THE IMPACT OF PUBLIC CAPITAL SPENDING ON PRIVATE INVESTMENT IN NIGERIA

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ABSTRACT
This study investigates the effects of public capital spending (PCS) on private investment (PINVT) in Nigeria. However, some previous studies have provided empirical evidence for the complementarity relationship between public capital spending and private investment while other studies have provided evidence for their substitutability. The study attempts to address the issue of complementarity and substitutability of public capital spending and private investment in a country a specific analysis. It employs ordinary least squares method of analysis; however, stationarity was not assumed in this case, as unit root test was carried out to determine the order of integration of the variables employed. Results suggest that contemporaneous PCS is negatively related to PINVT while the lagged PCS is positively related to it. In fact, for every 1 per cent increase in lagged PCS, PINVT increased by approximately 0.79 per cent. This implies that over time public capital spending (PCS) has a complementarity effect on private investment (PINVT). This substantiates the importance of PCS in building a good macroeconomic environment for the take-off of privatisation and also as an engine of growth of private investment and ultimately gross investment for the purpose of economic growth and development.

KEYWORDS: Public Capital Spending, Private Investment, Substitutability, Complementarity, Stationarity

1. INTRODUCTION
Considerable attention has been given to the issue of whether public investment crowds out or crowds in private investment in economic literature. Empirical studies have been carried out to determine the long run relationship between public and private investment with focus on developed countries and very little attention on the developing ones. A faction opined, with robust evidences that the importance of public capital spending (PCS) in economic development cannot be overemphasised; as it is complementary to private investment by improving the productivity of the private capital (Blejer and Khan, 1984; Aschauer, 1989; Greene and Villanueva, 1991, Karras, 1994; Erenburg and Wohar, 1995; Monadjemi and Huh, 1998; Pereira, 2000; Canaleta et al, 2002; Pereira and Andraz, 2003).
Another faction examined the empirical implications of public capital spending on private investment and concluded that PCS leads to higher interest rates and crowds out private investment (Barro, 1974; Kormendi, 1983; Balassa, 1988; Nazmi and Ramirez, 1997; Voss, 2002; Andolfatto, 2005). Hence, the relationship between public investment, private investment and economic growth is an on-going discussion in economic growth and development; as well as, in the making of public policy. Aschauer (1985, 1988) and Lynde and Richmand (1992) examined the role of public capital spending in explaining the rate of the return on private investment and consequently on total factor productivity in the United States’ non-financial corporate sector. They established that private investment can be enhanced by increasing public capital spending, as PCS has positive marginal product.

According to the first group, public capital spending and private investment have complementarity relationship while the other group opined that both investments relate as substitutes. Karras (1994) drew a thin line between the substitutability and complementarity nature of private investment and public capital spending by establishing that both depend on the size of the government. He opined that as the size of the government sector expands, the relationship between private and public investment changes from being complimentary to being substitutive. However, According to the Ricardian Equivalence Hypothesis, whether deficit is raised by borrowing or through tax the effect on the total level of demand in the economy is the same. This study attempts to explore the relationship between public capital spending and private investment in Nigeria and discuss whether public and private investments are complements or substitutes. The distinguishing features of the present study from the previous research in this area are: (1) examine the link between public capital spending and private investment for a country specific developing country rather than developed countries, (2) the use of the more robust tests of unit roots to check the dynamic properties of the time series, and (3) the empirical model is based on the marginal efficiency theory as well as neoclassical theory of investment.

The next section of this paper is structured to examine the theoretical underpinnings of the relationship between public capital spending and private investment and also review past literature, while Section 3 is on the research method and analysis of the macroeconomic determinants of PCS in Nigeria. Section 4 discusses the result and Section 5 contains the summary and conclusion of the study.
2. Literature Review and Theoretical Framework

The studies by (Aschauer, 1985; 1988; Lynde and Richmand, 1992) looked into how public capital explains the total factor productivity and consequently, private capital in the United States’ non-financial corporate sector. It was discovered that public capital has positive marginal product and that private investment can be improved by increasing public investment. Also, corroborated by (Lynde and Richmand, 1992), public and private capitals are complements rather than substitutes. The categories of public capital spending such as expenditure on research, roads and transports, water and power projects, education and health may enhance private sector’s productivity and ultimately, the growth and development of an economy.

