PUBLIC INVESTMENT AND OUTPUT PERFORMANCE IN NIGERIA

BY

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ABSTRACT

In Nigeria, there is a divergence between growth in public investment and output performance. The average annual growth rate of public investment (PI) was 3.6% in 1970-74, increased significantly to 20.5% during 1980-84 and declined steadily to 9.0% and 4.2% in 1990-94 and 2005-10, respectively. Over the same periods, the average output growth fluctuated considerably between 2.5% and 6.2%. While there are studies on the impact of PI on output, little attention has been devoted to the channels through which PI affects output performance. This study, therefore, examined the channels and effects of PI on aggregate and sectoral output in Nigeria during 1970-2010.

A macro-econometric model derived from Keynes' income-expenditure framework was employed. The model was disaggregated into demand and supply sides in order to trace the direct and indirect effects of PI on aggregate and sectoral output. Agriculture, manufacturing, services, wholesale and retail, mining and quarrying, crude petroleum, building and construction constituted the supply side. Household consumption, domestic investment and external trade represented the demand side. The direct effect was assessed using the magnitude of PI multiplier coefficients on aggregate and sectoral output. The indirect effect of PI on demand side was evaluated with marginal propensity to consume, accelerator coefficient and import multiplier, respectively. Three-stage least squares estimation technique that took into consideration cross error correlation and simultaneity bias was used. Tests of the model's reliability were carried out using root mean square error, proportion inequality and graphical representation of both actual and simulated values of the endogenous variables. Data were collected from Central Bank of Nigeria's Statistical Bulletins and National Bureau of Statistics' Annual Abstracts. All the estimates were validated at $p \leq 0.05$.

There were marginal direct effects of PI on aggregate and some sectoral output, while the indirect effects were significant. Public investment multiplier for aggregate output was 0.21 and significant. The small value of the multiplier was attributed to low marginal productivity, inefficient and relative decline of public investment. Wholesale and retail trade had the largest significant multiplier of 0.31, followed by building and construction (0.21), manufacturing (0.17), agriculture (0.16) and mining and quarrying (0.11). The multipliers of public investment in services (0.13) and crude petroleum (0.03) sectors were insignificant. The values of marginal propensity to consume (0.68),

the accelerator coefficient (0.49) and the import multiplier (0.86) were significant. This suggested that a ₦1 increase in PI would increase household consumption, domestic investment and external trade by 68k, 49k and 86k, respectively. The graphical representation indicated that the actual and simulated series are close and the turning points of the actual series were well tracked by the simulated values.

Public investment exerted marginal influence on aggregate output. The significant effect of the indirect channel with the import multiplier being the most pronounced was evident. Therefore, in order to accelerate aggregate and sectoral output growth, there should be increased emphasis on productivity and efficiency of public investment.

Keywords: Public investment, Output performance, Keynes' income-expenditure framework

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DEDICATION

I dedicate this first to Allah, the beneficent and merciful, for granting me His unmerited favour to complete this research. Second, to my late father; Alhaji Malik Ibrahim whose main concern is to give me the best start in life and to whom I owe an immense debt of gratitude for my overall education.

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CERTIFICATION

I certify that this work was carried out by Taofik Mohammed **IBRAHIM** in the Department of Economics, University of Ibadan.

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CHAPTER ONE

INTRODUCTION

1.0 Statement of the Problem

The relationship between public investment and economic growth has continued to generate debate in the academic and policy arena. The Keynesians contend that the provision of public goods and services plays a central role towards solving collective action problems and serve as a panacea for sustainable economic growth and development.[1] The Non-Keynesians emphasised the scope for rent-seeking in the determination of public investment, and the resulting low social returns on a number of investment projects carried out by government of developing countries (Pineda and Francisco, 2006). The argument in support of the latter view is that high public investment may inhibit the overall performance of the economy. For instance, in an attempt to finance public investment, government may increase taxes and/or borrowing. Apparently, high income tax will be a disincentive to workers while borrowing enlarges or creates fiscal deficits.[2]

Ascertaining the efficiency effects of public investment is a key factor in the design of adjustment policies in developing countries. Governments tinkering with fiscal adjustments for economic growth have to face the question of how to cut public investment *vis-à-vis* recurrent expenditures. Reducing recurrent expenditures often lead to the retrenchment of public sector workers and cutting the operating expenditures of government. This can be a politically complex decision. In contrast, reducing public investment projects may result in the abandonment of new investment

[1] For example, public investment on infrastructure such as roads, communications and power reduces production costs, increases private sector investment and profitability of firms, thus fostering economic growth. Similarly, public investment on health and education raises the productivity of labour and increases the growth of national output.

[2] High income tax reduces disposable income and aggregate consumption on the demand side whereas on the supply side, higher profit tax tends to increase production costs and reduce investment expenditure as well as profitability of firms.

projects. This perhaps explains why it is not surprising that governments facing the two contending adjustment programmes often decide to maintain recurrent expenditures while significantly curtailing public investment (Charkraborty and Dabla-Norris, 2009). When fiscal deficits are reduced by cutting productive public investments, it could be illusory in that it would not take into account the reduction in government net worth arising from the loss of revenue occasioned by reduced expected future national income (Dabla-Norris *et. al*., 2011).

In Nigeria, government expenditure has continued to rise in nominal and real terms, partly due to the huge receipts from production and sales of crude oil, as well as the increased demand for public goods. Meanwhile, the ratio of public investment to government expenditure has been fluctuating over the years. For instance, average annual growth rate of public investment was 3.6% between 1970 and 1974; it increased significantly to 20.5% between 1980 and 1984 and declined steadily to 9.0% and 4.2% from 1990 to 1994 and from 2005 to 2010, respectively. Over the same periods, the average output growth fluctuated considerably between 2.5% and 6.2%. Further, the trend of sectoral public investments and outputs also followed the same pattern. Thus, indicating that there is a divergence between growth in public investment and output performance.

In addition, the combination of factors such as low domestic investment due to dilapidated infrastructure (especially roads and power supply), large current account imbalance caused by high import value and the inefficiencies in the management of public expenditure, ignored or absorbed by substantial government transfers in the form of subsidies or subventions have not made growth in output impressive in recent years (Aladejare, 2013). Consequently, the above-mentioned problems lead us to the following questions: What are the channels through which public investment affect output growth? What has been the effect of public investment on aggregate output in Nigeria? What has been the effect of public investment on sectoral output performance in Nigeria?

1.2 Objectives of the Study

The broad objective of this study is to analyse the impact of public investment on economic growth in Nigeria. The specific objectives are to:

(i) identify the channels through which public investment affect aggregate output.

(ii) examine the effect of public investment on aggregate output; and

(iii) investigate the effect of public investment on sectoral output performance in Nigeria.

1.3 Justification for the Study

The justification for this study is underpinned by the observed gaps in the literature. These gaps are basically threefold: theory, methodology and empirics.

First, unlike the neoclassical and Ricardian views that focused more on the supply side of the economy, the Keynesians emphasise the importance of the demand side of the economy. The latter view explains the impact of changes in government spending as a policy on consumption, import and investment through changes in output via its effect on values of multipliers and accelerator coefficients. While most studies on the impact of public investment on output in Nigeria placed more emphasis on the supply side of the economy (Adenikinju, 1998; Akpan, 2005; Olapade and Olapade, 2010; Nurudeen and Usman, 2010; Aladejare, 2013), this study examined the impact of public investment on output growth (aggregate and sectoral) in Nigeria by considering the demand side of economy thereby making it easier to trace the direct and indirect effects of public investment on output.

Second, this study contributes to the methodological literature by examining if the impact of public investment in infrastructures on output varies from one sector of the economy to the other by creating a system of equations to show the contribution of each sector to GDP in Nigeria during the study period. The study also adopts the eclectic macroeconomic modelling approach to model the component of aggregate demand in order to account for basic features of Nigerian economy.

Another contribution is that, apart from the use of Ordinary Least Square (OLS), Generalized Least Square (GLS), Error Correction model (ECM), Vector Error

Correction Model (VECM) often adopted in literature (Adenikinju, 1998; Ayogu, 2000; Olapade and Olapade, 2010; Nurudeen and Usman, 2010; and Aladejare, 2013), this study departs from previous studies by estimating a macroeconometric model via a policy applicable instrumental variable technique that took into consideration possibility of cross error correction and simultaneity bias common with system equation. The Two-stage-least square (2SLS) and the Three-stage-least square (3SLS) techniques are employed for each equation to estimate the effect of public investment on aggregate and sectoral outputs. Although, the 2SLS and 3SLS are hypersensitive to any specification errors within the system equation, this was addressed by subjecting the model to the order of condition of identification in order to ensure that the model is over identified[3]. Diagnostic tests are also conducted to affirm the robustness of the baseline results. Simulations are equally conducted for many scenarios to show the effects of adopting public investment policy that enhances output growth.

Finally, empirical evidence on the interaction of sectoral output growth and public investment in infrastructure is still scanty. Conceptual standpoint that infrastructure facilitates production needs to be reinforced, by measuring the magnitude of these impacts. Besides, linking infrastructure investment and output growth is part of the broad goal of understanding the importance a country attaches to growth induced public investment (Arslanalp *et. al.*, 2010). This study explores one of such assertions by determining the impact of public investment on sectoral output growth to know which sector of the economy recorded the most impact and its consequences on aggregate output.

1.4 Scope of the Study

This study is limited to the investigation of the impact of public investment on output changes in Nigeria. The analysis covers 1970 to 2010. The reasons for choosing this period are: first, it corresponds with when Nigeria experienced variation in public investment partly due to fluctuation in oil export income and second, the availability of data.

[3] The order condition states that "the total number of variables in the model, M, minus the number of variables appearing in a particular equation, M*, should be equal or greater than the number of endogenous variables in the model, N, minus one, that is, M-M* ≥ N-1 (Gujarati, 2004).

1.5 Organisation of the Thesis

This thesis is in six chapters. The background to the study follows this introductory chapter. It contains information on the overview of the economy from 1970 to 2010; output performance; sectoral output performance; public investment; sectoral allocation of public investment; public investment on infrastructure; and macroeconomic policies on public investment in Nigeria.

A review of the literature is presented in chapter three. This chapter has three sections. The three sections are devoted to reviewing theoretical, methodological and empirical issues in this order.

Theoretical framework, methodology and data for this work are presented in chapter four. The first section is the theoretical framework on which this study is anchored. The second section on methodology duels on the development of the empirical model, model estimation, data compilation as well as data screening processes. In chapter five we present and examine results of statistical and time series tests of properties of the variables in all the estimated models. This is followed by a discussion of the estimated results.

The final chapter presents the summary and conclusion. Here, the major findings of the research were stated, policy implications highlighted, and recommendations made. The chapter also contains some suggestions for further research, limitations of the study and the concluding remarks.

CHAPTER TWO

BACKGROUND TO THE STUDY

2.1 Overview of the Nigerian Economy

Nigeria is a mixed economy with the government responsible for creating an enabling environment in which businesses can thrive and contribute to the overall development of the country. The government is expected to provide social amenities and infrastructure which should stimulate investment and create job opportunities. Economic policy formulations in Nigeria are structured to achieve national development objectives as outlined in various National Developmental Plans (NDPs) (i.e., first NDP (1962-1968); second NDP (1970-1974); third NDP (1975-1980); fourth NDP (1981-1985); Structural Adjustment Programme (SAP); Vision 2010; National Economic Empowerment and Developmental Strategy (NEEDS: 1& 2) and Vision 20:2020).

The overall government objectives are to sustain economic growth, create job opportunities, eradicate poverty and reduce income disparities as well as create enabling environment for private sector participation. The Nigerian economy has a large non-tradable sector (government services) and an export-oriented primary sector – mainly crude oil and agriculture. Oil is the main source of revenue for Nigeria, the sector is not fully developed and it is capital-intensive. The revenues from the oil sector are not utilised to develop other sectors, resulting in slow economic growth and high unemployment level in the country. The agricultural sector which supports more than 60 per cent of the population is still at subsistence level. Thus, the Nigerian economy is susceptible to exogenous shocks such as fluctuations in oil price and international business cycles.

Nigeria's main trading partners are United States of America (USA), Spain, Brazil, Ivory Coast, China, Netherlands and United Kingdom. Nigeria is the second largest

exporter of oil in Africa, the twelfth in the world. Oil contributes more than 45 per cent of the Nigerian nation's GDP. Nigeria's economy is closely linked to that of the USA and increasingly China too in recent time. Both countries are main trading partners to Nigeria with about 60 percent of exports to USA, while about 50 percent of its imports come from the USA and China. Table 2.1 shows the country's economic performance from 1970 to 2010. In the early 1970s, Nigeria recorded a relatively high economic growth due to the oil boom. Exports and imports expressed as percentage of GDP, government deficit as a percentage of GDP fluctuated over time while unemployment rate increased steadily.

Table 2. 1. Selected Indicators of Macroeconomic Performance in Nigeria (1970-2010)

Year	GDP Growth (%)	Oil Export as a (%)	Non-oil Export as a (%) of	Import as a (%) of	Inflation rate (%)	Deficit (%) of GDP	Unemployment rate (%)
1970-1974	2.5	9.7	7.1	14.3	13.8	-8.2	4.1
1975-1979	-5.2	21.2	1.7	17.3	33.9	-2	4.3
1980-1984	4.2	27.5	1.1	18.3	10	-3.9	6.4
1985-1989	8.7	16.5	0.7	10.4	5.5	-2.1	6.1
1990-1994	6.2	39.9	1.2	17.1	7.4	-4.4	3.5
1995-1999	2.5	47.9	1.2	39.1	72.8	-1.2	1.8
2000-2004	3.8	41.9	0.5	21.5	6.9	-1.5	18.1
2005-2010	5.4	49.0	0.7	19.2	12.8	-3.8	19.8

***Source*:** Central Bank of Nigeria: Statistical Bulletin and Annual Report and Statement of Accounts (various years).

2.2 Output Performance

The output history of Nigeria's economy is unstable over the years. Prior to the 1970s, the GDP recorded 3.1 per cent growth annually. During the oil boom era, between 1970 and 1978, the GDP grew by 6.2 per cent annually, a remarkable growth. However, in the 1980s, the GDP declined. Between 1988 and 1997 structural adjustment and economic liberalisation era, the GDP responded to economic adjustment policies and grew at a positive rate of 4.0.

The economy improved marginally in 2000 as the real GDP growth rate rose to 3.8 per cent from 2.8 per cent in 1999 and 1.8 per cent in 1998. The performance in 2000 was largely due to the positive terms of trade shock, following an oil price increase from $18 per barrel in 1999 to $28 per barrel in 2000. The income effect of the shock enabled an expansion in government expenditure. The structure of Nigeria's GDP showed a major change in 2000 with the oil sector emerging as the dominant contributor to GDP ahead of agricultural sector as in 1999. The share of the oil sector in GDP increased from 28.3 per cent in 1999 to 39.5 per cent in 2000, while that of agricultural activities fell from 35.1 per cent in 1999 to 28.5 per cent in 2000. The services sector accounted for 27.2 per cent of GDP in 2000 compared with 30 per cent in 1999. Notwithstanding the stable performance, the 3.1 per cent growth rate in 2000 was lower than the 5.5 per cent annual growth target set in the 2000-2002 National Rolling Plan.

This performance was mixed in 2001. The economy maintained its moderate rate of growth with real GDP recording 3.9 per cent compared with 3.8 per cent in 2000 and the yearly average of 3.3 per cent achieved between 1995 and 1999. The economic expansion in 2001 was achieved in an atmosphere of weakening economic fundamentals as inflationary pressure was exacerbated, interest rates trended upwards, the naira depreciated in all segments of the foreign exchange market, and the external sector experienced renewed pressure. The moderate growth in total output in 2001 was reflected in all the major sectors of the economy.

Nigeria continued to demonstrate mixed performances marked by macroeconomic imbalances. While the economy further weakened in 2002, some economic fundamentals improved. The growth rate of real GDP slowed dramatically from the

revised 4.2 per cent in 2001 to less than one per cent in 2002. Growth performance rebounded in 2003 to an estimated 10.7 per cent. The low economic growth noticed in 2002 was attributed to the significant fall of crude oil production. While in 2003, the increase in the volume of crude oil exported and the 16 per cent increase in oil prices helped boost economic activity. In 2004, real GDP rose to 6.1 per cent above the 2003 figure largely as a result of the oil price increases. Growth in 2005, estimated at 4.4 per cent was lower than the government's medium-term NEEDS target of ten per cent.

The economy performed well between 2006 and 2010 despite the negative effects of the global economic crisis which started in 2007 and continued till 2010. The GDP at 1990 constant prices grew consistently between 2006 and 2010, except for 2008 when a slight decrease occurred. The GDP growth rate increased from 6.03 per cent in 2006 to 6.60 per cent in 2007 and fell slightly to 5.98 per cent in 2008. The GDP grew by 6.96 per cent and 7.87 per cent in 2009 and 2010, respectively. The fall of GDP growth in 2008 was due to the global economic crisis which resulted in a decline of demand for Nigeria's crude oil abroad. This also affected the flow of credit into the country, triggering a crash in the stock market as well as a decline in Foreign Direct Investment (FDI).

The analysis of growth sources revealed that non-oil sectors broadly powered growth in 2009 and 2010. Non-oil GDP accelerated averagely by 8.32 per cent while oil and gas registered modest growth of 0.45 per cent (Figure 2.1). This was not the case with the building and construction sector which reduced by 11.97 per cent in 2010 as against 13.1 per cent in 2009. Primary activities comprising agriculture, solid minerals as well as oil and gas grew by 4.34 per cent in 2009 and 4.67 per cent in 2010 reflecting the depressive effects of the oil and gas sector performance. In addition, the manufacturing sector recorded a real growth rate of 7.85 per cent in 2010 as against 8.89 per cent in 2009.

At current population growth rate of 3.2 per cent, the real GDP growth of 7.85 per cent in 2010 resulted in a real per capita growth rate of 3.46 per cent. At current basic price, the per capita GDP of ₦165,517.52 or US $1,395.98 in 2009 declined to ₦150,008.2 or US$1,000.32 in 2010. Thus, a negative real per capita GDP growth concomitant

with a positive nominal per capita GDP growth is a reflection of price driven growth performance

A modest structural change was observed in the economy between 2009 and 2010. The contribution of agriculture to real GDP growth declined from 42.13 per cent in 2009 to 41.7 per cent in 2010 while the share of oil and gas sector fell to 16.29 per cent from 17.35 per cent. The declining fortunes of the oil and gas sector occasioned by the Niger Delta crisis were responsible for the marginal shift in structure. However, the deepening reforms in the telecommunications sector raised its share to GDP from 2.85 percent in 2009 to 3.59 percent in 2010.

Figure 2. 1. Aggregate Output Growth (%) (1970-2010)

***Source*:** Central Bank of Nigeria: Statistical Bulletin and Annual Report and Statement of Accounts (various years).

2.3 Sectoral Output Performance

2.3.1 Agriculture

Nigeria is one of the largest countries in Africa, with a total geographical area of 923 768 square kilometres and an estimated population of about 163 million (2010 estimate). It lies wholly within the tropics along the Gulf of Guinea on the western coast of Africa. Nigeria has a highly diversified agro-ecological condition, which enables the production of lots of agricultural products. Hence, agriculture constitutes one of the most important sectors of the economy. The sector is particularly important in terms of its employment generation and its contribution to GDP and export revenue earnings. Despite Nigeria's rich agricultural resource endowment, the sector has been growing at a very low rate. Less than 50 per cent of the country's cultivable agricultural land is under cultivation.

The contribution of the agricultural sector to GDP, 63 per cent in 1960 declined to 34 per cent in 1988 not because the industrial sector increased its share, but due to neglect. It was therefore not surprising that by 1975, the economy had become a net importer of basic food items. The structure of agricultural production in Nigeria shows the dominance of crops production which accounted for 71.88 per cent of the total output between 1981 and 1985, 76.87 per cent between 1986 and 1990, 79.30 per cent between 1991 and 1995, 79.92 per cent between 1996 and 2000 and 82.46 per cent between 2000 and 2005. As at 2010, crops production accounted for 89.1 per cent of the total agricultural output. This was followed distantly by livestock with a share of 17.07 per cent between 1981 and 1985, 15.39 percent between 1986 and 1990, 13.69 per cent between 1991 and 1995, 13.02 per cent between 1996 and 1999, and 14.10 per cent between 2000 and 2005. This figure stood at 6.4 percent of agricultural production in 2010.

In terms of contribution to growth, the agricultural sector share of GDP was 37 per cent between 1981 and 1985, 41 per cent between 1986 and 1990, 38 per cent between 1991 and 1995 and 40 per cent between 1996 and 2000. The share of agricultural activities fell from 35.1 per cent in 1999 to 28.5 per cent in 2000. The fall in the share of agriculture in total GDP in 2000 did not reflect a major decline in growth of agricultural output as growth in the sector remained relatively stable at 3.1 percent in

2000 compared with 3.3 percent in 1999. This relatively stable level in agricultural production was largely due to favourable weather conditions. Regardless of the stable performance, the 3.1 per cent growth rate in 2000 was lower than the 5.5 per cent annual growth target set in the 2000-2002 National Rolling Plan.

Agricultural output rose by 3.7 percent in 2001 compared with 3.1 per cent in 2000 with the sector contributing 29.3 per cent of GDP in 2001. All the sub sectors contributed to the agricultural expansion in 2001. The output of staples rose by 3.5 per cent in 2001 compared with 3 per cent in 2000 with all the major staples such as maize, cassava, millet and sorghum, recording output increases. Cash crop production increased by 3.4 per cent in 2001 from 3.3 percent in 2000 largely due to improvements in demand and market prices. The outputs of cotton, soya bean and palm oil as well as coffee, rubber and cocoa increased in 2001.

The modest increase in agricultural production in 2001 was attributed largely to favourable weather conditions. Other factors that contributed to the increase included the supply of high-yielding and disease-resistant seeds, low incidence of pests and diseases, improved post-harvest handling as well as continued intensification of off-farm research efforts by research institutions. Meanwhile, Nigeria faced difficulties in achieving the annual agricultural growth target of 5.5 per cent set in the 2000-2002 National Rolling Plan. The expansion of agricultural output continues to be hindered by major constraints such as inadequate supply of fertiliser.

Agricultural output increased by 4.2 per cent in 2002 compared with 3.7 per cent in 2001. Crop production in particular was strong in 2002, with the output of food staples rising by 4.2 per cent from a 3.5 per cent in 2001. The outputs of potatoes, beans and yam, for example, increased by 9.5 per cent, 8.4 per cent and 5 per cent respectively, while outputs of sorghum and maize increased by 3 per cent and nearly 2 per cent respectively. Cash crop production also improved, rising by 2.2 percent compared with 0.5 per cent in 2001. The rise in output was derived from favourable weather conditions, particularly rainfall been timely, adequate and well-distributed throughout the country. The government's renewed active support for the sector also benefited

production, especially in 2003, when its new agricultural policy encouraged the private sector to invest in agriculture.

In that year, output was also helped by the adoption of new strategies of credit delivery, particularly the trust fund model, which included the Micro Credit Scheme for Agricultural Development (MICSAD) of the Shell Petroleum Development Corporation, the Green Card of the Nigerian Agip Oil Company, and the Jigawa State Trust Fund for Agricultural Development. Weather conditions in 2003 remained favourable for agricultural production and livestock. These improvements will, however, stagnate unless Nigeria finds solutions to some of the perennial problems confronting agricultural production, such as inadequate supply of fertiliser. Locally produced fertiliser remains virtually non-existent as a result of the shutdown of the National Fertilizer Company of Nigeria (NAFCO), which, before its closure, accounted for over 85 per cent of total local production.

Agricultural production continued to increase as a result of favourable weather conditions and improved government policies, growing at an estimated 6.8 per cent in 2004 compared to 6.1 percent in 2003. All the major staples and cash crops recorded higher output in 2004 compared with the previous years. However, the achievement of higher output levels is hampered by inadequate supply of fertilisers and other farming inputs. In addition, natural hazards including the perennial problems of quela birds invasion and flooding in some farming areas such as Jigawa, Kano and Kebbi, continued to stem growth. Bans on the import of cassava, fruit juices, vegetable oil and poultry and related products boosted local production, although such bans may eventually lead to smuggling. The special rice programme, as well as the root and tuber expansion programme aimed at achieving self-sufficiency in rice, root and tuber production, also contributed to increased output.

In 2005, agricultural output increased by 7 per cent, up from 6.2 per cent in 2004, reflecting favourable weather conditions and government efforts to increase farmers' access to credit and fertilisers. The agricultural sector had the biggest share of overall component of real GDP with 41.72, 42.01, 42.13, 41.70 and 40.84 per cent in 2006,

2007, 2008, 2009 and 2010 respectively (Table 2.2) and annual growth rates of 7.40, 7.19, 6.27, 5.88 and 5.64 per cent respectively.

The livestock, forestry and fishing sub sectors hold tremendous potential for growth and development of the economy being a principal source of inputs for industrial production. Their combined output in nominal terms totalled ₦985.4 billion in 2010, an increase, from ₦866.60 billion in 2009. As a share of GDP, they contributed 4.54 per cent in 2009. Their growth performance was moderately good as livestock grew by 6.5 per cent in 2010 a marginal drop from 6.8 per cent in 2009, while fishing output rose marginal by 6.57 per cent and 6.17 per cent respectively during the period. Forestry production on the other hand, fell by 5.85 per cent in 2010 from 6.10 per cent in 2009. In summary, the Nigerian economy is still dominated by agriculture. Over 60 per cent of the population are engaged in this sector with an average of 41 per cent contribution to the GDP.

2.3.2 Manufacturing

Manufacturing involves the conversion of raw materials into finished consumer, intermediate or producer goods. Like other industrial activities, it creates avenues for employment, helps boast agriculture as well as diversify the economy, augments foreign exchange earnings, and allows local labour acquire pertinent skills. In addition, it minimises the risk of overdependence on foreign trade and leads to the full utilisation of available resources.

The organisation of manufacturing in Nigeria had passed through four clear stages of development. First, the pre-independence era when it was limited to primary processing of raw materials for exports and the production of simple consumer items by foreign multinational corporations anxious to gain a foothold in a growing market. During this period, manufacturing was mostly resource-based, concomitant with some elements of import-substitution underscoring imported raw materials base was already present.

The second is the immediate post-colonial era of the 1960s characterised by more vigorous import-substitution signalling the beginning of decline for the export-oriented processing of raw materials. The import-substitution policy initially designed to reduce

over-dependence on foreign trade and save foreign exchange, turned out to be a mere assemblage of the goods produced rather than manufacturing. This negated the original aim since almost every item needed by the so-called manufacturing industries was imported. At the same time, foreign ownership of manufacturing facilities reached its peak.

The third is the decade of the 1970s, remarkable because the advent of oil and the enormous resources it provided for direct government investment in manufacturing which made the government exercise almost a complete monopoly in the following sub sectors: basic steel production, petrol-chemicals, edible salt, flat steel plants, machine tools, pulp paper (basic), yeast and alcohol, as well as fertiliser (nitrogenous and phosphoric). The period was marked by initiation of the indigenisation programme, accompanied with intense economic activity. The outcome of the programme was poor, because attempts at diversification into non-traditional products such as steel, petrochemicals, fertilisers and vehicle assembly yielded little success.

The last phase is the decade of the 1980s marked by dwindling government revenue consequent upon the oil prices that nose-dived at the world market, following which attempts were made to improve the economy. These attempts included the adoption of export promotion strategy on the realisation of the pitfalls of import substitution strategy. The SAP era which started in 1986 emphasised this strategy, especially as it related to non-oil exports, hence the extension of export promotion incentives of various descriptions. Also, due to observed lopsided development in the entire manufacturing sector, a strategy of balanced development was emphasised to deepen the linkage in the sector, the result was more rhetorical than practical.

The manufacturing sector's growth and contribution to GDP over the years under review have been abysmal as a result of decay in infrastructure. The value added of manufacturing activities at current basic prices rose averagely from a mere ₦3.93 billion between 1971 and 1975 to ₦8.16 billion between 1976 and 1980; ₦19.75 billion between 1981 and 1985 and fell drastically to ₦4.18 between 1986 and 1990. The figure rose averagely to ₦288.71 between 1991 and 1995 and ₦1,034.64 billion between 1996 and 2000. Further, it rose to ₦612.3 billion in 2010 from ₦585.6 billion

in 2009. In real terms, manufacturing value-added growth rate fell to 7.85 per cent in 2010 from 8.89 per cent in 2009.

In terms of contribution to growth, the manufacturing sector recorded 7.2 per cent in 1970. It fell to 5.6 per cent in 1975 and rose to 8.3 and 8.6 per cent in 1980 and 1985 respectively. Its share rose to 8.71 per cent in 1991 from where it maintained a continuous annual decline such that in 1995 it stood at 6.88 per cent. It further fell to 3.5 per cent in 1999 and increased by 0.5 per cent to 4 percent in 2000. The below expectation performance of the sector in 2000 was attributed to the continued weak demand for local manufactures, increased cost of production, as well as the general insecurity of lives and property in Nigeria that disrupted production programmes and discouraged new investment.

The manufacturing sector recorded modest improvement in 2001 as it production rose by 2.9 per cent. The enhancement was largely due to improved supply of inputs, especially the restoration of normal supply of petroleum products, a moderate improvement in electricity supply, the introduction of comprehensive inspection of imports at the ports, which forced importers of finished goods to pay appropriate duties, thereby increasing slightly the competitiveness of local manufactures. The improvement in manufacturing in 2001 was corroborated by a CBN (2001) survey on capacity utilisation which showed an average capacity utilisation rate rising from 36.1 per cent in 2000 to 39.6 per cent in 2001. At the same time, manufacturing expansion in Nigeria continues to be generally impaired by low effective demand for locally made goods, occasioned by the continued influx of cheaper and better quality of imported products, especially from South East Asia; and the poor state of social and economic infrastructure, including power and water supply.

In 2003, the manufacturing sector increased by three per cent. The reasons for this noticeable increase included but not limited to the policy of physically inspecting all of imported goods at the ports. This compelled importers to pay duties, which in turn improved the competitiveness of local manufacturers. Further, enhanced surveillance by the National Agency for Food, Drug Administration and Control (NAFDAC) assisted in curtailing the influx of substandard goods. Increased availability electricity also of contributed to manufacturing output improvement.

