Public Investment and Output Performance: Evidence from Nigeria

Omo Aregbeyen [*]
Taofik Ibrahim Mohammed [**]

Abstract: *This study examined the direct/indirect long-run relationships and dynamic interactions between public investment (PI) and output performance in Nigeria using annual data spanning 1970-2010. A macro-econometric model derived from Keynes' income-expenditure framework was employed. The model was disaggregated into demand and supply sides to trace the direct and indirect effects of PI on aggregate output. The direct supply side effect was assessed using the magnitude of PI multiplier coefficient, while the indirect effect of PI on the demand side was evaluated with marginal propensity to consume, accelerator coefficient and import multiplier. The results showed relatively less strong direct effect of PI on aggregate output, while the indirect effects were stronger with the import multiplier being the most pronounced. This is attributed to declining capital expenditure, poor implementation and low quality of PI projects due to widespread corruption. By and large, we concluded that PI exerted considerable influence on aggregate output.*

Keywords: Public Investment; Output performance; income-expenditure framework; Macro-econometric simulation, Nigeria.

JEL Classification: H5, H50, H54

Introduction

The relationship between PI 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

---

[*] Omo Aregbeyen is at Department of Economics, University of Ibadan, Ibadan, Nigeria.
[**] Taofik Ibrahim Mohammed is at Nigerian Institute of Social and Economic Research (NISER), Ibadan, Nigeria.

PI, and the resulting low social returns on a number of investment projects carried out by government of developing countries. The argument in support of the latter view is that high PI may inhibit the overall performance of the economy. For instance, in an attempt to finance PI, 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 PI is a key factor in the design of adjustment policies in developing countries. Governments in considering 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 PI may result in few new projects as well as the abandonment of old 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. When fiscal deficits are reduced by cutting productive PIs, 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.

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 PI to government expenditure has been fluctuating over the years. For instance, average annual growth rate of PI 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%. Thus, there is a divergence between growth in PI and output performance. Consequently, this study examined the effect of PI on aggregate output in Nigeria between 1970 and 2010; and identified the channels through which PI affected aggregate output.

A macro-econometric model derived from Keynes' income-expenditure framework and disaggregated into demand and supply sides to trace the direct and indirect effects of PI on aggregate output was employed. The direct effect was assessed using the magnitude of PI multiplier coefficient on aggregate output. The indirect effect of PI on demand side was evaluated with marginal propensity to consume, accelerator coefficient and import multiplier. The models were estimated via a superior and more policy applicable instrumental variable techniques; two-stage-least square (2SLS) and three-stage-least square (3SLS). Summarily, the results obtained indicated that PI exerted considerable influence over aggregate output.

The rest of the paper has six main sections. Section II presents stylised facts on the Nigerian economy while section III profiled output and public investment over the

study period. Review of the literature on the relationship between output and PI was undertaken in section IV. The theoretical framework and methodological approach to the study were outlined section V. Section VI discussed the empirical results and findings while the concluding remarks are contained in section VII.

Overview of the Nigerian Economy

In the beginning and indeed, at independence in 1960, the agricultural sector dominated the economy, accounting for 70 per cent of the GDP, about two-thirds of labour employment, provided substantial raw materials for industries and more than 90 per cent of exports; and was therefore the mainstay of the Nigerian economy. But as petroleum became increasingly significant to the economy in the 1960s, culminating in a boom in the 1970s, agriculture thereafter grew slowly and its relative contributions to macroeconomic aggregates declined. Thus, the 1970s marked an important turning point in the socio-political and economic development of Nigeria. There occurred a dramatic change in the main source of growth of the economy- a spontaneous switch from predominantly agricultural economy to one driven largely by crude oil, following a boom in 1973/74 caused by a favourable external shock in the oil market. Accordingly, oil became very significant, contributing tremendously to GDP (over 45%), government finances (over 70%) and foreign exchange earnings (at least 80 %). Presently, Nigeria is the second largest exporter of oil in Africa and the twelfth in the world. Table 1 presents selected relevant economic indicators from 1970-2010.

The oil boom, however, brought with it some fundamental changes and developments in the economy, some of which were the afflictions of the economy with the "Dutch Disease", the erosion of the competitiveness of the agricultural sector by an overvalued exchange rate, inadequate pricing policies, rural-urban migration and neglect arising from the oil boom syndrome. The new oil wealth radically affected the scope and content of government investment, production and consumption patterns, the government's approach to economic management and policies and programmes implementation. The structure of policy incentives and controls encouraged import-substitution production and consumption patterns with little incentives for on-oil exports. More importantly, the public sector became the prime mover of the economy through direct participation in basic production and investment of growing oil revenues in social, physical and economic infrastructure in all sectors of the economy. Consequently, 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. Nevertheless, the ratio of public investment from government expenditure has fluctuated over the years. Aggregate and sectoral outputs have also declined over time, except for crude petroleum sector; the contributions of the other sectors to aggregate output have been generally low.