The developing nations are after rapid economic development which requires huge expenditure in the various sectors of the economy and this, the private sector is either unable to supply because of the huge amounts involved or is unwilling to invest such amounts because of the uncertainty or delay associated to the return from these investments. Hence, economic development has to depend almost entirely on public capital spending. Therefore, public spending plays a vital role in economic development of any economy and this leads us to the study of the impact of public capital spending on private investment; hence, review of the following papers on it.

Aschauer (1989) opined the possibility that public investment may spur private investment, focusing on increases in the productivity of private capital resulting from the accumulation of public capital through public investment using a highly neoclassical theory, not Keynesian theory. In fact, in addition to a private investment function which included public investment and the profit of private capital, the model also contained a profit function for private capital, which included public capital as a right-hand side variable based on a production function. The study employed a simple model of simultaneous equations and without resorting to the traditional argument that emphasizes the importance of aggregate demand management, Aschauer posited the likelihood that an active fiscal policy may have a crowding-in effect through the productivity effect of public capital (investment). In Aschauer’s model, public investment affects private investment largely in two different ways. One is the negative effect of public investment that appears in the private investment function, and this effect is the crowding-out effect (substitutability). The other is the positive effect that appears in the profit function through the productivity effect of public capital, which is called the crowding-in effect (complementarity). Aschauer’s results suggested that
the crowding-in effect is more pronounced than the crowding-out effect in the United States. Also, (Argimón et al, 1997) came up with similar conclusions in a study which adopted panel data for 14 countries; so also in a study on Japan by (Mitsui, et al, 1995). Several empirical studies have confirmed the productivity effect and the likelihood that public capital spending has a complementarity effect on private investment.

In contrast to these results, (Bairam and Ward, 1993) worked on data for 25 countries, Japan inclusive, and observed a substitutability effect of public capital spending on private investment. (Monadjemi, 1993) analysed data on Australia and the United States, and (Kitaoka, 2002), on Japan. All their results suggested that the crowding-out effect of public capital spending was predominant based on their estimation of a reduced-form private investment function. More specifically, their functions which have private investment as the dependent variable and public investment as one of the independent variables showed coefficients of public capital spending estimated to be significantly negative, revealing a substitutability effect.

The study carried out by (Rossiter, 2002) in USA to explore the relationship between the public and private investment also established empirically a crowding out effect. This is contrary to the result of (Aschauer, 1985; 1988; Lynde and Richmand, 1992) on the same study for the same country. However, these results make it clearer that research on this particular study is inconclusive. The work of (Rashid, 2005) on Pakistan revealed the two kinds of investments to be both complements and substitutes. Buiter (1977) and Munnell (1992) confirmed in their different studies that public capital spending complements private investment when public capital spending is provided to improve infrastructure. These results are corroborated by (Kollamparambil and Nicolaou, 2001) who made use of quarterly data from 1960 to 2005 to explore the relationship between private and public investment in South Africa. The inconclusiveness of these various studies, make a country specific study of great importance, so that the peculiarity of each country can be readily attended to.

2.1 Theoretical Framework
The accelerator theory is perhaps the simplest of investment theories and perhaps surprisingly, the most empirically successful! The modern form of the theory was put forward by Clark in 1917; the original principle is traceable to the works of Aftalion in 1911. In the context of growth, the accelerator principle suggests that increases in output lead to increases in investment; this principle relates investment to GDP. It follows from the fact that the
demand for machinery and factories is a derived one. Thus, if the demand for the goods that capital equipment produces rises and the existing industrial capacity cannot meet this demand, if production were to be increased, then, new plant and equipment would be required. While new capital is being built and installed, investment expenditure has taken place. If the desired stock of capital good increases, there will be an investment boom which will translate to increased GDP in that economy. This makes investment depend on changes in final demand, and hence changes in GDP. In the extreme, the idea that investment responds immediately and entirely to changing demand conditions implies a relation in the following form:

\[ I_t = K_t - K_{t-1} = \alpha (Y_t - Y_{t-1}) \]  

(2.1)

Where

- \( I_t \) = investment
- \( K_t \) = capital stock at time \( t \)
- \( K_{t-1} \) = capital stock at time \( t-1 \)
- \( \alpha \) = accelerator co-efficient
- \( Y_t \) = aggregate demand (GDP)

