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AN ASSESSMENT OF THE IMPACT OF THE CONSTRUCTION SECTOR ON THE GROSS DOMESTIC PRODUCT (GDP) OF NIGERIA

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ABSTRACT

The construction sector makes significant contribution to employment, domestic capital formation and the Gross Domestic Product (GDP). However, the Nigerian Construction Sector (NCS) is beset by a number of challenges including over-dependent on foreign inputs, economic volatility, low linkages and poor project cost and time performance. The study investigates the impact of the construction sector on the GDP using a 47-year annualized Time Series Data (TSD) gotten from the United Nations Statistics Department (UNSD) database. The study employs econometric methodology which involves series of tests and procedures including tests for unit root and cointegration and Polynomial Distributed Lag (PDL) model. The summary of the estimates including the PDL indicate significant effect of the construction sector on the GDP only when the lag of the GDP is not included as one of the regressors. The study concludes that the effect of the construction sector on the GDP is not robust. Finally, the study recommends for a new national housing and transport infrastructure policy for the sustainable development of the Nigerian constructed infrastructure facilities. The study has demonstrated the relationship between the NCS and GDP. The study added to the body of knowledge by using time series data involving the use of distributed lag model (DLM), autoregressive distributed lag (ADL) model and polynomial distributed lag (PDL) model to assess the relationship.

Keywords: Construction Sector, Econometric methodology, Gross Domestic Product (GDP), Polynomial distributed-lag (PDL) Models

1. INTRODUCTION

The construction sector is a dynamic system that encompasses a wide variety of technologies for the production of building and engineering facilities. The construction sector especially in developing economies contributes as much as 10% to employment and GDP, about 50% to the Domestic Fixed Capital (DFC) Formation, aggregate demand and other sectors through backward and forward linkages, and strong multiplier effect on the economy (Odediran et al., 2012; Nawi et al., 2014; ILO, 2019; Olanipekun & Saka, 2019). However, the seasonal and cyclical nature of the construction sector as well as the rampant project delays, abandonment and bankruptcy simmers down the viability of the sector. The construction sector remains very important in policy due to its roles in the economy. The contributions and the dynamics of the construction sector vary largely during the development process as an economy transforms from a low income economy into a middle income economy, and eventually into a high income economy (Anaman & Osei-Amponsah, 2007; Oladinrin, Ogunsemi & Aje, 2012; Isa, Jimoh & Achuenu, 2013).

The construction sector encompasses a number of entities and activities that contributes to the actualisation of the built environment which includes the builders (contractors & subcontractors), manufacturers and suppliers of machinery and equipment (e.g., cranes & bulldozers), construction materials (e.g., cement & bricks), construction workers (skilled & unskilled) and construction professionals (e.g. architects, engineers & surveyors). In a narrower sense the construction sector involves only the firms and processes that construct and maintain physical infrastructure facilities. The construction sector is mainly a domestic industry for the developed economies but an international industry in developing economies, given the high dependency on foreign inputs including contracting, technology and materials (Chinowsky & Molenaar, 1999; Hillebrandt, 1988; Manseau & Seaden, 2001; Boadu et al., 2020; Paul et al., 2019)).

The construction sector has historically been known to facilitate the process of industrialization, urbanization and transportation etc. Construction infrastructures ease trade and investment as well as the diffusion of technology innovations from the developed to the developing regions of the globe. Additionally, the construction sector is critical for reconstruction after conflicts and natural hazards (Amaratunga & Haigh, 2010; Ruddock *et al.,* 2010). The reconstruction efforts post 2004 Indian Ocean tsunamis in Sri Lanka generated far reaching economic shocks due to the wide linkages of the construction sector across the economy (Ruddock et al., 2010). The construction sector plays significant roles in the stages in building a society resilient to disaster and its management (Haigh & Amaratunga, 2010). Thus Amaratunga and Haigh (2010) propounds a theoretical framework for disaster management in the built environment or construction context.