Table 1: Selected Indicators of the Economy of Nigeria (1970-2010)

Year	GDP Growth (%)	Total Revenue as (%) of GDP	Total Government Expenditure as (%) of GDP	Deficit (%) of GDP	Oil Revenue as (%) of GDP	Non-oil Revenue as (%) of GDP	Oil Revenue % Total Revenue	Non-Oil Revenue % Total Revenue	Export as a (%) of GDP	Oil Export as (%) of GDP	Non-Oil Export as (%) of GDP	Import as a (%) of GDP	Export + Import as a (%) of GDP	Exchange rate (Naira/US Dollar)
1970	2.5	12.0	17.1	-8.6	3.2	8.9	26.3	73.7	16.7	9.6	7.1	14.4	31.1	0.71
1975	5.3	25.7	27.7	-1.9	19.9	5.8	77.5	22.5	22.9	21.2	1.7	17.4	40.3	0.63
1980	6.5	30.7	30.2	-3.9	24.9	5.8	81.1	18.9	28.6	27.5	1.1	18.3	46.9	0.54
1985	5.9	22.2	19.2	-4.5	16.1	6.1	72.6	27.4	17.3	16.6	0.7	10.4	27.7	1.0
1990	8.0	36.7	22.5	-8.3	26.9	9.8	73.3	26.7	41.1	39.9	1.2	17.1	58.2	9.0
1995	-7.5	23.8	12.9	0.05	16.8	7.0	70.6	29.4	49.2	47.9	1.3	39.1	88.3	84.58
2000	3.9	41.6	15.3	-2.3	34.7	6.9	83.5	16.5	42.5	41.9	0.6	21.5	64.0	109.55
2005	9.5	38.1	12.5	-1.1	32.7	5.4	85.8	14.2	49.7	49.0	0.7	19.2	68.9	130.4
2010	7.9	25.0	14.4	-3.8	18.5	6.5	73.9	26.1	37.8	36.6	1.2	27.4	65.2	148.67

Source: CBN Statistical Bulletin and Annual Reports and Statements of Accounts, Various Issues

In addition, the combination of factors such as low private, particularly domestic investment due to dilapidated infrastructure (especially roads and power supply), large current account imbalance caused by high import values and the inefficiencies in the management of public expenditure (occasioned by widespread corruption), 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.

The Nigerian economy, therefore, has a large non-tradable sector (government services) and an export-oriented primary sector – mainly crude oil and agriculture. However, the revenues from the oil sector over time have not been used to properly develop other sectors and diversify the economy, thus resulting in non-inclusive economic growth, going by the high unemployment level and poverty incidence in the country. Thus, the Nigerian economy is susceptible to exogenous shocks such as fluctuations in oil price and international business cycles. The main trading partners are United States of America (USA), Spain, Brazil, Ivory Coast, China, Netherlands and United Kingdom. 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.

In summary, the key features of the Nigerian economy include dominance of agriculture (with a dualistic structure), low industrial development, large size of the informal sector, oil revenue dominate total revenue, oil export accounts for 80% of total exports, highly-import dependent economy, multinational corporation in-charge of mining, and huge size of the public sector and the associated poor financial management.

Output and Public Investment Profile in Nigeria (1970-2010)

The output (measured by real GDP growth) history of Nigeria's economy has been unstable over the years. During the oil boom eras, 1970-1974 and 1975-1979; output grew by 2.5% and 5.2 % annually respectively. However, in the early 1980s, it declined. Between 1980 and 1984, it fell to 4.2%. During the structural adjustment and economic liberalisation era (1985 to 1989), output responded to economic adjustment policies and grew positively and steadily and peaked at 8.7 %. It then decreased to 6.2% during 1990-1994 and sharply further to 2.5% between 1995 and 1999. Output level improved marginally between 2000 and 2004 to 3.8 %, linked to the increase in the volume of crude oil exported and the high prices. From 2005 to 2010, output level which averaged 5.4 %, is lower than the targeted 10.0% anticipated in the national development strategy document. Despite the negative effects of the global economic crisis which started in 2007 and continued till 2010, output levels remain positive and significant (see Figure 1).

Figure 1: Aggregate Output Growth (%) in Nigeria (1970-2010)
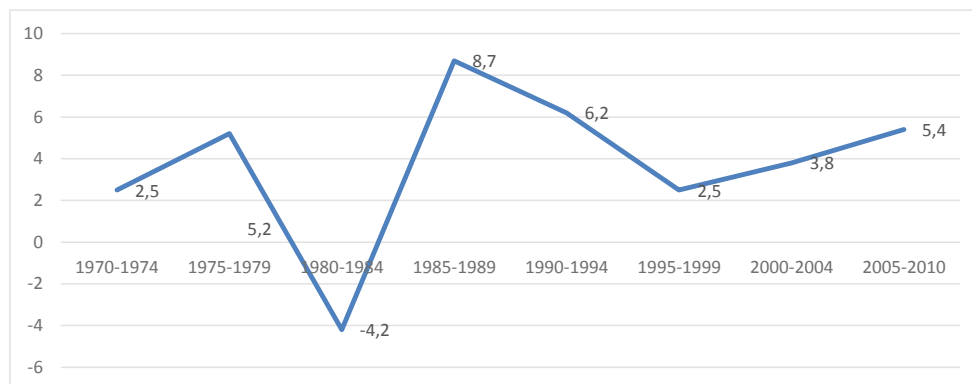
Just like the output trajectory and perhaps at the instances of it, the policy focus of PI has been characterised by momentous shifts. During the colonial era, PI revolved around the support of private sector leadership through the provision of financial assistance and infrastructure, such as electricity, 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). Accordingly, the Nigerian economy witnessed heavy investment of public funds by states and federal Governments in many industrial production enterprises[3], 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 % of the total investment in the economy over the four developmental plans periods in Nigeria. Also, 53 % 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. Figure 2 shows that PI contribution to GDP rose from 3.6 % between 1970 and 1974 through 14.9% during 1975-1979 to 20.5% during 1980- 1984. It declined sharply thereafter and stood at 9.0 % by 1990-1994 and fell drastically further to 4.2% from 2005 to 2010.