Equation 1-9-1 can thus be rewritten as:

\[ I = \Delta K = \Delta Y \]  

(2.2)

Hence, the investment function can be written as:

\[ I = \beta (\Delta GDP) \]  

(2.3)

The explanatory variables in this study are public capital spending (PCS), Real Gross Domestic Product (RGDP), trade openness (TROPEN) and bank credit (BCREDIT)

3. Model Specification

This empirical study analysed the relationship between private and public investments in a single structural equation framework, not assuming implicitly or explicitly stationarity of variables. Hence, the need for unit root test.

Drawing from equation (2.3), we hereby specify our model with the outlined explanatory variables. Therefore, we have the implicit form of the model specified below.

\[ PIVT = f (RGDP, PCS, TROPEN, BCREDIT, u_t) \]  

(3.1)

Where

- \( PINVT \) = Private investment (Gross fixed capital formation minus PCS)
- \( RGDP \) = Real Gross Domestic Product (Deflated Gross Domestic Product)
- \( PCS \) = Public capital spending (Public expenditure minus recurrent expenditure)
- \( TROPEN \) = Trade openness (Import plus export divided by GDP)
- \( BCREDIT \) = Bank credit
Econometric representation of equation (3.1):
\[ PINVT = \beta_0 + \beta_1 \text{RGDP} + \beta_2 \text{BPCS} + \beta_3 \text{TROPEN} + \beta_4 \text{BCREDIT} + u \]  

Equation (3.2) is the model of estimation for the determination of the relationship that exist between private investment and public capital spending and for any valuable regression analysis, it is crucial to identify the order of integration of all time series variables, so that the variables can be transformed into stationary series, in case of non-stationarity to avoid spuriousness of results. All variables are real values and are in Nigeria’s local currency, as is necessitated by the theory of estimation.

Two methods of analysis were employed in this study; the descriptive statistics and econometric analyses. The descriptive statistics analysis was used in achieving the first objective of examining the profile of private investment and public capital spending in Nigeria while the objective of analysing the the relationship between private investment and public capital spending in Nigeria was achieved using ordinary least squares econometric technique.

3.1 Unit Root Tests

A non-stationary series which can be transformed into a stationary series by differencing ‘n’ times is said to be integrated of order ‘n’. A stationary series is integrated of order I(0), while non-stationary series could be of order I(1) or I(2) and needs to be differenced once or twice respectively. The Dickey Fuller (DF) and Augmented Dickey-Fuller (ADF) unit root tests were used to determine the order of integration of each series. The DF test was based on equation (3.4) below. Under the null hypothesis of unit root, the coefficient of \( Y_{t-1} \) will not be statistically different from zero i.e. \( \beta = 0 \). If there is no unit root, the series \( Y_t \) is said to be stationary in levels or integrated of order zero [denoted as I(0)]. A differenced stationary series is said to be integrated of order ‘n’ represented as I(n). The order of integration is the number of unit roots contained in the series, or the number of differencing operations it takes to make the series stationary. If there is a unit root, but differencing the series once is sufficient to make it stationary, then it is said to be integrated of order one i.e. I(1). On the other hand if the process is not AR(1), then additional differencing will be required.

\[ \Delta Y_t = b + \alpha t + \beta Y_{t-1} + u_t \]  

In addition to testing for the unit root, equation (3.4) will establish if there is a deterministic trend (\( \alpha \neq 0 \)) and/or a drift (\( b \neq 0 \)). The error term (\( u_t \)) should be white noise. If
Y_t, is a first order autoregressive process [AR(1), the single lagged value of the variable with deference terms will be added to equation (3.4) to make (u_t) a white noise, hence the ADF test which is based on equation (3.5) below:

\[ \Delta Y_t = b + \alpha t + \beta Y_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta Y_{t-1} + u_t \] .......................... (3.5)

The null hypothesis of non-stationarity is rejected if the t-statistic is less than the critical t-value i.e., if estimated \( \beta \) is significantly negative (Gujarati, 2004).