Most growth theorems have come to a consensus that investment including construction is critical to growth (Solow, 1956; Griffiths & Wall, 1999; Dlamini, 2012; Daniele, 2017; Thong & Hao, 2019) The uniqueness, size and perverseness of the construction sector make it an important issue in public policy. The construction sector and the GDP are inextricably interwoven and remain an important issue facing the academia, government and supranational organisations since the 1970s (Hillebrandt, 1988; Wong et al., 2008). Thus, it is reasonable to assume that the policy for the construction sector to a large extent reflects the political, economic, social and technology values of a given nation. However, the Nigerian Construction sector (NCS) is beset by a number of challenges including operating environment, low local content and poor project cost and time overruns (Adekunle, 1980; Aniekwu, 1995; Anyawu et al. 1997; Doumbia-Henry, 2003; Seaden & Manseau, 2001; Wong, Chiang & Ng, 2008). Therefore, this study investigates the impact of the NCS on the GDP.

2. LITERATURE REVIEW

2.1 The Nigerian Economy

Nigeria is Africa's largest and the most populous economy and a leading oil exporter producing about 2million oil barrel per day (OPEC, 2021). After several decades of military dictatorship, democratic governance was restored in May 1999. The new democratic administration embarked on political, economic and social reforms aimed at making Nigeria one of leading economies in the world. Since Nigeria gained its independence in 1960, its mixed economic system has not been remarkable. The Nigeria's oil export revenue over the decades have not been able to significantly uplift the mass of the out of poverty. At independence in 1960 the state was the engine of growth and the economy was then managed through a series of National Development Plans. Petroleum exports replaced agricultural exports shortly after the civil war (1967-1970) as the largest economic growth driver. The revenue from oil exports produces a boom in the 1970s, with large scale expansion in government expenditures on DFC particularly construction. Nigeria allocated massive sums to public sector mega-projects largely driven by political than economic factors especially under civilian government and corruption dramatically increased the costs of public projects. In 1982 the Nigerian economy fell into recession following the collapse of world oil market (Faruqee, 1994; Iyoha, 1995, Diejomaoh, 2008; 2007; Udeh, 2000; & World Bank, 2005; CIA, 2018).

The government after several frantic efforts to manage the economic crisis was eventually forced to adopt the Structural Adjustment Programmes (SAPs) in 1986 to implement market-based reforms which includes: deregulation and liberalisation of the foreign exchange rate, the financial sector and trade; privatization of state owned enterprises (SOEs); and tight fiscal and monetary policies (Federal Government of Nigeria, 1986). The Nigerian Naira (NGN) went into freefall following the deregulation of foreign exchange rate in 1986. SAPs improved conditions in agriculture and the financial sector and the GDP growth was restored. The performance of the import dependent manufacturing sector was poor as a result of lack of international competitiveness (CBN, 2002). The early 1990s were characterized by rising fiscal deficits, declining social spending, increasing poverty and pro-democracy agitations. The government adopted pegged exchange rate policy regime for a wide range of transactions in 1994. The introduction of SAPs exposed the economy to international trade shocks and adverse BOPs position. The Nigerian export is heavily dominated by crude oil which constitutes over 95 percent of total exports by value. The 2003 adoption of the National Economic Empowerment and Development Strategy (NEEDS) and a favourable international oil market gave the economy a significant push. In 2006 Nigeria made history when it exits its Paris Club debt after paying USD12.2 billion (see for example Aliyu, 2001; BusinessDay, 2004; CBN Annual Report, 2004; CBN

Statistical Bulletin 2002; Economic Confidential, 2007; Falana, 2005; Ibe *et al.,* 2005; Ifionu & Ogbuagu, 2007; Iyoha, 1996, 2007; Nwozor, 2009; Okoh, 2004).