Figure 2: Public Investments contribution to Output in Nigeria (1970-2010)
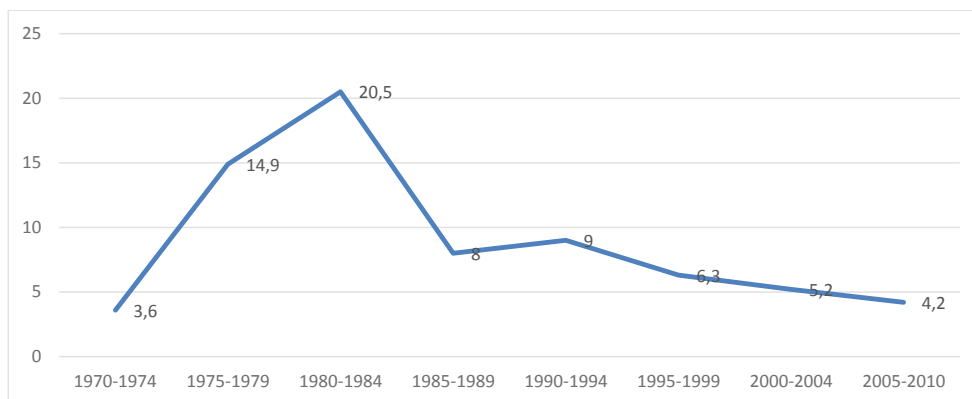
Source: Underlying data are from Central Bank of Nigeria's Statistical Bulletin and Annual Report and Statement of Accounts- various years

Review of Selected Previous Studies

Aschauer (1989) studied the effect of PI on private sector productivity from 1949-1985 in the United States and reported a strong and positive relationships. Munnell (1990) used estimates of gross state product and of private inputs of capital to develop estimates of public capital stocks for 48 states over the period 1970–86. She concluded that public capital has a positive impact on private output, investment, and employment. However, Munnell's estimates of the relative effects of PI were smaller than those made by Aschauer. Studies like Mas et al (1996), Otto and Voss (1994), and Wylie (1996) found the same relationship between PI and economic growth in 17 Spanish Region, Australia and Canada respectively

The study by Alexiou (2009) on the impact of PI on economic growth of South Eastern European (SEE) countries (Albania, Austria, Bosnia, Herzegovina, Greece, Macedonia, Montenegro, Croatia, Romania, Serbia, Hungary and Turkey) indicated 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 effects on economic growth. In contrast, the impact of population growth was statistically insignificant.

Ghani and Musleh-ud (2006) explored the role of PI in the process of economic growth for Pakistan between 1975 and 2005. They reported that growth was largely driven by private investment and the lack of strong inference on the effects of PI and public consumption on economic growth.

Fedderke, *et al.* (2006) examined the relationship between investment in economic infrastructure and long-run economic growth for South Africa. The main findings were that investment in infrastructure enhanced economic growth both directly and indirectly (by raising the marginal productivity of capital). However, there was weak evidence of feedback from output to infrastructure. They concluded that PI in infrastructure impact on growth was robust.

Nurudeen and Usman (2010) analysed government expenditure and economic growth in Nigeria during 1970 to 2008. The error correction model (ECM) was estimated. The reported findings revealed that government total capital expenditure; total recurrent expenditures and government expenditure on education had negative effects on economic growth. Contrarily, rising government expenditure on transport & communication and health positively impacted economic growth. They recommended that government should increase both capital expenditure and recurrent expenditure, 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 found positive and significant relationship between government investment and economic growth.

Khan (2011) used the macro-econometric approach to evaluate the effects of economic growth on PI in Pakistan. The results revealed that expansion in output and reserves has favourable impacts on PI. Based on these findings, he recommended that long term private/public investment policies of government be strengthened to enhance PI towards increasing employment opportunities and reduce poverty. He also recommended that the export sector be accorded more attention in term of quality, prices and marketing strategies for growth enhancement.

Khan and Musleh ud Din (2011) investigated the effects 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 error correction mechanism (ECM) to determine the speed of adjustment of the aggregate and sectoral outputs to equilibrium. The empirical results showed that capital expenditure on infrastructure positively impacted on the agricultural, manufacturing and services sectors.

Akanbi and Du Toit, (2011) used the Neo-classical business cycle model to analyse the effects of government expenditure and oil price shock on the non-oil sector in Nigeria. They compared results from the ordinary least squares (OLS) and instrumental variables (IV) estimation techniques. The results obtained generally showed that government expenditure had no meaningful impact on non-oil sector while oil price shock impacted positively on the sector.

The summary from the foregoing review of the literature is that the approach used in developing models and estimation techniques adopted in examining the effect of PI on output matter. In addition, exploring and understanding the specific channels through which public investment affect output in a particular country is important.