The improvement in electricity output was largely due to the restoration of generating equipment, as well as the enhanced or increased use of existing capacity. Growth in the manufacturing sector was 4.79 per cent in 2005, lower than the 4.98 per cent recorded in 2004. It grew slightly from 4.39 per cent in 2006 to 4.57 per cent in 2007 and dropped to 3.89, 3.85 and 3.64 per cent in 2008, 2009 and 2010 respectively; while there was no significant change in its contribution to GDP over these years.

2.3.3 Mining and Quarrying/Crude Petroleum

Nigeria is richly endowed with vast but largely untapped natural resources including such minerals as petroleum, limestone, tin columbite, kaolin, gold and silver, coal, lead, Zinc, gypsum, clay, shale, marble graphite, iron-ore, stone, zircon and natural gas. Mining and quarrying are central to Nigerian economy. Modern activities in mining include crude petroleum, solid minerals and associated gas production.

The contribution of the mining and quarry sub sector to the national economy only became significant after five years of independence. By 1970, mining and quarry had emerged to become the leading sector in terms of percentage share of GDP. It recorded 33.1 per cent in 1970, 45.5 per cent in 1975, it latter fell drastically to 21.9 per cent in 1977 and 15.3 per cent in 1981. It increased slightly to 15.6 per cent in 1985, substantially to 37.5 per cent in 1990 and stood at 39.6 per cent in 1995.

In 2000, the 12 per cent expansion in crude petroleum, which accounted for about 99 per cent of mining output, was attributed to increase in OPEC quota, which raised Nigeria's shares from 1.89 mbd in March to 2.03, 2.09 and 2.18 mbd in July, October and November respectively. The performance of the mining sub sector was low in 2001, as the rising trend in output observed in 2000 fell in 2001. Crude oil production rose by only 0.4 per cent in 2001, compared with 14.9 per cent of the previous year. The sluggish growth of the mining sub sector in 2001 was largely due to the marginal increase in crude petroleum production, which accounted for about 98.7 per cent of the total output of the mining sub sector.

The OPEC quota for Nigeria was reviewed downwards to 2, 075, 1, 993, and 1, 911 mbd in February, April and September 2001 respectively. This downward trend in

Nigeria's OPEC quota continued at the beginning of 2002 when she recorded 1.787 mbd in January. However, Nigeria's crude oil production, according to data from the International Energy Agency (2002), was 2.17 million b/d in October, 2001 and 2.08 million b/d in November, 2001; the Nigerian authorities put crude oil output for December 2001 at 1, 992 million b/d.

These output levels were well above the OPEC quota, which gives credence to the view that Nigeria is the worst OPEC offender with respect to exceeding its quota. At the same time, it was hard to imagine Nigeria reducing output substantially as the reduced quota coincided with reduced oil prices. The spot price of Nigeria's reference crude, the Bonny Light (370 API), averaged $24.53 a barrel in 2001, which denoted a fall of 14.1 per cent when compared with the level in 2000. Besides, in 2001, the Nigeria National Petroleum Corporation (NNPC) began crude oil production from the Okono field, marking the beginning of Nigeria's production of offshore oil. The second field, Okpoho, started production in mid-2003. The downturn in oil production had significant effects for the mining sector in 2002 and 2003. Crude oil production declined by 7.8 per cent in 2002, mainly due to OPEC's cut of Nigeria's production quota to 1.787 mbd, according to official sources.

Notably, independent observers measured actual production in 2002 at about 1.94 mbd, substantially above the quota. In early 2003, production was estimated at 2 mbd, consistent with the quota for February. However, following the communal crisis in the Niger Delta area, especially in Warri, oil output took a downward slide. In March 2003, oil multinationals had shut down practically all their operations in the western delta, with a total production loss of nearly 40 per cent at the height of the violence. Thereafter, oil output increased gradually, reaching 1.98 mbd in May as a result of government interventions directed at ending the crisis. Since July 2003, output was estimated at 2.2 mbd, although disturbances which resulted in closures of production facilities in the Niger Delta area continued.

In 2004, Nigeria's crude oil output was estimated at an average of 2.33 million barrels per day (mbd), compared with an average of 2.018 mbd in 2003. A major problem for Nigeria's oil sector remained the unrest in the Niger Delta region, as well as sub

optimal performance of local refineries, leading to domestic shortages of petroleum products. The domestic shortages may also be the result of smuggling, as Nigeria maintained artificially low prices in the domestic market. In 2005, mining sector (primarily oil) accounted for about 36 per cent of GDP. Crude petroleum production was estimated at 2.5 million barrels per day (mbd), of which 2.05 mbd was destined for exports. At an estimated average price of $55 per barrel in 2005, the price of Nigeria's reference Bonny Light crude oil increased by 11 per cent during the preceding year as a result of high world prices.

The crude petroleum and natural gas sector at constant prices decreased consistently from a level of ₦130.2 billion in 2006 to ₦124.3 and ₦116.6 in 2007 and 2008 respectively. It increased slightly to ₦117.1 billion in 2009 and ₦123.0 billion in 2010. The following figures; 22.86, 20.54, 17.29 and 19.34 per cent accounted for the mining sector component of the GDP in 2006, 2007, 2008, 2009 and 2010 respectively. The growth rate of the oil and gas sector stood at 4.98 per cent in 2010, which improved from 0.45 per cent in 2009, -6.19 per cent in 2008, -4.54 per cent in 2007 and -4.51 per cent in 2006.

Solid minerals, which include coal mining, iron ore, quarrying and other mining activities grew by 12.28 per cent in 2010 compared to 12.08 per cent in 2009. This growth was reinforced by demand for road and housing construction.

2.3.4 Services

Despite the size of the services sector, there is considerable confusion about what actually constitutes services industries. Broadly, services comprise the "tertiary sector" of the economy, the primary sector being mining and farming, and the secondary, manufacturing. Thus, services consists of service-producing sub sectors like domestic trade, tourism/hotel and restaurant, transportation, post and telecommunications, social services, utilities, finance and insurance as well as real estate.

Before the introduction of the SAP, the nation's services sector had shown little growth, although its share of GDP increased from 25 per cent in 1980 to 28 per cent in 1986. In the services sector, most activities (except for government services which showed moderate growth) declined. The share fell to 10.3 and 7.9 per cent in 1990 and

1995 respectively. The sector as a whole grew to 19 per cent in 2000 with all the sub sectors achieving significant growth rates. Growth in the services sector was largely due to improvement in the purchasing power of consumers as a consequence of increased public spending. The main sources of this growth were transport, communications, finance and insurance as well as producers of government services. The share of the services sector in total GDP remained at 24.8 per cent in 2001, which later grew by 4.8 per cent in 2002.

This sector remains a major growth driver in the economy, accounting for 14.8 per cent and 17.5 per cent of the total GDP growth in 2009 and 2010, respectively (Table 2.2). The strong growth rate of the services sector was underpinned by increased activities in domestic trade and the telecommunications sector.

Despite exceptional growth performance of services sector in the last couple of years, the sector's link with the rest of the economy is weak and insufficient to boost growth in other sectors. Therefore; there is need for activities in these sectors to be deepened so that it can play a more productive role in the economy.

2.3.5. Building and Construction

The construction sector in Nigeria consists of all establishments involved with the erection of residential and non-residential buildings as well as civil engineering works. Construction activities are varied which include jobbing contracts (labourers hired periodically for some wages), supply of buildings, construction of houses, offices, school, factory roads, bridges and other complex contracts (Olaloku 1987).

Available data reveal that the sector has significantly contributed to the growth and development of the economy. From a percentage GDP share of 4.4 per cent in 1970 through 5.7 per cent in 1975, it rose massively to about 20 percent in 1980. This is connected with the post-civil war reconstruction activities by the public and private sector. The share of this sector in GDP however declined to an average of about 4 per cent in late 80's and early 90's. This contribution increased in the early 2000's. This strong growth is sustained in the last five years of the study period as it registered

growth rate of 12.99 per cent in 2006, 13.03 per cent in 2007, 13.03 per cent in 2008, 11.97 per cent in 2009 and 13.08 percent in 2010 (Table 2.2).

The sectoral distribution of construction investment reveals that in 1970 and 1975, building construction and land improvements stood at an average of 26.3 and 4.2 per cent respectively. Investment in construction machinery and equipment stood at an average of 19.8 per cent in 1975. Other constructions except land improvements rose massively to 34.1 per cent; transport equipment also rose to 15.2 per cent in the same period. This trend continued in the last five years of the study period as construction machinery and equipment increased to 22.6 per cent in 2006, 23.1 per cent in 2007, 23.9 per cent in 2008, 27.5 per cent in 2009, and 29.6 per cent in 2010. Other building constructions (residential and official) rose to 49.2 per cent in 2006, 52.5 per cent in 2007, 58.7 per cent in 2008, 60.2 per cent in 2009, and 63.4 per cent in 2010.

2.3.6. Wholesale and Retail Trade

The contribution of this sector fluctuated during the study period. In terms of its contribution to GDP, it recorded 12.69 per cent in 1970, 19.37 per cent in 1980, 13.39 per cent in 1990 and 11.51 per cent in 2000. The sector recorded an increase from 14.95 per cent in 2006 to 16.18 per cent, 17.41 per cent, 18.14 per cent and 18.70 per cent in 2007, 2008, 2009 and 2010 respectively. This noticeable increment recorded was attributed to improvement in wholesale activities following recent consumer promotions embarked on by various firms to revive consumer demand in the wake of recent credit crunch experienced in the country. Also, there was appreciable improvement in credit lending by commercial and microfinance banks to consumers and micro business enterprises which improved retail trade activities across Nigeria (Table 2.2).

Table 2. 2. Percentage Sectoral contribution to Aggregate Output (1970-2010)

Year	Agricultural sector (₦)	Manufacturing sector (₦)	Mining & Quarry sector (₦)	Services sector (₦)	Building & construction sector (₦)	Wholesale and Retail trade sector (₦)
1970	64.27	7.23	33.10	18.45	4.35	12.69
1975	44.74	5.61	45.50	16.30	5.69	15.61
1980	20.61	8.32	15.30	15.05	20.00	19.37
1985	32.70	8.60	15.05	9.45	16.69	17.52
1990	31.52	8.71	37.50	10.25	14.63	13.39
1995	34.19	6.88	39.60	7.85	11.86	12.20
2000	28.50	4.00	32.45	19.12	12.96	11.51
2005	41.19	4.79	36.13	15.21	13.52	14.25
2010	40.84	3.64	19.34	17.50	13.08	18.70

***Source*:** Central Bank of Nigeria: Statistical Bulletin and Annual Report and Statement of Accounts various years

2.4 Public Investment in Nigeria

The colonial policy on public investment in enterprises revolved around the support of private sector leadership through the provision of financial assistance and infrastructure, such as electricity, railway and telecommunications. The post-colonial policy on public enterprise (although a bit unstable) also rested largely on the ideology that government investment in public enterprises should aim at promoting private investment. In the 1960 budget speech, the government stated that direct investment in industrial development was the exclusive concern of the private sector (Owosekun, 1991). Four years later, government modified its stance by maintaining that government policy would be aimed at stimulating the rigorous growth of the private sector through the provision of adequate infrastructure and financial assistance (First National Development Plan, 1964).

By 1970, when the poor performance of the private sector had become glaring and foreign capital inflow was very disappointing, government announced the need for more public sector initiative and participation in economic activities through the use of public enterprises (Second National Development Plan, 1970-74). From 1970, the Nigerian economy witnessed heavy investments of public funds by states and federal Governments in many industrial production enterprises[4], infrastructure supply/development enterprises and financial enterprises. Indeed, by the early 1980s, the public sector accounted for about 50 per cent of the GDP in Nigeria (Ojo, 1992). According to Obadan (1992), the public sector accounted for 65 percent of the total investment in the economy over the four developmental plans periods in Nigeria. Also, 53 per cent of the total investment in economic activities (housing, agriculture/natural resources, transport/communication and road/construction) over the same period was accounted for by the public sector.

This suggests that the public sector has been the major stimulus for economic growth since the mid-1970s. From one in 1946 to seven in 1960; the number of non-commercial and commercial parastatals owned by the Federal Government increased to over 200 by 1986 (Ukpong, 1993). According to Usman (1991), the number of public enterprises in Nigeria (at all levels of government) was over 500 in 1986. In

[4] See, Owosekun 1991

1998, the total number of commercial public enterprises stood at 96. Further, public investment contribution to GDP declined over time. In the 70s and 80s, public investment contribution to GDP rose from 3.6 per cent between 1970 and 1974 to 20.5 per cent between 1980 and 1984. Public investment contribution to GDP stood at 9 per cent between 1990 and 1994 and fell drastically to 4.2 per cent between 2005 and 2010. This is depicted in the second column of Table 2.3. Also from the table, private investment fell drastically from 56.6 per cent between 1970 and 1974 to 8.2 per cent between 1985 and 1989, 5.9 per cent between 2000 and 2004 and increased slightly to 7.8 per cent between 2005 and 2010. This indicates that public investment that should be a catalyst that spurs growth in the private sector was generally low and this has affected private investment negatively during the study period.

Table 2. 3. Trend of Public Investment, Private Investment and GDP Growth Rate (1970-2010)

Year	GDP Growth (%)	Public investments as % of GDP	Private investments as % of GDP	Saving as a (%) of GDP	Lending to public sector (₦ million)	Lending to private sector (₦ million)
1970-1974	2.5	3.6	56.6	7.8	101.4	351.7
1975-1979	-5.2	14.9	23.4	8.5	986.7	1671.6
1980-1984	4.2	20.5	21.8	11.6	3596.6	7190.9
1985-1989	8.7	8.0	8.2	18.4	18980.1	13700.2
1990-1994	6.2	9.0	11.4	11.1	21043.9	36631.0
1995-1999	2.5	6.3	6.0	12.1	263002.8	211358.6
2000-2004	3.8	5.2	5.9	8.4	71620.2	596001.5
2005-2010	5.4	4.2	7.8	15.6	52706.9	1922775.6

Source: Central Bank of Nigeria: Statistical Bulletin and Annual Report and Statement of Accounts various years

Government investments in enterprises in Nigeria have been heavily criticised for their operational and pricing inefficiencies. Ajakaiye (1985) reveals that operating losses of public enterprises (PEs) amounted to a staggering sum of ₦96.44 million in 1985 and increased to about ₦3.7 billion by 1997. According to BPE (2000), successive Nigerian administrations invested about ₦800 billion in PEs while the annual returns on the investment were well below ten per cent of the investment capital.

2.5 Functional Composition of Public Investment in Nigeria

Public investment in Nigeria is often disaggregated into capital expenditure in economic services (housing, manufacturing, mining/quarrying, agriculture/natural resources, transport/communication and road/construction), social and community services (education and health) as well as administration (general administration, national assembly, defence and internal security).

A breakdown of public investment from 1970 to 2010 shows that investment in economic, social and community services fluctuate over time. Public investment in administration on the other hand has increased relatively within this period. Investment in economic services accounted for ₦43.3 million or 8.3 per cent of the total public investment in 1970, it increased drastically to ₦1,314.7 million or 41 per cent of the total public investment in 1975. This can be largely attributed to the increase in the inflow of oil export revenue. Compared to the 1970s, there was fluctuation in the investment in economic services in the 1980s. For instance, it accounted for ₦5,921.1 million or 58.8 per cent in 1980 and fell precipitously to ₦892.7 million or 16.3 per cent in 1985. This invariably can be attributed to the contractionary fiscal policy stance of government occasioned by a decline in oil export revenue inflow.

This figure increased in 1990 in real term to the tune of ₦3,485.7 million or 14.5 per cent which implies a decrease when considering the total investment for that year. This increase continued all through the 1990s to 2000. Public investment in economic service stood at ₦434,500.5 or 46.6 of total public investment in 2010 (Table 2.4). On the other hand, public investment in social and community service accounted for ₦1.4 million or 0.7 per cent of the total. It increased sharply to ₦927.4 million or 28.9 per cent in 1975, ₦2456.7 million or 24.2 per cent in 1980; fell to ₦2,096.0 million or 8.7 per cent in 1990 and by 2000 it increased fairly to ₦27965.2 million or 11.7 per cent of

the total in 2000. In 2010, public investment in social and community service accounted for ₦104,900.0 million or 16.7 per cent of total public investment in that year.

Specifically, public investment in agricultural sector stood at 5.6 million in 1970; ₦467.3 million in 1980; ₦1598.2 million in 1990; ₦8803.2 million in 2000; ₦60030 million in 2005; ₦89500 million in 2006; ₦94100 million in 2007; ₦106000 million in 2008; ₦138900 million in 2009; and ₦140700 million in 2010. Public investment in manufacturing sector on the other hand, stood at ₦ 0.53 million in 1970; ₦853.8 million in 1980; ₦278.2 million in 1990; ₦3307 million in 2000; ₦1680 million in 2005; and ₦11033.3 million in 2010. Further, public investment in crude petroleum sector rose from ₦0.7 million in 1970 to ₦1133 million in 1980; fell drastically to ₦401.73 million in 1990; rise to ₦4612.9 million in 2000; and further increased to ₦14711.1 million in 2010. Generally, public investments in other sectors like services, wholesale and retailing, building and construction, and mining and quarry have followed the same pattern or trend (Figure 2.2).

Public investment in administration increased in absolute term from ₦70.2 million in 1970 to ₦1,501.1 million in 1980, ₦2,919.9 million in 1990, ₦53279.5 million in 2000 and ₦311,868.8 million in 2009. Compared to 1970 in terms of percentage of this figure to the total investment, there has been a steady decrease from 37.4 per cent in 1970 to 14.8 per in 1980, 12.1 per cent in 1990 and 22.3 per cent in 2000 (Table 2.4).

Table 2. 4. Functional Allocation of Public Investment in Nigeria (1970-2010)

Year	Economic Service (₦) Nominal	Economic Service (₦) Real	% of Total	Social & community service (₦) Nominal	Social & community service (₦)	% of Total	Administration (₦) nominal	Administration (₦) Real	% of Total
1970	43.3	191.5	8.3	1.4	6.2	0.7	70.2	310.4	37.4
1975	1,314.7	2950.9	41.0	927.4	2081.6	28.9	747.8	1678.5	23.3
1980	5,921.1	6762.2	58.8	2,456.7	2805.7	24.2	1,501.1	1714.3	14.8
1985	892.7	472.3	16.3	1,154.0	610.6	21.1	459.6	243.2	8.4
1990	3,485.7	612.1	14.5	2,096.0	368.1	8.7	2,919.9	512.7	12.1
1995	43,149.2	958.3	35.6	9,215.6	204.6	7.6	13,337.8	296.2	11.0
2000	111,508.	1530.2	46.6	27,965.2	383.8	11.7	53,279.5	731.1	22.3
2005	265,034.	1831.6	51.0	71,361.2	493.2	13.7	171604.1	1185.9	33.0
2006	262,207.	1669.1	47.5	78,681.3	500.8	14.2	185,224.	1179.1	33.5
2007	367,900	2197.7	48.5	131,100.0	783.2	17.3	220,900.	1319.6	29.1
2008	504,400	2618.9	52.5	152,100.0	789.7	15.8	287,100.	1490.7	29.9
2009	509,120.	2357.2	44.2	120,049.2	555.8	10.4	311,868.	1443.9	27.1
2010	434,500.	3804.7	46.6	104,900.0	918.6	16.7	326,000.	2854.6	29.9

***Source*:** Central Bank of Nigeria: Statistical Bulletin and Annual Report and Statement of Accounts various years

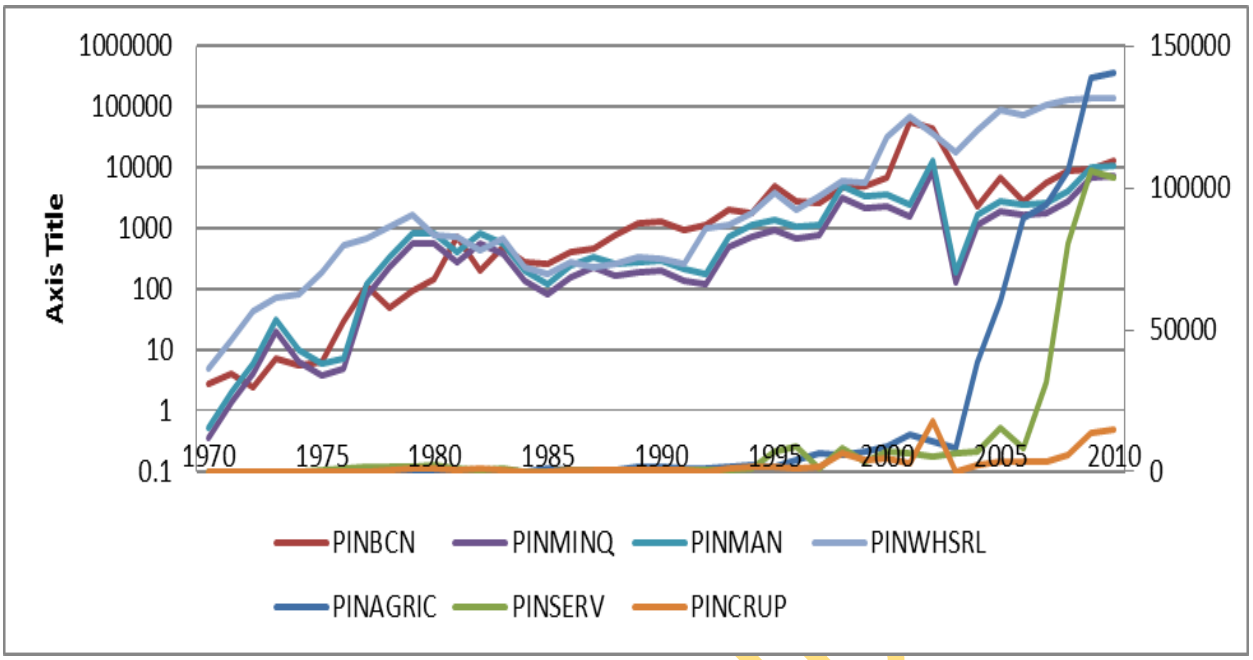


Figure 2. 2. Trend of Sectoral Public Investment (₦ million)

***Source*:** Central Bank of Nigeria. Various years: Statistical Bulletin and Annual Report and Statement of Accounts

NOTE: Public investments are capital expenditure in these sectors

KEY:

PINAGRIC = Public investment in agricultural sector

PINBCN = Public investment in building and construction sector

PINSERV = Public investment in services sector

PINMINQ = Public investment in mining and quarry sector

PINMAN = Public investment in manufacturing sector

PINCRUP = Public investment in crude petroleum sector

PINWHSRL = Public investment in wholesale and retailing sector

2.6 Public Investment on Infrastructures

In this study, capital expenditure on infrastructure that affects the output of agricultural, manufacturing, services, crude petroleum, mining and quarry, building and construction as well as wholesale and retailing sectors are discussed in this subsection. For example, capital expenditure on infrastructure that affects services sector basically includes expenditure on transport and communication; on agricultural sector, it includes expenditure on water resources, fertilizer and machinery.

2.6.1 Transport

The transport sector in Nigeria contributed about 6.71 per cent to real GDP in 2010 with road alone accounting for nearly 86 per cent of the sector's output. This implies roads are very important to the transport sector and the economy as a whole. Notably, the growth of road transport has been largely constrained by the poor state of roads. The country has a total of 213,700 km of roads of which only 15 per cent are paved, 23 per cent of the tarred roads are in bad condition, requiring urgent rehabilitation.

The growth in the number of road accidents reached an average of 3.1 per cent per annum between 2005 and 2010, rising from 12,705 to 14,279, respectively. Deficiencies of the road sub sector posed serious problems for the national economy. It is estimated that inadequate road investment and maintenance will lead to increased costs of $570 million (₦80 billion) in vehicle operating costs and road accidents.

The responsibility for construction and maintenance of the national road network in Nigeria is shared among the three tiers of government as follows: Federal Government (17 per cent), state government (16 per cent) and local government (67 per cent). At the federal level, the Federal Roads Maintenance Agency (FERMA) is responsible for federal roads, while the Rural Development Department of the Federal Ministry of Agriculture and Rural Development is responsible for rural roads. The current construction and maintenance of roads fall short of the needs in rural and urban areas.

Reform of the road sector has just begun. The BPE is collaborating with the Roads Sector Development. The reform will address deferred maintenance and investment through public-private partnership (PPP) arrangements or concessions. Financing is to

be improved through a "Road Fund" obtained from road-user charges. An autonomous agency known as the National Roads Board (NRB) is to manage the fund, while concessions will be granted private operators on a build-operate-and-transfer (BOT) basis.

Total public investment stood at ₦139.2 billion in 2010 from a mere ₦5.1 million in 1970 to ₦76.3 million in 1980, ₦315.1 million in 1990, ₦32.39 billion in 2000 and ₦89.57 billion in 2005. The less than impressive performance of transportation sector during the period under study could largely be attributed to the poor state of transport infrastructure. Therefore, government shoud invest more to improve the performance of this sector and other sectors of the economy.

2.6.2 Communication

The provision of telecommunications services in Nigeria has until recently been the exclusive preserve of public sector monopolies. The largest provider was Nigerian Telecommunication Limited (NITEL), a public limited liability company whose antecedent was Nigerian External Telecommunications Limited (NET), established by Cables and Wireless of United Kingdom during the colonial era. The Nigerian government acquired 51 per cent of the company in 1962 and by 1972 had taken over the remaining 49 per cent. The name of the company was changed from Cables and Wireless incorporated to NET.

In December 1984, the telecommunications arm of Post and Telecommunications (P&T), a commercial department of the Ministry of Communications that had started out as a postal branch of the British Post Office in 1851, was detached from its postal affiliate and merged with NET to form NITEL, an autonomous public company incorporated under the Companies Decree of 1968. NITEL officially commenced business on 1 January, 1985. At inception, the company inherited NET's authorised share capital of four million shares of ₦1.00 each with ₦2 million fully paid. The company was commercialised and renamed NITEL Plc. in 1992, although no public shareholding other than that of the Nigerian government.

Prior to deregulation and commercialisation of the telecommunication sector, NITEL operated very inefficiently as a monopoly, grappled with lack of clear policy direction, counterproductive bureaucratic red tape and a myriad of other problems. These problems led to sub optimal performance in all spheres of operations, from inadequate infrastructure to very low quality customer service. Up to 1991, access to telephone services was limited to about 20 per cent of the population and area of coverage. As at December 1991, there were about 450,000 direct exchange lines giving an average penetration level of about one line per 250 inhabitants as against International Telecommunications Union recommendation of one line per 100 persons for developing nations.

There were over 500,000 waiting applicants nationwide, while telex subscriber figures stood at 7,985. These figures reflect poor capacity utilisation since installed telephone and telex capacities were over 500,000 and 15,000, respectively. The quality of service was also poor and constant congestion of switching equipment led to long dial tone delays and very low call completion rates. On average, the call completion rates for local, long distance and incoming international calls were as low as 40, 40 and 45 per cent, respectively, as against the expected 60 and 50 per cent for local and international calls respectively (Jerome, 2002).

Further, an efficient billing system was lacking, indeed it was suspected that about 20 per cent of subscribers did not receive bills, while only seven per cent of amounts generated were being collected. These factors culminated in consistent operating losses and low returns on investments as shown in its audited accounts, which recorded persistent losses.

Improvements in telecommunications received a boost in 2001 with the deregulation of the sub sector. The Nigeria Communication Commission (NCC) licensed two private operators in addition to NITEL to operate the Global System of Mobile (GSM) telecommunications in 2001. Of the three licenses, two of the operators commenced operation during the year and by end- 2001, about 300 000 cell phones had been rolled out, bringing the total operational telephone lines available in Nigeria to 726 500 or a tele-density of about 1:165, an improvement on the ratio of 1:284 in 2000.

In telecommunications, the total number of telephone lines of the incumbent operator NITEL increased by 20.3 per cent, from 767, 862 in 2001 to 932, 424 in 2002. Deregulation in the sub sector has improved communication services. Since the introduction of GSM technology in 2001, the two private operators, MTN and ECONET have increased telephone lines from 300, 000 in 2001 to 1, 660, 000 in 2002. In 2003, a further private operator, GLOBACOM, entered the telecommunications market with its mobile service Glo-mobile.

Expansion in telecommunications continued to lead growth of the services sector, with telephone density increasing from 1 per 165 people in 2001 to 1 per 49 people in 2003. Since the liberalisation of telecommunications in 2001, private operators have brought about innovation, wider coverage, competition, and improved investment financing. However, severe operational inefficiencies continued to limit the sector. For instance, NITEL increased its telephone lines by 20.3 per cent in 2003 but only 50 per cent of its lines were functional.

Nigeria's telecommunications sector grew by 12 per cent following its accelerated liberalisation and privatisation, which led to the introduction and rapid spread of the GSM services. The number of mobile phone lines increased from 230, 000 in 2001 to 8.3million in 2004 while fixed land lines increased by an average of 20 per cent annually, from 600, 000 to 1.03 million during the same period.

The communications sector in Nigeria has boomed in the last five years, with growth averaging around 30 per cent per annum, driven largely by the expansion of GSM services. Large inflows of foreign direct investment (FDI) have played a crucial role. The stock of telecommunications FDI jumped from $50 million in 1999 to $7.5 billion in 2005, from where it increased by more than 2000 per cent to more than $18 billion in 2010. The number of mobile phone lines has increased from less than 0.25 million in 1999 to nearly 20 million in 2005, with tele-density attaining 15.7 lines per 100 inhabitants. The tremendous progress made in telecommunications has contributed to an overall improvement in the business climate, benefiting the manufacturing sector in particular. In 2008, telecommunications and postal services jumped by an estimated 34 per cent, continuing the 30 per cent plus growth rates in 2007 and 2006.

The number of mobile phone lines has increased from less than 19 million in 2005 to nearly 80 million in 2010, with tele-density reaching 54.2 lines per 100 inhabitants. The tremendous progress made in telecommunications has contributed to an overall improvement in the business climate, benefiting in particular the manufacturing sector.

2.6.3 Water Resources

Nigeria is endowed with surface water resources such as rivers, streams, lakes and wetlands which provide a source of drinking water for a large proportion of the population in areas with limited public water supply facilities. Rainfall, which constitutes a significant source of freshwater, is highly variable across the different regions of the country, ranging from about 250 mm in the extreme north to over 500mm in the south. The urban and peri-urban populations, however, rely heavily on underground water resources.