2.2 The Nigerian Construction Sector (NCS)

The NCS contributes on the average up to 10percent to the GDP, over 50percent to domestic fixed capital (DFC) formation; and about 10percent to employment (Hillebrandt, 1988). However, the sector is challenged by a number of factors which includes difficult operating environment, over dependence on foreign contractors, equipment and materials, poor sectoral linkages and poor project cost and time performance (Aboyade, 1966; Adekunle, 1980; Anyawu et al., 1997; Baukley et al.,1993). The prospect for the NCS remains bright with increasing public construction expenditure. Additionally, considering the huge housing and infrastructure deficit the construction sector stands as an important pillar in supporting the growth and development of the economy. Nevertheless, the trend of its impact on the GDP remains low; statistics on the construction- GDP contribution indicates 3.78, 5.71, 2.36, 2.88 and 3.13 in years 1971, 1981, 1991, 2001 and 2011 respectively. Thus the NCS is far from its potential (Idrus & Sodangi, 2007; Oluwakiyesi, 2011; UNSD, 2018).

Recent studies now emphasize the impact of the construction sector on the GDP using Nigerian TSD. Oladinrin, Ogunsemi and Aje, (2012) investigate the relationships between the construction sector and the GDP using TSD from 1990 - 2009. The study uses econometric techniques and finds bidirectional granger causality between the construction sector and the GDP. The study concludes that the construction sector is fundamental to any economy as it has the capacity to increase the growth of the economy.

Isah ,Jimoh and Achuenu (2013) assess the contribution of the construction sector to the GDP using the Nigerian TSD. The study finds that the construction sector contributes between 3 and 6 percent to the GDP from 1960 to the 1980s before declining to about 1percent in the 1990s. However, the contribution improved to around 3percent in the recent time.

Okoye (2016) examines the impact of the construction sector on the Nigerian GDP using TSD for the period 2010 through 2015. The study finds a positive and significant correlation ($R = 0.709$) between the construction sector and the GDP. Additionally, the study establishes significant bi-directional Granger causality between the GDP and the construction sector.

Okoye et al (2016) investigate the impact of the GDP on the construction sector using Nigerian quarterly TSD for the period 2010 through 2015 and econometric methodology. The study finds an inverse relationship between the GDP and the construction sector ($R = -0.088$). The study recommends for construction development policy for the sustainable growth of the economy.

Polycarp and Ubangari (2017) examine the effect of the construction sector to the GDP using Nigerian TSD and find positive contribution between 2010 and 2014 to the GDP; however, there was a decline from 2014 to the third quarter of 2016.

Olanrewaju et al. (2018) investigate the causes and effects of the 2016 Nigerian recession on the construction sector. The study finds three major causes of recession to include- fall in volume and price of crude oil export; unfavourable exchange rates; and high corrupt practices whereas the three major effects of the recession on the construction sector were - high rate of unemployment and bankruptcy and the reduction in mortgage lending rate.

Abubakar, Abdullahi and Bala (2018) examine the relationships between the construction sector and the GDP using econometric methodology and a 26 year TSD for the period 1990 through 2015. The study finds bidirectional relationships between the construction sector and the GDP at one-year lag. Therefore, it is inevitable to access the impact of construction sector on GDP of Nigeria.

2.3 Theories of the Impact of the Construction Sector on the GDP

The Harrod–Domar model postulates that growth rate (r) of the economy is a function of the national saving ratio (s) and inversely of the national capital/output ratio (k) i.e. $r = s / k$ (Pettinger, 2019). However, in the long run, economic growth rate is limited by population growth and rate of technological change. The Exogenous Growth Theory (EGT) (or Neoclassical Growth theory (NGT)) of Solow (1956) seeks to explain the contribution of different inputs to the overall growth of output of the economy. The underlying assumption is that variation in input such as labour (L) and physical capital (K) together with technological progress (A) can account for any observed change in output(Y). Thus, the change in output can be expressed in functional notation as:

Y=Af(L,K). .... (1)

In a sense the neoclassical growth theory certainly points to increasing labour (L) and capital input (K) as a means of stimulating economic growth. This suggests encouraging saving (or at least access to saving) in order to finance investment in capital input (K) may be a useful policy. The limitation of the neoclassical growth theory inspired the formulation of the endogenous growth theory. The endogenous growth theory added many variables to the neoclassical production function. For example by adding human capital variable (H) to the neoclassical production function leads to the following expression:

Y=Af(L,K,H)..(2)

The addition of H helps to reduce the unexplained elements of the total factor productivity growth in empirical works. In summary it is very clear that all growth models agree that investment like construction is critical for development and growth. The construction sector accounts for approximately 60% of the Gross Domestic Fixed Capital Formation (GDFCF) and over 70% of capital stock in developing economies (Griffiths & Wall, 1999; Begg, Fischer & Dornbusch, 2000).

