMY_M + ln_povertyd_index(-1)

povertyd_index = exp(ln_povertyd_index)

Agric Production

RESID_AGRIC1_1 = LN_INDEX_AGRIC(-1) - (- 0.137146446709 * LN_PPI(-1) + 0.400086304569 * LN_ELEP(-1) + 0.580866145411 * LN_LAND(-1) - 0.556776445008 * DUM(-1) - 0.165236631234 * DUMMY_M(-1))

LN_INDEX_AGRIC = - 0.190114100061 * RESID_AGRIC1_1 + 0.187988440706 * (LN_CPI - ln_cpi(-1)) - 0.697645588961 * (LN_RK_STOCK2(-1) - ln_rk_stock2(-2)) - 4.70194380403 * (LN_LAND(-4) - ln_land(-5)) - 0.033844484003 * (LN_AID(-2) - ln_aid(-3)) + 0.10754425889 * (LN_UCC(-3) - ln_ucc(-4)) - 0.322952206752 * (PI(-4) - pi(-5)) + 0.181144701167 * (LN_INDEX_AGRIC(-1) - ln_index_agric(-2)) + 0.123403670113 * (LN_OPEN(-4) - ln_open(-5)) + 0.151371328198 * (LN_PPI - ln_ppi(-1)) - 0.104567508704 * (LN_ELEP(-1) - ln_elep(-2)) + ln_index_agric(-1)

index_agric = exp(ln_index_agric)

Disposable Income

resid_hh_tot_1 = LN_HH_RGDP(-1) - (0.979738 * LN_RWAGE_LF(-1) + 0.144799 * LN_TRANSFER(-1) + 0.092152 * DUM(-1) + 2.297017)

LN_HH_RGDP = - 0.245771 * RESID_HH_TOT_1 + 0.869462 * (LN_RWAGE_LF - ln_rwage_lf(-1)) + 0.030977 + ln_hh_rgdp(-1)

hh_rgdp = exp(ln_hh_rgdp)

Foriegn Direct Investment

RESID_FDI_1 = LN_FDI(-1) - (0.6816131507 * LN_RGDP(-1) - 0.4966291681 * LN_CPI(-1) + 0.07596241635 * LN_OPEN(-1) + 0.2880109528 * LN_EXCH(-1) + 1.16824926 * DUMMY_M(-1) + 0.978210767 * DUM(-1))

LN_FDI = - 0.5906001952 * RESID_FDI_1 - 0.3733726592 * (LN_FDI(-1) - LN_FDI(-2)) + 0.2173172107 * (LN_FDI(-3) - LN_FDI(-4)) - 0.7926940282 * (LN_GCF(-3) - LN_GCF(-4)) + 0.6653683842 * (LN_OPEN(-3) - LN_OPEN(-4)) + LN_FDI(-1)

FDI = EXP(LN_FDI)

IDENTITIES AND DEFINITIONS

rk_stock2 = (1 - depr) * rk_stock2(-1) + gcf(-1)

ln_rk_stock2 = log(rk_stock2)

ln_gcfpot = log(gcfpot)

rk_stock2pot = (1 - depr) * rk_stock2pot(-1) + gcfpot(-1)

ln_rk_stock2pot = log(rk_stock2pot)

ln_pop_active = log(pop_active)

ln_tfp_totpot = log(tfp_totpot)

ucc = (1 + int) * exch

ln_ucc = log(ucc)

cu_tot = rgdp / potrgdp

ln_cu_tot = log(cu_tot)

ln_capflow = log(capflow)

ln_oil_p = log(oil_p)

ln_aid = log(aid)

open = (rexp + rimp) / rgdp

ln_open = log(open)

labprod_tot = rgdp / labor_f

ln_labprod_tot = log(labprod_tot)

gcfgdp = gcf / rgdp

ln_gcfgdp = log(gcfgdp)

finconstr = gds_nom + capflow + creserv + depr_value

ln_finconstr = log(finconstr)

relcpi = cpi / cpi_us

ln_cpi_us = log(cpi_us)

ln_relcpi = log(relcpi)

relrgdp = rgdp / rgdpus

ln_rgdpus = log(rgdpus)

ln_relrgdp = log(relrgdp)

relm2 = m2 / m2_us

ln_m2_us = log(m2_us)

ln_m2 = log(m2)

rm2 = m2 / gdp_def

ln_rm2 = log(rm2)

ln_relm2 = log(relm2)

relint = int / int_us

ln_int_us = log(int_us)

ln_relint = log(relint)

relremit = remit / remit_us

ln_remit = log(remit)

ln_remit_us = log(remit_us)

ln_relremit = log(relremit)

LN_DIS_RATE = LOG(DIS_RATE)

rgdp = hh_rconexp + gcf + total_govexp + rexp - rimp

ln_rgdp = log(rgdp)

excessd = gne_nom / gdp

gne_nom = (rgdp - rexp + rimp) * gdp_def

ln_gne_nom = log(gne_nom)

gdp = rgdp * gdp_def

ln_gdp = log(gdp)

ln_excessd = log(excessd)

total_govexp = rexpsocial + transfer + other_govexp

ln_other_govexp = log(other_govexp)

ln_total_govexp = log(total_govexp)

ln_rexpsocial = log(rexpsocial)

ln_transfer = log(transfer)

eleppop = elep / pop

ln_eleppop = log(eleppop)

ln_pop = log(pop)

wage_labor = rwage_lf / labor_f

ln_wage_labor = log(wage_labor)

ln_land = log(land)

RINT = INT - INF

INF = ((CPI - CPI(-1)) / CPI(-1))

ln_imp_p = log(imp_p)

wage_lf = rwage_lf * gdp_def

ln_wage_lf = log(wage_lf)

ln_labor_pot = log(labor_pot)

cad = rexp - rimp

aidpop = aid / pop

ln_aidpop = log(aidpop)