Analytical Framework and Methodology

Analytical Framework

This study adopted the Keynes Income-Expenditure approach. This approach suggests that the economy's equilibrium level of output or real GDP may not be consistent with the actual level of output. The basic tenet is that the real GDP equilibrium level corresponds to current aggregate expenditure level and 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:

$$AE = C + I + G \tag{1}$$

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

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

$$AE = C + I + G + (X - M) \tag{2}$$

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

From the perspective of Keynes, GDP is reasonably thought of as being determined by aggregate demand (AD). Aggregate demand is the sum of the expenditures

of each economic agent on goods and services. Hence, the components of aggregate demand are; household consumption expenditure (C), domestic investment (I), government purchases (G) and net export (X-M). This is expressed as:

$$AD = C + I + G + (X \times M) \tag{3}$$

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

$$AS = GDP \tag{4}$$

At equilibrium, aggregate supply is set to be equal to aggregate demand:

$$AS = AD \tag{5}$$

This implies that:

$$Y = C + I + G + NX \tag{6}$$

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 (6) is specified in its structural form using an eclectic approach[4] as follows.

Household Consumption

The standard life cycle household consumption model postulates that a representative household devise a consumption plan that maximizes utility over its lifetime, subject to an inter-temporal budget constraint. This is expressed below as:

$$C = f(\overset{+}{yd}, \overset{+}{ir}) \tag{10}$$

Where, yd is disposable income and ir is nominal interest rate.

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. This relationship is expressed below:

$$I = f(\overset{+}{Y}, \overset{+}{ir}) \tag{11}$$

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

Government Expenditure

In practice, G component is fixed because government has commitment to a set of public services (i.e. 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 model the basic effects of PI on economic output.

Real Export of Goods and Services

The export function adopted was based on the simple Heckscher-Ohlin and Samuelson (HOS) factor endowment model. This is the combination of the simple Stolper-Samuelson theorem of relative price[5] and Heckscher-Ohlin Quantity Version theorem[6]. 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 fluctuations are 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, fluctuations in oil price are expected to have a significant impact on the Nigerian economy. This is expressed functionally below:

$$X = f(\overset{+}{Yw}, \overset{-}{RPG}, \overset{+}{OP}) \qquad (12)$$

Where X is real exports of goods and services, Yw is real world income (in U.S$), RPG is relative price of goods and services (the ratio of domestic prices to U.S prices) and OP is World oil price.

Real Import of Goods and Services

The basic import function adopted 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 expected to have a 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 expected determinants of real imports in Nigeria are; national income, relative prices of goods and services, foreign reserves and exchange rate. This is specified thus:

$$M = f(\overset{+}{Y}, R\overset{+}{P}G, \overset{-}{ex}, \overset{+}{R}) \tag{13}$$

Where; M is real imports of goods and services, ex and R are real effective exchange rate and international reserves respectively. Others are as define earlier.

The equilibrium output can be derived by substituting expressions (10), (11), (12), (13) and exogenous government expenditure (g_o) into (6).

Thus:

$$Y = C(Y^d, ir) + I(Y, ir) + g_o + NX(Y_w, Y, rpg, op, ex, r) \tag{14}$$

Behaviourally, the components can further be decomposed into;

$$C = a_0 + a_1 Y^d + a_2 ir \tag{15}$$

$$I = b_0 + b_1 Y + b_2 ir \tag{16}$$

$$G = g_0 \tag{17}$$

$$NX = e_1 Y_w + e_2 Y + e_3 rpg + e_4 op + e_5 xr + e_6 r \tag{18}$$

Where a_0 and b_0 are autonomous consumption and investment respectively.

Putting equations (15), (16), (17) and (18) into (6) yields the equilibrium output expressed below:

$$Y = a_0 + a_1 Y^d + a_2 ir + b_0 + b_1 Y + b_2 ir + g_o + e_1 Y_w + e_2 Y + e_3 rpg + e_4 op + e_5 xr + e_6 r \tag{19}$$

Therefore:

$$Y = \gamma_0 + \gamma_1 Y^d + \gamma_2 ir + \gamma_3 Y + \gamma_4 ir + \gamma_5 g_o + \gamma_6 Y_w + \gamma_7 Y + \gamma_8 rpg + \gamma_9 op + \gamma_{10} xr + \gamma_{11} r \tag{20}$$

$$Y^d = (Y - T) \tag{21}$$

Substituting equation (21) into equation (20) and solving for Y gives us:

$$y = \phi_0 + \phi_1 T + \phi_2 ir + \phi_3 g_o + \phi_4 Y_w + \phi_5 rpg + \phi_6 op + \phi_7 xr + \phi_8 r + \phi_9 \pi + \varpi \tag{22}$$

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:

$$M = f(ir, y, \pi) \tag{23}$$

Where M is nominal money balances and π is expected inflation[7] which has major impact on total money balance in the economy.