2.4 The Impact of Construction Sector Output on the GDP

Various studies looked into the relationships between the construction sector and the GDP at different stages of economic development (Moavenzadeh, 1978). UNIDO (1969) finds clear variance in the construction sector of developed and developing economies where construction sector accounts for between 3% and 5 % of the GDP in many developing economies. However, its GDP is higher in developed economies ranging between 5% and 9%. The construction sector represents between 45 and 60 percent of the GDFCF in most economies, but house construction and maintenance represents between 30 and 45percent of the construction sector activities in developed economies as opposed to between 20 and 45percent in developing economies. The construction sector accounts for 6-10percent of total employment in most developed economies but only 2-6 percent in developing economies. Thus the study concludes that insufficient construction works were constraints to fast and sustainable socioeconomic development and that adequate development of the construction sector were crucial to solving the challenges of developing economies.

Turin (1969) using 46 country's data finds no significant relationships between the construction sector and the GDP. Strassmann (1970) finds that the growth of construction sector output is particularly distinct as economies transform from low income countries (LICs) to middle income countries (MICs) giving rise to the MICs bulge. Thus the construction sector is capable of replacing manufacturing in driving economic growth during the MICs stage.

Turin (1973) using cross sectional data (CSD) for 87 LICs and MICs for the period of 1955 through 1965, finds positive linear relationship between the construction sector and the GDP which also indicates a hihh significance. This is consistent with the classical and neoclassical growth theories that DFC is a major growth driver. Turin (1978) using time series data (TSD) of a sample of 87 LICs and MICs for the period of 1960 through 1978, finds that the relationship between the construction sector and the GDP is S-shaped. The Turin (1973, 1978) model suggests that the share of the construction sector in the GDP and the construction value added (CVA) per capita increase with economic development. As an economy continues to grow, construction output assumes a higher proportion of the GDP. Additionally, civil engineering works has a higher proportion in the total construction output of developing economies than developed economies. Turin concludes that the construction sector is crucial to development strategy of developing economies through sustainable mass employment generation at low capital intensity. The Turin-Strassmann studies argue that the construction sector should be ahead of the economy to provide the pre-requisite infrastructure to support growth.

The Turin–Strassmann findings have been criticized for: weakness of data; limited coverage; lack of corrections for output, prices and factor substitutions; and the notion of compulsory development path, i.e. a minimum proportion of construction/GDP ratio before economic growth (see for example Drewer, 1980; Bon, 1992; & Ofori & Han, 2003 etc.). Turin admits to the natural problem of deducing time series relationships from the analysis of CSD.

Drewer (1980) using data of countries included in the UN Economic Commission for Europe concludes that high construction sector /GDP ratio may not imply higher level of economic development. However, Wells (1986) affirms that there is an increase in GDP when construction activities are on the rise and rise is highest when the country passes through the MIC range. Subsequently, the growth then diminishes as infrastructure facilities are developed in the High Income Countries (HICs).

Maddison (1987) asserts economic development follows a pattern of bell shaped industrialization and de-industrialization. The construction/GDP ratio and manufacturing/GDP ratio progressed to the peaked (MIC stage) as subsequently decline as the economy becomes developed and the services sector assumes the role of engine of growth (HICs).

Akintoye and Skitmore (1994) note that construction sector investment that influences the trend and cyclical components of economic growth could be regarded as growth-initiating. Drewer (1997) using data for 1990 similar to Turin (1973, 1978) find that the world's construction sector now favour developed economies. However, Wells (1999) criticises Drewer (1997) for poor quality of data in developing economies, particularly the failure to capture the output of the informal construction sector.