Nigeria has a policy on national water resources called the Master Plan. This provides a framework for integrated water resources planning, development and management for 1995 to 2020. The first review of the plan was carried out in 2006, Nigeria shares three major river/lake systems with neighbouring countries, requiring bilateral and multilateral cooperation through regional bodies such as the Niger Basin Authority (NBA) and the Lake Chad Basin Commission (LCBC). The Federal Ministry of Water Resources represents Nigeria in these international bodies. Recently, the NBA held an extraordinary session in Abuja to consider a regional report on the River Niger. Similarly, efforts were taken by the LCBC to halt the disastrous reduction of the water surface of Lake Chad, from 25,000 square kilometres in 1964 to less than 2,000 square kilometres at present. One such initiative involved the transfer of water from River Ubangi in the Democratic Republic of Congo to Lake Chad.

The agency charged with the overall responsibility for water supply and sanitation in Nigeria is the Federal Ministry of Water Resources. A number of projects were completed recently, and new ones are being planned. Between 2000 and 2005, the government completed the development of 1,519 motorised boreholes and 3,552 hand-pump boreholes to cater for the water needs of 24.5 million people. In 2004, the

Federal Ministry of Water Resources procured and distributed water-related equipment to states and local governments.

In 2004, contracts worth ten billion naira were awarded for the drilling of 3,250 additional motorised boreholes and 1,579 hand-pump boreholes. New on-going projects include 482 primary hydrological stations, 50 groundwater motorised boreholes and hydrological mapping for effective water resource administration, and 42 small- and medium scale dams. Water pricing in Nigeria differs across the country, but in all situations, it is generally subsidised. In urban and peri-urban areas, water charges are based either on the volume of water consumed or on a flat rate. In most rural areas, however, water is often supplied free of charge. Water scarcity is a common phenomenon in many towns and cities in Nigeria, which compels people to buy water from private water vendors. The proportion of unaccounted water supply varies across different regions, with the national average being estimated at around 40 per cent of total water supply. Public spending on water supply increased substantially from a mere ₦7.3 billion in 1999 to ₦80 billion in 2006.

Priority was accorded the completion of the Gurara Water Project for Abuja – the federal capital – and environs. Huge investments were also proposed for the construction of dams in various parts of the country, including the Owiwi Dam, Shagari Dam, Ile-Ife Dam, Jada Multipurpose Dam, Kashimbila Dam Project, and the Galma Multipurpose Dam. Similarly, significant funds are being provided for various irrigation and water supply projects nationwide. Nigeria's water infrastructure has suffered from years of poor maintenance and the lack of sanitation also constitutes a serious public-health problem. The government launched a National Water Supply and Sanitation Policy aimed at addressing these problems through: the completion of hydrogeological mapping of the country and the establishment of water-quality laboratories; intensifying the rehabilitation and reactivation of the River Basin Development Authorities (RBDAs) and existing urban water-development schemes; encouraging private sector participation in the development and supply of water; and expanding and improving rural water supply systems.

The international development agencies play a key role in Nigeria's water sector. Some of the principal participants include the United Kingdom's Department for International Development (DFID), the United Nations, the African Development Bank (AfDB), the World Bank, Japan International Cooperation Agency (JICA), the government of China, and the European Commission (EC). The AfDB is assisting the Federal Ministry of Water Resources to prepare a national Rural Water Supply and Sanitation (RWSS) programme. The World Bank-assisted Small Towns Water Supply and Sanitation Programme (STWSSP) is a comprehensive initiative for improving water supply and sanitation in more than 4,000 small towns in Nigeria. This initiative focuses on community ownership and management of water supply and sanitation facilities.

The World Bank also assisted the National Urban Water Sector Reform Project, aimed at increasing access to piped-water networks in urban areas. This project has four main components: system rehabilitation and expansion; public-private partnership (PPP); capacity building and project management; and policy reform and institutional development. Further, the World Bank assisted in the development of National Guidelines for Regulating Water Supply and Sanitation, as well as in analytical studies on dam safety. With respect to access to water supply, the proportion of the population with access to potable water rose from 30 per cent in 1999 to 65 per cent in 2006.

A breakdown of the 2006 figure shows that 67 per cent coverage had been achieved for state capitals, 60 per cent for urban areas, 50 per cent for semi-urban areas, and 55 per cent for rural areas. The Millennium Development Goals (MDGs) target for Nigeria is to increase access to clean water to 68 per cent of the population by 2015. On current trends, Nigeria is likely to meet the target on access to water supply.

A number of obstacles militate against the efficient exploitation of Nigeria's water resources. One of this is the lack of coordination between the various agencies involved in the management, quality control and monitoring of water projects. There is also the problem of lack of adequate project preparation, which has led to project abandonment and failure. Related to this is the problem of a poor maintenance culture, as well as corruption and economic mismanagement. Another important problem is the

poor funding of water resources development. Although, the amounts devoted to water resources development have increased in recent years, these are inadequate relative to the other sectors of the economy and the amounts required to make good progress towards achieving the water related MDGs.

2.7 Macroeconomic Policy Basis of Public Investment in Nigeria (1970-2010)

2.7.1 Developmental Plans

Since independence in 1960, the Nigerian government has prepared and implemented four different national development plans. These plans are as follows: First National Development Plan, 1962-1968, Second National Plan, 1970-1974, Third National Development Plan, 1975-1980, as well as Fourth National Development Plan, 1981-1985.

2.7.1.1 First National Development Plan (1962-1968)

The total capital expenditure profile of the first national plan amounts to £676.8 million over the six-year period. Of this sum, approximately 14 per cent was allocated to primary production and 13 per cent to trade and industry. Thus, the two sectors accorded top priority in the plan accounted for more than one quarter of the total capital expenditure over the period. Equally notable was the fact that more than 70 per cent of the total expenditure was devoted to those sectors which contributed directly to economic growth (primary production; trade and industry; electricity; transport system; communications; irrigation and industrial water supplies). As Table 2.5 shows, there was substantial shift in the composition of capital expenditure, from administrative to developmental expenditure compared with 1955 to 1961 Economic Programmes.

Total planned fixed investment for the six years of the national plan was £1,183 million. About £90 million of this amount was to be invested in the private sector at an average of £65 million annually. The plan assumed that £793 million would be invested in projects in the public sector at an average annual investment of £132.2 million. The public sector investment will be in descending order; transport, electricity, primary production, trade and industry education dominated as well as in terms of the allocation of funds.

In summary, the first year of the plan was essentially a period of preparation: detail costing, designing, planning of projects and similar preparatory works such as site acquisition. Public investment, which in the first year of the plan period amounted to £64.6 million, declined slightly to £63.4 million in 1963. Thereafter, it rose gradually

to approximately £90.0 million in 1966. The expected annual average investment of £112.8 million was really never achieved due to the civil war.

Table 2. 5. Distribution of Capital Programmes among Major Expenditure Categories (all governments) 1955-61 and 1962-68

EXPENDITURE TYPE	1955-61 Plan	1962-68 Plan
Development Expenditure	50.8%	71.4%
Social Overhead Expenditure	19.9%	20.8%
Administrative Expenditure	29.3%	7.8%

Source: Outline of the First National Development Plan (1962-68)

2.7.1.2 Second National Development Plan (1970-1974)

The second National Development Plan contains policy framework and programmes for the reconstruction of the damaged areas as well as the construction and development of the rest of the country. The Plan sets out clearly the national objectives and priorities of post-war Nigeria. It also outlined the general policy measures and programmes of action which flowed from the objectives as well as the agreed national scale of priorities. The estimated net nominal investment expenditure amounted to £780 million. The Plan projection was that in the first year, aggregate expenditure will be distributed among the economic, social and administrative sectors in the proportion of 60.0 per cent, 25.9 per cent and 14.1 per cent, respectively. In broad terms, strict adherence of these proportions was important to ensure that available resources are not channelled to the less productive sectors of the economy. The actual figure for 1970 to 1974 was quite different as shown in Table 2.6.

From Table 2.6, there was a sharp drop of 9.0 per cent in the percentage shares of the economic and social overhead sectors. These are reflected in the gain of 18.1 per cent in the share of the administrative sector, regarded as of lowest priority from the point of view of growth. This large proportionate share to the general administrative sector was partly due to the large expenditure of £27.7 million on defence which exceeded the £15 million allocated to it in the Plan. Though, the overall performance was considered satisfactory, this performance varied from state to state, this is worthy of note from the point of view of balanced development. Two states, Mid-west and Benue-Plateau, did better than expected. The Mid-West exceeded its target fulfilment by 22.7 per cent and Benue-Plateau by 6.1 per cent. Two states generally did not meet up the expectation; these states were Rivers State and the East-Central State.

Table 2. 6. Plan and Actual Sectoral Proportion of Public Investment in the Second Development Plan (1970-1974)

Sectors	Plan Proportions 1970-73 (%)	Actual Proportions 1970-73 (%)	Deviation (%)
Economic	60.0	51.0	-9.0
Social	25.9	16.8	-9.1
Administrative and Financial Obligations	14.1	32.2	+18.1
Total	100	100	0

Source: Outline of the Second National Development Plan (1970-74)

2.7.1.3 Third National Development Plan (1975-1980)

The nominal total of the capital expenditure programmes of all the governments of the federation during the Third National Development Plan period was ₦32.9 billion. The amount embodied an element of "double counting" to the tune of ₦727.6 million which represented the bulk of Federal Government transfers to state governments for meeting part of their capital expenditures in the fields of agriculture, water supply, urban road development, sewage, etc. The exclusion of this inter-governmental transfer from the nominal total expenditure of ₦32.9 billion reduced the size of the public sector investment programmes to about ₦32 billion. This sum was the total estimated cost of the programmes of all the governments of the federation during the Plan period. An important feature of the Third National Development Plan was the annual phasing of capital expenditures. About 16.8 per cent of gross capital expenditure was disbursed in the first year of the Plan, 20.7 per cent in the second, 21.8 per cent in the third, 20.7 per cent in the fourth and 20.0 per cent in the fifth years.

In summary, sectoral percentage distribution of the gross capital expenditure shows that the Economic sector with 62.3 per cent of the total outlay had the largest allocation followed by Administration with 13.6 per cent, regional development with 12.6 per cent and Social Sector with 11.5 per cent. This shows that the policy was designed to significantly increase the economy's productive capacity and improve the nation's social services to meet the policy objectives set out by the government.

2.7.1.4 Fourth National Development Plan (1981-1985)

Fourth Plan recognised the role of social services in bridging the gap between urban and rural sectors but continued to receive a small share of the aggregate government public investment. The total allocation under the federal allocation programme was ₦2.2 billion which amounted to about 5.5 per cent of the projected total Federal Government capital investment during the plan period. A significant distinction between the fourth and third development plans in the educational sector is that Federal investment in primary education was completely absent in the latter. For the health sector, a total of ₦1.2 billion was estimated as total capital estimation of the Federal Government of which National Basic Health Scheme had a financial allocation of ₦100 million, while the establishment of new hospitals gulped about ₦150 million.

Of the total investment of ₦82 billion spent in the fourth development plan, the share of public sector was ₦70.5 billion. This was distributed among the federal (₦40 billion), state and local (₦28 billion) governments and the Federal Capital Development Authority, ₦2.5 billion. The balance of ₦11.5 billion was reserved for the private sector. In summary, the fourth development plan was a success in terms of regional development, but some public sector investment did not yield return as expected (e.g. National Electric Power Authority and Nigeria Telecommunication Corporation).

2.7.2 The Structural Adjustment Programme (SAP)

In 1986, government initiated SAP as a short-term plan whose major objectives centred on rural development and poverty alleviation. The key elements of SAP were deregulation and reduction or full withdrawal of subsidies. In line with these objectives, government established the Directorate of Food, Roads and Rural Infrastructure (DFRRI). The directorate had the responsibility of providing basic infrastructure that will facilitate the development of agriculture by increasing agricultural output and creating enabling environment for farm produce to get to final consumers. In the fiscal 1986, it received a budgetary allocation of ₦300 million, in 1987 it received ₦400 while ₦500 million was allocated to the agency in 1988 to develop rural infrastructure.

The share of total public investment in economic, social and community services and administration rose to 31.1, 17.8 and 9.2 per cent respectively in 1986 compared to 11.7, 13.4 and 5.6 per cent respectively in 1985. In 1987 the total public investment fell by 25.3 per cent to ₦6, 372.5 million from ₦8, 526.8 million in 1986. In 1988 this amount rose by 30.9 per cent to ₦8, 340.1. This amount rose by 80.3 per cent to ₦15, 034.1 in 1990. This trend continued until 1991. Generally, public investment increased during the SAP era.

2.7.3 The Petroleum (Special) Trust Fund (PTF)

The PTF was established by Decree 25 of 1994 (and amended by Decree 1 of 1995). It was empowered to utilise the gains from increase in the prices of petroleum products to complete all government-abandoned projects and rehabilitate decaying

infrastructure nationwide. The PTF influence was felt in seven sectors of the economy, namely roads, health, education, water supply, food supply, security and agriculture. In the area of water supply, a total of ₦120 million was used to drill boreholes in some selected states like Katsina, Cross River, Akwa-Ibom, Kogi, Abia and Borno. Also, ₦11, 953.000 million was allocated to construct roads between 1995 and 1997. A total of ₦9,588 billion was expended on education specifically, university education, technological/technical and teacher education. For the health sector, a total of ₦1.354 billion was allocated to support some key priority programmes in the health sector such as: The National Essential Drugs Programme, National AIDS Control Programme and Improvement of Physical Infrastructure and Equipment Maintenance Programmme.

2.7.4 National Economic Empowerment Development Strategy (NEEDS)

The macroeconomic policy thrust of Nigeria outlined in the National Economic Empowerment and Development Strategy (NEEDS) document aimed at creating a stable environment for accelerated pro-poor growth. In this regard, the government's fiscal policy sought to enhance revenue collection, strengthen public financial management through effective fiscal allocation, coordination and monitoring. NEEDS reforms in improving the transport sector infrastructure was aimed at completing 3,000 kilometres network of roads and strengthening the Road Maintenance Agency, which monitored the repair and rehabilitation of some 500 roads in the country. Roads rehabilitation, maintenance and new roads were expected to increase from 3,000 in 2003 to 3,500 in 2004, 4,000 in 2006 and 4,500 in 2007.

NEEDS policies in the health sector targeted priority diseases such as malaria, tuberculosis, HIV/AIDS and reproductive health related illness. The NEEDS policy was designed to target the reduction in HIV/AIDS prevalence rate from 6.1 per cent in 2003 to 5.0 per cent in 2007. Access to safe water was supposed to increase from 64.1 per cent in 2003 to 70.0 per cent in 2007 while access to adequate sanitation was expected to increase from 53.0 per cent in 2003 to 65.0 per cent in 2007. In terms of power generation (megawatts), 4,000 were expected to be generated in 2004, 5,000 in 2005, 7,000 in 2006 and 10,000 in 2007. In the educational sector, the major policy thrust of NEEDS was targeted at increasing adult literacy rate from 57.0 per cent in

2003 to 65.0 per cent in 2007. In summary, most of these targets were not met, for instance, as at September, 2009 the total megawatts in Nigeria was less than 6,000 as against the targeted value of 10, 000 in 2007. Adult literacy as at 2010 was less than 52 per cent while access to safe water and good sanitation did not improve.

CHAPTER THREE

LITERATURE REVIEW

This chapter focuses on the literature review of this study. It reviews issues on public investment and output performance. The review is in three parts, namely theoretical, methodological and empirical

3.1. Theoretical Literature

There are three main views regarding the role of government in the economy: Neoclassical, Keynesian and Ricardian (Bernheim, 1989). Neoclassical paradigm believes that government economic activity may crowd out that of the private sector (Buiter, 1977). Therefore, government intervention should be limited. Keynesian view advocates the active role of government because of its multiplier effects (Fazzari, 1994) while Ricardian Equivalence proposition argues for the neutrality of government deficits (Barro, 1989). Each of these views is discussed in detail in the following subsections.

3.1.1. Neoclassical View

The standard Neoclassical model has three central features: the consumption of each individual is determined as the solution to an intertemporal optimisation problem, where borrowing and lending are permitted at the market rate of interest; individuals have finite lifespans while each consumer belongs to a specific cohort or generation, and the lifespans of successive generations overlap; and market clearing is generally assumed in all periods.

Diamond's (1965) seminal paper was the first effort to study formally the effects of budget deficits in the context of Neoclassical model. Diamond (1965) argues that a permanent increase in the ratio of domestically held debt to national income depresses the steady state of capital-labour ratio. At the original rate of interest, consumers are

unwilling to hold the original volume of physical capital and bonds, plus new bonds. Rising interest rates stimulate additional saving and reduce investment until capital market equilibrium is re-established. Thus, persistent government deficits crowd out private capital accumulation. Diamond's analysis focuses on permanent changes in deficits and does not shed light on the effects of temporary changes.

Auerbach and Kotlikoff (1986) conducted a research on policy simulation in a much more complex neoclassical model. Their analysis emphasised that the immediate impact of a temporary budget deficit may be extremely small, and possibly perverse (a temporary deficit might stimulate savings in the short run). This result reflects several considerations. First, economic lives are quite long, so the impact of an increment to lifetime wealth on current consumption (the "wealth effect") is small. In addition, if one holds government spending constant, temporary deficits will reflect tax reductions. Typically, this implies reduced marginal tax rates. Reduced capital income tax rates stimulate savings directly by raising the after tax rate of return. Temporarily low labour income tax rates induce intertemporal substitution, raising current income, and hence savings. Thus, the neoclassical paradigm implies that temporary deficits should have very little effect or even a perverse effect on economic variables in the short run.

Notably, Auerbach and Kotlikoff (1986) point out that wealth effects cumulate over time, such that even temporary deficits eventually crowd out private capital formation. As in Diamond's model, unconstrained consumers would not be willing to hold the original volume of capital and bonds, plus the new bonds, at the original rate of interest. As one increases the fraction of consumers who are liquidity constrained, the interest sensitivity of savings falls, and more increases in interest rates are required to equilibrate capital markets. Accordingly, the introduction of liquidity constrained consumers might well strengthen the conclusion that permanent deficits depress capital accumulation. The remaining two features of the standard neoclassical model are essential. Indeed, the second characteristic (finite lifetimes) defines the central difference between the Neoclassical and Ricardian frameworks, while the third characteristic (full employment) is the primary distinction between the Neoclassical and Keynesian paradigms.

Meanwhile, temporary deficits should depress savings and raise interest rates in the short run. Thus, the Neoclassical paradigm does not tie down the effects of temporary deficits, rather the evidence it bears is not useful for testing this paradigm. The fundamental lessons of the Neoclassical framework concern the effects of permanent deficits.

In summary, the main empirical implications of Neoclassicism are; if consumers are rational, farsighted, and have access to perfect capital markets, permanent deficits will significantly depress capital accumulation while temporary deficits have either a negligible or perverse effect on most economic variables (including consumption, savings, and interest rates). If many consumers are either liquidity constrained or myopic, the impact of permanent deficits remains qualitatively unchanged.

3.1.2. Keynesian View

The most fundamental of the Keynesian view is that Gross Domestic Product (GDP) is determined in the short run by aggregate demand. According to this view, the two major factors that affect aggregate demand are changes in government spending and taxation. Keynes advocates increase in government spending and tax cut to increase GDP. He contends that an increase in government spending would not only boost demand directly but would also set off a chain reaction of increased demand from workers and suppliers whose incomes had been increased by the government's expenditure. Tax cut would put more disposable income in the wallets of consumers, which would boost demand. He submits that budget deficit (government expenditure above government revenue) is the appropriate measure during periods of high unemployment. Therefore, GDP is logically thought of as being determined by aggregate demand. The components of aggregate demand are consumption, investment, government purchases and net exports. Let us denote aggregate demand by AD. Thus we have:

$$AD = C + I + G + X \tag{3.1}$$

Where C is Consumption, I is investment, G is government purchases and X is net exports. In Keynesian postulation, aggregate supply denoted as AS is just equal to the actual value of GDP observed in the economy. Thus:

$$AS = GDP \tag{3.2}$$

Setting aggregate supply equal to aggregate demand, will give:

$$GDP = C + I + G + X \tag{3.3}$$

Equation (3.3) implies that GDP is determined by the sum of demand from the four sectors of the economy. This indicates that GDP is "demand determined".

The traditional Keynesian view differs from the standard Neoclassical paradigm in two fundamental ways: it allows for the possibility that some economic resources are unemployed; and presupposes the existence of a large number of myopic or liquidity constrained individuals. This second assumption guarantees that aggregate consumption is very sensitive to changes in disposable income. In the simplest and most naive Keynesian model increasing the budget deficit by ₦1, will cause output to expand by the inverse of the marginal propensity to save (MPS). In the standard IS-LM analysis of monetary economics, this expansion of output raises the demand for money. If the money supply is fixed (that is, the deficit is bond-financed), interest rates must rise and private investment falls. This in turn reduces output and partially offsets the Keynesian multiplier effect. Many traditional Keynesians argue that deficits need not crowd out private investment. Eisner (1989) suggests that increased aggregate demand enhances the profitability of private investments, and leads to a higher level of investment at any given rate of interest. Thus, deficits may actually stimulate aggregate savings and investment, despite the fact that they raise interest rates. In Eisner's (1989) view, increased consumption is supplied from otherwise unutilised resources.

Bernheim (1989) opposed the Keynesian view in three ways. First, while Keynesians are applauded for recognising the importance of unemployed resources, after more than five decades they still have not arrived at a fully satisfactory theory that accounts for the presence of unemployment. Shifting the explanation to old fashioned wage-

price stickiness simply begs the question. While a variety of authors have recently proposed more complete theories of unemployment (for example, Shapiro and Stiglitz, 1984), none of them have been widely accepted. Keynesians' poor understanding of the unemployment phenomenon is quite troubling. When a market failure exists, it is potentially misleading to analyse the effects of government policies on the assumption that the manifestations of the failure will remain unchanged. Without a more complete theory of unemployment, Keynesian analysis is an exercise in blind faith. Second, the Keynesian outlook on budget deficits presupposes that the government can and will "fine tune" fiscal policy. If we grant that deficits stimulate aggregate demand, it follows that there are circumstances in which this stimulation may be detrimental. Even the most steadfast Keynesian is willing to concede that, at full employment, real deficits crowd out private investment and raise the rate of inflation. Recognising the real costs of crowding out, many Keynesians (such as Eisner) argue for a policy of "nominal" deficits, which would preclude real deficits from rising once the economy achieved full employment. This policy would channel all the effects of inappropriately timed deficits into inflation. Advocates of this strategy apparently adopt the purist view that inflation is costless. Third, Keynesians provide misleading advice to policy makers by failing to distinguish between temporary and permanent deficits.

3.1.3 Ricardian View

The proposition of Ricardian equivalence is that deficits and taxes are equivalent in their effect on consumption (Barro, 1974). Reduction in taxes leads to an equivalent increase in savings and lump-sum changes in taxes have no effect on consumers spending ability. This is because a consumer endowed with perfect foresight recognises that the increase in government debt resulting from a reduction in taxes will ultimately be paid off by increased future taxes, the present value of which is exactly equal to that of the reduction in current taxes. Taking the implied increase in future taxes into account; the consumer saves today the amount required to pay them tomorrow.

Ricardian equivalence implies that fiscal deficits have no effect on aggregate savings or investment. The conditions required for Ricardian equivalence to hold are the existence of effectively infinite planning horizons, certainty about future tax burdens,

perfect capital markets (or the absence of borrowing constraints), rational expectations, and non-distortionary taxes. The restrictive nature of these assumptions has been demonstrated by authors such as Bernheim and Bagwell, (1988) and Bernheim, (1989). In particular, the debt neutrality proposition has been shown to break down if agents have finite horizons, capital markets are imperfect or uncertainty and distributional effects play a pervasive role in individuals' consumption and savings decisions.

The strict irrelevance of fiscal policy ("Ricardian equivalence") depends upon a variety of strong assumptions. These include: successive generations are linked by altruistically motivated transfers; capital markets are either perfect or fail in specific ways; consumers are rational and farsighted; the postponement of taxes will not redistribute resources across families with systematically different marginal propensities to consume (MPC); taxes are non-distortionary; the use of deficits cannot create value (not even through bubbles); and the availability of deficit financing as a fiscal instrument does not alter the political process.

The collective implications of the Ricardian assumptions were explored by Bernheim and Bagwell (1988). They note that the structure of families in Barro's (1974) analysis is highly unrealistic. Implicitly, Barro (1974) takes each dynastic family to be an independent, self-contained unit. For the human species, propagation normally requires the participation of two unrelated individuals. Thus, family linkages form complex networks, in which each individual belongs to many dynastic groupings, and in which unrelated individuals share common descendants. Due to the linkages between families, it is generally impossible to represent any family (or set of families) as a single, utility-maximising agent, even when the well-being of each individual is assumed to depend only on his/her own consumption and that of his/her children.

Bernheim and Bagwell (1988) further demonstrate that Barro's (1974) central result which essentially establishes the insensitivity of consumption to the distribution of endowments over family members, depends only upon the existence of altruistically motivated transfers (sometimes called "operative linkages") between family members and not upon the particular structure of the family tree. Meanwhile, the proliferation of linkages between families gives rise to incomparably stronger neutrality properties

under weaker conditions than those imposed by Barro (1974). In particular, all government transfers (including those between seemingly unrelated members of the same generation) are irrelevant, since they simply redistribute resources among individuals who are related albeit distantly.

Further, all tax instruments (including the so-called "distortionary" taxes) are equivalent to lump-sum taxes. This follows from the fact that, with fixed government spending, taxes are merely transfers conditioned upon specific actions. Since each contingent transfer is irrelevant, the whole package will be irrelevant. Finally, under dynastic assumptions, prices would play no role in the resource allocation process (prices are simply action-contingent transfers between distantly related parties). It is important to emphasise that these results do not require each individual to care directly or indirectly about all of his/her distant relatives.

Indeed, the conclusions hold even when each individual cares only about his/her own consumption and that of his/her children. What matters is simply that distant relatives are connected by some chain of altruistically motivated private transfers. In equilibrium, the flow of resources through these chains shoud offset government policy.

Overall, theoretical arguments do not rule out the possibility that many individuals make altruistically motivated transfers. However, Bernheim (1989) suggests that the Ricardian paradigm which assumes that nearly all individuals are parties to such transfers is extremely implausible. The existing empirical evidence is consistent with this judgment.

3.2. Methodological Review

On the methodological issues, four basic analytical approaches to develop models that show the link between public investment (in infrastructures) and output growth have been suggested in the literature. These approaches are: the production-function; the cost- function; the growth-model; and the macroeconometric.

3.2.1 The Production-Function Approach

The production function approach models the amount of output that can be produced for each factor of production, given technological constraints. Studies following this approach include Aschauer (1989), Adenikinju (1998), Duggal *et al*., (1999), Mansouri (2008), Arslanalp *et. al.*, (2010) sharing the same underlying idea that public capital can be considered as an additional input/ factor having the characteristics of a public good in the proper economic sense (i.e. being not rival and not excludable). The stock of public capital (*G*) may enter in the production function in two ways.

First, public capital may enter directly, as a third input together with *L* and *K*:

$$Y = AF(K, L, G) \tag{3.4}$$

Where *Y* is the real aggregate output of the private sector, *L* is the flow of labour of the private sector, *K* is the non-residential stock of private capital and *A* is the "technological progress". Second, it may influence total factor productivity (*A*):

$$Y = A(G)F(K, L) \tag{3.5}$$

Equation (3.5) implies that changes in public capital (G), private capital (K) and labour (L) will influence the productivity of input over time. Clearly, to quantify the impact of different inputs on output we need a specific functional form. Usually, an aggregate Cobb-Douglas production function is utilised in empirical works:

$$Y = AL^{\alpha}K^{\beta}G^{\gamma} \tag{3.6}$$

Equation (3.6) is often transformed taking natural logarithms of the left and right sides, obtaining the following:

$$\ln Y = \alpha \ln AL + \beta \ln K + \gamma \ln G \tag{3.7}$$

A further transformation that does not impose an elasticity of substitution (neither unitary nor constant) is the transformation of equation (3.7) to translog:

$$\ln Y = \ln A + \beta_k \ln K + \beta_L \ln L + \beta_G \ln G + \beta_{kk} (\ln K)^2 + \beta_{LL} (\ln L)^2 + \beta_{GG} (\ln G)^2 + \beta_{LK} \ln L \ln K + \beta_{LG} \ln L \ln G + \beta_{KG} \ln K \ln G \quad (3.8)$$

Notably, the high collinearity caused by the inclusion of the second order terms in the regression, led to some problems in the estimation of the true coefficients. Most authors, therefore, have used the more restrictive Cobb-Douglas for instance, to control for the influence of business cycle. Aschauer (1989) imposes constant returns to scale. He also introduces a linear trend as a proxy for disembodied technological progress by parameterising the model in terms of capital unit and the capacity utilisation rate (*cu*):

$$\ln \frac{y_t}{K_t} = \ln A_0 + gt + \beta \ln \frac{L_t}{K_t} + \gamma \ln \frac{G_t}{K_t} + \lambda \ln cu_t \quad (3.9)$$

Equation (3.9) implies that output per private capital is influenced by changes in labour per private capital, public per private capital and capacity utilisation of technological progress over time.

According to Munnel (1992) "the implied impact of public (infrastructure) investment on private sector output emerging from aggregate time series studies is too large to be credible" This is because this model depend solely on whether both effects can be identified independently.

Duggal *et al*. (1999) criticised the production-function approach on the basis that treating public investment as a factor input in production-function like private capital and labour, violates the standard marginal productivity theory as it assumes a market-determined per unit cost of infrastructure known by individual firms which can be included in the total cost. It implies that treating public investment as a factor input in the production-function, presumes that the marginal cost (MC) of an increase in public investment is well-known by firms. Aaron (1990) also faulted this approach for its inability to separate the direct and indirect effects of public investment on economic growth.

Most studies that adopted the production function analytical approach for country specific studies made use of the Ordinary Least Squares (OLS) estimation technique to capture the signs of each of the explanatory variable and to measure output elasticity with public and private capital in the production process (Aschauer, 1989; Rioja, 2003; Akpan, 2005; and Arslanalp *et. al.*, 2010). Cross section studies made use of panel data estimation technique to avoid spurious regression. Studies in this regard include Adenikinju, (1998) and Shioji, (2001). Canning and Bennathan, (2002) try to solve the problem of non-stationarity associated with the use of time series data by estimating a production-function in a cointegrated panel framework. Demetriades and Mamuneas (2000) and Esfahani and Ramìres (2003) handled the causality issue by introducing a "time-lag" between variables of public infrastructure and productivity. The issue of causality was handled differently by Calderon and Serven (2007) by introducing an instrumental variable to estimate a Cobb-Douglas production function (in first difference) as lagged values of explanatory variables.