3.2 Sources of Data

This study employed annual time series data for the period of 1970-2006 due to data limitation and these series data were sourced via:


iii. Penn World Table (2008)

Some of the data employed were derived by calculation—using the sourced time-series data and it is necessary to remark that the data on Real Gross Domestic Product from the CBN statistical Bulletin of 2008 made use of 1962/63 constant basic prices for the period of 1960-1973; 1977/78 constant basic prices for 1974-1980 and 1990 constant basic prices for 1981-2008.

4.0 Empirical Estimation and Analysis

4.1 Profile of Private Investment and Public Capital Spending (PCS) in Nigeria

![Real Private Investment (PINVT)](source)

**FIG. 4.1** Real Private Investment (PINVT)

**SOURCE:** Calculated by the Author from Central Bank of Nigeria Statistical Bulletin, 2008 and World Development Indicators, 2007
From Figures 4.1 and 4.2 above, public capital spending showed an upward movement from 1971 to 1975 with the values of N445.1m and N5012m respectively; this could be as a result of the oil boom of 1970. However, private investment also increased from 1971 to 1973 N4535.4m to N5191.2m and fell to N4033.3m in 1975. This movement in private investment between 1971-1973 could also have been as a result of the oil boom; although, the increase faded away sharply and private investment was at an all time low with its value being N379.3m in 1980. At this point public capital spending was at its highest of N7418.5m which suggests a substitutability relationship all things being equal. However, both private investment and public capital spending took a low turn till 1984, this may be due to low economic activities generally, as Structural Adjustment Programme (SAP) was adopted in 1986 by the Babangida government in 1985 because of the depressed oil prices. Gradually, both PCS and PINVT began to rise again with PINVT gaining higher momentum and got to a value of N8150.3m in 1993 and N10161.5m in 2003. Although, they were both moving in tandem, PCS did not get to a second peak until 1999 with N5418.1m worth of spending and has been on a declining trend thereafter. This downward movement could be said to reflect a reduced commitment of government to capital projects. By 2005 PINVT had increased to N10553.2m. Literature has it that when spending is on infrastructure, it enhances the growth of the private sector (Seruvatu and Jayaraman, 2001). Hence, the growth in private investment from 2000 could suggest an inducement by PCS. In conclusion, the profile of PINVT and PCS shows substitutability relationship at the early stage and complementarity relationship over time. This descriptive analysis corroborated the studies by (Aschauer, 1989; Karras, 1994; Monadjemi and Huh, 1998; Pereira, 2000; Canaleta et al, 2002; Pereira and Andraz, 2003).
4.2 Unit Root Tests Results

According to Sub-section (3.3.1) of chapter three, an attempt was made to test for the order of integration of the variables to characterise their time series property. In achieving this, the DF and ADF test were employed. The test took into consideration the null hypotheses of the presence of a unit root both in a random walk with a drift and a random walk with a drift and a trend term. The results of the unit root tests are reported in Tables 4.1.2 and 4.1.3 below.

<table>
<thead>
<tr>
<th>SERIES</th>
<th>UNTRENDED</th>
<th>TRENDED</th>
<th>SERIES</th>
<th>UNTRENDED</th>
<th>TRENDED</th>
<th>REMARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>PINVT</td>
<td>-1.452103</td>
<td>-2.054434</td>
<td>ΔPINVT</td>
<td>-6.740787</td>
<td>-6.808422</td>
<td>I(1)</td>
</tr>
<tr>
<td>PCS</td>
<td>-3.268731</td>
<td>-3.283884</td>
<td>ΔPCS</td>
<td>-8.305925</td>
<td>-8.336213</td>
<td>I(1)</td>
</tr>
<tr>
<td>RGDP</td>
<td>1.024508</td>
<td>-1.251446</td>
<td>ΔRGDP</td>
<td>-5.321982</td>
<td>-5.530225</td>
<td>I(1)</td>
</tr>
<tr>
<td>BCREDIT</td>
<td>-2.185450</td>
<td>-2.056538</td>
<td>ΔBCREDIT</td>
<td>-6.647541</td>
<td>-6.659353</td>
<td>I(1)</td>
</tr>
<tr>
<td>TROPEN</td>
<td>-2.464808</td>
<td>-2.469928</td>
<td>ΔTROPEN</td>
<td>-5.960541</td>
<td>-5.855019</td>
<td>I(1)</td>
</tr>
</tbody>
</table>