Bon (1988, 1990, 1992, 2000 & 2001) examines the developing trend of the construction sector based on countries' stage of economic growth. Bon finds that construction sector follows an inverted U-shaped pattern of development both in terms of total construction sector output and construction sector /GDP ratio as an economy develops from LICs to MICs and eventually to HIC. This implies that the portion of construction sector in the GDP rises from LICs until the end of MICs stage, after which it start a gradual decline in relative terms in HICs. Bon states that Turin's S-shaped relationship may be as a result of sample bias against HICs, so that the trend characteristics of LICs and MICs were exaggerated. A growing number of studies confirmed the Bon's notion of curvilinear relationship between the construction sector and the GDP (Crosthwaite, 2000; Jin et al. 2003; Yiu et al. 2004; Pietroforte & Gregori, 2003, 2006; Ruddock & Lopes, 2006; Wong et al. 2008; Lopes et al. 2011). However, Dlamini (2012) suggests that Bon's studies far emphasis on HICs probably due to lack of reliable data from LICs and MICs.

As any economy develops, the mix of the construction demand and supply also develops and changes. This derives directly from the importance of DFC in setting the basis for economic development. Consequently, the share of maintenance and repair works which are more labour intensive than new construction grow to approximately 50 percent of the total construction output in HICs. Productivity in the construction sector at this stage will remain static or decline (Pietroforte & Gregori, 2003; Wong et al. 2008; Lopes et al. 2017.). Most of the early studies of construction sector and GDP relationships have been criticised for - limitations of the coverage; the use of CSD across countries rather than country's TSD or panel data; and the focus on the correlation between the construction sector and GDP/GDP per capita (Wong et al. 2008; Lopes, Nunes & Balsa, 2011). More recently the application of econometric methodology has opened a new vista on this subject (Oladinrin, Ogunsemi & Aje, 2012; Abubakar, Abdullahi & Bala, 2018).

Anaman (2003) examines the relationship between the construction sector and the GDP using Brunei TSD and finds that the GDP (-1) positively Granger-causes the construction sector. However, construction sector (-1) negatively affects the real GDP. Yiu et al. (2004) find using Hong Kong's TSD that the real GDP growth leads the real construction sector growth at least in the short term. Ching et al. (2005) using Hong Kong TSD from 1978 through 2004 examines the relationship between residential real estate price and the GDP. The study finds significant Granger causality from real GDP to residential real estate price. Khan (2008) investigates the relationships between the construction sector and the GDP using Pakistani TSD for the period 1950 through 2000. The study finds significant effect of the construction sector on the GDP.

Chen and Zhu (2008) investigate the effect of housing investment on the GDP using Chinese TSD. The study finds a bi-directional Granger causality between GDP and housing investment for China. However, the relationships for three regions were different. Rameezdeen and Ramachandra (2008) investigate linkages of the construction sector using Sri Lankan input–output tables. Gregori and Pietroforte (2011) provide explorative regressions linking the construction sector /GDP ratio to GDP per capita.

A growing number of time series studies have addressed the construction sector –GDP relationships for African countries (see for example Lopes & Ruddock, 1997; Lopes, 1998; Lopes et al. 2002; Anaman & Osei-Amponsah, 2007; Saka, 2008; & Lopes, Nunes & Balsa, 2011 etc.).

Lopes (1998) studies the construction sector and related sectors using 15 Sub Saharan African (SSA) nations TSD for the period 1980 through 1993. The study finds that the construction sector at most grows at the same rate with the GDP. Lopes et al. (2002) using data of 22 SSA countries, finds a critical level of construction sector /GDP ratio (at 4–5%) below which the GDP per capita declines.

Anaman & Osei-Amponsah (2007) study the relationship between the construction sector and the GDP using Ghanaian TSD from 1968 through 2004. The study finds that the construction sector Granger-causes the GDP with three-year lags. The study concludes that the construction sector is a major growth driver.