3.2.2 The Cost- Function Approach

Cost-function approach assumes that public investment (public capital) is provided externally by government as a free input in the production process. Most studies specify a cost function for the private sector, with firms being assumed to aim at producing a given level of output at minimum private cost (C). Because the input prices (p^i) are exogenously determined, the instruments of the firm are the quantities of the private inputs (q^i). Alternatively, firms are assumed to maximise their profits (Π) given the output prices (p^Q) and input prices. This can be presented as:

$$C\left(p_t^i, q_t^i, A_t, G_t\right) = \min \sum p_t^i q_t^i \qquad \text{Subject to } Q_t = f(q_t^i, A_t, G_t) \tag{3.10}$$

$$\Pi\left(p_t^Q, p_t^i, q_t^i, A_t, G_t\right) = \max p_t^Q Q_t - \sum p_t^i q_t^i \quad \text{Subject to } Q_t = f(q_t^i, A_t, G_t) \tag{3.11}$$

When firms optimise, they take into account the environment in which they operate. One of these environmental variables is the state of technical knowledge (A). Another is the amount of public infrastructure capital available (G). The public capital stock enters the cost or profit function as an unpaid fixed input. Although the stock of

infrastructure is considered externally given in the cost-function approach, each individual firm will still decide the amount to be use. This implies that a firm's use of the infrastructure is part of its optimisation problem, which, in turn, leads to the need of a demand function for infrastructure that must satisfy the conditions of standard marginal productivity theory (Duggal *et al*. 1999). To make this approach comparable with the production-function approach, authors such as Demetriades and Mamuneas 2004) used Hotelling's Lemma to obtain supply functions, which can be used to calculate output elasticities of public capital.

Sturm *et al*. (1998) noted that many authors estimating a cost or profit function adjust the stock of public capital by an index, such as the capacity utilisation rate, to reflect its use by the private sector. Two reasons have been advanced for adjusting the stock of public capital. First, it is a collective input that a firm must share with the rest of the economy. However, since most types of public capital are subject to congestion, the amount of it that one firm may employ will be less than the total amount supplied in the economy. Moreover, the extent to which a capacity utilisation index measures congestion is dubious. Second, firms might have some control over the use of the existing public capital stock. For example, a firm may have no influence on the highways provided by the government, but can vary its use of existing highways by choosing routes. Therefore, there are significant swings in the intensity with which public capital is used. As pointed out by Sturm *et al.* (1998), an important advantage of the cost-function approach is that it is less restrictive than the production-function approach.

The use of a flexible functional form hardly enforces any restrictions on the production structure. For example, a-priori restrictions placed on the substitutability of production factors, as in the production-function approach, do not apply. Apart from the focus on the direct effects in the production-function approach, public capital might also have indirect effects. Firms might adjust their demand for private inputs if public capital is a substitute or a complement to other production factors. It seems very plausible that, for instance, a large stock of infrastructure raises the quantity of private capital used and therefore, indirectly raises production.

By using a flexible functional form, the influence of public capital through private inputs can be determined. A flexible function not only consists of many parameters that need to be estimated, but also of many second-order terms which are cross products of the inputs. These second-order variables can create multicollinearity problems. Therefore, the data set not only has to be relatively large, it must also contain enough variability so that multicollinearity can be dealt with. In other words, the most appealing feature of the cost-function approach also induces the most problem; the flexibility of the functional form requires considerable information to be included in the data. Most cost-function studies therefore use panel data, which combine a time dimension with either a regional or a sectoral range.

Ayogu (2000) used the Generalised Least Square (GLS) technique to jointly consider the contemporaneous correlation across equation when estimating the output elasticities parameters for each respective regional cost function in the six geo political zones of Nigeria.

Using pooled regression analysis, Moreno *et al.* (2003) estimated a cost function model for 12 manufacturing sectors in Spanish regions between 1980 and 1991. Ezcurra, Gil et al. (2005) also used a pooled regression to analyse Spanish regional production costs in the agricultural, industrial, and services sectors from 1964 to 1991.

Cohen and Morrison (2004) estimated a cost-function model using maximum likelihood techniques; they analysed data for 48 US states on prices and quantities of aggregate manufacturing output and inputs (specifically: capital, production and non-production labour, as well as materials) as well as on public highway infrastructure; their analysis 1982 to 1996. They assume that manufacturing firms minimise short run costs by choosing a combination of inputs for a given level of input prices, demand (output), and capacity (capital) as well as for given (external) technological and environmental conditions. The model also distinguishes between intra- and interstate effects of public infrastructure and accounts for interaction between the two. More specifically, for a given state, the model includes not only the public infrastructure of that state but also the infrastructure in neighbouring states.

Notably, Ahn and Hammings (2000) have pointed out problems associated with cross section regressions. These problems are: bias due to omitted variables, reverse causation and sample selection; parameter heterogeneity; presence of outliers; endogeneity of regressors (inverse causality); and possibility of multicollinearity among the regressors.

To deal with theoretical limitations and significant empirical controversies over the impact of public capital on output growth summarised above, the Vector Autoregression (VAR) models are used by some researchers. The VAR model allows for limited number of variables to be considered, explained by their own lags and that of the other variables, so that all variables are treated as jointly determined.

Typically, studies following the VAR approach apply Granger-causality tests, error correction model (ECM) and Vector Error Correction Model (VECM) to find relationships between variables. Most researchers are particularly interested in testing if public investment (public capital) Granger-causes economic growth (output), if the time series prediction of GDP (or some other measure of economic growth) from its own past improves when lags of measures of infrastructure are considered, and\or vice versa. Another interesting property is the possibility of performing a dynamic analysis with the impulse-response function and the Forecast Error Variance Decomposition (FEVD). This allows us to check the effect of public capital on economic growth for several periods since the effect is not instantaneous (Ashipala 2003; Pereira and Sagalés 2006; Sola 2008; and Mansouri 2008).

In conclusion, the results of the cost-function studies are broadly in line with those of studies using the production-function approach: public capital reduces cost, but there is much heterogeneity across regions and/or industries.

3.2.3. Growth- Model Approach

Growth models have been classified in the literature into two broad categories: those built on the basis of the neoclassical view (Solow, 1956; Swan, 1956), and those known as endogenous growth models (Romer 1986, 1990; Lucas, 1988; Grossman and Helpman, 1991; Aghion and Howitt, 1992; among others). In the neoclassical

framework, government policy, particularly fiscal plays no role in determining the long run economic growth rate, given this is determined by the exogenous population growth and technological progress rates. On the other hand, the endogenous growth framework, the engine of growth is human capital, knowledge and/or technology. Accumulation of any of these three variables takes place according to a conscious decision by private agents in the economy. This allows fiscal policy to impact on the long run growth rate through either some taxes or types of public expenditure affecting decisions by private firms about investing in human capital, knowledge or research and development. In this regard, it is important to mention that public goods play a crucial role as they can bring about changes in the long run growth rate.

Using Arrow's (1962) model, Romer (1986) constructed the "learning by doing" model, by assuming that knowledge creation is a product of investment. This model indicates the significance of learning through experience. Further, it implies that capital by itself produces knowledge. Therefore, by increasing capital, the firm will increase knowledge through learning how to produce more efficiently, which suggests that learning by doing works via firms' investment. Romer (1986) further assumes that there is a spillover effect, suggesting knowledge is a public good that any firm can access at no cost. Therefore, once a piece of knowledge is discovered, it is disseminated throughout the whole economy. The fact that the model exhibits externality effects allow for the possibility that government policies can have an effect on economic growth, as shown below.

$$Y_i = F(K_i, A_i L_i), \qquad (3.12)$$

Where: A_i represents the index of knowledge available to a firm or the baseline technology. The assumption that learning by doing works through firms' investment implies that changes in A_i represent overall learning in the economy, which is proportional to K, aggregate capital accumulation. Given that knowledge is assumed to be a public good due to its non-excludability and non-rivalry characteristics, this implies that once discovered it becomes common knowledge. Combining the assumption of learning by doing and knowledge spillover implies replacing A_i by K, which gives:

$$Y_i = F(K_i, K, L_i). \quad (3.13)$$

Equation (3.13) indicates diminishing marginal returns to capital at the firms' level, but constant returns to capital at the aggregate level resulting from the spillover effect. This also involves assuming a competitive market where each firm is a price taker and very small, such that its investment does not have a major effect on aggregate investment, and thus, takes K as given. Since each firm takes price and K as given when maximizing profit, each firm considers its private marginal product, ignores its investments' (k_I) contribution to aggregate investment, K, and as a result, ignores its contribution to aggregate knowledge. Thus, in equilibrium, all firms follow the same decision rule (Romer, 1986).

To determine the optimal growth rate, the decentralised economy results are compared with those from the social planner. Unlike the individual firms who took K, the aggregate capital, as given, the planner recognises the contribution of each firm's investment to aggregate capital stock and to the production of all firms in the economy; therefore, the planner internalises the spillover effect. This indicates that the social planner sets the growth rate of consumption in consideration of the average product of capital, whereas individual firms consider their private marginal product of capital. Consideration of the private marginal product instead of the average product of capital indicates that the growth rate is too low in the decentralised economy (Romer, 1986).

By internalising the spillover effect, the social planner offsets the diminishing returns to capital faced by individual firms, thereby enjoying constant returns at the social level. The decentralisation growth rate is low because firms base their decision on the private marginal product of capital, which is less than the social marginal product. This is where government policy may have an effect on economic growth, because it presents an opportunity for government policy to increase the decentralised growth rate to the central planner growth rate, which indicates clearly how government policy may affect economic growth (Cellini and Torrisi, 2009).

Various extensions of the basic endogenous growth models with fiscal policy have been derived by allowing publicly-provided goods to be productive in stock and/or flow form (Futagami et al., 1993; Cashin, 1995; Turnovsky, 1997; Tsoukis and Miller, 2003; Ghosh and Roy, 2004; Agenor, 2008). Another way is by allowing different forms of expenditure to be productive (Devarajan et al., 1996, Glomm and Ravikumar 1997, Kaganovich and Zilcha 1999, Zagler and Durnecker, 2003, Aregbeyen, 2006, Gomez, 2007).

Scholars that adopted the growth model approach have used pooled regression for cross country studies while those working on country based studies have used ordinary least square (OLS). Easterly and Rebelo (1993)'s article represents an important piece of work using public capital in an empirical growth model. The Authors run pooled regressions (using individual country decade averages for the 1960s, 1970s and 1980s) of per capita GDP growth on a set of conditional variables and on public investment in different sectors (added one at time): agriculture, education, health, housing and urban infrastructure, transport and communication, industry and mining. Milbourne *et al.* (2003) used the OLS to measure the effect of public investment on economic growth at steady state. Cellini and Torrisi (2009); Nurudeen and Usman (2010); and Aladejare (2013) also used OLS to determine the effects of various types of public investment on economic growth in Italy and Nigeria.

3.2.4 Macroeconometric Approach

Macroeconometric model provides an avenue to analyse the inter-linkages among the different sectors of the economy as well as among the macroeconomic variables. This is considered crucial as the result derived from such model serves as a vital tool for meaningful evaluation of actions and prediction of economy policy outcomes. Therefore, given the nature of economic phenomenon (they do not happen in isolation), maceconometric model accounts simultaneously for interrelationship between a set of macroeconomic variables. This model often consists of set of regression equations, solved simultaneously.

The primary goal of a macroeconometric model is to serve as a tool for policymakers to assess both qualitatively and quantitatively the likely impact of various policy

options on the behaviour of economic aggregate such as output, employment, consumption and prices (Bhattarai, 2005). The effect of economic policy on structural parameters such as the marginal propensity to consume and import, elasticities of investment to the interest rate or change in aggregate output, elasticity of production to capital and labour inputs are of utmost importance to policymakers. Macroeconometric model provides a system framework analysising changes in these structural parameters.

In building a macroeconometric model to analyse the impact of public investment on output, most studies adopt the eclectic macroeconomic modelling approach (Zerfu, 2002, Bhattarai, 2005, Geda *et al*., 2006, Akanbi and Du Toit, 2011, Khan and Musleh ud Din, 2011). This approach involves modelling the components of aggregate demand (consumption, investment, government and net export) using different economic theories in order to account for the eclectic nature of most economy in the world.

Using the Keynesian IS-LM model, Bhattarai (2005) analysed the impact of public investment on household consumption and domestic investment in England. The Two-Stage Least Square instrumental variable (2SLS) estimation technique was used to estimate the models. Geda et al., (2006) also used the Keynesian IS-LM model to show the effect of capital infrastructure on non-agricultural output in Ethiopia. However, OLS technique was used to estimate the models.

Khan and Musleh ud Din (2011) investigated the effect of government expenditure on aggregate and sectoral output in Pakistan, using the IS-LM-BP framework. Specifically, they considered the agricultural, manufacturing and services sectors. The models were estimated using the ECM to determine the speed of adjustment of the aggregate and sectoral output to equilibrium.

Akanbi and Du Toit (2011) used the Neoclassical business cycle model to analyse the effect of government expenditure and oil price shock on the non-oil sector in Nigeria. They used Instrumental Variables (IV) estimation technique and compared the result with OLS estimates of the same equations. Zerfu (2002) also adopted the same modelling approach when analysing the effect of capital infrastructure on agricultural output. However, they made use of VECM estimation technique to determine the long

run causal relationship between capital infrastructure and agricultural output in South African economy.

In summary, it should be noted that the effects of new investment depend on "past history" (the quality and quantity of the capital stock in place): the larger the quantity and the better its quality, the lower the impact of additional investment. Nonetheless, even with several points of caution, the general idea that public investment has an economic enhancing effect appears to be quite robust across studies with different methodological approaches.

3.3 Empirical Review

The empirical literature on the impact of public investment on economic growth has witnessed major contributions by different scholars over the years. Observably, the empirical evidence provided by most of these studies has been mixed, and a consensus has not yet emerged.

3.3.1 Impact of Public investment on Output: Country-based Empirical Evidence

Aschauer (1989) studied the effect of public investment on private sector growth from 1949 to 1985 in the United States and finds a strong and positive relationship between public investment and private sector productivity. Munnell (1992) used estimates of gross state product and private inputs of capital to develop estimates of public capital stocks for 48 states between 1970 and 1986. She concludes that public capital has a positive impact on private output, investment, and employment in United State. However, Munnell's (1992) estimates of the relative effects of public investment were smaller than those made by Aschauer (1989).

Pereira (2000) analysed the effects of public investment on private sector performance in the United States. He gets two striking results; one, in the long-term, public investment crowds in private investment and, to a lesser extent, private employment. Two, aggregate public investment has a positive effect on private output. He observes that core infrastructure investment in electric and gas facilities, transit systems and airfields as well as in sewage and water supply systems, displays the highest marginal returns on private sector output.

On bilateral basis, Shioji (2001) examined the relationship between infrastructural capital and economic growth in the US and Japan, using data spanning 1958 to 1970. His findings show that infrastructure capital had significant positive effect on long run output in both countries. Studies like Mas *et al* (1996), Otto and Voss (1994), and Wylie (1996) note the same relationship between public investment and economic growth in 17 Spanish regions, Australia and Canada, respectively

Alexiou (2009) on the impact of public investment on economic growth of South Eastern European (SEE) countries (Albania, Austria, Bosnia and Herzegovina, Greece, Macedonia, Montenegro, Croatia, Romania, Serbia, Hungary and Turkey) indicate that four of the five variables used in the model, namely government spending on capital formation, development assistance, private investment and trade-openness had positive and significant effect on economic growth. In contrast, population growth was found to be statistically insignificant

Egert *et al.* (2009) analysed the empirical relationship between public investment and economic growth in Organisation for Economic Cooperation and Development (OECD) countries. Their results reveal a positive impact of infrastructure investment on growth. Observably, the effect varies across countries and sectors over time. Specifically, it was noted that infrastructure investment in telecommunications and power sectors has a robust positive effect on long-term growth (but not in railways and road networks) and that; this effect is highly non-linear as the impact is stronger if the physical stock is lower.

Devarajan *et al*. (1996) report a negative and significant relationship between the ratio of transportation and communication expenditure to GDP for a sample of 43 LDCs. Sanchez-Robles (1998), using an index of physical infrastructure, finds some evidence of growth effects from the physical indices of infrastructure but finds negative effects from expenditure share measures of infrastructure on a sample of Latin American economies (Brazil, Argentina, Chile and Venezuela). These are attributed to a potentially transitory effect on growth rates of public sector infrastructure, but discounts the possibility that infrastructure can have permanent effects on the growth rate.

Ghani and Musleh-Ud Din (2006) explore the role of public investment in the process of economic growth in Pakistan's economy between 1975 and 2005. Their results show that growth is largely driven by private investment and that no strong inference can be drawn from the effects of public investment and consumption on economic growth.

Fedderke, *et al*. (2007) examined the relationship between investment in infrastructure and long run economic growth between 1972 and 2004. The main findings were that investment in infrastructure enhanced economic growth in South Africa and does so directly and indirectly (the latter by raising the marginal productivity of capital). However, there was weak evidence of feedback from output to infrastructure. They conclude that public investment in infrastructure impact on growth is robust.

Swaby (2007) analysed the relationship between public investment and growth in Jamaica from 1975 to 2006 and reported that public investment had a positive impact on GDP but it was not significant; and it also crowed out net private investment as it resulted in high domestic private investment but low foreign domestic investment, with the latter effect being much more substantial. He concludes that running large deficits with extra funds being channelled towards capital expenditure would not be feasible as the impact on GDP would be very small. However, he notes the importance of directing funds towards productive capital projects that might spur domestic private investment in the long run.

Bukhari, *et al*. (2007) investigated the relationship between public investment and economic growth in Korea, Singapore, and Taiwan from 1970 to 2003. Their analysis suggests that public and private investment and public consumption have long-term dynamic impact on economic growth in all the three countries. They conclude that there is bidirectional causality between public investment and economic growth.

For India, Pal (2008) evaluates the effect of public investment on economic growth from 1980 to 2006. His result reveals that there is evidence that public investment exerts a significant influence on real exchange and growth rates and non-linearly. He concludes that governance has effective role on public investment.

Cavallo and Daude (2008) analysed the impact of public investment on private investment in panel of 116 developing countries between 1980 and 2006. They find a strong and robust crowding out effect that seems to be the norm rather than the exception across regions and over time. They also noted that this effect is dampened (or even reversed) in countries with better institutions which are more open to international trade and financial flows. Their results are consistent with the hypothesis that, while public investment in infrastructure may be complementary to private capital in the aggregate production process, there are distortions associated with the public investment process that might initiate crowding out of private investment in the course of building public capital stocks. These distortions, in turn, are more prevalent in countries with bad institutions or that lacked trade and financial openness. These results conform to Nouzad (2000) study on that public investment has the tendency to crowd out private investment.

Obaseki and Onwioduokit (1998) study on the effect of public and private investment on economic growth in Nigeria show that public investment contributed to more output growth between 1970 and 1995. They conclude that government should create the enabling environment for effective private sector participation by providing the necessary infrastructure in the economy.

Nurudeen and Usman (2010) study on Government Expenditure and Economic Growth in Nigeria from 1970 to 2008 reveal that government total capital and recurrent expenditures as well as government expenditure on education have negative effect on economic growth. Contrarily, rising government expenditures on transport and communication as well as health result to economic growth increase. They recommend that government should increase capital and recurrent expenditures, including expenditures on education, as well as ensuring that funds meant for the development of these sectors are properly managed. In similar studies, Akpan (2005), Sola (2008) and Aladejare (2013) also find positive and significant relationship between government investment and economic growth.

Khan (2011) critically evaluates the effects of economic growth on public investment in Pakistan. The results of this study reveal that expansions in output and reserves have

favourable impacts on public investment. Based on the finding, he recommends that long- term private/public investment policies of government can produce improved results in economic growth which will ultimately enhance public investment ensure increasing employment opportunities and reduce poverty. He also advises that export sector should be giving more attention in terms of quality, prices and marketing strategies for growth enhancement.

Notably, empirical evidence on the effects of public investments at the regional/state level has traditionally been unable to replicate the large effects of public investment in infrastructures identified at the aggregate level. Some of the early contributions provide evidence of a positive effects on output with elasticities ranging between 0.03 and 0.20, clearly lower than the estimates reported by the aggregated studies Duffy-Deno and Eberts, 1991; Garcia-Mila and McGuire, 1992; Merriman, 1990; Moomaw and Williams, 1991; and Munnell, 1992.

Later studies reveal that after controlling for region and state-specific and unobserved characteristics, public capital effects are not significant (Andrews and Swanson, 1995; Garcia-Milà *et al*., 1996; and Moomaw *et al*., 1995). One possible explanation for this paradox is that spillover effects captured by aggregate level studies are not captured at the regional level (Boarnet, 1998; and Mikelbank and Jackson, 2000). Thus, it could be argued that spillover effects should be an integral part of the regional impact analysis of public capital formation (Haugwout, 2002) given that the effects in question in region can be induced by public infrastructure installed there as well as those outside the area.

Paradoxically, possibly due to the inconclusive nature of the results on the impact of public capital on output at the regional level, the issue of the possible existence of regional spillovers from public capital formation has received little attention. Holtz-Eakin and Schwartz (1995) conclude that regional level estimates are essentially identical to those from national data, suggesting no quantitatively important spillover effects across regions. On the other hand, several other studies report evidence of spill-overs (Boarnet 1998; Cohen and Paul 2004; and, Pereira and Andraz 2004; 2010). The empirical results reported in Pereira and Andraz (2004), for example, suggest that only

about 20 per cent of the aggregate effects of public investment in highways in the US are captured by the direct effects of public investment in the state itself. The remaining 80 per cent corresponds to the spillover effects from public investment in highways in other states.

The spillover effects are generally more important for the western states, the states along the corridor from the Great Lakes to the Gulf Coast and, to a lesser extent, for some of the states along the Eastern Atlantic Coast. This suggests that there are intensive economic connections among the states located in each of these areas and that they depend heavily on the regional network of highways and implicitly on investment in highways located in the other states. As a follow up, Pereira and Andraz (2010) report that public investment in highways affects private sector variables positively in most states but that relative to their share of the US private sector variables, the most beneficiaries of public investment in highways tend to be the largest states in the country.

This suggests that public investment in highways has contributed to the concentration of private sector activity in the largest states. In general, output elasticities are positive and relatively large in Japan (Merriman 1990); Spain (Mas et al., 1996); Belgium (Everaert and Heylen, 2004); and Germany (Stephan, 2003) and substantially lower for France (Cadot *et al*., 1999). Further, adoption of cost and profit equation approaches appears to have led to a smaller public capital effects (Boscá *et al*., 2000), and Moreno *et al*., 2003). In addition, the significance of spill over effects is observed in some countries like Portugal (Pereira and Andraz, 2004) and Spain (Pereira and Roca-Sagales, 2003, 2007), which can explain some of the divergences found between regional and aggregate studies.

These studies also tend to reinforce the idea that public investment in infrastructure affects the regional patterns of economic activity. In Spain, for example, Pereira and Roca-Sagales (2007) show that among the large regions, Andalucía, Castilla-León, Madrid, Valencia, and País Vasco, benefit more proportionally than their share of the Spanish GDP, while among the small regions the beneficiaries are Baleares, Canarias, Cantabria, Castilla-Mancha, and Murcia. Accordingly, public infrastructure has

contributed to the concentration of economic activities in these ten regions, to the detriment of the remaining seven.

3.3.2 Impact of Public Investment on Output: Sectoral-based Empirical Evidence

Studies with a sectoral focus are not common. Several studies make reference to specific sectors like manufacturing, agriculture, communication, transportation, services, building and construction. Public capital seems to affect sectors differently and they react differently to different components of public investment. Specifically, manufacturing sector seems to benefit from public investment in highways, public buildings and water as well as sewage systems. In contrast, agriculture, traditionally a declining sector, does not seem to benefit much.

Notably, whatever positive results are found at the aggregate level tend to hide a wide variety of sector-level effects. Empirical results reported by Pereira and Andraz (2003) for example, suggest that public investment in infrastructure in the US tends to shift the sectoral composition of employment towards construction and transportation as well as the composition of private investment toward manufacturing, public utilities and communications. Further, public investment tends to shift the composition of private output toward construction and durable manufacturing and to a lesser extent, towards transportation and wholesale trade.

Haque and Kim (2003) find that there is a dynamic effect of public investment in transportation and communication on economic growth with the impact being positive. Comparing their result with earlier studies, their estimated coefficients were somewhat lower. However, for the reverse causal relationship proposed by the investment acceleration hypothesis, they find that there is significant heterogeneity across countries, suggesting the non-presence of reverse causality.

Paul, *et al*. (2004) examined the effects of public infrastructure on the productive performance of 12 two-digit Canadian manufacturing industries. The effects of public infrastructure on productivity were measured in terms of both costs-saving (dual) and output-augmenting (primal) measures. They also investigated how public capital

influences the input demand and cost structure in each industry and calculated the rate of return to public capital. Their empirical results provide strong evidence of the important role public infrastructure plays in the productivity of manufacturing industries. They conclude that public capital serves as a substitute for private capital and labour in most industries and the rates of return to public capital are significant and vary over the years.

Ezcurra and Gil (2005) in their study regarding Spanish regional production costs in the agricultural, industrial, and services sectors for the period from 1964 to 1991 find that public infrastructure reduces private costs and increases productivity. Their estimate shows that while agricultural and service sectors behave similarly, most savings in private costs (in terms of dollar costs per unit of public capital) are found in the industrial sector compared to services and agricultural sectors.

Nasir (2005) evaluate the Role of Public Investment for Agricultural Development in Hokkaido, Japan between 1963 and 1995. His empirical result shows that public investment in major agricultural inputs like fertilizers, rural education and modern machineries had significant effect on Hokkaido economy in general and the productivity of the farmers in particular. He concludes that government should commit resources to the formation of capital assets which would in turn allow the generation of new stream of resources that will enhance productivity in the agricultural sector. Other developed countries-specific contributions are Berndt and Hansson (1992) for Sweden, Conrad and Seitz (1994) and, Pereira and Andraz (2007) for Portugal.

Using available data in Africa, Adenikinju's (1998) study on government investment and manufacturing performance in Nigeria 1970-1996 concludes that government expenditure on economic infrastructure have positive impact on performance of manufacturing firms in Nigeria. The empirical results of Fajingbesi and Odusola (1999) also reveal the importance of public investment to growth of output in the manufacturing sector.

Amaghionyeodiwe and Folawewo (1998) examine the effect of government investment policy on the transport subsector and economic performance in Nigeria.

Their results show that transport sector as contributed immensely to economic growth in Nigeria. They conclude that for government to optimise the gains from its investment, government should reassess its transport policy and implement the needed reforms in the subsector.

Olomola (2000) investigated the trend and structure of government investment on agriculture, the degree of government commitment to its funding and the effect of such investment on output supply in Nigeria between 1970 and 1996. The results indicate a high expenditure variability and lopsided pattern of government commitment to agricultural funding over the studied years and the trend reveals that the SAP era was the worst. He also finds there is a positive correlation between public investment and agricultural output but impact was not substantial over the years of study. He recommends that a balanced view of public investment that recognises the unique role of agriculture is required to ensure that the sector obtains its share of public investment. Also, Purokayo and Umaru, (2012) note that there is a positive and significant relationship between capital expenditure in agricultural sector and output from the sector.

Odularu (2007) concludes that government expenditure on infrastructure in petroleum sector have insignificant impact on the output of the petroleum because of the influence of OPEC on the quantity of output produced by member states. In another study on the effect of government capital spending on mining and quarry productivity, Olaide *et al*., (1981) and Olofin (1985) conclude that the government capital expenditure in mining and quarry sector exert little impact on output from the sector.

Pineda and Rodríguez (2007) used expenditures of the Venezuelan Intergovernmental Decentralisation Fund (FIDES) to estimate the effect of public infrastructure investment on the productivity of Venezuelan manufacturing firms. Their results show that this fund has positive and significant effect on the productivity and output of the sampled firms.

Ahmad and Qayyum (2009) explored the role of public investment (development and non- development) and macroeconomic uncertainty in determining private sector's

fixed investment in large-scale manufacturing in Pakistan. They find that there is cointegrating relationship between the private investment, public consumption expenditures, public development expenditures and size of market. Their result also indicates that public development investment enhances growth in the manufacturing sector whereas non-development investment and macroeconomic uncertainty negatively affects the sector.

Harishmani, *et al.* (2011) investigated inter sectoral linkage of public investment in agricultural and GDP growth in India and reveal that there has been a reduction in the rate of public investment. They conclude that the new economic policy package introduced in the early nineties has negative impact on agricultural sector which tends to affect other sectors linked to agriculture. This invariably affects the entire economy negatively.

Khan and Musleh ud Din (2011) investigated the effect of government expenditure on aggregate and sectoral output in Pakistan. Specifically, they considered the agricultural, manufacturing and services sectors and find that capital expenditure on Infrastructure affects agricultural, manufacturing and services sectors.

3.3.3 Summary of Gap in the Literature

The review of literature shows that the debate on the role of public investment on aggregate and sectoral output is yet to be concluded. The deep search into theory methodology and empirics of the link between public investment and output revealed that the following gaps existed:

- The direction of the impact of public investment on aggregate output varies from country to country although what seem to dominate the literature are studies that found positive relationship between public investment and aggregate output.

- The magnitude of the coefficient or multiplier derived from the link between public investment and aggregate output is a function of the measurement, productivity and efficiency of public investment.

- Holistic studies on the effect of public investment on sectoral output are scanty because it is assumed that aggregate estimates are essentially identical to those from sectoral analysis. However, the need to show the spillover effect of public investment on sectoral output is essential in order to account for the importance a country attached to sectors that attract real and sustainable growth.

- The single equation analysis dominates the literature with little attention devoted to the channels through which public investment affects aggregate and sectoral output.

- Studies on macroeconometric system equation are more recent but none has been done for Nigeria.

Table 3. 1. Summary of some Empirical Findings

Author/year	Study Area	Methodology	Findings
Aschauer (1989)	US	Production function approach	Strong and positive relationship between productivity and public investment
Barro (1990)	76 countries	Growth model approach	Public investment has insignificant effect on economic growth
Adenikinju (1998)	Nigeria	Production function approach	Government expenditure on economic infrastructure has positive impact on performance of manufacturing firms in Nigeria.
Obaseki and Onwioduokit (1998)	Nigeria	Growth model approach	Public and private investments have significant effect on economic growth.
Nourzad (2000)	12 developing/ developed countries	Production function approach	Public capital exerts a positive and statistically significant effect on labour productivity
Stephane, (2003)	Germany and France	Cost function approach	Public investments on infrastructure have positive impact on productivity.
Ashipala, (2003)	SACU region	VAR approach	Public investment has positive significant relationship with economic growth in Namibia and South Africa.
Ezcurra and Gil (2005)	Spanish region	Cost function approach	Public infrastructure reduces private costs and increases productivity.
Mansouri (2008)	Egypt, Morocco and Tunisia	Production function approach	Public spending has positive effect on short and long run economic growth in three countries
Cellini and Torrisi (2009)	Italy	Growth model approach	Public spending on tourism has little effect on some macroeconomic indicators such as GDP.
Nurudeen and Usman (2010)	Nigeria	Growth model approach	Government non-productive expenditure has negative effect on the economy.
Khan and Musleh ud Din (2011)	Pakistan	Macroeconometric Approach	Capital expenditure on Infrastructure affects agricultural, manufacturing and services sectors.