5% CRITICAL VALUES
| PINVT  | -2.9446  | -3.5386  | ΔPINVT | -2.9472  | -3.5426  |
| PCS    |          |          | ΔPCS   |          |          |
| RGDP   |          |          | ΔRGDP  |          |          |
| BCREDIT|          |          | ΔBCREDIT|          |          |
| TROPEN |          |          | ΔTROPEN|          |          |

<table>
<thead>
<tr>
<th>SERIES</th>
<th>UNTRENDED</th>
<th>TRENDED</th>
<th>SERIES</th>
<th>UNTRENDED</th>
<th>TRENDED</th>
<th>REMARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>PINVT</td>
<td>-1.080160</td>
<td>-1.797663</td>
<td>ΔPINVT</td>
<td>-4.079498</td>
<td>-4.204565</td>
<td>I(1)</td>
</tr>
<tr>
<td>PCS</td>
<td>-2.684414</td>
<td>-2.816969</td>
<td>ΔPCS</td>
<td>-4.361965</td>
<td>-4.394792</td>
<td>I(1)</td>
</tr>
<tr>
<td>RGDP</td>
<td>0.809493</td>
<td>-1.556009</td>
<td>ΔRGDP</td>
<td>-3.625207</td>
<td>-3.830369</td>
<td>I(1)</td>
</tr>
<tr>
<td>BCREDIT</td>
<td>-2.115621</td>
<td>-1.908463</td>
<td>ΔBCREDIT</td>
<td>-3.919201</td>
<td>-3.941184</td>
<td>I(1)</td>
</tr>
<tr>
<td>TROPEN</td>
<td>-2.454146</td>
<td>-2.495738</td>
<td>ΔTROPEN</td>
<td>-4.512333</td>
<td>-4.405359</td>
<td>I(1)</td>
</tr>
</tbody>
</table>

5% CRITICAL VALUES
| PINVT  | -2.9472  | -3.5426  | ΔPINVT | -2.9499  | -3.5468  |
| PCS    |          |          | ΔPCS   |          |          |
| RGDP   |          |          | ΔRGDP  |          |          |
| BCREDIT|          |          | ΔBCREDIT|          |          |
| TROPEN |          |          | ΔTROPEN|          |          |

Using the DF test in levels, all variables were found to be non-stationary in levels for both the untrended and trended equations. The results of the DF and the ADF test in levels shown in Tables 4.2 and 4.3 are consistent with the presence of unit roots in all the variables investigated. Having discovered that all the variables were non-stationary, there was the need to bring them to stationarity by testing whether taking the first difference of the variables would bring them to stationarity. The results of the DF and ADF tests in first difference established that the variables are of the order I(1). This means that the stationarity of the variables were achieved by taking their first difference.
4.3 Effect of Public Capital Spending on Private Investment.

Series are employed according to the unit root tests conducted earlier, which revealed the variables as I(1) series i.e. stationary at first difference and from Sub-section 2.3.4, the private investment model is specified below with all variables in their log forms.

\[
\Delta \log(PINVT) = \beta_0 + \beta_1 \Delta \log(PCS) + \beta_2 \Delta \log(RGDP) + \beta_3 \Delta \log(BCREDIT) + \\
\beta_4 \Delta \log(TROPEN) + \beta_5 \Delta \log(PINVT(-1)) + u \quad \ldots \ldots \ldots (4.1)
\]

where

- PINVT(-1) = Proxy for investment climate
- BCREEDIT = Domestic credit to private sector

By fitting OLS for the above model, the result in Table 4.9 was obtained.

**TABLE 4.4 Result of the Effect of PCS on Private Investment**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.043049</td>
<td>0.118223</td>
<td>-0.364132</td>
<td>0.7184</td>
</tr>
<tr>
<td>DLOG(PCS)</td>
<td>-0.838359</td>
<td>0.289789</td>
<td>-2.892995</td>
<td>0.0072</td>
</tr>
<tr>
<td>DLOG(RGDP)</td>
<td>0.722985</td>
<td>0.343966</td>
<td>2.101908</td>
<td>0.0444</td>
</tr>
<tr>
<td>DLOG(BCREDIT)</td>
<td>0.208657</td>
<td>0.632945</td>
<td>0.329661</td>
<td>0.7440</td>
</tr>
<tr>
<td>DLOG(TROPEN)</td>
<td>0.065121</td>
<td>0.728822</td>
<td>0.089351</td>
<td>0.9294</td>
</tr>
<tr>
<td>DLOG(PINVT(-1))</td>
<td>-0.026006</td>
<td>0.179314</td>
<td>-0.145029</td>
<td>0.8857</td>
</tr>
</tbody>
</table>