K'Akumu (2007) finds that the construction sector statistics are inadequate in Kenya partly due to: weak institutions, underdevelopment, informal construction sector system, and poor national culture on statistics.

Lopes et al. (2011) investigate the relationships between construction sector and the economy using Cape Verde TSD for the period 1970 through 2008. The study finds that a positive GDP growth trend produces similar positive growth in the construction sector.

Okoye, (2016) investigates the potential of the CNS as an instrument of socio-economic development of Nigeria using quarterly TSD from the NBS for the period 2010 through 2015. The study deploys econometric methodology including test for stationarity, cointegration and granger causality as well as the OLS regression model. The study finds positive and significant relationships between the CNS and the GDP. The granger causality test indicates a bidirectional between the GDP and the CNS. The estimates of the OLS regression model indicate a R2 of 50.33percent which implies that over 50percent of the variation in the GDP is explainable by the CNS. The study concludes that both construction and the GDP Granger cause each other. Thus the Construction sector may serve as a policy instrument for the development for the development of Nigeria.

Abubakar et al. (2018) examine the relationships between the CNS and the GDP using Nigerian TSD for the period 1990 through 2015. The study extracts data from the CBN statistical bulletin. The study deploys test for stationarity, cointegration and granger causality. The study finds bidirectional causality between the CNS and the GDP. The study recommends for the integration of the CNS in the diversification and the transformation of the Nigerian economy.

Okoye & Igbo (2018) investigate the effect of the volatility of oil price on the CNS and the economy using Nigerian TSD for the period 1981 through 2016 extracted from the NBS and OPEC annual statistical bulletin2017, and BP statistical review of world energy June 2017. The study adopts econometric methodology including tests of stationarity, cointegration and vector error correction model (VECM) and granger causality test. The study finds no significant causal effect of oil price shocks on construction and economic growth. However, the economy significantly impacts on the construction sector. Additionally, the long run relationships between the variables are unstable. The study concludes that the construction sector and the economy are not significantly caused by the oil price volatility they are nonetheless sensitive to the volatility of oil prices. The study thus recommends for renew focus on the non-oil sectors for the sustainable growth of the Nigerian economy.

Wethal (2018) investigates using lionkage theory investigates the backward linkages of Chinese firms in construction projects in Mozambique. The study finds that the underlying factors for the lack of backward linkages of Chinese firms is the underdevelopment of local firms capability, weak social development, and liberal policy frameworks not supportive of backward linkages.

Lopes, Oliveira and Abreu (2017) examined the indicators of construction in two divisions of SSA and considered the correlation between construction investment and the economic and social targets of the sustainable development goals (SDGs). The study finds that the construction sector /GDP ratio increases with the per capita income in the initial stage of development. At some point (when the construction sector /GDP ratio falls between 5.5 & 6%) the construction sector grows at the same rate with the GDP. However, the construction sector /GDP ratio decreases at the later stages of development. The study suggests overcoming the problems of finance and sustainability toward attaining the SDGs. There is the need to increase investment in the construction sector for LICs to the level of sustainable growth and development.

3. METHODOLOGY

The study adopts econometric methodology specifically the Polynomial Distributed Lag (PDL) model procedure to assess the effect of the construction sector on the GDP as used by (Atique & Ahmad, 2003; Saka & Lowe, 2010; and Siddiqui 2009; Ojo & Aiyebutaju, 2015). The study adopts different models to capture the relationships. Since the effect of construction on the GDP are supposed to last for a while, we used the various distributive lag models including distributive lag model (DLM) autoregressive distributive lag model (ADL) and polynomial lag model (PDL). The reason for the lags in the model is to estimate how long the effect of construction shocks on the economy.

The polynomial distributive lag (PDL) model is a distinctive and efficient approach to distributed lad modelling. Standard econometric procedure includes testing for stationarity and co-integration and then model estimation that capture the relationships among TSD.