Source: **Author's compilations**

CHAPTER FOUR

THEORETICAL FRAMEWORK AND METHODOLOGY

This chapter focuses on the theoretical framework, model specification, estimation technique and data sources used for this study.

4.1 Theoretical Framework

The review of theoretical literature in Chapter 3 reveals that there are basically three major plausible relationships between government expenditure in form of public investment and output growth. These theoretical views are; the neoclassical, Keynesian and Ricardian. Unlike the neoclassical and Ricardian views that focus more on the supply side of the economy, the Keynesian view gives more insight to the importance of the demand side of the economy. This view explains the impact of changes in government spending as a policy on consumption and investment through changes in output via its effect on values of multiplier and accelerator coefficients. This makes it easy to trace the direct and indirect effects of public investment on output. Therefore, this study adopts the Keynes income-expenditure framework.

This framework suggests that the economy's equilibrium level of output or real GDP may not be consistent with the actual level of output. In this approach, the real GDP equilibrium level corresponds to current aggregate expenditure level. The approach is based on the assumption that the levels of output and employment depend directly on the level of aggregate expenditures. Changes in output reflect changes in aggregate spending. Aggregate Expenditure (AE) is defined as the total spending on output during a given period.

In a closed economy, there are only three classes of agents; households, businesses and the government. Aggregate expenditure on goods and services is the sum of the component spending by these agents:

$$AE = C + I + G \quad (4.1)$$

Where:

AE	=	Aggregate Expenditure
C	=	household consumption expenditure
I	=	Domestic Investment
G	=	Government expenditure

In an open economy, a country engages in foreign trade, accounted for as net receipt from abroad. This is denoted as the difference between exports and imports (X –M). Thus, our aggregate expenditure identity is expressed as:

$$AE = C + I + G + (X - M) \quad (4.2)$$

Where:

X	=	Export
M	=	Import
$(X - M)$	=	Net Export (NX)

From the perspective of Keynes, GDP is approximately thought of as being determined by aggregate demand (AD), which implies the expenditure of each economic agent on goods and services. Hence, the components of AD are; household consumption expenditure (C), domestic investment (I), government purchases (G) and net export (X-M). This is expressed as:

$$AD = C + I + G + (X - M) \quad (4.3)$$

Aggregate supply is denoted as AS, which is just equal to the actual value of GDP that the economy produced. Thus:

$$AS = GDP \quad (4.4)$$

At equilibrium, aggregate supply should be equal to aggregate demand;

$$AS = AD \tag{4.5}$$

This implies that:

$$Y = C + I + G + NX \tag{4.6}$$

The above identity suggests that GDP is determined by the sum of demand from the four sectors of the economy. Thus, each of the components of output (Y) in equation (4.6) is specified in its structural form using an eclectic approach[5]. Experience has shown that combination of different models in economic simulation and forecast series could outperform those with single approach.

4.1.1 Household Consumption

The standard life cycle household consumption model postulates that a representative household will devise a consumption plan that maximises utility over its lifetime, subject to an intertemporal budget constraint. With additively separable utility and no uncertainty, the household maximises lifetime utility U as given by:

$$U = \sum_{t=0}^{T} \frac{u(c_t)}{(1+\rho)^t} \tag{4.7}$$

Where u(·) is a concave period utility function, c is real consumption, and ρ is a constant rate of time preference. Assuming a constant real interest rate r, the function U is maximised by choosing a path of consumption $\{0\}_{t=0}^{T}$ subject to:

$$\sum_{t=0}^{T} \frac{u(c_t)}{1+r)^t} \leq a_0 + \sum_{t=0}^{T} \frac{y_t}{(1+r)^t} \tag{4.8}$$

Equation (4.8) dictates that in the absence of resource wastage, lifetime consumption must be offset by lifetime resources. a_0 is household's initial wealth and y denotes

[5] The nature of the Nigerian economy could make it impossible to rely on a particular theory or single model. Experience has shown that a combination of different models in forecasts series could outperform those with single approach.

disposable income. We also assume that the discount rate is not equal to zero and instantaneous utility function takes the constant relative risk aversion form:

$$U = \sum_{t=1}^{T} \frac{1}{(1+\rho)^t} \frac{C_t^{1-\theta}}{1-\theta} \tag{4.9}$$

Assuming consumption is decrease in some period, say period t or increase in consumption in the next period by the amount of the decrease multiply by the interest rate (1+r). Optimization requires that the marginal utility of this type has no effect on the life time utility. This condition is summarized that; the marginal utility in period t is $\frac{1}{(1+\rho)^t} C_t^{-\theta}$ while Marginal utility in period t+1 is $\frac{1}{(1+\rho)^{t+1}} C_{t+1}^{-\theta}$. Thus, this condition is expressed as:

$$\frac{1}{(1+\rho)^t} C_t^{-\theta} = (1+r) \frac{1}{(1+\rho)^{t+1}} C_{t+1}^{-\theta} \tag{4.10}$$

Rearranging equation (4.10) gives:

$$\frac{C_t^{-\theta}}{C_{t+1}^{-\theta}} = \frac{(1+\rho)^t}{(1+\rho)^{t+1}} (1+r) \tag{4.11}$$

Simplifying equation (4.11) gives:

$$\left(\frac{C_{t+1}}{C_t} \right)^{\theta} = \left(\frac{1+r}{1+\rho} \right)^{1/\theta} \tag{4.12}$$

Equation (4.12) implies that once we allow for the possibility that the real interest rate and discount rate are not equal, consumption may not necessary be a random walk. Thus if real interest rate exceed discount rate, wealth is growing without bound; consumption grows gradually. When real interest rate is less than discount rate, wealth drops with bound and therefore consumption falls. This suggests that variation in real interest rate, leads to variation in the predictable component of consumption growth (Romer, 1996).

The key implication of this model is that household consumption is a function of disposable income and real interest rate since the model suggests that household would smoothen consumption; that is, consumption will not necessarily be tied to current

income, as in the simple Keynesian consumption function (KCF). This is expressed below as:

$$C = f(\overset{+}{yd}, \overset{+}{ir}) \tag{4.13}$$

Where: yd is disposable income and ir is nominal interest rate

4.1.2 Domestic Investment

The modelling of investment relies on the flexible accelerator approach in which investment is determined by the rate of interest, the cost of capital and income. Interest rate denotes the cost of capital and determines the level of investment. Real interest rate is expected to have negative effect on domestic investment while increase in income leads to increase in investment. Notably, Mckinnon (1973) argues that real interest can exert positive influence on investment through increase in savings. This relationship is expressed as:

$$I = f(\overset{+}{Y}, \overset{+}{ir}) \tag{4.14}$$

Where: I is domestic investment while other variables retain their earlier definitions

4.1.3 Government Expenditure

Wagner's law of increasing state activities posits that government expenditure grows as economy grows. Government expenditure is said to be elastic with respect to increase in income because the traditional function of government expands rapidly in terms of coverage and magnitude than economy expansion. Hence, national income, a measure of economic expansion is also a determinant of government expenditure.

In practice, government expenditure component is fixed because government has commitment to a set of public services (e.g. roads and bridges, national defence, air traffic control, and education) that cannot be altered. Thus, government is assumed to

be exogenous in the model. Introducing the government in this way allows us to study the basic effects of public investment on economic output.

4.1.4 Real Export of Goods and Services

The export function adopted for this study is based on the simple Heckscher-Ohlin and Samuelson factor endowment model (HOS). This is the combination of the simple Stolper-Samuelson theorem of relative price[6] and Heckscher-Ohlin Quantity Version theorem[7]. Therefore, in the long run, the demand for real exports of goods and services are mainly driven by the level of world income and relative prices of goods and services. Oil price is also included to account for the dominance of oil export in Nigeria which reflects the comparative factor endowment advantage of the country. Exchange rate fluctuation is also expected to have influence on real export in the long run but this depends on the productive structure of the economy in question. Therefore, fluctuation in oil price is expected to have a significant impact on the Nigerian economy. This is expressed functionally below:

$$X = f(\overset{+}{Yw}, \overset{-}{rpg}, \overset{+}{OP}) \tag{4.15}$$

Where: X is real exports of goods and services, Yw is real world (US) income, RPG is relative price of goods and services (the ratio of domestic prices to US prices) and OP is World oil price

4.1.5 Real Import of Goods and Services

The basic import function adopted for this study is the combination of the traditional and Hemphill (1974) import functions in which import of goods and services is determined by national income, relative prices of goods and services as well as international reserves. The fluctuations in the exchange rate are also found to have a

[6] the theorem states that a small increase in the relative price of a good will increase, in terms of the price of both goods, the price of the factor used intensively in producing the good whose relative price has risen and will decrease, in terms of the price of both goods, the price of the other factor, provided both goods are initially produced

[7] The simple Heckscher-Ohlin Quantity Version theorem which state that suppose two countries with identical homothetic demands, identical technologies of production and not separated by a FIR engage in free trade, then each country will exports the good that makes relatively intensive use of its relatively abundant factor (in the quantity sense).

significant impact on the long run specification of real imports for Nigeria. This is because imported goods constitute a large portion of the country's consumption expenditure (CBN, 2010). Therefore, the determinants of real imports in Nigerian are; national income, relative prices of goods and services, foreign reserves and exchange rate. This is specified thus:

$$M = f(\overset{+}{Y}, \overset{+}{rpg}, \overset{-}{ex}, \overset{+}{R}) \tag{4.16}$$

Where: M is real imports of goods and services, ex and R are real effective exchange rate and international reserves respectively. Other variables are as defined earlier.

The equilibrium output can be derived by substituting expressions (4.13), (4.14), (4.15), (4.16) and exogenous government expenditure (g_o) into (4.6).

Thus:

$$Y = C(Y^d, ir) + I(Y, ir) + g_o + NX(Y_w, Y, rpg, op, ex, r) \tag{4.17}$$

Behaviourally, the components can further be decomposed into:

$$C = a_0 + a_1 Y^d + a_2 ir \tag{4.18}$$

$$I = b_0 + b_1 Y + b_2 ir \tag{4.19}$$

$$G = g_o \tag{4.20}$$

$$NX = e_1 Y_w + e_2 Y + e_3 rpg + e_4 op + e_5 xr + e_6 r \tag{4.21}$$

Where: a_0 and b_0 are autonomous consumption and investment respectively.

Putting equations (4.18), (4.19), (4.20) and (4.21) into (4.6) yields the equilibrium output expressed below:

$$Y = a_0 + a_1 Y^d + a_2 ir + b_0 + b_1 Y + b_2 ir + g_o + e_1 Y_w + e_2 Y + e_3 rpg + e_4 op + e_5 xr + e_6 r \tag{4.22}$$

Therefore:

$$Y = \gamma_0 + \gamma_1 Y^d + \gamma_2 ir + \gamma_3 Y + \gamma_4 ir + \gamma_5 g_o + \gamma_6 Y_w + \gamma_7 Y + \gamma_8 rpg + \gamma_9 op + \gamma_{10} xr + \gamma_{11} r \quad (4.23)$$

$$Y^d = (Y - T) \quad (4.24)$$

Substituting equation (4.21) into equation (4.20) gives us:

$$Y = \gamma_0 + \gamma_1 (Y - T) + \gamma_2 ir + \gamma_3 Y + \gamma_4 ir + \gamma_5 g_o + \gamma_6 Y_w + \gamma_7 Y + \gamma_8 rpg + \gamma_9 op + \gamma_{10} xr + \gamma_{11} r \quad (4.25)$$

Expanding equation (4.22) yields:

$$Y = \gamma_0 + \gamma_1 Y - \gamma_1 T + \gamma_2 ir + \gamma_3 Y + \gamma_4 ir + \gamma_5 g_o + \gamma_6 Y_w + \gamma_7 Y + \gamma_8 rpg + \gamma_9 op + \gamma_{10} xr + \gamma_{11} r \quad (4.26)$$

Solving for Y and rearranging like terms

$$Y - \gamma_1 Y - \gamma_3 Y - \gamma_7 Y = \gamma_0 - \gamma_1 T + (\gamma_2 + \gamma_4) ir + \gamma_5 g_o + \gamma_6 Y_w + \gamma_8 rpg + \gamma_9 op + \gamma_{10} xr + \gamma_{11} r \quad (4.27)$$

Factoring out Y yields:

$$Y(1 - \gamma_1 - \gamma_3 - \gamma_7) = \gamma_0 - \gamma_1 T + (\gamma_2 + \gamma_4) ir + \gamma_5 g_o + \gamma_6 Y_w + \gamma_8 rpg + \gamma_9 op + \gamma_{10} xr + \gamma_{11} r \quad (4.28)$$

Completing the factorisation will produce the expression:

$$Y = \frac{\gamma_0 - \gamma_1 T + (\gamma_2 + \gamma_4) ir + \gamma_5 g_o + \gamma_6 Y_w + \gamma_8 rpg + \gamma_9 op + \gamma_{10} xr + \gamma_{11} r}{1 - \gamma_1 - \gamma_3 - \gamma_7} \quad (2.29)$$

Further deflating both sides by the price level gives the following expression:

$$y = \phi_0 + \phi_1 T + \phi_2 rir + \phi_3 g_o + \phi_4 Y_w + \phi_5 rpg + \phi_6 op + \phi_7 xr + \phi_8 r + \phi_9 \pi \quad (4.30)$$

The above equilibrium or reduced form output is derived mainly from the real sector of the economy. To make the model more realistic, the monetary sector of the economy is incorporated into the model. At equilibrium, the money market suggests that real money supply equals real money demand. This gives the equation:

$$m^s = m^D, \text{ or } \frac{M^s}{P} = \frac{M^D}{P} \quad (4.31)$$

The real money demand balance is expressed functionally as:

$$m^D = f(ir, y) \quad (4.32)$$

Where: y is real income, and ir is the nominal interest rate. The nominal money balance is further expressed as:

$$M = f(ir, y, \pi) \tag{4.33}$$

Where: M is nominal money balances and π is expected inflation[8] which has major impact on total money balance in the economy.

Behaviourally, the money market equation (4.33) is expressed as:

$$m = b_0 + b_1 i + b_2 y + b_3 \pi \tag{4.34}$$

Simplifying π from equation (4.34) yields:

$$b_3 \pi = m - b_0 - b_1 i - b_2 y \tag{4.35}$$

$$\pi = \frac{1}{b_3}(m - b_0 - b_1 i - b_2 y) \tag{4.36}$$

Substituting equation (4.36) into equation (4.30) gives:

$$y = \phi_0 + \phi_1 T + \phi_2 rir + \phi_3 g_o + \phi_4 Y_w + \phi_5 rpg + \phi_6 op + \phi_7 xr + \phi_8 r + \phi_9 [\frac{1}{b_3}(m - b_0 - b_1 i - b_2 y)]$$

(4.37)

Where: $\vartheta_0 = \phi_9(\frac{1}{b_3})$; $\vartheta_1 = \phi_9(b_1)$; $\vartheta_2 = \phi_9(b_2)$; substituting appropriately gives:

$$y = \phi_0 + \phi_1 T + \phi_2 rir + \phi_3 g_o + \phi_4 Y_w + \phi_5 rpg + \phi_6 op + \phi_7 xr + \phi_8 r + \vartheta_0 m - \vartheta_1 i - \vartheta_2 y \tag{4.38}$$

Factoring out *y* and *i* yields:

$$y(1 - \vartheta_2) = \phi_0 + \phi_1 T + \phi_3 g_o + \phi_4 Y_w + \phi_5 rpg + \phi_6 op + \phi_7 xr + \phi_8 r + \vartheta_0 m + (\phi_2 - \vartheta_1) rir \tag{4.39}$$

Letting $(\phi_2 - \vartheta_1) = \psi_2$, and substituting into equation (4.39) yields;

$$y(1 - \vartheta_2) = \phi_0 + \phi_1 T + \psi_2 rir + \phi_3 g_o + \phi_4 Y_w + \phi_5 rpg + \phi_6 op + \phi_7 xr + \phi_8 r + \vartheta_9 m \tag{4.40}$$

[8] The expected rate of inflation does not follow the random walk hypothesis as economic agents seem to repose confidence in the government policies and tend to anticipate their effects (Kallon, 1994).

Solving for *y* gives:

$$y = \frac{\phi_0 + \phi_1 T + \psi_2 rir + \phi_3 g_o + \phi_4 Y_w + \phi_5 rpg + \phi_6 op + \phi_7 xr + \phi_8 r + \vartheta_9 m}{1 - \vartheta_2} \tag{4.41}$$

Thus, the equilibrium output can be expressed as:

$$y = \theta_0 + \theta_1 T + \theta_2 rir + \theta_3 g_o + \theta_4 Y_w + \theta_5 rpg + \theta_6 op + \theta_7 xr + \theta_8 r + \theta_9 m \tag{4.42}$$

Definition of the reduced form or equilibrium parameter

$$\vartheta_{10} = \phi_9(\frac{1}{b_3});\ \ \vartheta_1 = \phi_9(b_1);\ \ \vartheta_2 = \phi_9(b_2);\ \ (\phi_2 - \vartheta_1) = \psi_2;\ \ \gamma_0 = a_0 + b_0$$

$$\theta_0 = \frac{\phi_0}{1-\vartheta_2};\ \theta_1 = \frac{\phi_1}{1-\vartheta_2};\ \theta_2 = \frac{\psi_2}{1-\vartheta_2};\ \theta_3 = \frac{\phi_3}{1-\vartheta_2};\ \theta_4 = \frac{\phi_4}{1-\vartheta_2};\ \theta_5 = \frac{\phi_5}{1-\vartheta_2};\ \theta_6 = \frac{\phi_6}{1-\vartheta_2}$$

$$\theta_7 = \frac{\phi_7}{1-\vartheta_2};\quad \theta_8 = \frac{\phi_8}{1-\vartheta_2};\quad \theta_9 = \frac{\phi_9}{1-\vartheta_2};\quad \phi_0 = \frac{\gamma_0}{1-\gamma_1-\gamma_3-\gamma_7};\quad \phi_1 = \frac{\gamma_1}{1-\gamma_1-\gamma_3-\gamma_7};$$

$$\phi_2 = \frac{(\gamma_2+\gamma_4)}{1-\gamma_1-\gamma_3-\gamma_7};\quad \phi_3 = \frac{\gamma_5}{1-\gamma_1-\gamma_3-\gamma_7};\quad \phi_4 = \frac{\gamma_6}{1-\gamma_1-\gamma_3-\gamma_7};\quad \phi_5 = \frac{\gamma_8}{1-\gamma_1-\gamma_3-\gamma_7};$$

$$\phi_6 = \frac{\gamma_9}{1-\gamma_1-\gamma_3-\gamma_7};\ \phi_7 = \frac{\gamma_{10}}{1-\gamma_1-\gamma_3-\gamma_7};\ \phi_8 = \frac{\gamma_{11}}{1-\gamma_1-\gamma_3-\gamma_7}$$

4.1.6 Aggregate Supply

Aggregate supply is given as the output produced by each sector of the economy. The output produced by a sector is a function of the basic variables in equation (4.42) and other factors in relation to the sector in question. In this study, seven sectors are considered, namely Agriculture, Manufacturing, Services, Wholesale and Retail trade, Mining and Quarry, Crude Petroleum, and Building and Construction. These sectors are chosen primarily because of the structure of the economy and availability of data.

4.1.7 Agricultural Output Function

Following Zerfu (2002) and Iqbal, *et al.* (2003) agriculture sector output is assumed to be a function of labour force engaged, disbursement of credit to the sector, interest rate

and availability of water (majorly rainfall). Public investment in agriculture sector is also included in the model to capture government expenditure in agricultural infrastructure. Fixed capital assets are also included in the equation to account for private capital in agricultural sector. One important factor affecting the performance of mechanised farming in Nigeria is the availability of bank credit (Manyong *et al.*, 2005). This study uses real bank credit to agricultural sector to account for credit disbursed to it (Akanbi and Beddies, 2008). Manufacturing output is also included in the model to account for the forward-backward linkage between agricultural and manufacturing sectors (Akanbi and Du Toit, 2011). The agriculture sector output function is specified as:

$$AGRICY = f(PINAGRIC, AGRICEMP, AGRICK, ATRF, BCAGRIC, MANY, ir) \quad (4.43)$$

Where: $AGRICY$ is agricultural output, $PINAGRIC$ is public investment in agriculture sector, $AGRICEMP$ is number of employed people in agriculture sector, $AGRICK$ is fixed capital assets in agricultural sector, $ATRF$ is average total rainfall in Nigeria, $BCAGRIC$ is bank credit to agricultural sector and $MANY$ is manufacturing output. Other variables are as defined earlier

4.1.8 Manufacturing Output Function

The manufacturing sector includes small–scale, large-scale and export-processing industries. In the manufacturing sector, capital stock and labour force are important factors of production. Capital stock in this context is fixed capital assets in machinery and equipment. Besides capital stock and labour, other factors such as credit disbursed and public investment to the sector account for the infrastructure which are likely to influence the volume of manufacturing production (Zerfu, 2002). Other factors that impact on manufacturing output from equation (4.42) are company income tax, interest rate, exchange rate and oil price. Agricultural output is also included as input in the production process.[9] In line with Du Toit (1999), urban population is included in the

[9]Marcellino and Mizon 2000 argue that agricultural outputs are intermediate goods to the manufacturing firms as they serve as major input in the production process. For example textile and sugar industries use the outputs of the agriculture sector as raw materials.

model to account for potential consumers of manufacturing output. The manufacturing output function is expressed as:

$$MANY = f(PINMAN, MANEMP, MANK, UPOP, BCMAN, CIT, ir, xr, op, AGRICY,) \quad (4.44)$$

Where: $MANY$ is manufacturing output, $PINMAN$ is Public investment in manufacturing sector, $MANK$ is fixed capital assets in the sector, $MANEMP$ is number of employed people in manufacturing sector, $UPOP$ is urban population, $BCMAN$ is bank credit to the sector, and CIT is Company income tax. Other variables retain their earlier definition.

4.1.9 Services Output Function

Services sector include transport, communication, utilities, hotel and restaurant, finance and insurance, and real estate and business services. Following Khan and Musleh ud Din (2011), services sector output is expressed as a function of aggregate demand in real term (domestic absorption). Real aggregate demand is defined as the sum of private consumption, government consumption and investment. Thus, factors affecting private consumption and investment in equation (4.42) are the major factors affecting services output. These factors are value-added tax (VAT), interest rate, public investment, oil price and money supply. Other factors include; fixed capital assets, labour and bank credit. The output of the crude petroleum sector is also included as intermediate goods used in the sector. Thus, the functional form of services output is specified as:

$$SERVY = f(PINSERV, SERVEMP, SERVK, BCSERV, CIT, GCON, ir, m, CRUPY) \quad (4.45)$$

Where: $SERVY$ is services sector output, $SERVEMP$ is number of employed people in services sector, $PINSERV$ is public investment in services sector, $SERVK$ is fixed capital assets in services sector, $BCSERV$ is bank credit to services sector, VAT is value added tax, $GCON$ is government consumption and m is money supply. Other variables are as defined earlier.

4.1.10 Wholesale and Retail Trade Output Function

The determinants of output in this sector are basically variables in equation (4.42) except that, fixed capital assets, bank credits and labour in the wholesale and retail sector are also included. In line with Amaghonyeodiwe and Folawewo (1998), output of manufacturing sector is included since some of the goods sold in this sector are domestically manufactured while others are imported. Thus, the functional form is specified as:

$$WHSRLY = f(PINWHSRL, WHSRLEMP, WHSRLK, BCWHSRL, CIT, ir, Y_w, rpg, xr, MANY,) \quad (4.46)$$

Where: $WHSRLY$ is wholesale and retail trade output, $WHSRLEMP$ is number of employed people in wholesale and retail sector, $PINWHSRL$ is public investment in wholesale and retail sector, $WHSRLK$ is fixed capital assets in wholesale and retail sector and $BCWHSRL$ is bank credit to wholesale and retail sector. Other variables are as defined earlier.

4.1.11 Mining and Quarry Output Function

The modelling of the mining and quarry output follows the specification of Rangarajan and Arif, (1990) which took into consideration public investment in mining and quarry sector, bank credit to mining and quarry firms and labour employed in the sector as major determinants. Other factors include lending and exchange rates. In this study, the output of building and construction industry is also included in the model[10]. The functional form is specified thus:

$$MINQY = f(PINMINQ, MINQEMP, MINQK, BCMINQ, plr, xr, BNCTY,) \quad (4.47)$$

Where: $MINQY$ is mining and quarry output, $PINMINQ$ is public investment in mining and quarry sector, $MINQEMP$ is number of employed people in mining and quarry sector, $MINQK$ is fixed capital assets in mining and quarry sector, $BNCTY$ is

[10] Building and construction output serves as intermediate good for the mining industry since most of the exploration companies need warehouses and homes for their staffs.

building and construction output and $BCMINQ$ is bank credit to mining and quarry sector. Other variables are as defined earlier.

4.1.12 Crude Petroleum Output Function

The determinants of crude petroleum output are similar to that of the mining and quarry sector but world oil price is included because the output quota produced by Nigeria is determined by the Organization of Petroleum Exporting Countries (OPECs). Hence, world oil price is expected to significantly affect the quantity produced. Following Hamilton (1996), relative price of goods and international reserve were also included in the function. The output function is specified as follows:

$$CRUPY = f(PINCRUP, CRUPEMP, CRUPK, BCCRUP, xr, op, rpg, r, BNCTY,) \quad (4.48)$$

Where: $CRUPY$ is crude petroleum output, $PINCRUP$ is public investment in crude petroleum sector, $CRUPEMP$ is number of employed people in the sector, $CRUPK$ fixed capital assets in petroleum sector and $BCCRUP$ is bank credit to the sector while other variables retain their earlier definition.

4.1.13 Building and Construction Output Function

Following Olaide *et al*., (1981) and Olofin (1985), the factors affecting this sector are: public investment in building and construction sector, total number of employed persons in the sector, fixed capital asset and bank credit. Interest rate and output from manufacturing sector[11] are also included in the model. The functional form is expressed as:

$$BNCTY = f(PINBNCT, BNCTEMP, BNCTK, BCBNCT, ir, MANY) \quad (4.49)$$

Where: $BNCTEMP$ is number of employed people in building and construction sector, $PINBNCT$ is public investment in the sector, $BNCTK$ is fixed capital assets in building and construction sector, $BCBNCT$ is bank credit to the sector. Other variables are as defined earlier.

[11] Geda, *et al*., (2006) included the above variables when modelling the non-agricultural sector of the Ethiopian economy.

4.1.14 Price Function

The price equation links the aggregate supply and aggregate demand blocks. The price equation adopted for this study is in line with the monetarists' and structuralists' theories of inflation. Thus, following Moser (1995) and Khan and Musleh ud Din (2011), the general level of price is expressed as a weighted average of tradable good price (P_t^T) and non-tradable good price (P_t^{NT}). This is expressed in log-linear form as:

$$\ln P_t = \nabla \ln P_t^T + (1-\nabla) P_t^{NT} \tag{4.50}$$

∇ in equation (4.50) represents the share of tradable goods in the total expenditure. The price of tradable goods (P_t^T) is assumed to be determined in the world market exogenously. Expressing price of tradable goods in domestic currency imply the adjustment of foreign price (P_t^f) by nominal exchange rate (Er_t). This is expressed as:

$$\ln P_t^T = \ln P_t^f + \ln Er_t \tag{4.51}$$

Equation (4.51) suggests that an increase in foreign prices adjusted for exchange rate will possibly lead to an increase in the general price level. On the other hand, non-tradable good price (P_t^{NT}) is assumed to be determined in the domestic money market. Therefore, non-tradable good price is derived by the equilibrium in the money market where money supply (M^s) equals real money demanded $\left(M^d / P\right)$. Further, disequilibrium in the money market affects prices of non-tradable goods, expressed below as:

$$\ln P_t^{NT} = \Omega\left[\ln M_t^s - \ln M_t^d\right] \tag{4.52}$$

Where: M^d is real money balance demand while the relationship between economy-wide demand and demand for non-tradable goods is represented by a scale variable (Ω). Since real money demand is a function of Y_t and i_t, substituting this into equation (4.52) gives us non-tradable good price equation:

$$\ln P_t^{NT} = \Omega\left[\ln M_t^s - (\ln Y_t, i_t)\right] \quad (4.53)$$

Substituting the expressions for tradable and non-tradable goods prices in to equation (4.50) gives the final function of general price level.

$$p = f(M^s, Y, ir, P^f, xr) \quad (4.54)$$

Where: P_t^f is regarded as international oil price because of its effect on domestic price level.