R-squared: 0.363218
Adjusted R-squared: 0.253428
S.E. of regression: 0.627189
Sum squared resid: 11.40763
Log likelihood: -30.04419
Durbin-Watson stat: 1.520533

The result revealed that PCS is negatively related to PINVT and significant at 5 per cent. Following the lead of complimentarity by (Blejer and Khan, 1984; Greene and Villanueva, 1991), PCS was lagged to find out whether positive result could be obtained. Hence, the model 4.5 below and the result in Table 4.9b

\[
\Delta \log(PINVT) = \beta_0 + \beta_1 \Delta \log(PCS) + \beta_2 \Delta \log(PCS(-1)) + \beta_3 \Delta \log(RGDP) + \\
\beta_4 \Delta \log(BCREDIT) + \\
\beta_5 \Delta \log(TROPEN) + \beta_6 \Delta \log(PINVT(-1)) + u \quad \ldots \ldots \ldots (4.5)
\]
Table 4.5

Result of the Effect of PCS(-1) on Private Investment

Dependent Variable: DLOG(PINVT)
Method: Least Squares
Date: 07/18/10   Time: 20:14
Sample(adjusted): 1972 2006
Included observations: 35 after adjusting endpoints

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.058491</td>
<td>0.106136</td>
<td>-0.551098</td>
<td>0.5859</td>
</tr>
<tr>
<td>DLOG(PCS)</td>
<td>-0.766299</td>
<td>0.261054</td>
<td>-2.935407</td>
<td>0.0066</td>
</tr>
<tr>
<td>DLOG(PCS(-1))</td>
<td>0.794432</td>
<td>0.279547</td>
<td>2.841856</td>
<td>0.0083</td>
</tr>
<tr>
<td>DLOG(RGDP)</td>
<td>0.566413</td>
<td>0.313276</td>
<td>1.808035</td>
<td>0.0814</td>
</tr>
<tr>
<td>DLOG(BCREDIT)</td>
<td>0.148573</td>
<td>0.567880</td>
<td>0.261627</td>
<td>0.7955</td>
</tr>
<tr>
<td>DLOG(TROPEN)</td>
<td>-0.328561</td>
<td>0.667969</td>
<td>-0.491880</td>
<td>0.6266</td>
</tr>
<tr>
<td>DLOG(PINVT(-1))</td>
<td>0.111249</td>
<td>0.167867</td>
<td>0.662719</td>
<td>0.5129</td>
</tr>
</tbody>
</table>

R-squared 0.505771     Mean dependent var 0.021401
Adjusted R-squared 0.399864     S.D. dependent var 0.725877
S.E. of regression 0.562325     Akaike info criterion 1.863384
Sum squared resid 8.853870     Schwarz criterion 2.174453
Log likelihood -25.60921     F-statistic 4.775640
Durbin-Watson stat 1.909447     Prob(F-statistic) 0.001813

The adjusted R² revealed that 40 per cent of the variation in private investment is explained by the significant exogenous variables. The contemporaneous PCS is negatively related to PINVT while the lagged PCS is positively related to it. In fact, for every 1 per cent increase in lagged PCS, PINVT increased by 0.79 per cent. This implies that over time public capital spending (PCS) has a stimulating effect on private investment (PINVT). This substantiates the importance of PCS in building a good macroeconomic environment for the take-off of privatisation and also as an engine of growth of private investment and ultimately gross investment for the purpose of economic growth and development.

4.4 Diagnostic Tests Result for Table 4.4

Histogram and normality test result for Table 4.4
The histogram is bell-shaped and the Jarque-Bera statistic is not significant at 5 per cent level; hence, the conclusion that the residual of the result is normally distributed.