3.1 Time Series Data (TSD)

The study uses TSD of the construction sector and the GDP. The TSD for the study were extracted from the United Nation Statistical Department (UNSD) database covering a forty-seven (47) year period from 1970 to 2016.

3.2 Test for Stationarity

If the underlying stochastic process that generated the TSD can be assumed to be invariant with respect to time, the process or series is said to be stationary. An underlying assumption in regression is that TSD are stationary in other words the mean, variance and autocovariance of the process or TSD invariant irrespective of time. One of the most popular methods of testing for stationarity is the unit root test. The study employs the Dickey Fuller (DF), augmented Dickey Fuller (ADF) and Phillips Perron tests to test the two TSD for unit root (Dickey & Fuller, 1979; Phillip Perron 1988; Gujarati, 2005).

3.3 Co-integration analysis

Spurious estimates may result from regression with non-stationary TSD (Granger & Newbold, 1974). Statisticians formulated the concept of cointegration to overcome the problem of spurious regression. Two non-stationary TSD may be co-integrated, if their linear combination is stationary (Engle & Granger, 1987). The study deploys vector autoregression (VAR) based co-integration test developed by Johansen (Johansen, 1995).

3.4 Simple Regression Model

Regression is a statistical model where the expected value of one variable Y is presumed to be dependent on one or more other variables ($X_1, X_2, \ldots Xi$). Regression model states the relationships between a dependent variable Y and an independent variable X (Upton & Cook, 2006). In a simple regression model the dependent variable is predicted by a single independent variable (Collis & Hussy, 2009). A simple regression model can be written as follows:

$$Y = \alpha + \beta x + \varepsilon \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

Where Y=regressand; X=regressor; α (alpha) =the parameter corresponding to the intercept; β(beta)=the parameter corresponding to the slope; ε(epsilon)=a random error which is the difference between the observed (actual) values and expected (theoretical) values of the model. The standard error of the estimate is a measure of goodness of fit which is the standard deviation of the regressand estimate around its mean. The standard error is considered to be high if it is more than 10 percent of the mean. The F ratio- is another measure of the goodness of fit of the model (i.e. to what extent did the model explain the deviation in the regressand); the P-value of F ratio gives the significance of the model (i.e. the goodness of fit of the model); the adjusted R^2 measures the proportion of the variance in the regressand that is explained by variations in the regressor. The study uses a simple regression with a trend. In regression involving TSD, the time, or trend variable is often added as one of the regressors to overcome spurious correlation problem. In other words, the introduction of time or trend in the regression model is to de-trend the TSD (i.e. removing the effect of trend from the regressors and regressand) (Gujarati, 2005).

3.5 Distributed Lags Model (DLM)

A regression model with lags of the regressors (explanatory variables) (Gujarati, 2005). Thus equation 4 is a DLM.

$$Y_t = \alpha + \beta_0 X_t + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \cdots + \beta_k X_{t-k} + u_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

In equation 4, the variable Yt is modeled as a linear function of X of different lags (1 to n). This is done to measure the effects of Xt at different periods or lags given that Xt may still continue to affect the Yt after the current period. The coefficient B_t measures variation in the mean value of Yt following a unit change in Xt in the same time period. It can be assumed that the change in X will continue at the same level thereafter. Thus B_0 and B_1 summed up give the variation in Yt in the next period, B_0, B1andB2 add up to give it for the following period etc. The optimal lag length is the model with the highest adjusted $R,^2$ lowest Akaike Information Criterion (AIC) or lowest Shwarz Information Criterion (SIC) criteria etc.(Gujarati, 2005).