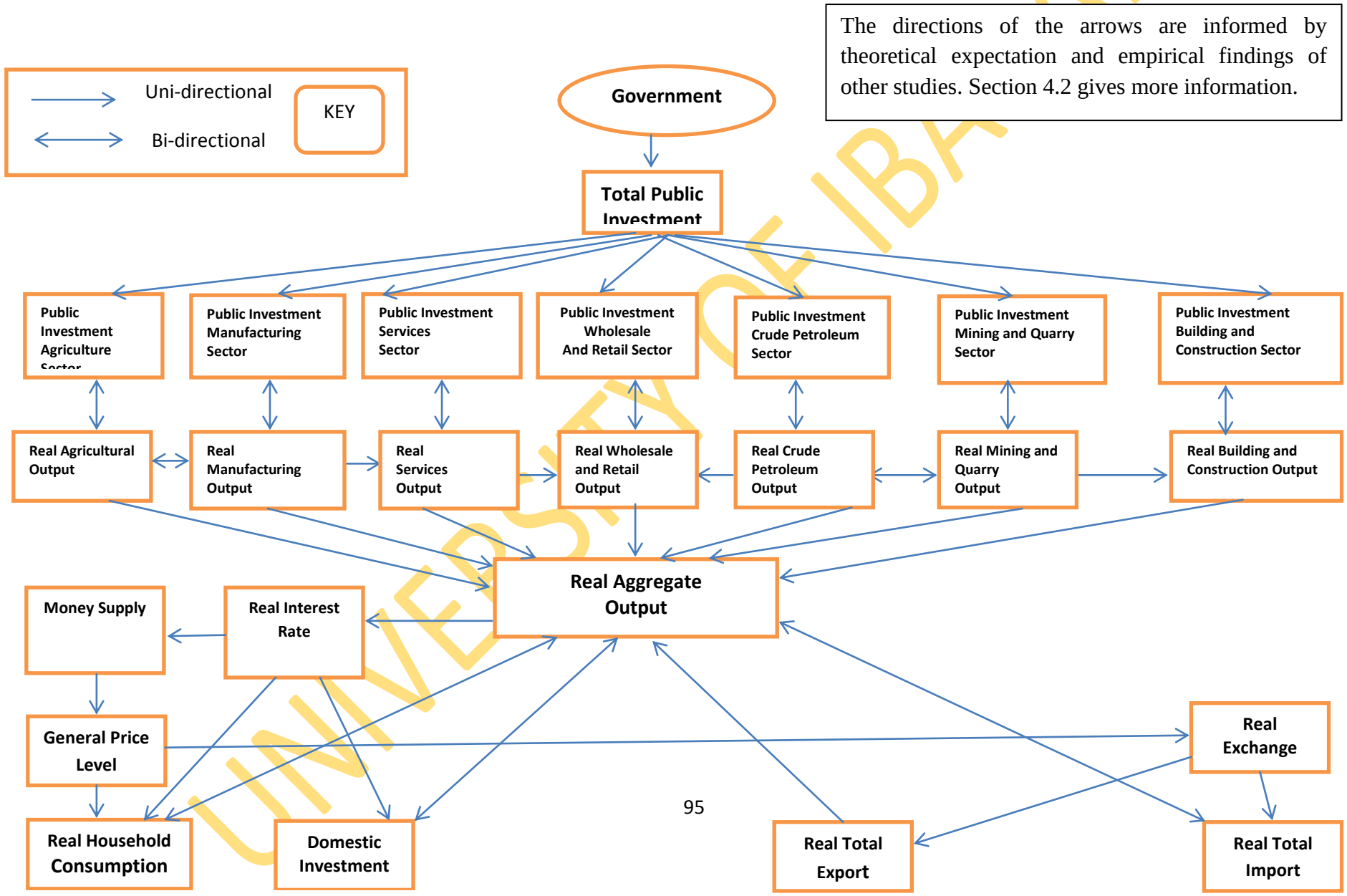
4.2 The Fundamental Reasoning of the Macroeconomic Model

The channels through which government capital expenditure (public investment) influences output, investment, export, consumption and import in the model are discussed in this sub-section. We focus explicitly on the impact of public investment on the determinants of the key endogenous variables in the model. For instance, increase in public investment in the seven sectors, increases sectoral output as will be depicted in equations (4.62) to (4.68) which leads to increase in aggregate output (Y) in equation (4.69) (Figure 4.1). This increase in aggregate output leads to increase in domestic investment as shown in equation (4.57) via the accelerator coefficients. Also, increase in public investment in crude petroleum sector, will increase output from the sector which implies increase in oil export as depicted in equation (4.58). This suggests an improvement in the trade balance (NX).

Further, an increase in government spending (public investment), increases consumption as shown in equation (4.55) through increase in aggregate output which causes changes in marginal propensity to consume (MPC). High MPC implies more expansion of demand which has significant effect on domestic investment, leading to rise in output. This channel is regarded as the indirect channel because it is through the demand side of the economy. Another indirect channel is the effect of public investment on real import as captured in equation (4.59) through changes in aggregate output via the import multiplier. High import multiplier implies more leakages of resources from the economy, which worsens trade balance. Within this model, an

alternative route for explaining output effect of changes in public investment is via the impact of general price level on aggregate output and aggregate demand. Disequilibrium between aggregate demand and aggregate supply also affects the domestic price level (Figure 4.1). Therefore, market clearing may be achieved through fiscal policy adjustments (i.e. changes in government spending).

Figure 4. 1. Schematic Representation of the Macroeconomic Model



Source: Author's Compilation

4.3. Research Methodology and Model Specification

The macro-econometric model developed for this study is a small macro model based on the fact that the focus of the research is on output in relation to public investment only.

Basically, government expenditure is separated into current and capital. Current expenditure mostly comprises wages and salaries which are related to private consumption, while capital expenditures are mostly regarded as public investment. These expenditures (current and capital) are related to government total revenue, the monetary value of the GDP. In a situation where government expenditure is higher than its revenue (budget deficit), government finances its expenses through an increase in money supply, a decrease in foreign exchange reserves, rise in the amount borrowed from the private sector or amount transferred from extra budgetary funds. However, because of the scope and objectives of this study, the issue of financing was neutralised. Therefore, the real sector of the economy is considered in this study.

The aggregate supply block is the real output produced in the economy by adding up the output from the seven sectors, equations (4.62) to (4.68). The aggregate demand block comprises of household consumption equation (4.55), domestic investment equation (4.56), real export equation (4.58) and real import equation (4.59). Each block captures specific equations whose formulations are guided by economic theory and the specific objectives of this study. The lag values of the dependent variables is included in the equations[12] and for ease of appreciation all the estimable equations from the two blocks are presented in log form below:

$$\ln C_t = a_0 + a_1 \ln yd_t + a_2 ir_t + a_3 \ln C_{t-1} + \psi_t \qquad (4.55)$$
$$a_1, a_2, a_3 > 0$$

[12] The lag value of the regressand is included in all the models to correct for possibility of first order serial correlation (Fair, 1971). Thus the normal Durbin Watson test would not be appropriate, therefore the Durbin h test was used.

$$h = \left(1 - \frac{DW}{2}\right)\sqrt{\frac{T}{1 - T[Var(\hat{\beta})]^2}}$$

The decision rule is that when /h/ > 1.645, the null hypothesis of no first-order autocorrelation is rejected at 5% significant level.

$$\ln I_t = b_0 + b_1 \ln AGGTY_t + b_2 ir_t + b_3 \ln I_{t-1} + \square_t \quad (4.56)$$
$$b_1, b_3 > 0 \text{ and } b_2 < 0$$

$$\ln G_t = \overline{G} \quad (4.57)$$

$$\ln X_t = q_0 + q_1 \ln Yw_t + q_2 \ln RPG_t + q_3 \ln OP_t + q_4 \ln X_{t-1} + \Re_t \quad (4.58)$$
$$q_1, q_3, q_4 > 0 \text{ and } q_2 < 0$$

$$\ln M_t = d_0 + d_1 \ln Y_t + d_2 \ln RPG_t + d_3 xr_t + d_4 \ln R_t + d_5 \ln M_{t-1} + \hbar_t \quad (4.59)$$
$$d_1, d_2, d_4, d_5 > 0 \text{ and } d_3 < 0$$

$$\ln m_t = i_0 + i_1 \ln y_t + i_2 ir_t + i_3 \pi_t + i_4 \ln m_{t-1} + \Im_t \quad (4.60)$$
$$i_1, i_4 > 0 \text{ and } i_2, i_3 < / > 0$$

$$\ln P_t = c_0 + c_1 \ln m_t^s + c_2 \ln y_t + c_3 ir_t + c_4 \ln op_t + c_5 xr_t + c_6 \ln P_{t-1} + \aleph_t \quad (4.61)$$
$$c_1, c_3, c_4, c_5, c_6 > 0 \text{ and } c_2 < 0$$

$$\ln AGRICY_t = \alpha_0 + \alpha_1 \ln PINAGRIC_t + \alpha_2 \ln AGRICEMP_t + \alpha_3 \ln AGRICK_t \quad (4.62)$$
$$+\alpha_4 \ln ATRF_t + \alpha_5 \ln BCAGRIC_t + \alpha_6 \ln MANY + \alpha_7 ir + \alpha_8 \ln AGRICY_{t-1} + \ell_t$$
$$\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6, \alpha_7 > 0 \text{ and } \alpha_7 < 0$$

$$\ln MANY_t = \beta_0 + \beta_1 \ln PINMAN_t + \beta_2 \ln MANEMP_t + \beta_3 \ln MANK_t \quad (4.63)$$
$$+\beta_4 \ln UPOP_t + \beta_5 ir_t + \beta_6 \ln BCMAN_t + \beta_7 \ln CIT_t + \beta_8 xr + \beta_9 op_t$$
$$+\beta_{10} \ln AGRICY_t + \beta_{11} \ln MANY_{t-1} + \varepsilon_t$$
$$\beta_1, \beta_2, \beta_3, \beta_4, \beta_6, \beta_9, \beta_{10}, \beta_{11} > 0 \text{ and } \beta_5, \beta_7, \beta_8 < / > 0$$

$$\ln SERVY_t = n_0 + n_1 \ln PINSERV_t + n_2 \ln SERVEMP_t + n_3 \ln SERVK_t \quad (4.64)$$
$$+n_4 \ln BCSERV_t + n_5 \ln CIT_t + n_6 GCON_t + n_7 ir_t + n_8 \ln m_t + n_9 \ln CRUPY_t$$
$$+n_{10} \ln SERVY_{t-1} + \upsilon_t$$
$$n_1, n_2, n_3, n_4, n_6, n_9, n_{10} > 0 \text{ and } n_5, n_7, n_8 < / > 0$$

$$\ln WHSRLY_t = \kappa_0 + \kappa_1 \ln PINWHSRL_t + \kappa_2 \ln WHSRLEMP_t + \kappa_3 \ln WHSRLK_t$$
$$+\kappa_4 \ln BCWHSRL_t + \kappa_5 \ln CIT_t + \kappa_6 ir_t + \kappa_7 xr_t + \kappa_8 \ln Y_{wt} + \kappa_9 \ln RPG_t + \kappa_{10} \ln MANY_t$$
$$+\kappa_{11} \ln WHSRLY_{t-1} + \square_t \quad (4.65)$$
$$\kappa_1, \kappa_2, \kappa_3, \kappa_4, \kappa_8, \kappa_{10}, \kappa_{11} > 0 \text{ and } \kappa_5, \kappa_6, \kappa_7, \kappa_9 < / > 0$$

$$\ln MINQY_t = \varphi_0 + \varphi_1 \ln PINMINQ_t + \varphi_2 \ln MINQEMP_t + \varphi_3 \ln MINQK_t$$
$$+\varphi_4 \ln BCMINQ_t + \varphi_5 PLR_t + \varphi_6 xr_t + \varphi_7 \ln BNCTY + \varphi_8 \ln MINQY_{t-1} + \nu_t \quad (4.66)$$
$$\varphi_1, \varphi_2, \varphi_3, \varphi_4, \varphi_7, \varphi_8 > 0 \text{ and } \varphi_5, \varphi_6 < / > 0$$

$$\ln CRUPY_t = s_0 + s_1 \ln PINCRUP_t + s_2 \ln CRUPEMP_t + s_3 \ln CRUPK_t + s_4 \ln BCCRUP_t \; s_5 xr_t + s_6 \ln OP_t + s_7 \ln RPG_t + s_8 \ln R_t + s_9 \ln BNCTY_t + s_{10} \ln CRUPY_{t-1} + \chi_t \quad (4.67)$$

$$s_1, s_2, s_3, s_4, s_8, s_9, s_{10} > 0 \text{ and } s_5, s_6, s_7 < / > 0$$

$$\ln BNCTY_t = \partial_0 + \partial_1 \ln PINBNCT_t + \partial_2 \ln BNCTEMP_t + \partial_3 \ln BNCTK_t + \partial_4 \ln BCBNCT \; \partial_5 ir_t + \partial_6 \ln MANY_t + \partial_7 \ln BNCTY_{t-1} + \mu_t \quad (4.68)$$

$$\partial_1, \partial_2, \partial_3, \partial_4, \partial_6, \partial_7 > 0 \text{ and } \partial_5 < / > 0$$

$$\ln y_t = \theta_0 + \theta_1 \ln T_t + \theta_2 ir_t + \theta_3 \ln g_o + \theta_4 \ln Y_{wt} + \theta_5 \ln rpg_t + \theta_6 \ln op_t + \theta_7 xr_t + \theta_8 \ln R_t + \theta_9 \ln m_t + \varpi_t \quad (4.69)$$

$$\theta_2 < 0, \; \theta_3, \theta_4, \theta_6, \theta_8 > 0, \; \theta_1, \theta_5, \theta_7, \theta_9 < / > 0$$

Identities

$$AD = C + I + G + NX \quad (4.70)$$

$$GDP = C + I + G + NX \quad (4.71)$$

$$AS = AGRICY + MANY + SERVY + WHSRLY + MINQY + CRUPY + BNCTY \quad (4.72)$$

$$AS = AD \quad (4.73)$$

The model has 12 behavioural equations, one linking equation (4.61) and four identities. There are 58 variables in the model, of which 45 are exogenous and the remaining 13 are endogenous. The model was subjected to the order of condition of identification[13] and the results showed that the model is over identified.

4.4. Estimation Technique and Procedures

Simultaneous equation system is adopted for this study. The AD and AS blocks comprises of simultaneous equations because some of the regressors are correlated with the error terms of the equations, they appear as dependent variables. To solve this problem of potential endogeneity, the two stage least squares plus lagged dependent variable (2SLSLDV) and three stage least squares (3SLS) simultaneous estimation technique were adopted.

[13] The order condition states that "the total number of variables in the model, M, minus the number of variables appearing in a particular equation, M*, should be equal or greater than the number of endogenous variables in the model, N, minus one, that is, M-M* ≥ N-1 (Gujarati, 2004).

The 2SLS an equation by equation technique, produces a consistent estimate if the predetermined variables therein to be estimated should be in the set of instrumental variables. This implies that the instrumental variables must be uncorrelated with the error disturbance and correlated with the endogenous variables in the model. However, the 2SLS technique cannot account for the possibility of serial correlation in residuals across equations in the system. Thus, the 3SLS is applied to correct for this problem. The major drawback of the 3SLS is that it is possible for an error in the specification of a particular equation to be transferred to other equations in the system since the equations in the system are estimated simultaneously. Diagnostic tests are conducted on the results obtained from the 2SLS and 3SLS estimators to validate the robustness of the estimates and their goodness of fit. To validate the instruments used for the 2SLS and 3SLS estimations, the J-statistics (along with p-values) and Cragg-Donald F-statistics were conducted. The J-statistics was used to test whether the instruments are valid. The decision rule is that the larger it is, the more likely the instruments are invalid. While Cragg-Donald F-statistics was used to test the weakness of the instruments.

Further, the time series properties of the variables were examined. The classical econometric theory is anchored on the assumption that the observed data should be stationary. The concept of stationarity is important when establishing a causal link between time-series variables. When a time-series variable is regressed on another time-series variable, it is possible for one to have a high R^2 result, though there is no meaningful relationship. This presents the problem of a spurious regression between the two variables, in which the strong relationship noticed is due to a common trend (Gujarati, 2004). It therefore follows that any analysis, forecast and policy recommendation based on such results would be meaningless. These problems are avoided by determining the order of integration of the variables.

To conduct this stationary test, the Augmented Dickey Fuller (ADF) and Phillip Perron (PP) stationarity tests were adopted. If the variables are non-stationary in levels, they are differenced at least ones to make them stationary. Notably, differencing a variable may lead to a loss of long run information. Thus, to determine whether a long run relationship exists between the dependent variable and the explanatory variables, cointegration test is conducted.

In cointegration, it is believed that individual variables might not be stationary but a linear combination of the variables tends to be stationary, implying the existence of cointegration. To test for cointegration, this study adopted the Engle-Granger and Johansen maximum-likelihood approach.

4.5. Data Sources

This study made use of macroeconomic time series from 1970 to 2010. The data would be obtained from IFS CD-ROM, Penn World Table and Central Bank Nigeria statistical bulletin and annual report and statement of Account (various issues). The variables of interest include; public investment in agriculture, manufacturing, services, mining and quarry, crude petroleum, wholesale and retail trade and building and construction sectors, private investment, sectoral employment, technological progress (tertiary student enrolment), bank credit to each sector mentioned above, sectoral output growth, household consumption expenditure, real export of goods and services, real import of goods and services and GDP.

LIST OF VARIABLES

Endogenous Variables

AGRICY	=	Agricultural Output (value) (₦ million)
MANY	=	Manufacturing Output (₦ million)
SERVY	=	Services Sector Output (value) (₦ million)
WHSRLY	=	Wholesale and Retail Trade Output (value) (₦ million)
MINQY	=	Mining and Quarry Output (value) (₦ million)
BNCTY	=	Building and Construction output (value) (₦ million)
CRUPY	=	Crude Petroleum Output (value) (₦ million)
HC	=	Household Consumption Expenditure (₦ million)
I	=	Domestic Investment (₦ million)
P	=	Consumer Price Index
X	=	Real Exports of Goods and Services Value (₦ million)
M	=	Real Import of Goods and Services Value (₦ million)
Y	=	Aggregate Income (₦ million)

Exogenous Variable

AGRICEMP	=	Number of employed people in agriculture sector (000 persons)
AGRICK	=	Fixed capital assets in agricultural sector (₦ million)
ATRF	=	Average total rainfall in Nigeria (millimetre)
BCAGRIC	=	Bank credit to agricultural sector (₦ million)
MANK	=	Fixed capital assets in manufacturing sector (₦ million)
MANEMP	=	Number of employed people in manufacturing sector (000 persons)
UPOP	=	Urban population (000 persons)
BCMAN	=	Bank credit to manufacturing sector (₦ million)
SERVEMP	=	Number of employed people in services sector (000 persons)
SERVK	=	Fixed capital assets in services sector (₦ million)
BCSERV	=	Bank credit to services sector (₦ million)
PLR	=	Prime lending rate

RPG	=	Relative price of goods and services (the ratio of domestic prices to US prices)
R	=	International Reserves
WHSRLEMP	=	Number of employed people in wholesale and retail sector (000 persons)
WHSRLK	=	Fixed capital assets in wholesale and retail sector (₦ million)
BCWHSRL	=	Bank credit to wholesale and retail sector (₦ million)
BCMINQ	=	Bank credit to mining and quarry sector (₦ million)
MINQEMP	=	Number of employed people in mining and quarry sector (000 persons)
MINQK	=	Fixed capital assets in mining and quarry sector (₦ million)
CRUPEMP	=	Number of employed people in petroleum sector (000 persons)
CRUPK	=	Fixed capital assets in petroleum sector (₦ million)
BCCRUP	=	Bank credit to petroleum sector (₦ million)
BNCTEMP	=	Number of employed people in building and construction sector (000 persons)
BNCTK	=	Fixed capital assets in building and construction sector (million)
BCBNCT	=	Bank credit to building and construction sector (₦ million)
yd	=	Disposable income (₦ million)
GCON	=	Government consumption (₦ million)
ir	=	Real interest rate
Yw	=	real world income (US)
xr	=	Real effective exchange rate
PINAGRIC	=	Public investment in agriculture sector (₦ million)
PINMAN	=	Public investment in manufacturing sector (₦ million)
PINSERV	=	Public investment in services sector (₦ million)
PINWHSRL	=	Public investment in wholesale and retail sector (₦ million)
PINMINQ	=	Public investment in mining and quarry sector (₦ million)
PINCRUP	=	Public investment in crude petroleum sector (₦ million)
PINBNCT	=	Public investment in building and construction sector (₦ million)

OP	=	Oil price ($)
g_o	=	Government expenditure (public investment) (₦ million)
m^s	=	Real money supply
T	=	Government tax revenue (₦ million)
CIT	=	Company income tax (₦ million)

PARAMETERS

θ_0 = Level of output, net of the determinant of real gross output.

θ_1 = Contribution of government tax revenue to the real gross output.

θ_2 = Coefficient for the effect of interest rate on real gross output.

θ_3 = The effect of government spending (public investment) on aggregate output.

θ_4 = Effect of world income on output.

θ_5 = Effect of relative prices of goods and services on gross domestic output.

θ_6 = Effect of oil price on gross domestic output.

θ_7 = Impact of exchange rate on national output.

θ_8 = Contribution of international reserve to national output.

θ_9 = Contribution of money supply on aggregate output.

a_1 = Marginal Propensity to Consume (MPC).

a_2 = The effect of real interest rate on household consumption.

a_3 = The effect of past household consumption expenditure on present consumption.

b_1 = The impact of aggregate output on domestic investment (accelerator coefficient).

b_2 = The impact of real interest rate on domestic investment.

b_3 = The effect of past domestic investment expenditure on present investment.

q_1 = Contribution of world income to real export value of goods and services.

q_2 = Impact of relative price of goods and services on real export value.

q_3 = Effect of oil price on real export value.

q_4 = Impact of past real export value on present real export.

d_1 = Marginal propensity to import.

d_2 = Impact of relative price of goods and services on real import value.

d_3 = Effect of real effective exchange rate on real import of goods and value.

d_4 = Contribution of international reserves to real import of goods and services.

d_5 = Impact of past real export value on present real export.

i_1 = Contribution of aggregate output on real money supply.

i_2 = Impact of real interest on real money supply.

i_3 = Effect of real interest rate on money supply.

c_1 = Contribution of money supply to general price level.

c_2 = Contribution of real aggregate output to general price level.

c_3 = Effect of real interest rate on general price level.

c_4 = Effect of oil price on general price level.

c_5 = Impact of real exchange rate on general price level.

α_1 = Effect of public investment in agricultural sector on its output.

α_2 = Impact of employment in agricultural sector on its output.

α_3 = effect of fixed capital asset in agricultural sector on its output.

α_4 = impact of rainfall on agricultural output.

α_5 = Impact of bank credit to agricultural sector on its output.

α_6 = Contribution of manufacturing sector output to agricultural output.

α_7 = Effect of real interest rate on agricultural output.

β_1 = Effect of public investment in manufacturing sector on the sector's output.

β_2 = Impact of employment in manufacturing sector on the sector's output.

β_3 = Effect of fixed capital asset in manufacturing sector on the sector's output.

β_4 = Impact of urban population on manufacturing output.

β_5 = Effect of real interest rate on manufacturing output.

β_6 = Impact of bank credit to manufacturing sector on its output.

β_7 = Effect of company income tax on manufacturing output.

β_8 = Effect of real exchange rate on manufacturing output.

β_9 = Effect of oil price on manufacturing output.

β_{10} = Contribution of agricultural output to manufacturing output.

n_1 = Effect of public investment in services sector on its output.

n_2 = Impact of employment in services sector on its output.

n_3 = Effect of fixed capital asset in services sector on its output.

n_4 = Impact of bank credit to services sector on its output.

n_5 = Impact of value added tax on services output.

n_6 = Contribution of government consumption to services output.

n_7 = Effect of real interest rate on services output.

n_8 = Contribution of money supply to services output.

n_9 = Contribution of petroleum sector output to services output.

κ_1 = Effect of public investment on wholesale and retail sector's output.

κ_2 = Impact of employment on wholesale and retail sector's output.

κ_3 = Effect of fixed capital asset on wholesale and retail sector's output.

κ_4 = Impact of bank credit to wholesale and retail sector's on output.

κ_5 = Impact of value added tax on wholesale and retail output.

κ_6 = Effect of real interest rate on wholesale and retail output.

κ_7 = Effect of real exchange rate on wholesale and retail output.

κ_8 = Contribution of world income to wholesale and retail output.

κ_9 = Impact of relative prices of goods and services on wholesale and retail output.

κ_{10} = Contribution of manufacturing sector output to wholesale and retail output

φ_1 = Effect of public investment in mining and quarry sector's output.

φ_2 = Impact of employment on mining and quarry sector's output.

φ_3 = Effect of fixed capital asset on mining and quarry sector's output.

φ_4 = Impact of bank credit to mining and quarry sector on its output.

φ_5 = Effect of prime lending rate on mining and quarry output.

φ_6 = Impact of real exchange rate on mining and quarry output.

φ_7 = Contribution of building and construction output to mining and quarry output.

s_1 = Effect of public investment on crude petroleum sector's output.

s_2 = Impact of employment in crude petroleum sector on its output.

s_3 = Effect of fixed capital asset in crude petroleum sector on its output.

s_4 = Impact of bank credit to crude petroleum sector on its output.

s_5 = Impact of real exchange rate on crude petroleum output.

s_6 = Effect of oil price on crude petroleum output.

s_7 = Effect of relative price of goods and services on crude petroleum output.

s_8 = Contribution of international reserves to crude petroleum output.

s_9 = Contribution of building and construction output to crude petroleum output.

∂_1 = Effect of public investment in building and construction sector on its output.

∂_2 = Impact of employment in building and construction sector on its output.

∂_3 = Effect of fixed capital asset in building and construction sector on its output.

∂_4, = Impact of bank credit to building and construction sector on its output.

∂_5 = Effect of real interest rate on building and construction output.

∂_6, = Contribution of manufacturing output to building and construction output

CHAPTER FIVE

EMPIRICAL RESULTS AND ANALYSIS

This chapter examines the time series properties and characteristics of the data employed using different diagnostic tests; presentation of the estimated model results and validation of the estimated macroeconometric model to ascertain its appropriateness for forecasting and policy analysis. The information obtained from the ex-ante forecast is also presented.

5.1 Time Series Properties of the Variables in the Model

5.1.1 Stationarity Test

The variables used for the analysis are subjected to two unit root tests to determine if the they have unit root (non-stationary) or do not have unit root (stationary series). The Augmented Dickey Fuller (ADF) and the Philips Perron (PP) tests are adopted and underlying models are assumed to be with a constant and linear trend. The null hypothesis in the *ADF* and *PP* test is the presence of unit root in the series.

The results of the stationarity tests show that all variables are stationary after the first diffference is taken. However, public investment in crude petroleum, manufacturing as well as mining and quarry sectors were stationary at level, when the assumption of constant and trend is considered in the model. Table 5.1 reports the results of ADF and PP tests.

Table 5. 1. Unit Root Test Results: ADF and PP Tests

Augmented Dickey Fuller (ADF) Levels			Phillip-Perron (PP) Levels		
Variables	Constant	Constant and Trend	Variable	Constant	Constant and Trend
LNHC	-0.1453	4.7364	LNHC	-0.0605	0.3823
LNDI	-0.5237	7.2612	LNDI	-0.5338	18.486
LNEXPORT	-0.5936	7.2173	LNEXPORT	-0.5596	0.9916
LNIMPORT	-0.3505	4.2604	LNIMPORT	-0.3505	7.8683
LNAGRICY	0.1738	-2.5125	LNAGRICY	0.4219	-2.1036
LNBNCTY	-0.0262	-1.0755	LNBNCTY	-0.2414	-1.5408
LNCRUPY	-0.9941	-2.2837	LNCRUPY	-1.0035	-2.3924
LNMANY	-1.2996	-2.8795	LNMANY	-1.1147	-1.8256
LNMINQY	-0.6012	-1.5981	LNMINQY	-0.8063	-1.8469
LNSERVY	-0.1993	-1.8753	LNSERVY	0.1585	-1.5763
Augmented Dickey Fuller (ADF) First Difference			Phillip-Perron (PP) First Difference		
Variables	Constant	Constant and Trend	Variable	Constant	Constant and Trend
LNHC	-9.1821***	-9.0710***	LNHC	-11.2767***	-11.1925***
LNDI	-4.6556***	-4.5596***	LNDI	-5.1849***	-5.0797***
LNEXPORT	-6.9153***	-6.8219***	LNEXPORT	-7.0127***	-6.9088***
LNIMPORT	-7.1870***	-7.0860***	LNIMPORT	-7.1396***	-7.0443***
LNAGRICY	-4.5251***	-4.4938***	LNAGRICY	-4.4040***	-4.3604***
LNBNCTY	-5.2608***	-5.2376***	LNBNCTY	-5.3535***	-5.3178***
LNCRUPY	-6.6946***	-6.6188***	LNCRUPY	-6.6973***	-6.6188***
LNMANY	-6.3888***	-6.4846***	LNMANY	-6.3888***	-6.4847***
LNMINQY	-5.1369***	-5.0671***	LNMINQY	-5.2312***	-5.1653***
LNSERVY	-4.3779***	-4.3048***	LNSERVY	-4.3524***	-4.2784***

Note: Critical values with constant: 1% = -3.6105. 5% = -2.93898. With constant and trend: 1% = -4.219. 5% = -3.5331.

Table 5.1 cont'd

Augmented Dickey Fuller (ADF) Levels			Phillip-Perron (PP) Levels		
Variables	Constant	Constant and Trend	Variable	Constant	Constant and Trend
LNWHSRLY	-0.4607	-3.6282	LNWHSRLY	-0.3905	-2.0422
LNAY	-0.7824	-1.6415	LNAY	-0.5274	-1.5890
LNPUBK	-2.0295	-3.6450	LNPUBK	-1.6577	-2.4167
LNPINAGRIC	1.5585	-3.5804	LNPINAGRIC	-1.2673	-3.5551
LNPINBCNT	-1.7554	-2.6238	LNPINBNCT	-2.1478	-2.5194
LNPINCRUP	-2.6751	-3.7413*	LNPINCRUP	-2.7402	-3.7179*
LNPINMAN	-2.3085	-3.7446*	LNPINMAN	-2.7401	-3.7368*
LNPINMINQ	-2.3065	-3.7422*	LNPINMINQ	-2.7431	-3.7157*
LNPINSERV	-0.8082	-1.6958	LNPINSERV	-1.1101	-2.3252
LNPINWHSRL	-1.4771	-2.1349	LNPINWHSRL	-1.4787	-2.2981
Augmented Dickey Fuller (ADF) First Difference			Phillip-Perron (PP) First Difference		
Variables	Constant	Constant and Trend	Variable	Constant	Constant and Trend
LNWHSRLY	-5.4707***	-5.3968***	LNWHSRLY	-5.4701***	-5.3958***
LNAY	-7.8341***	-5.0092***	LNAY	-7.8513***	-7.9193***
LNPUBK	-6.9402***	-7.1708***	LNPUBK	-6.9316***	-7.1041***
LNPINAGRIC	-7.2073***	-4.5654***	LNPINAGRIC	-7.9132***	-7.7267***
LNPINBNCT	-7.4979***	-7.5574***	LNPINBNCT	-8.2119***	-12.4159
LNPINCRUP	-5.1724***	-5.1349***	LNPINCRUP	-8.4122***	-8.8170***
LNPINMAN	-5.1724***	-5.1349***	LNPINMAN	-8.4122***	-8.8170***
LNPINMINQ	-5.1724***	-5.1349***	LNPINMINQ	-8.4122***	-8.8170***
LNPINSERV	-7.9601***	-7.8565***	LNPINSERV	-7.8959***	-7.7984***
LNPINWHSRL	-5.8535***	-5.7783***	LNWHSRL	-5.8521***	-5.7688***

Note: * implies significant at1%, 5% and 10%. While * implies significance at 5% or 10%.**

Source: Author's Computation

5.1.2 Cointegration test

Times series variables stationary may have linear combination that is stationary. In such a case, the variables are presumed to be cointegrated which implies the existence of a long run relationship between the non-stationary variables. Thus, this study adopts the Engle-Granger Two-Step (EGTS) and the Johansen Maximum Likelihood (JML) approaches to establish the existence or otherwise of a cointegrating relationship between the variables. The two approaches were adopted in order to compare their results.