Behaviourally, the money market equation (23) is expressed as:

$$m = b_0 + b_1 i + b_2 y + b_3 \pi \tag{24}$$

Simplifying π from equation (24) yields;

$$\pi = \frac{1}{b_3} (m - b_0 - b_1 i - b_2 y) \tag{25}$$

Substituting equation (25) into equation (22) and solving for y gives;

$$y = \frac{\phi_0 + \phi_1 T + \psi_2 ir + \phi_3 g_o + \phi_4 Y_w + \phi_5 rpg + \phi_6 op + \phi_7 xr + \phi_8 r + \vartheta_9 m + \varpi}{1 - \vartheta_2} \tag{26}$$

Thus, the equilibrium output can be expressed as;

$$y = \theta_0 + \theta_1 T + \theta_2 ir + \theta_3 g_o + \theta_4 Y_w + \theta_5 rpg + \theta_6 op + \theta_7 xr + \theta_8 r + \theta_9 m + \varpi \tag{27}$$

The Fundamental Reasoning of the Macroeconomic Model

The channels through which government capital expenditure (public investment) influence output, investment, export, consumption and import in the model is discussed in this sub-section. We focus explicitly on the impact of PI on the determinants of the key endogenous variables in the model. For instance, increase in public investment leads to increase in aggregate output (Y) in equation (34). This increase in aggregate output leads to increase in domestic investment as in equation (29) via the accelerator coefficients. Also increase in oil export in equation (31) suggests an improvement in the trade balance (NX).

Furthermore, an increase in government spending (public investment) increases consumption in equation (28) through increase in aggregate output which causes changes in marginal propensity to consume (MPC). Higher MPC implies more expansion of demand with likely significant effect on domestic investment thereby leading to increase 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 in equation (32) through changes in aggregate output via the import multiplier. Higher import multiplier implies more leakages of resources from the economy and this worsen trade balance. Within this model, an alternative route for explaining output effect of changes in PI 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. Therefore, market clearing may be achieved through fiscal policies adjustment (i.e. changes in government spending). Figure 3 presents a schematic representation.

Figure 3: Schematic Representation of the Macroeconomic Model

Source: Authors

Methodological Approach and Model Specification

Based on the foregoing Keynes Income-Expenditure and Aggregate Supply-Demand framework, a macro-econometric model was developed relating sectoral and aggregate outputs in the economy to PI. Basically, government expenditure is separated into current and capital expenditure. Current expenditure mostly comprises of wages and salaries which are related to private consumption, while capital expenditures are mostly regarded as PI. These expenditures (current and capital) are related to government total revenue which is the monetary value of the gross domestic prod-

uct. In a situation where government expenditure is higher than its revenue (budget deficit), government finances its expenses through an increase in the money supply, a decrease in foreign exchange reserves, an increase in the amount borrowed from the private sector, or an increase in the 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 only is considered.

The aggregate supply block is the real output produced in the economy by adding up the outputs from all sectors of the economy (equation 34). The aggregate demand block comprises of household consumption equation (28), domestic investment equation (29), real export equation (30) and real import equation (31). Each block captures specific equations whose formulations are guided by economic theory and the specific objectives of the study. The lag values of the dependent variables is included in the equations[8] and for ease of appreciation all the estimable equations from the two blocks are presented in log form below:

$$\ln C_t = a_0 + a_1 \ln yd_t + a_2 ir_t + a_3 \ln C_{t-1} + \psi_t \tag{28}$$
$$a_1, a_2, a_3 > 0$$

$$\ln I_t = b_0 + b_1 \ln AGGTY_t + b_2 ir_t + b_3 \ln I_{t-1} + \mathbb{Z}_t \tag{29}$$
$$b_1, b_3 > 0 \text{ and } b_2 < 0$$

$$\ln G_t = \bar{G} \tag{30}$$

$$\ln X_t = q_0 + q_1 \ln Yw_t + q_2 \ln RPG_t + q_3 \ln OP_t + q_4 \ln X_{t-1} + \Re_t \tag{31}$$
$$q_1, q_3, q_4 > 0 \text{ and } q_2 < 0$$

$$\ln M_t = d_0 + d_1 \ln Y_t + d_2 \ln RPG_t + d_3 xr_t + d_4 \ln R_t + d_5 \ln M_{t-1} + \hbar_t \tag{32}$$
$$d_1, d_2, d_4, d_5 > 0 \text{ and } d_3 < 0$$

$$\ln m_t = i_0 + i_1 \ln y_t + i_2 ir_t + i_3 \pi_t + i_4 \ln m_{t-1} + \Im_t \tag{33}$$
$$i_1, i_4 > 0 \text{ and } i_2, i_3 </ > 0$$

$$\ln y_t = \theta_0 + \theta_1 \ln T_t + \theta_2 ir_t + \theta_3 \ln g_o + \theta_4 \ln Y_{wt} + \theta_5 \ln rpg_t +$$
$$+ \theta_6 \ln op_t + \theta_7 xr_t + \theta_8 \ln R_t + \theta_9 \ln m_t + \varpi_t \tag{34}$$
$$\theta_2 < 0, \theta_3, \theta_4, \theta_6, \theta_8 > 0, \theta_1, \theta_5, \theta_7, \theta_9 </ > 0$$

Identities

$$AD = C + I + G + NX \tag{35}$$

$$GDP = C + I + G + NX \tag{36}$$

$$AS = AD \tag{37}$$

The model has five (5) behavioural equations, one (1) linking equation and three (3) identities. There are 18 variables in the model, of which 13 are exogenous and the remaining 5 are endogenous. The model was subjected to the order of condition of identification[9] and the results showed that the model was over identified.