### Serial Correlation LM Test for Table 4.9b

<table>
<thead>
<tr>
<th>Breusch-Godfrey Serial Correlation LM Test:</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistic</td>
</tr>
<tr>
<td>Obs*R-squared</td>
</tr>
</tbody>
</table>

Insignificant F-statistic strongly indicates the absence of serial correlation in the residual.

### Autoregressive Conditional Heteroskedasticity Test for Table 4.4

<table>
<thead>
<tr>
<th>ARCH Test:</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistic</td>
</tr>
<tr>
<td>Obs*R-squared</td>
</tr>
</tbody>
</table>

The ARCH test result strongly suggests the absence of ARCH in the residual of the estimated equation, as the p-value of the F-statistic is highly insignificant.

### Ramsey Reset Test for Functional Mispecification in Table 4.4

<table>
<thead>
<tr>
<th>Ramsey RESET Test:</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistic</td>
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<tr>
<td>Log likelihood ratio</td>
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</table>

Finally, the insignificant p-value of the F-statistic suggests that there is no functional misspecification error in the model. This result indicates that the model adopted is consistent with the data.

### 5.0 Summary, Recommendation and Conclusion

#### 5.1 Summary of Findings

The empirical analysis of the study followed the model of (Aschauer, 1989). The model was developed and estimated using EViews 3.1 statistical package. The analysis started with the determination of the order of integration—the unit root properties of the employed series i.e. (private investment, public capital spending, real gross domestic product, bank credit, trade openness, lagged private investment and lagged public capital spending). Based on the ADF test, it was clearly observed that the results accepted the null hypothesis of non-stationarity for all variables and taking the first difference brought each variable to stationarity, confirming their random walk properties.

Ordinary Least Square (OLS) econometric technique was specified. The result revealed that contemporaneous PCS is negatively related to PINVT while the lagged PCS is positively
related to it. For every 1 per cent increase in lagged PCS, PINVT increased by 71.9 per cent. This implies that over time public capital spending (PCS) has a complementarity effect on private investment (PINVT). This substantiates the importance of PCS in building a good macroeconomic environment for the take-off of privatisation and also as an engine of growth of private investment and ultimately gross investment for the purpose of economic growth and development. However, care should be taken in making sure government investment are better on infrastructure to reduce cost of production, thereby stirring up private investment (Seruvatu and Jayaraman, 2001)

Diagnostic and stability tests were carried out on the result of Table 4.5. The results showed that the Jarque–Bera normality test for the distribution of the residuals, the serial correlation LM test for autocorrelated residuals, the ARCH test for heteroscedastic errors and the Ramsey reset test for functional misspecification were not significant as indicated by the p-values of the F- statistic results. Consequently, these tests validated the result arrived at in this study.

5.2 Recommendation
Following the results of this study, it is of great importance to transform the structure of public capital spending in Nigeria, as (Usman, 2007) revealed that four-fifths of Nigeria’s spending is on consumption expenditure. As earlier stated the improvement on private investment hinges on a good macroeconomic environment. According to (Ebajemito et al, 2004) private investment outcome has not been encouraging in Nigeria and it is a reflection of the sub-optimal operating environment, resulting from inappropriate policy initiatives. Corroborated by (Okonjo-Iweala, 2004), the Nigerian economy mirrors poor roads and portable water, poor health care delivery system, inadequate power supply, low quality of education, unhygienic environment, unreliable security system for life and property which are impediments to high investment. However, a positive move to make this present status quo better could ultimately put the economy in the path of sustainable growth and development.

Private investment has been empirically discovered to be stimulated by Public capital spending over time. Then, it follows that more of PCS should be on infrastructural development and not on consumption, as investment can put the economy in the path of sustainable growth and development.
5.3 Conclusion

This research study has employed ordinary least square method of econometric analysis to examine the relationship that exists between private investment and public capital spending in Nigeria between the periods of 1970-2006. This result has important policy implications for policy makers, as it showed that increase in productivity of private investment can be engendered by public capital spending. This implies that improvement in public capital spending creates a good macroeconomic environment that can make an economy like Nigeria attract not only domestic private investment, but also foreign direct investment.

Conclusively, the implications for policymakers seem to be very unambiguous: public capital spending should go into infrastructural development to encourage private investment and internationally financed foreign direct investment, to put the economy in the path of sustainable growth and development.

REFERENCES