The Engle and Granger cointegration test entail two steps; the first is conducting a static OLS regression on all the behavioural equations variables. The second is to conduct an ADF test on the residual from the regression. If the residual is stationary, then the series are considered to be cointegrated. Table 5.2 shows the Engle-Granger cointegration test results.

The Johansen and Juselius (1990) method on the other hand, uses estimates from a linked Vector Autoregression (VAR), sensitive to the selected lag length. Therefore, the lag length of the VAR which must be small enough to allow estimation and high enough to ensure that errors are approximately white noise was first determined. In order to arrive at the maximum lag length, five different information criteria; Akaike Information Criterion (AIC), Schwartz Information Criterion (SIC), Hannan-Quinn Information Criterion (HQ), Final Prediction Error (FPE) and Sequential Modified LR test Statistic (LR) were considered. From the result, the optimal lag length suggested for the stochastic equation is two.

In determining the number of cointegrating vectors, trace test and maximum eigenvalue test using the recent critical values of Mackinon-Haug-Michelis (1999) was applied. The assumption of no deterministic trend and restricted constant was applied to all the variables. The choice was tested using AIC and SIC. The result for trace test and maximum eigenvalue for unrestricted cointegration rank test is presented in Table 5.3. Generally, the cointegration tests reveal that the EGTS method and the Johansen approach yielded similar results for all the stochastic equation in the macroeconometric model. Thus, there exists a long run relationship amongst the variables in the behavioural equations that make up the macroeconometric model.

Table 5. 2. Engle-Granger Two-step approach Cointegration Test Results

Residuals of Static model	Augmented Dickey-Fuller Test	Conclusion
HC	-6.9516***	Cointegrated
I	-6.5614***	Cointegrated
X	-6.0919***	Cointegrated
M	-6.7754***	Cointegrated
AGRICY	-6.6367***	Cointegrated
MANY	-6.9318***	Cointegrated
SERVY	-4.9401***	Cointegrated
MINQY	-5.5962***	Cointegrated
CRUPY	-7.1195***	Cointegrated
BNCTY	-6.5759***	Cointegrated
WHSRLY	-4.5351***	Cointegrated
CRITICAL VALUES 1% -3.6156 5% -2.9412		

Notes: (i) * implies that the residual is significant at both 1% and 5%.**
(ii) Deterministic component is not included in the auxiliary regression

Source: **Author's computation**

Table 5. 3. Johansen Maximum Likelihood Procedure Cointegration Test Results

Model	Lag Length Chosen	Trace Statistics		Maximum Eigen Statistics		Conclusion
		Cointegrating Rank	Level of Significance	Cointegrating Rank	Level of Significance	
HC	1	1	5%	1	5%	Cointegrated
I	1	1	5%	1	5%	Cointegrated
X	1	3	5%	1	5%	Cointegrated
M	1	4	5%	4	5%	Cointegrated
AGRICY	1	5	5%	3	5%	Cointegrated
MANY	1	9	5%	9	5%	Cointegrated
SERVY	1	9	5%	9	5%	Cointegrated
MINQY	1	7	5%	7	5%	Cointegrated
CRUPY	1	8	5%	8	5%	Cointegrated
BNCTY	1	6	5%	5	5%	Cointegrated
WHSRLY	1	7	5%	7	5%	Cointegrated

Source: **Author's computation**

5.2 Macroeconometric Model Results and Interpretation

The results of the estimated behavioural equations in the macro-econometric model using 2SLS and 3SLS are presented and discussed in this sub section; they are presented in Tables 5.4 – 5.16. The signs of the estimated coefficient are the same for 2SLS and 3SLS but the size and significance of these coefficients tend to be more appropriate in the case of the 3SLS results for most of the stochastic equations estimated. Hence, this study chose the 3SLS estimates for comprehensive interpretation of all the behavioural equations except for aggregate output equation in which only the 2SLS estimation method was used. This is because the equation was estimated separately.

The diagnostic statistics of the estimated system equations reveal an R^2 which ranged from 65% to 87%. It is worthy of note that the R^2 is valid when considering the adequacy of a specific equation but it does not predict the overall goodness of fit within a system of equations. Thus, a dynamic historical simulation is undertaken to show the ability of the model to replicate observable variations in the historical series. Also, other validity test such as Theil inequality test its decomposition and root mean square error are presented and discussed. The value of the J-statistics and its p-values for each equation estimated were small revealing that the instrument used are valid. The Cragg-Donald F-statistics showing the weakness of the instrument used were insignificant for all the behavioural equation estimated.

5.2.1 Household Consumption Equation

The effect of current disposable income on household consumption is positive and significant with an elasticity of 0.68 (Table 5.4). This indicates an averagely stable marginal propensity to consume which implies that consumption is significantly a function of individual's income. This result is similar to that of Khan and Musleh ud Din (2011) as well as Akanbi and Du Toit, (2011)[14]. The coefficient for real interest rate is significant, it is 0.03. Though relatively low, the inter-temporal substitution holds at the aggregate level, suggesting that agents can smoothen their consumption over time by borrowing from financial intermediaries, especially commercial banks.

[14] Khan and Musleh ud Din (2011) estimated MPC of 0.94 for Pakistan economy while Akanbi and Du Toit, (2011) estimated MPC of 0.564 for Nigerian economy.

This also indicates that despite the less sophisticated structure of the Nigerian financial system and low income earnings of workers, borrowing constraints do not appear binding particularly with respect to consumption decisions. The lagged household consumption coefficient is positive and significant indicating consistent and transitive consumption behaviour.

Table 5. 4. Household Consumption Equation Regression Result

Variable	OLS		2SLS		3SLS	
	Coefficients	t-statistics	Coefficient	t-statistic	Coefficient	t-statistic
Constant	-0.587	-1.309	-0.644	-1.341	-0.667	-1.471
Lnryd	0.463	1.823*	0.669	3.296***	0.678	3.552***
Rir	0.028	1.431	0.031	1.837*	0.032	2.064**
Lnrhc(-1)	0.565	3.316**	0.562	4.225***	0.554	4.406***
R^2	0.921		0.872		0.871	
Adj R^2	0.908		0.869		0.868	
Durbin h	1.263		1.124		1.071	
J-statistic			2.264			
Prob (J-statistic)			0.132			
Instruments: lnhc(-2) lnyd(-1) ir(-1)						
Cragg-Donald F-statistics: 3.040						

Note: ****, ** and *** depict significance at the 10%, 5% and 1% levels respectively***

Source: **Author's computation**

5.2.2 Domestic Investment Equation

The result of the domestic investment equation is presented in Table 5.5. With a significant coefficient of 0.489 for real outputs, the result seems to support the accelerator principle, which posits that output has a positive effect on the level of investment. The general wisdom is that increase in real output would drive domestic savings and hence, fund would be available for investment financing. However, the Nigerian economy is characterised by low-income earnings which dampen savings in the country and expectedly, the amount of funds available for investment is low. This is similar to the results of Du Toit and Moolman, (2004) on South Africa economy. The estimation results also show a positive and significant real interest rate which concurs with the McKinnon-Shaw hypothesis that there exist a positive relationship between interest and investment through savings. The 0.020 coefficient is low, implying that low interest rate exerts positive impact on investment. Thus, it can be argued that the interest rate-investment channel is weak in Nigeria. Lagged domestic investment coefficient is very high and significant; indicating that past value of investment will affect the present investment significantly.

Table 5. 5. Domestic Investment Regression Result

Variable	OLS		2SLS		3SLS	
	Coefficients	t-statistics	Coefficient	t-statistic	Coefficient	t-statistic
Constant	-3.766	-2.543**	-4.504	-2.871	-4.510	-3.035
Lnrgdp	0.425	2.792**	0.487	3.068***	0.489	3.243***
Rir	0.013	1.399	0.020	1.910*	0.020	2.019**
Lnrdi(-1)	0.931	5.213***	0.930	34.292***	0.930	36.198***
R^2	0.926		0.790		0.791	
Adj R^2	0.912		0.788		0.789	
Durbin h	0.925		0.669		0.702	
J-statistic			0.392			
Prob (J-statistic)			0.532			
Instruments: lndi(-2) lnry(-1) ir(-1)						
Cragg-Donald F-statistics: 2.155						

Note: *, ** and *** depict significance at the 10%, 5% and 1% levels respectively

Source: **Author's computation**

5.2.3 Export Equation

It is evident from the results presented in Table 5.6 that only the relative price of goods and services as well as lagged value of export carried the expected signs, statistically significant at the five and one per cent levels respectively. The implication of this result is that depreciation of the Nigerian exchange rate makes exports relatively cheaper thereby impacting positively on real export value in the country, a result similar to that of Akanbi and Du Toit, (2011). The result also shows that oil price coefficient is positive but insignificant while the magnitude of 0.068 is relatively small[15]. Lagged export has a positive and significant impact on the current level of real export.

[15] Hamilton (1996) posits that oil price shock affect oil exporting countries output positively but affects oil importing nations negatively.

Table 5. 6. Export Equation Regression Results

Variable	OLS		2SLS		3SLS	
	Coefficients	t-statistics	Coefficient	t-statistic	Coefficient	t-statistic
Constant	-17.405	-0.531	-16.574	-0.494	-18.205	-0.582
lnY_w	0.827	0.757	0.800	0.717	0.848	0.815
Lnrpg	0.627	2.057**	0.632	2.058**	0.600	2.098**
Lnop	0.071	0.604	0.068	0.475	0.048	0.361
Lnexport(-1)	0.486	3.124**	0.485	3.076**	0.503	3.429***
R^2	0.941		0.785		0.785	
Adj R^2	0.922		0.784		0.784	
Durbin h	0.698		0.762		0.766	
J-statistic			0.055			
Prob (J-statistic)			0.814			
Instruments: lnexport(-2) lnyw(-1) lnreprice(-2) lnoilprice(1)						
Cragg-Donald F-statistics: 3.360						

Note: ***** and *** depict significance at the 5% and 1% levels respectively***

Source: **Author's computation**

5.2.4 Import Equation

The result of import equation presented in Table 5.7 reveals that output has positive impact on import value. The coefficient of about 0.822 implies that a 10% increase in real income for instance, will result in about 8.2% surge in imports. This suggests that output exerts considerable influence on import in Nigeria. This result seems to support the findings of Fatukasi and Awomuse (2010) that changes in income affect import positively. Similarly, relative price of goods and services also has positive and significant impact on imports. Though relatively small, the elasticity of real exchange rate is negative and significant. The International reserve coefficient is positive, small and insignificant. This is in dissonance with submission of Hemphill (1974) that international reserve exerts positive and significant impact on import values. The lagged value of import coefficient is positive and significant, suggesting that past values of import impact on the current values of import.

Table 5. 7. Import Equation Regression Results

Variable	OLS		2SLS		3SLS	
	Coefficient	t-statistics	Coefficient	t-statistic	Coefficient	t-statistic
Constant	-0.387	-0.176	-0.413	-0.183	-0.641	-0.311
Lnrgdp	0.823	2.901**	0.822	2.854***	0.845	3.198***
Lnrpg	0.632	1.476	0.863	4.269***	0.866	4.660***
Lnxr	-0.005	-2.645**	-0.006	-2.537***	-0.006	-2.840***
lnR	0.013	0.165	0.014	0.176	0.011	0.143
Lnimport(-1)	0.413	3.677***	0.415	3.556***	0.417	3.891***
R^2	0.942		0.851		0.851	
Adj R^2	0.941		0.842		0.842	
Durbin h	0.938		0.876		0.892	
J-statistic			1.581			
Prob (J-statistic)			0.209			
Instruments: lnimport(-2) lnrgdp(-1) lnreprice(-1) xr(-2) lnreserve(-1)						
Cragg-Donald F-statistics: 1.851						

Note: ** and *** depict significance at the 5% and 1% levels respectively

Source: **Author's computation**

5.2.5 Price Level Equation

Table 5.8 contains the price level equation results. All the regressors are rightly signed and theory consistent but two are statistically insignificant while the remaining are statistically significant. Money supply exerts strong positive impact on price level in Nigeria. The result shows that a 10% increase in money supply will result in about 2.4% increase in price level. This result confirms earlier findings of Khan and Musleh ud Din (2011) and Kallon (1994) for Pakistan and Sierra Leone, respectively. This result also validates the position of the monetarist that inflation is always a monetary phenomenon. This implies that if government desires to achieve price stability, the monetary authority must control money supply.

Real output produces a positive but insignificant impact on price level. This connotes that real output is not a strong determinant of inflation in Nigeria, partly explained by the fact that Nigerians depend heavily on imported goods to compliment domestic production. This result corroborates Odusola and Akinlo (2001).

The elasticity of real interest rate is relatively small, positive but insignificant. This suggests that interest rate do not exert much impact on price level in Nigeria. Though relatively small, real exchange rate possesses the right sign and it is statistically significant. 10% depreciation in exchange rate triggered less than 1% increase in the general price level. This also suggests that the impact of exchange rate on inflation is negligible.

The impact of oil price on general price level is positive and significant. This supports the popular view in the literature that changes in oil price cause changes in the general price level. In Nigeria, indeed most economic activities are one way or the other tied to oil price. Specifically, the results reveal that a 10% increase in oil price leads to about 1.9% increase in general price level. Further, the lagged value of general price level has a positive and significant effect on current general price level.

Table 5. 8. Price Level Equation Regression Results

Variable	OLS		2SLS		3SLS	
	Coefficients	t-statistics	Coefficient	t-statistic	Coefficient	t-statistic
Constant	-0.339	-0.297	2.996	1.393	3.022	1.557
lnM^s	0.206	3.173***	0.236	2.002**	0.229	2.150**
Lnrgdp	0.191	-0.880	0.129	0.569	0.138	0.672
Rir	0.005	0.834	0.012	1.403	0.012	1.625
Lnop	0.143	-2.270**	0.189	2.462**	0.187	2.690**
Xr	-0.002	-1.411	0.003	1.721*	0.003	1.903*
lnP(-1)	0.737	8.685***	0.806	7.678***	0.813	8.599***
R^2	0.943		0.747		0.747	
Adj R^2	0.940		0.736		0.736	
Durbin h	0.816		0.919		0.917	
J-statistic			0.682			
Prob (J-statistic)			0.409			
Instruments: lncpi(-2) lnM^s(-1) lnrgdp(-1) rir(-1) lnoilprice(-2) Xr(-2)						
Cragg-Donald F-statistics: 2.305						

Note: *, ** and *** depict significance at the 1%, 5% and 10% levels respectively

Source: **Author's computation**

5.2.6 Aggregate Output Equation

Table 5.9 shows that the coefficient of tax is positive and significant; suggesting that a 10% increase in tax would result in about 1.3% increase in aggregate output. This result affirms the hypothesis that tax hikes ease budgetary pressures, thereby encouraging investment and inducing long-term growth. This also supports Skinner's (1987) submission that "it is less important whether trade, personal or excise taxes are used to raise revenue, since the effect of tax-induced distortions are thought to be small relative to institutional constraints such as price controls, trade quotas and foreign exchange allocations"

Although small at -0.032, the coefficient of real interest rate is negative and significant. This is in line with theory that there exist an inverse relationship between output growth and interest rate. Money supply coefficient is significant and positive at 0.420, this result supports the Keynesian Liquidity preference theory that interest rate is purely a monetary phenomenon. Thus, a 10% increase in money supply leads to about 4.2% increase in aggregate output. This result is similar to that of Udoka and Roland (2012) and also validates the argument that an expansionary monetary policy reduces interest rate and spurs growth in output, partly through investment.

Public investment coefficient possesses the right sign, and it is significant. Specifically, a 10% increase in public investment will lead to about 2.1% increase in aggregate real output. This result suggests that public investment can act as expansionary fiscal policy that would spur output growth as suggested by theories. This result is compatible with Pereira, (2002), Sola (2008), Alexiou (2009), Egert et al, (2009), Nurudeen and Usman (2010) and Aladejare (2013) who note that government capital expenditure impact positively on aggregate output.

Exchange rate and international reserve are positive and significant suggesting that a 10% increase in international reserve leads to 2.1% increase in aggregate output. The positive coefficient of exchange indicates that 10% depreciation in exchange rate will increase output by about 1.1%. This result supports literature that depreciation of exchange rate tends to expand exports and reduce imports, while the appreciation of exchange rate would discourage exports and encourage imports (Shehu-Usman, 2012).

Exchange rate depreciation leads to income transfer from importing countries, which distorts the terms of trade, thereby leading to increase in international reserves for the exporting country. Although in the case of Nigeria where oil is the major export, changes in oil price instantaneously affect international reserve accumulation. However, our result indicates that oil price coefficient is negative and insignificant. Shehu-Usman (2012) on the impact of oil price shock and exchange rate volatility on output growth presents similar findings.

Conversely, the responsiveness of aggregate output to changes in world income and relative prices of goods and services are positive and significant, suggesting that a 10% increase in the world income will lead to about 13.5% increases in aggregate output. This result supports the assertion in literature that positive economic growth of a country's major trading partners would improve the country's economy via increased demand for its exports (Shehu-Usman, 2012). Lagged value of real aggregate output is positive and insignificant. This implies that real aggregate output is not path-dependent, in other words, the level of output in the year previous does not determine that of current year.

Table 5. 9. Aggregate Output Equation Regression Result

Variable	OLS		2SLS	
	Coefficient	t-statistic	Coefficient	t-statistic
Constant	38.744	2.221**	44.105	2.276**
lnT	0.114	1.341	0.128	1.843*
Rir	-0.019	-2.063**	-0.032	-2.728***
lng_o	0.136	1.996*	0.206	2.438**
lnY_w	-1.160	-1.476	1.345	2.067**
Lnrpg	-0.266	-1.910*	-0.349	-2.264**
Lnop	-0.028	-0.299	-0.102	-0.966
Xr	-0.001	-0.952	-0.114	-1.799*
lnR	0.181	3.612***	0.208	3.872***
lnM^s	0.258	1.714*	0.420	2.357**
Lnrgdp(-1)	0.149	1.558	0.041	0.239**
R^2	0.935		0.729	
Adj R^2	0.913		0.705	
Durbin h	1.418		1.227	
J-statistic			1.327	
Prob (J-statistic)			0.249	
Instruments: lnry(-2) ir(-1) lnpubk(-1) lnyw(-2) lnrpg(-1) lnop(-1) lnR(-1) lnM^S(-1)				
Cragg-Donald F-statistics: 4.239				

Note: *, ** and *** depict significance at the 10%, 5% and 1% levels respectively

Source: **Author's computation**

5.2.7 Sectoral Output Equations

5.2.7.1 Agricultural Output Equation

From Table 5.10, elasticity of public investment on infrastructure in agricultural sector had a significant positive impact on its output. A coefficient of about 0.159 means that a 10% increase in public investment in agriculture will lead to about 1.5% increases in agricultural output. The implication of this is that government spending on agricultural infrastructure would go a long way to improve agricultural output. This result is in accordance with Olomola (2000), Zerfu (2002), Manyong *et al.*, (2005), Nasir (2005), Harishmani *et al*., (2011), Khan and Musleh ud Din (2011) and Purokayo and Umaru (2012).

Employment in agricultural sector has positive impact as theory suggests but it is insignificant. This result also confirms the argument that primitive farming tools are still being used for farming in Nigeria, making it difficult for the sector to attract more labour force.

The coefficient of bank credit to the agriculture sector (0.040) is positive but insignificant. This implies that credit to agriculture does not exert any meaningful impact on its output. This could be attributed to the fact that the return on investment in agricultural sector takes long time and most banks in Nigeria prefer to give credit to businesses with short return on investment. This result is at variance with Pinda and Rodriguez (2007) and Purokayo and Umaru (2012). These two studies reported a negative and significant coefficient of bank credit to agricultural sector. However, Saleem and Ali Jan (2010) as well as Iqbal, *et al*. (2003) results reveal a positive and significant coefficients.

Also from the results, rainfall depicts a negative and insignificant relationship. This is not in consonance with most studies in the literature. The implication of this is that rainfall negatively affects agricultural output which can be partly attributed to incessant flood incidences and draught in the north. The coefficient of interest rate and the lagged value of agricultural output are positive and statistically significant.

Table 5. 10. Agricultural Output Equation Regression Results

Variable	OLS		2SLS		3SLS	
	Coefficients	t-statistics	Coefficient	t-statistic	Coefficient	t-statistic
Constant	-19.508	-1.389	-18.417	-0.246	-11.382	-0.174
Lnpinagric	0.034	1.284	0.159	1.786*	0.155	1.806*
Lnagricemp	1.323	1.476	1.643	0.867	1.221	0.892
Lnagrick	0.069	0.730	0.144	0.791	0.146	0.916
lnatrf	-0.134	-1.542	-0.955	-0.826	-1.028	-1.021
Lnbcagric	0.014	0.213	0.040	1.155	0.041	0.182
Lnmany	0.181	1.559	0.033	0.041	0.012	0.017
Rir	0.020	2.048**	0.039	1.815*	0.037	1.812*
Lnagricy(-1)	0.679	5.319***	0.533	1.918*	0.589	1.932*
R^2	0.951		0.692		0.691	
Adj R^2	0.943		0.689		0.688	
Durbin h	1.233		1.002		1.007	
J-statistic			1.569			
Prob (J-statistic)			0.210			
Instruments: lnagricy(-2) lnpinagric(-1) lnagricemp(-1) lnagrick(-2) lnatrf(-1) lnbcagric(-1) lnmany(-1) Rir(-2)						
Cragg-Donald F-statistics: 1.132						

Note: *** and * depict significance at the 1% and 10% levels respectively

Source: **Author's computation**

5.2.7.2 Manufacturing Output Equation

From Table 5.11, public investment in manufacturing sector has the hypothesised positive sign and is statistically significant. The elasticity of about 0.195 implies that for instance, a 10% increase in public investment in manufacturing sector will cause about 1.9% increase in manufacturing output. This result supports Adenikinju (1998), Fajingbesi and Odusola (1999), Paul, *et al*., (2004) and Joseph (2012). Coefficient of employment in manufacturing sector is negative and insignificant. This result is not surprising as it is evident that employment in this sector is very low, compared to other sectors.

Fixed capital asset in manufacturing sector is positive and significant; suggesting that capital accumulation positively affects the sector. This result supports the findings of Ahmad and Qayyum (2009) for Pakistan economy and Philips *et al.* (2011) on the determinants of productivity among manufacturing firms in south-eastern, Nigeria.

Bank credit to manufacturing sector, corporate income tax, real interest rate and exchange rate are rightly signed but insignificant. However, the coefficients of oil price and output from agriculture sector are negative and positive, respectively and both statistically significant.

Relatively, high coefficient of output from agricultural sector (0.617) possibly suggests that, a 10% increase in agricultural output will lead to about 6.2% increase in manufacturing sector output. This supports the argument in the literature that agricultural outputs serve as input in the manufacturing sector. The negative and significant impact of oil price further substantiates Philips *et al*. (2011) that an increase in oil price will negatively affect manufacturing firms in Nigeria since most of these firms depend heavily on generating set for power given the erratic national supply grid.

Table 5. 11. Manufacturing Output Equation Regression Result

Variable	OLS		2SLS		3SLS	
	Coefficients	t-statistics	Coefficient	t-statistic	Coefficient	t-statistic
Constant	1.204	0.217	4.119	0.501	4.105	0.601
Lnpinman	0.058	2.203**	0.169	1.920*	0.195	2.676***
Lnmanemp	-0.386	-1.579	-0.251	-0.493	-0.289	-0.969
Lnmank	0.452	1.315	0.584	2.781**	0.618	3.543***
lnupop	0.305	0.580	-0.110	-0.131	0.082	-0.117
Lnbcman	0.046	0.947	0.038	0.555	0.031	0.558
Lncit	0.156	1.233	-0.270	-1.435	-0.316	-2.03**
Rir	-0.001	-0.074	0.002	0.093	-0.003	-0.179
Xr	0.001	0.841	0.003	0.539	0.001	0.595
Lnop	0.176	1.380	-0.292	-2.197**	-0.316	-2.868***
Lnagricy	0.312	2.021*	0.617	1.921*	0.701	2.668***
Lnmany(-1)	0.211	1.452	-0.132	-0.456	-0.229	-0.956
R^2	0.967		0.725		0.724	
Adj R^2	0.964		0.713		0.711	
Durbin h	0.494		0.689		0.671	
J-statistic			1.784			
Prob (J-statistic)			0.182			
Instruments: lnmany(-2) lnpinman(-1) lnmanemp(-1) lnmank(-1) lnagricy(-2) lnupop(-2) lnbcman(-1) rir(-1) Xr(-1) lnop(-1) lncit(-2)						
Cragg-Donald F-statistics: 1.120						

Note: *, ** and *** depict significance at the 10%, 5% and 1% levels respectively

Source: **Author's computation**

5.2.7.3 Services Output Equation

Though the impact of public investment in the services sector is slightly high (0.659) implying the possibility of 6.6% increase in the sector output when public investment is increased by 10%. Meanwhile, its coefficient is positive but insignificant. This result is compatible with Haque and Kim (2003) on the effect of public investment in transport and communication on services sector in United Kingdom and Ezcurra, Gil *et al.* (2005) for Spanish regions but in dissonance with Onakoya, *et al*., (2012) for Nigeria.

Variables such as fixed capital assets, corporate income tax, interest rate, output of petroleum sector and money supply are insignificant, implying they do not exert significant impact on the output of services sector. Labour force, bank credit and government consumption had significant positive impact. Specifically, the elasticities of bank credit and government consumption suggest that a 10% increase in bank credit and government consumption will cause a 2.6% and a 3.2% increase in output respectively. This finding underscores the fact that government is a major player in economic activities in developing countries as suggested by Khan and Musleh ud Din (2011).

Table 5. 12. Services Output Equation Regression Result

Variable	OLS		2SLS		3SLS	
	Coefficients	t-statistics	Coefficient	t-statistic	Coefficient	t-statistic
Constant	-4.454	-1.233	-8.891	-1.499	-7.711	-1.541
Lnpinserv	0.019	0.891	0.656	0.948	0.659	1.012
Lnservemp	0.495	1.672	0.882	1.798*	0.791	1.909*
Lnservk	0.009	0.129	0.057	0.518	0.074	0.793
lnbcserv	0.162	2.419**	0.263	2.319**	0.265	2.775***
Lngcon	0.234	3.394***	0.322	2.949***	0.302	3.283***
Lncit	0.105	1.045	0.185	1.287	0.202	1.669
Rir	0.006	0.736	0.041	1.671	0.037	1.846
lnM^s	-0.031	-0.280	-0.429	-1.598	-0.398	-1.772
Lncrupy	0.164	2.792***	0.088	0.968	0.071	0.928
Lnservy(-1)	0.162	0.770	0.195	0.654	0.196	0.780
R^2	0.962		0.817		0.811	
Adj R^2	0.959		0.816		0.809	
Durbin h	0.953		1.168		1.172	
J-statistic			0.457			
Prob (J-statistic)			0.499			
Instruments: lnservy(-2) lnpinserv(-1) lnservyemp(-1) lnservk(-2) lnbcserv(-1) lngcon(-1) lncit(-2) Rir(-1) lnM^S(-1) lncrupy(-1)						
Cragg-Donald F-statistics: 1.334						

Note: *, ** and *** depict significance at the 10%, 5% and 1% levels respectively

Source: **Author's computation**

5.2.7.4 Wholesale and Retail Output Equation

The result for the wholesale and retail output equation is presented in Table 5.13. The results show that public investment on infrastructure like roads and transportation that ease distribution of wholesale and retail goods has a positive and significant effect. A 10% increase in public investment in wholesale and retail sector will trigger about 3% increase in wholesale and retail output. This result corroborates Amaghionyeodiwe and Folawewo (1998) on the effect of transport subsector on output performance.

Employment and fixed capital assets are rightly signed but insignificant. However, coefficients of bank credit, corporate income tax, real interest rate and output from manufacturing sector are positive and significant. The coefficient of bank credit to wholesale and retail suggests that a 10% increase in bank credit will lead to a 4.1% increase in the sector's output. This result is not surprising because importers and large firms dominate activities in this sector and most banks in Nigeria prefer to loan importers and large scale firms because their rate of return is faster compared to the real sectors like agriculture and manufacturing. The positive impact of manufacturing sector output supports the view that domestically produced goods are final output in the wholesale and retail sector since it distributes the goods to the final consumers.

Relative prices of goods and services coefficient is rightly signed but insignificant while coefficient of world income and exchange rate are negative and insignificant implying that they do not exert any influence on wholesale and retail output.