List and Definitions of Variables and Parameters

Endogenous Variables

HC   = Household consumption expenditure (₦ million)
I   = Domestic Investment (₦ million)
X   = Real exports of goods and services value (₦ million)
M   = Real import of goods and services value (₦ million)
Y   = Aggregate income (₦ million)

Exogenous Variable
PLR   = prime lending rate
RPG   = relative price of goods and services (the ratio of domestic prices to U.S prices)
R   = International Reserves
yd   = Disposable Income (₦ million)
GCON   = Government Consumption (₦ million)
ir   = Real interest rate
Yw   = real world (U.S) income
xr   = real effective exchange rate
OP   = Oil Price ($)
g_o = government expenditure (public investment) (₦ million)
m^8 = real money supply
T   = Government tax revenue (₦ million)
CIT   = Company Income Tax (₦ million)

Estimation Technique and Procedures

Simultaneous equation system was adopted for this study. This is because the AD and AS blocks comprised of simultaneous equations of which some of the regressors are correlated with the error terms of the equation they appeared 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. The 2SLS which is an equation by equation technique produces a consistent estimate if the predetermined variables included in the equation to be estimated 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 was 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 were conducted on the results obtained from the 2SLS and 3SLS estimators to validate the robustness of the estimates and their goodness of fit.

Data Sources

This study made use of macroeconomic time series for the period 1970-2010. The data were obtained from IFS CD-ROM, Penn World Table and Central Bank of Nigeria Statistical Bulletin and Annual report and statement of Account (various issues). The variables of interest include; total public investment, household consumption expenditure, real export of goods and services, real import of goods and services and gross domestic product.

Empirical Results

In line with the earlier enunciated estimation technique and procedure, results from both the 2SLS and 3SLS are jointly presented. Where applicable, the 3SLS results are considered superior and therefore our discussions of the results are focused on this. Table 2 showed the results obtained from the different models estimated. Starting with the household consumption model, the effects of current disposable income, interest rate and previous year consumption were positive and significant. Specifically, with respect to the disposable income, the marginal propensity to consume is 0.68. This implies that on the average 68k is spent on consumption out of every ₦1 income earned. The three variables considered in the investment model as expected exerted significant impacts. While the impacts of both real output and previous investment were positive, that of interest rate was negative. The result in respect of real output validated the accelerator principle, which posits a direct relationship between the rate of output of an economy and the level of investment in capital goods. In this case, the accelerator coefficient is 0.49, suggesting that the level of investment in capital

goods increased by 4.9% for every 10% increase in the level of output. The significant negative relationship of interest rate to investment underscores the fact that the Nigerian economy is characterised by low income earnings which dampen savings in the country and consequently the amount of funds available for investment is often low and interest rate high. This high interest in turn discourages investment.

Table 2: 2SLS and 3SLS Regression Results

Model/Regressors	Coefficient estimates from two techniques	
	2SLS	3SLS
Consumption equation		
Constant	-0.644 (-1.341)	-0.667 (-1.471)
Lnryd	0.669 (3.296)***	0.678 (3.552)***
Rir	0.031 (1.837)***	0.032 (2.064)**
Lnrhc(-1)	0.562 (4.225)***	0.554 (4.406)***
Investment equation		
Constant	-4.504 (-2.871)***	-4.510(-3.035)***
Lnrgdp	0.487 (3.068)***	0.489 (3.243)***
Rir	-0.020 (-1.910)*	-0.020 (-2.019)**
Lnrdi(-1)	0.930 (34.292)***	0.930 (36.198)***
Export equation		
Constant	-16.574 (-0.494)	-18.205 (-0.582)
lnY_w	0.800 (0.717)	0.848 (0.815)
Lnrpg	0.632 (2.058)**	0.600 (2.098)**
Lnop	0.068 (0.475)	0.048 (0.361)
Lnexport(-1)	0.485 (3.076)***	0.503 (3.429)***
Import equation		
Constant	-0.413 (-0.183)	-0.641 (-0.311)
Lnrgdp	0.822 (2.854)***	0.845 (3.198)***
Lnrpg	0.863 (4.269)***	0.866 (4.660)***
Lnxr	-0.006 (-2.537)***	-0.006 (-2.840)***
lnR	0.014 (0.176)	0.011 (0.143)
Lnimport(-1)	0.415 (3.556)***	0.417 (3.891)***
Real output equation		
Constant	44.105 (2.276)**	
lnT	0.128 (1.843)*	
Rir	-0.032 (-2.728)***	
lng_o	0.206 (2.438)**	
lnY_w	1.345 (2.067)**	
Lnrpg	-0.349 (-2.264)**	
Lnop	-0.102 (-0.966)	
Xr	-0.114 (-1.799)*	
lnR	0.208 (3.872)***	
lnM^s	0.420 (2.357)**	
Lnrgdp(-1)	0.041 (0.239)	

***, ** and * denote significance at 1%, 5% and 10%, respectively.

*Figures in parenthesis are t-statistics*

Exports were significantly explained by the relative price of goods and services and previous value of exports. The implication of this result is that depreciation of the naira made exports relatively cheaper thereby impacting positively on real export value in the country. The level of total output, the relative price of goods and services, real exchange rate and previous imports were significant in explaining the imports profile. However, real exchange rate had a negative impact.