Table 5. 13. Wholesale and Retail Output Equation Regression Result

Variable	OLS		2SLS		3SLS	
	Coefficients	t-statistics	Coefficient	t-statistic	Coefficient	t-statistic
Constant	9.339	0.386	5.752	0.175	5.550	0.204
Lnpinwhsrl	0.078	1.508	0.302	2.341**	0.307	2.848***
Lnwhsrlemp	-0.116	-0.215	0.670	0.820	0.748	1.096
Lnwhsrlk	0.055	0.996	0.109	1.409	0.111	1.722
lnbcwhsrl	0.359	2.351**	0.413	2.597**	0.389	2.946***
Lncit	0.478	1.234	0.490	2.482**	0.482	2.926***
Rir	0.016	1.167	0.053	2.007*	0.056	2.503**
lnYw	-0.207	-0.212	-0.492	-0.365	-0.527	-0.470
Lnrpg	0.113	0.499	-0.045	-0.144	-0.067	-0.258
Xr	-0.002	-0.959	-0.006	-1.562	-0.006	-1.888
Lnmany	0.544	3.208***	0.492	2.166**	0.453	2.413**
Lnwhsrly(-1)	0.207	1.372	0.067	0.307	0.088	0.483
R^2	0.968		0.864		0.844	
Adj R^2	0.957		0.842		0.832	
Durbin h	1.385		1.425		1.428	
J-statistic			1.946			
Prob (J-statistic)			0.548			
Instruments: lnwhsrly(-2) lnpinwhsrl(-1) lnwhsrlemp(-1) lnwhsrlk(-1) lnbcwhsrl(-1) lncit(-2) Rir(-1) lny_w(-1) lnrpg(-1) Xr(-2) lnmany(-1)						
Cragg-Donald F-statistics: 3.261						

Note: *, ** and *** depict significance at the 10%, 5% and 1% levels respectively

Source: **Author's computation**

5.2.7.5 Crude Petroleum Output Equation

Table 5.14 shows that public investment in this sector is very low and does not influence output. This result supports the conclusion of Odularu (2007) on the effects of government capital expenditure on petroleum sector. The world oil price is also a major determinant of output in this sector. Oil price coefficient is significant at 5% level. This is consistent with the literature on the effect of oil price on oil-exporting countries. Oil price is expected to increase output in oil-exporting countries and impact negatively on output of oil-importing nations (Hamilton, 1996). International reserves which primarily accrue from oil exports in Nigeria's case also carried a positive and significant coefficient

Employment coefficient is 0.431 and significant. Thus, a 10% increase in employment in the petroleum sector will cause about 4.3% increase in petroleum output. The implication is that employment in this sector contributes positively to the production process. The coefficients of exchange rate and relative prices of goods and services also exert positive and significant influence on crude petroleum output.[16] Output from the building and construction sector as expected had a positive effect on petroleum output. This suggests the existence of inter linkages between these two sectors.[17] The lagged value of petroleum output is positive and insignificant meaning that past value of petroleum output does not influence its present value. This is because the output from this sector is to some extent exogenous as OPEC determines the quantity a member country should produce.

[16] The activities of the oil companies are expected to affect exchange rate through the Inter-bank Foreign Exchange Market (IFEM). Under the IFEM, CBN, oil companies and banks can buy or sell their foreign exchange at government influenced rate. The implication of this is that operators of the informal economy can easily access oil firms to buy foreign exchange which makes it difficult for CBN to control the circulation of foreign exchange in the economy.

[17] Building and construction output serves as intermediate good for the mining industry since most of the exploration companies need warehouses and homes for their staffs.

Table 5. 14. Crude Petroleum Output Equation Regression Result

Variable	OLS		2SLS		3SLS	
	Coefficients	t-statistics	Coefficient	t-statistic	Coefficient	t-statistic
Constant	4.023	1.351	1.192	0.315	1.186	0.371
Lnpincrup	0.043	0.999	0.032	0.649	0.026	0.644
Lncrupemp	0.258	1.769*	0.412	2.159**	0.431	2.653***
Lncrupk	0.104	1.238	0.112	1.241	0.115	1.504
lnbccrup	-0.004	-0.078	-0.032	-0.567	-0.038	-0.805
Xr	-0.015	-1.819*	-0.005	-1.748*	0.538	2.441**
Lnop	0.036	0.258	0.021	1.836*	0.005	2.225**
Lnrpg	0.628	1.657	0.512	1.965*	0.524	2.232**
lnR	0.375	2.857**	0.330	2.869**	0.351	3.602***
Lnbncty	0.295	1.649	0.496	1.787*	0.524	2.232**
Lncrupy(-1)	-0.155	-0.832	-0.176	-0.902	-0.231	-1.389
R^2	0.956		0.654		0.652	
Adj R^2	0.952		0.641		0.639	
Durbin h	0.443		0.446		0.449	
J-statistic			0.614			
Prob (J-statistic)			0.433			
Instruments: lncrupy(-2) lnpincrup(-1) lncrupemp(-1) lncrupk(-1) lnbccrup(-1) lnrpg(-1) Xr(-1) lnbncty(-1) lnR(-1) lnop(-2)						
Cragg-Donald F-statistics: 2.525						

Note: *, ** and *** depict significance at the 10%, 5% and 1% levels respectively

Source: **Author's computation**

5.2.7.6 Mining and Quarry Output Equation

Table 5.15 shows that the impact of public investment as well as building and construction output on mining and quarry output are positive and significant. This shows for instance that a 10% increase in public investment will cause about 1.1% increase in the mining and quarry output. For employment, the negative and significant coefficient alludes to the fact that the sector's employment does not have a positive effect on the output of the mining and quarry sector. This result is not far from expectation, since this sector has not been given much attention by the Nigerian government.[18] The negative and significant coefficient (-0.162) of bank credit to the mining and quarry sector suggests the weak influence it exerts on the sector.

Exchange rate coefficient is positive and statistically significant. The implication of this is that exchange rate depreciation affects output from mining and quarry sector through export prices. Prime lending rate on the other hand had no effect on mining and quarry output. Interestingly, the coefficient of building and construction output had the highest impact of about 6.8% on mining and quarry output. The lagged value of mining and quarrying output is positive and highly significant, suggesting that it impacts heavily on the current output value.

[18] The Ajaokuta steel that supposed to produce steel that would serve the West African market is not operating and this massive investment is expected to create job opportunity for Nigerians.

Table 5. 15. Mining and Quarry Output Equation Regression Result

Variable	OLS		2SLS		3SLS	
	Coefficients	t-statistics	Coefficient	t-statistic	Coefficient	t-statistic
Constant	0.715	0.427	1.602	0.777	2.419	1.348
Lnpinminq	0.010	0.350	0.110	1.723*	0.109	1.943*
Lnminqemp	-0.223	-1.447	-0.296	-1.583*	-0.346	-2.123**
Lnminqk	0.059	1.321	0.071	1.314	0.063	1.333
lnbcminq	-0.125	-2.984	-0.162	-2.949***	-0.141	-2.949***
Plr	-0.003	-0.468	-0.009	-1.171	-0.008	-1.228
Xr	0.001	0.394	0.003	1.231	0.003	1.711
Lnbncty	0.686	5.479***	0.747	6.573***	0.668	6.835***
Lnminqy(-1)	0.475	5.703***	0.346	2.944***	0.403	3.935***
R^2	0.914		0.787		0.783	
Adj R^2	0.902		0.784		0.779	
Durbin h	0.717		1.157		1.161	
J-statistic			1.079			
Prob (J-statistic)			0.583			
Instruments: lnminqy(-2) lnpinminq(-1) lnminqemp(-1) lnminqk(-1) lnbcminq(-1) Xr(-1) lnbncty(-1) plr(-2) $lnM^s(-1)$						
Cragg-Donald F-statistics: 4.127						

Note: *, ** and *** depict significance at the 10%, 5% and 1% levels respectively

Source: **Author's computation**

5.2.7.7 Building and Construction Output Equation

From Table 5.16, coefficient of public investment in building and construction although small at 0.213 it is positive and statistically significant. Fixed capital asset in building and construction sector is found to be positive but insignificant. This result is contrary to the result of Olofin (1985) who found a positive and significant relationship between the lagged and current value of fixed capital assets. This is perhaps because he used changes in capital formation in building and construction sector to measure changes in capital asset due to unavailability of data, while this study used fixed capital assets on machinery and equipment in building and construction sector. Real interest rate (0.018) is also positive and insignificant while that of bank credit to building and construction sector (-0.045) is negative and insignificant.

The influence of manufacturing output is positive and significant indicating that a 10% increase in this sector's output will lead to 2.7% increase in building and construction output. This suggests that output from the manufacturing sector contributes positively to growth in the building and construction industry. Another major contributor to the building and construction output as revealed by empirical result in Table 5.16 is the number of people employed by the sector. The coefficient of this variable is 0.743, which suggests that a 10% increase in labour force would bring about 7.4% increases in output from the sector. This result substantiates the argument in the literature that the building and construction sector in Nigeria is labour- intensive (Olaide *et al*., 1981). Lagged value of building and construction is positive and significant, indicating that the past value of building and construction exerts high positive impact on the present or current value.

Table 5. 16. Building and Construction Output Equation Regression Result

Variable	OLS		2SLS		3SLS	
	Coefficients	t-statistics	Coefficient	t-statistic	Coefficient	t-statistic
Constant	-5.269	-1.586	9.690	2.004	8.255	1.949
Lnpinbnct	-0.129	-1.420	0.213	2.133**	0.202	2.273**
Lnbnctemp	0.469	1.519	0.882	1.959*	0.743	1.886*
Lnbnctk	-0.031	-0.351	0.054	0.462	0.034	0.328
lnbcbnct	-0.051	-0.718	-0.048	-0.518	-0.045	-0.546
Rir	0.005	0.361	0.018	0.885	0.016	0.869
Lnmany	0.281	2.750**	0.266	2.168**	0.279	2.569**
Lnbncty(-1)	0.794	4.079***	0.695	5.481***	0.725	6.478***
R^2	0.909		0.688		0.688	
Adj R^2	0.891		0.685		0.686	
Durbin h	1.107		0.659		0.674	
J-statistic			0.161			
Prob (J-statistic)			0.688			
Instruments: lnbncty(-2) lnpinbcn(-1) lnbnctyem(-1) lnbnctk(-1) lnbcbnct(-1) Rir(-1) lnmany(-1)						
Cragg-Donald F-statistics: 1.978						

Note: *, ** and *** depict significance at the 10%, 5% and 1% levels respectively

Source: **Author's computation**

5.3 Validation of the Macroeconometric Model

Traditionally, the forecasting ability of a macroeconometric model is done using historical simulation approach. The standard procedure is adopted in this study. This entails visual inspection of the chart of actual and simulated values of the independent variables in the behavioural equations. Summary of statistics such as Theil's inequality coefficient (decomposed into bias, variance and covariance); and the Root Mean Square Error (RMSE) are also considered in validating the results in this study. Figures 5.1 and 5.2 display the graphs of actual and baseline values of aggregate demand components and aggregate supply, respectively. From these figures, it is clear that the time path of the historical (actual) and simulated (baseline) series are close and the turning point of the actual series seem to be well tracked by the simulated values. It is worthy of note that the Theil's inequality coefficient gives more information on how well the model tracks turning points in the historical (actual) data.

The Theil's inequality coefficient normally lies between zero and one, where zero indicates a perfect fit. That is, the simulated series is exactly identical to the historical (actual) series. However, if it is one, it implies that the model's predictive power is weak. Thus, the smaller the Theil's inequality coefficient is, the better the goodness of fit of the model. Furthermore, the Theil's coefficient is decomposed into three components; namely bias, variance and covariance proportions. The decomposition of the Theil's coefficient makes it easier to appreciate the validation process of the model. These three components of the Theil inequality coefficient must add up to one, they are explain briefly in what follows.

The bias proportion tells us how far the mean of the simulated series is from the mean of the historical (actual) series. Therefore, the bias proportion must be close to zero. The variance proportion on the other hand, indicates how far the deviation of the simulated series is from the actual series. Thus, a low variance proportion implies that the model is good. Finally, the covariance proportion measures the remaining unsystematic simulating errors. That is, a large covariance proportion is expected from a good simulation exercise (Pindyck and Rubinfeld, 1998). Moreover, a forecast or simulation is adjudged good if the bias and variance proportion are small so that most of the differences between the actual and the simulated series can be concentrated on the covariance proportion.

The values of the root mean square error, Theil's inequality coefficient and its decomposition are presented in Table 5.17. From the table, the Theil's inequality coefficient ranges from 0.006 for aggregate output equation to 0.019 for price level equation. The bias proportion ranges from 0.000 to 0.002 for all equations, suggesting that the observed differences between the actual and simulated are not due to discrepancy in their means. The variance proportion which is generally, low ranges from 0.001 to 0.019 in all equations. The highest value (0.019) is recorded for aggregate output equation. This implies that the discrepancy between the actual and simulated series cannot be attributed to differences in variances of the actual and simulated series. The covariance proportion values are generally high for all the equations, this suggest that the observed discrepancy between the actual and simulated series is due to imperfect covariance between the actual and simulated series. The above diagnostics together with the low RMSE ranging from 0.120 to 0.339, suggesting that our model is consistent and meets the basic requirements of a good macroeconometric model capable of forecasting and policy simulations.

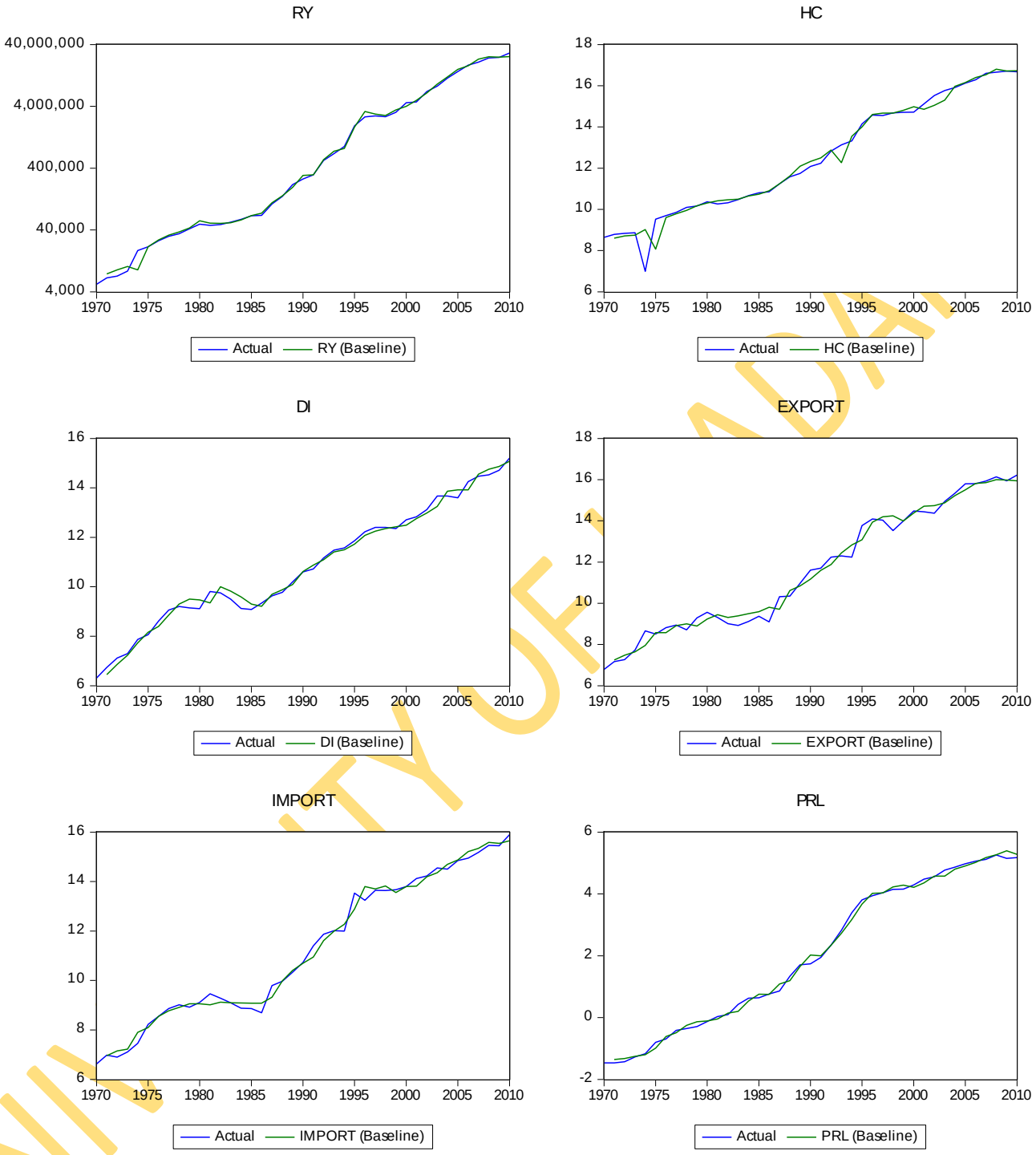


Figure 5. 1. Actual and Simulated Values of Some Endogenous Variables in Aggregate Demand Block

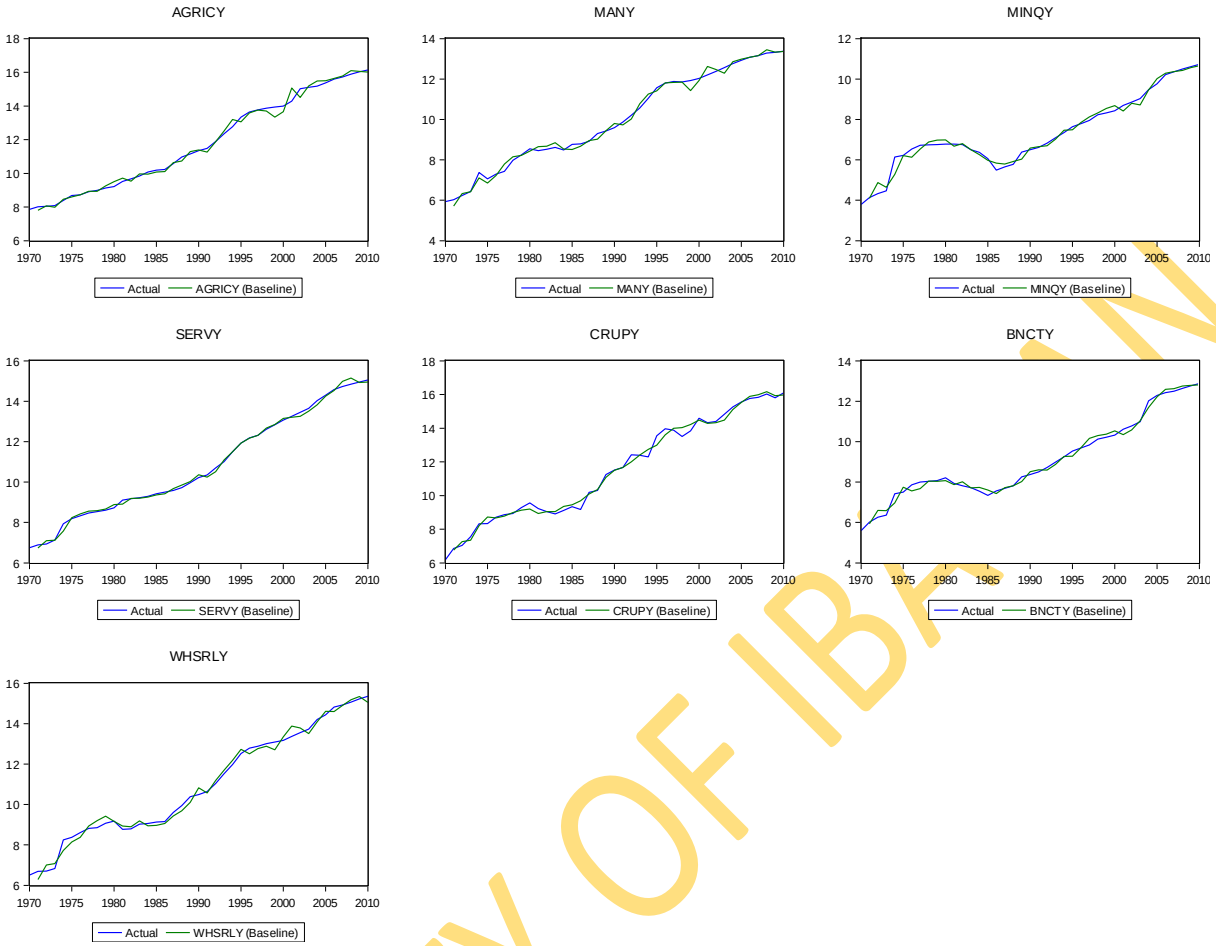


Figure 5. 2. Actual and Simulated Values of Some Endogenous Variable in Aggregate Supply Block

Table 5. 9. Summary Statistics of Validation of the Macroeconometric Model

Variables	Theil's Inequality Coefficient	Decomposition of Theil's Inequality Coefficient			Root Mean Squared Error
		Bias Proportion	Variance Proportion	Covariance Proportion	
House consumption	0.011	0.000	0.005	0.995	0.250
Domestic investment	0.009	0.001	0.000	0.999	0.221
Export	0.014	0.000	0.005	0.995	0.339
Import	0.011	0.000	0.002	0.998	0.250
Aggregate output	0.006	0.002	0.019	0.979	0.120
Agricultural output	0.009	0.000	0.005	0.994	0.235
Manufacturing output	0.008	0.001	0.004	0.995	0.159
Services output	0.006	0.001	0.002	0.997	0.126
Wholesale and Retail output	0.008	0.000	0.001	0.999	0.193
Mining and Quarry output	0.012	0.000	0.001	0.999	0.186
Crude petroleum output	0.009	0.000	0.001	0.999	0.222
Building and construction output	0.011	0.000	0.001	0.999	0.206
Price level	0.019	0.000	0.001	0.996	0.122

Source: **Author's computation**

5.3 Out of Sample Simulation and Policy Analysis

This subsection deals with the use of the validated estimated model to carry out policy experiments. The conventional approaches involve making certain assumptions about the path of one or more exogenous variables and then determine the plausible paths the endogenous variables would follow. There are many ways to approach this exercise; however, this study focuses on the out-of-sample (ex-ante) approach in order to ascertain the predictive power of the model. In this type of policy simulation, the question normally asked is what would be the path of the endogenous variables in the macroeconometric model, if a particular exogenous variable changes due to a policy change.

In this study, the simulation exercise for the aggregate demand component is done by adopting government targeted capital expenditure under the medium-term expenditure framework (MTEF) policy. Based on this, three scenarios are created in the exercise; Scenario 1: this involves the adoption of government targeted capital expenditure under the MTEF for 2011 to 2014; Scenario 2: this entails making assumption of a 10% increment on the medium term expenditure adopted in scenario 1; and scenario 3: involves making assumption of a 20% increment on the expenditure adopted in scenario 1.[19]

From Table 5.18, public investment based on the MTEF has impact on the endogenous variables. For example, real GDP grows at an average of 0.472%; household consumption grows at an average of 2.346%; domestic investment grows at an average of 1.138%; real import grows at an average of 13.305% while export grows at an average of 14.340%. These suggest that the targeted MTEF has positive impact on the endogenous variables, particularly export and import values. Tables 5.19 and 5.20 reveal that changes in the value of the targeted medium term expenditure (scenario 2 and 3) impacted more on real GDP. This suggest that government investment has more direct effect on real output.

[19] One of the major thrust of the MTEF is that government propose an increase in its expenditure by certain percentage, if the dividend of these expenditures are meant.

Table 5. 10. Ex-ante Simulation Experiment Results for Key Endogenous Variables: Adopting 2011-2014 Medium-term Expenditure Framework Capital Expenditure

SCENARIO 1

Year	Real GDP	Household Consumption	Domestic Investment	Real Export	Real Import	Price Level
2011	29495170	18044020	3653926	10965690	7326238	179.96
2012	30866300	18448200	3695425	12531860	8293478	181.38
2013	31662810	18518470	3780928	15321880	9360960	187.40
2014	32097966	18879520	3946015	18347390	1028680	188.66

Table 5. 11. Ex-ante Simulation Experiment Results for Key Endogenous Variables: Adopting 10% increment on 2011-2014 MTEF Capital Expenditure

SCENARIO 2

Year	Real GDP	Household Consumption	Domestic Investment	Real Export	Real Import	Price Level
2011	0.174	0.012	0.013	0.003	0.021	0.001
2012	0.208	0.014	0.015	0.005	0.023	0.003
2013	0.253	0.015	0.016	0.006	0.025	0.003
2014	0.308	0.017	0.019	0.006	0.026	0.004

Note: these figures are in percentage deviation from scenario 1 value

Table 5. 12. Ex-ante Simulation Experiment Results* for Key Endogenous Variables: Adopting 20% increment on 2011-2014 MTEF Capital Expenditure

SCENARIO 3

Year	Real GDP	Household Consumption	Domestic Investment	Real Export	Real Import	Price Level
2011	0.347	0.022	0.034	0.043	0.063	0.006
2012	0.415	0.025	0.036	0.045	0.064	0.009
2013	0.505	0.027	0.038	0.046	0.076	0.012
2014	0.614	0.029	0.040	0.049	0.081	0.017

Note: these figures are in percentage deviation from scenario 1 value

5.4 Synthesis of empirical results and study objectives

Objectives i:

To identify the channels through which public investment affect output

From the empirical results, two channels were identified (direct and indirect). The direct effect was assessed using the magnitude of PI multiplier coefficients on aggregate and sectoral output. The indirect effect of PI on demand side was evaluated with marginal propensity to consume, accelerator coefficient and import multiplier. There were marginal direct effects of public investment on aggregate and some sectoral output, while the indirect effects were significant. Public investment multiplier for aggregate output is 0.21 and it is significant. Wholesale and retail trade had the largest significant multiplier of 0.31, followed by building and construction (0.21), manufacturing (0.17), agriculture (0.16) and mining and quarrying (0.11). The multipliers of public investment in services (0.13) and crude petroleum (0.03) sectors were insignificant. The values of marginal propensity to consume (0.68), the accelerator coefficient (0.49) and the import multiplier (0.86) were significant. This suggests that a ₦1 increase in PI would increase household consumption, domestic investment and external trade by 68k, 49k and 86k, respectively.

Objective ii:

To examine the effect of total public investment on aggregate output

This objective is achieved by estimating the equilibrium output equation (4.69) using 2SLS estimation technique. The result shows that public investment provided or facilitated output growth as suggested by Keynesian theory.

Objective iii:

To evaluate the impact of public investment on sectoral output performance in Nigeria

To achieve this objective, equations (4.62 – 4.68) were estimated using the 2SLS and 3SLS estimation techniques. The results revealed that public investments in the output equations of the sectors considered were positive with only five of the seven sectors being significant. Public investment in agricultural, manufacturing, mining and quarry, wholesale and retailing as well as building and construction sectors were significant. Services and crude petroleum sectors were found to be insignificant. The implication of this is that public investment in services and crude petroleum sectors do not influence the output. The result also reveals that all the coefficients are generally low except for services sector, which is insignificant. On general note, public investments have positive impact on sectoral output, but the magnitude of this effect varies from sector to sector.

CHAPTER SIX

SUMMARY AND CONCLUSION

6.1 Summary and Conclusion

In Nigeria, government expenditure has continued to rise in nominal and real terms, partly due to the huge receipts from production and sales of crude oil, as well as the increased demand for public goods. Meanwhile, the ratio of public investment from government expenditure has been fluctuating over the years. Aggregate and sectoral outputs have also declined over time, except for crude petroleum sector; the contributions of other sectors to aggregate output have been generally low. In addition, the combination of factors such as low domestic investment due to dilapidated infrastructure (especially roads and power supply), large current account imbalance caused by high import value and the inefficiencies in the management of public expenditure, which were ignored or camouflaged by substantial government transfers in the form of subsidies or subventions have not made Nigeria fared well in the last couple of years (Aladejare, 2013).

Against the aforementioned problems, the study attempted to address the following issues: examine the effect of public investment on aggregate output; evaluate the impact of public investment on sectoral output performance; and identify the channels through which public investment will affect aggregate output.

Most studies have considered the supply side effect of public investment on output, with less emphasis on demand side effect of public investment on output which to a large extent is the indirect impact of public investment on output. This study differs considerably from other studies by developing a small macroeconometric system equation model using an eclectic approach to model the variables of interest with respect to its theoretical determinants, considering the Nigerian economy. To this end, annual data spanning 1970 to 2010 was used for the analysis. Aggregate and disaggregated output and public investment data were taken into consideration.

Two estimation techniques, the Two-Stage Least Square (2SLS) and Three-Stage Least Square (3SLS) were employed in this study. The 2SLS which is an equation by equation technique helps solve the possibility of endogeneity problem but fails with regard to accounting for likely serial correlation in residual across equations in the system. The 3SLS was therefore used to correct for this likely problem but the drawback of 3SLS is that an error in specification of any equation in the system is transferred to others since the system is estimated simultaneously. Thus, careful model identification was carried out to avoid this problem.

The results of the 2SLS and 3SLS were reported to achieve the stated specific objectives of this study. From the results, coefficient of total public investment in aggregate output equation estimated using the 2SLS estimation technique shows a positive sign, suggesting that public investments exert considerable influence on aggregate output in Nigeria. This result is consistent with other results in literature.

The analysis of the sectoral output was also consistent with the theoretical expectation, except for the coefficient of public investment in services and crude petroleum sectors that were positive but statistically insignificant. These results indicate that public investment in the agriculture, manufacturing, mining and quarry, wholesale and retail, building and construction sectors have slight positive impact on their outputs. The results also reveal that there two channels through which public investment affect aggregate output (direct and indirect). The direct channel is through the government capital expenditure multiplier while the indirect channels are through the import multiplier, accelerator coefficient and marginal propensity to consume (MPC). On the average, based on magnitude, the indirect channel appears to be larger than the direct channel with the import multiplier being the most pronounced.

Further, the out of sample simulation conducted also reveals that changes in total government public investment have considerable effect on household consumption, domestic investment and import multiplier through changes in output.

6.2 Policy Lessons from the Study

There are a number of policy lessons from the study. These include the followings:

- Total public investment has significant influence on aggregate output therefore, it would be suggested that government should increase public investment on infrastructures that have significant impact on aggregate output in the short-run while ensuring that in the long run, the prospect of economic growth is not hindered by increasing government capital outlays through sources that may crowd out productive investment.
- Investment in key sectors like agriculture, manufacturing, services, wholesale and retailing and crude petroleum that can impact positively on aggregate output and economic development should be encouraged given that it appears to be low as the results of the study suggest.

- It may not be possible to cut down current government expenditure in other to increase public investment in productive infrastructure as this is politically difficult therefore; government needs to adopt other possible measures that can help to improve the deplorable state of infrastructure in the country. The on-going public-private partnership (PPP) programme is in the right direction. Government also should encourage multinational companies to be more socially responsible to their host communities.

- Finally, to accelerate aggregate and sectoral output growth, there should be increased emphasis on productivity and efficiency of public investment to improve the low impacts on output growth noticed in the study.

6.3 Limitation of the Study and Future Research Suggestions

Most of the data on some of the key variables in the small macroeconometric model developed for this study were not available on higher frequency bases. This has implication the result of the simulation exercise as the impact of possible changes in the policy variable would have been more tangible using especially monthly or quarterly data. Thus, further studies could explore the use of monthly and quarterly data in order to re-examine the policy implication of these variables.

Also, the model considered in this study looked at direct and indirect channels of the impact of public investment on output by aggregating the supply side and the demand side components within a Keynesian framework. Notably, the sources of financing public investment were not discussed. Further studies therefore need to adopt a hybrid model such as the Computable General Equilibrium model (CGE) that could account for the possible effect of financing public investment on output growth. Those embarking on this type of studies could adopt this suggestion to enrich the understanding of the effect of public investment on output performance in Nigeria.

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