Total output in the economy was significantly explained by public investment, income (taxation), interest rate, world income, relative prices of goods and services, real exchange rate, international reserves, money supply and the previous level of output. The PI impact was positive and significant. Specifically, a 10% increase in PI resulted to 2.1% increase in aggregate real output. This result suggests that PI reflected an expansionary fiscal policy and spurred output growth as suggested by theories. The significant negative impact of real interest rate confirms the theoretical postulation of an inverse relationship between output growth and interest rate. Likewise, the positive and significant impact of money supply supports the Keynesian Liquidity preference theory that interest rate is purely a monetary phenomenon.

Validation of the Macroeconometric Model

Traditionally, the forecasting ability of a macro-econometric model is done using historical simulation approach. The standard procedure was adopted in this study. This entails visual inspection of the chart of both actual and simulated values of the independent variables in the behavioural equations. The graphical representation presented in figure 4 indicates that the actual and simulated series are close and the turning points of the actual series were well tracked by the simulated values.

Figure 4: Actual and Simulated Values of Some Endogenous Variables in Aggregate Demand Block
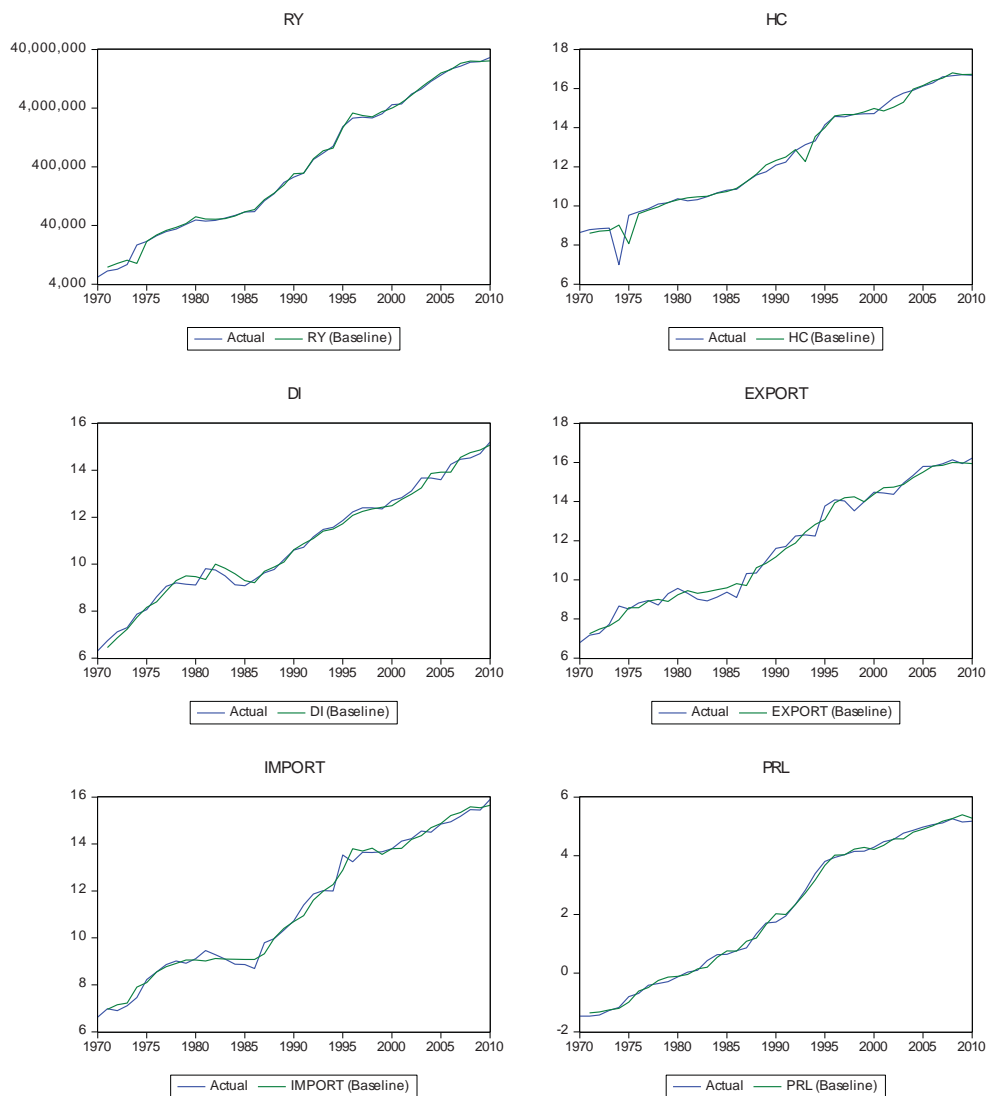
Conclusion

This study in broader perspective examined the impact of PI on output performance in Nigeria for the period 1970-2010. Specifically, the study analysed the impacts of PI on aggregate output and identified the channels of the impacts. The study was pri-

marily motivated by the fact that previous studies focused on supply side effects of PI on output; with less emphasis on demand side effect which, constitutes the indirect impact of PI on output. The study was anchored on the Keynes Income-Expenditure theoretical framework while the methodological approach involved developing a small macro-econometric system equation model. The 2SLS and 3SLS estimation techniques were explored and compared.

The results revealed that total PI exert considerable influence on aggregate output. This is consistent with supply-side driven and highly aggregated studies that dominated the empirical literature. The results also revealed the direct and indirect channels through which public investment affected aggregate output. The direct channel is through the government capital expenditure multiplier (0.21) while the indirect channels are through the import multiplier (0.85), accelerator coefficient (0.49) and marginal propensity to consume (0.68). 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. The less significant impact of the direct channel (i.e. government capital multiplier) is attributable to the observed declining trend in capital expenditure, poor implementation and low quality of public investment projects due to widespread corruption in the public sector. The policy implications of these results are therefore: (i) PI needs to be increased in key sectors (namely agriculture, manufacturing, services, wholesale and retailing and crude petroleum) that have greater potentials to impact positively on aggregate output performance; and (ii) the need for improvement in the implementation and quality of government capital spending.

REFERENCES

Akanbi, O. A. and. Du Toit, C. B. 2011. Macro-econometric Modelling for the Nigerian Economy: A growth–poverty gap analysis. *Economic Modelling,* Vol. 28, pp. 335–350.

Akpan N.I. 2005. Government Expenditure and Economic Growth in Nigeria: A Disaggregated Approach. CBN *Economic and Financial Review*, Vol. 43, no.1, pp. 51-69.

Aladejare, S. A. 2013. Government spending and economic growth: Evidence from Nigeria *MPRA Paper, n*o.43916.

Alexiou, C. 2009. Government Spending and Economic Growth: Econometric Evidence from the South Eastern Europe (SEE). *Journal of Economic and Social Research,* Vol.11, No.1, pp. 1-16.

Aschauer, D.A. 1989. Does public capital crowd out private capital? *Journal of Monetary Economics,* Vol. 24, No.2**,** pp.171-188.

Central Bank of Nigeria (CBN). *Annual Report and Statement of Account,* December, 2010.

Fair, R. C. 1971. A comparison of alternative estimators of macroeconomic models. Econometric Research programme, *Research Memorandum,* No: 121.

Fedderke, J.W., Perkins, P. and Luiz, J.M. 2006. Infrastructure investment in Long-run Economic Growth: South Africa 1875-2001. *World Development,* Vol. 34, No.6, pp. 1037-1059.

Ghani, E. and Musleh-Ud Din, 2006. The Impact of Public Investment in Pakistan, *The Pakistan Development Review,* Pakistan Institute of Development Economics, Vol. 45, No.1, pp.87-98.

Gujarati, D.N. 2004. *Basic econometrics,* Fourth Edition, New York: McGraw-Hill Inc.

Hemphill, W.L. 1974. The effects of foreign exchange receipts on imports of less developed countries. *IMF Staff Papers*, No.21, pp. 637–677

Khan, A. 2011. Inter-linkages of Public Investment and Economic Growth in Pakistan: An Econometric Analysis. *Academic Research International,* Vol. 1, No.1, pp.15-19.

Khan, M. A. and Musleh ud Din 2011. A Dynamic Macroeconometric Model of Pakistan's Economy. *PIDE Working Papers,* No: 69.

Mas, M., Maudos J., Perez, F. and Uriel, E. 1996. Infrastructures and productivity in the Spanish Regions. *Regional Studies*, Vol.30, No.7, pp. 641-650.

Munnel, A.H. 1992. Policy watch: infrastructure investment and economic growth. *The Journal of Economic perspectives,* Vol. 6, No.4, pp.189-198.

Nurudeen, A. and Usman, A. 2010. Government Expenditure and Economic Growth in Nigeria, 1970-2008: A Disaggregated Analysis. *Business and Economics Journal,* Vol. 2010: BEJ-4.

Obadan, M.I. 1992. Striking objectives balance between the public and private sectors in the management of the Nigerian economy. A paper presented at the Maryland Finance Company and Consultancy Services, Lagos.

Ojo, M.O. 1992. Monetary Policy in Nigeria in the 1980s and prospects in the 1990s. CBN *Economic and Financial Review*, Vol. 30, No. 1, pp.1-18.

Otto, G. and Voss, G. 1994. Public capital and private sector productivity. *The Economic Record*, Vol. 70, No. 209, pp. 121-132.

Owosekun, A.A. 1991. Macro-economic issues and case studies of public enterprises. In: Public Enterprise in Nigeria. Paper presented at *Nigerian Economic Society Annual Conference Proceedings*. pp. 1-15.

Sola, O. 2008. Public Investment and Economic Growth in Nigeria: An Autoregressive Model. *Journal of International Finance and Economics*, Vol. 8, issue 2, pp.51-63.

Wylie, P. 1996. Infrastructure and Canadian economic growth: 1946–1991. *The Canadian Journal of Economics,* Vol. 29, Special Issue, Part 1, pp. S350–S355.

NOTES

[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.

[3] See, Owosekun 1991

[4] The nature of the Nigerian economy could impose strict restriction making it impossible to rely on a particular theory or single model. However, experience has shown that combination of different models in forecasts series could outperform those with single approach.

[5] 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

[6] 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 export the good that makes relatively intensive use of its relatively abundant factor (in the quantity sense).

[7] 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 the effect of these policies

[8] The lag value of the regressand is included in all the models in order to correct for possibility of first order serial correlation (Fair, 1971).

[9] 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).