3.6 Autoregressive Distributed Lag (ADL) Model

This is a distributed lag model(DLM) with one or more lags of the regressand among the regressors. In other words it is a DLM with the addition of autoregressive components as regressors.

$$Y_t = \alpha + \beta X_t + \gamma Y_{t-1} + u_t \qquad (5)$$

3.7 The Almon Polynomial Distribution Lag (PDL) Model

The max lag length must be selected in advance following Hendry's top down procedure. The procedure is to start with a large value of *k* and then gradually reducing the length without deteriorating significantly the fit of the model. Generally, model with the lowest AIC and SIC is preferred. Similar procedure is adopted to determine the degree of the polynomial *d*(David & Mackinnon, 1993). The optimal lag length and degree choosen for this study is k=4, and d=2. Gujarati (2005) describes the principle of Almon DLM as follows. Consider the finite DLM in eqn 4 which may re-written as

$$Y_t = \alpha + \sum_{i=0}^{k} \beta_i X_{t-i} + u_t \qquad (6)$$

The βi can be expressed as function of i, the length of the lag (time). If the lag scheme is second degree polynomial in i then the βi can be estimated by

$$\beta_i = a_0 + a_1 i + a_2 i^2 \qquad (7)$$

Substituting eqn. 7 into 6

$$Y_t = \alpha + \sum_{i=0}^{k} (a_0 + a_1 i + a_2 i^2) X_{t-i} + u_t \qquad (8)$$

$$Y_t = \alpha + a_0 \sum_{i=0}^{k} X_{t-i} + a_1 \sum_{i=0}^{k} i X_{t-i} + a_2 \sum_{i=0}^{k} i^2 X_{t-i} + u_t \qquad (9)$$

$$Z_{0t} = \sum_{i=0}^{k} X_{t-i} \qquad (10)$$

$$Z_{1t} = \sum_{i=0}^{k} i X_{t-i} \qquad (11)$$

$$Z_{2t} = \sum_{i=0}^{k} i^2 X_{t-i} \qquad (12)$$

$$Y_t = \alpha + a_0 Z_{0t} + a_1 Z_{1t} + a_2 Z_{2t} + u_t \qquad (13)$$

In Almon technique Y is regressed on the constructed variables Z and not the original X variables. And after the a's are estimated from eqn. 13 the βi can then be estimated from eqn. 7 as follows

$$\hat{\beta}_0 = \hat{a}_0 \qquad (14)$$

$$\hat{\beta}_1 = \hat{a}_0 + \hat{a}_1 + \hat{a}_2 \qquad (15)$$

$$\hat{\beta}_2 = \hat{a}_0 + 2\hat{a}_1 + 4\hat{a}_2 \qquad (16)$$

$$\hat{\beta}_3 = \hat{a}_0 + 3\hat{a}_1 + 9\hat{a}_2 \qquad (17)$$

$$\hat{\beta}_4 = \hat{a}_0 + 4\hat{a}_1 + 16\hat{a}_2 \text{ ....(18)}$$

3.8 Model Specification

The models for this study are given as follows:

$$GDP_t = \alpha + \beta_1 LCNS_t + \beta_2 t + u_t \text{ ....(19)}$$

$$GDP_t = \alpha + \beta_0 LCNS_t + \beta_1 LCNS_{t-1} + \beta_2 LCNS_{t-2} + \beta_3 LCNS_{t-3} + \beta_4 LCNS_{t-4} + \beta_5 t + u_t \text{ .....(20)}$$

$$GDP_t = \alpha + \alpha_1 LGDP_{t-1} + \beta_0 LCNS_t + \beta_1 LCNS_{t-1} + \beta_2 LCNS_{t-2} + \beta_3 LCNS_{t-3} + \beta_4 LCNS_{t-4} + \beta_5 t + u_t$$
(21)

$$GDP_t = \alpha + \hat{\beta}_0 LCNS_t + \hat{\beta}_1 LCNS_{t-1} + \hat{\beta}_2 LCNS_{t-2} + \hat{\beta}_3 LCNS_{t-3} + \hat{\beta}_4 LCNS_{t-4} + u_t \text{ ....(22)}$$

$$GDP_t = \alpha + \alpha_1 LGDP_{t-1} + \hat{\beta}_0 LCNS_t + \hat{\beta}_1 LCNS_{t-1} + \hat{\beta}_2 LCNS_{t-2} + \hat{\beta}_3 LCNS_{t-3} + \hat{\beta}_4 LCNS_{t-4} + u_t \text{ (23)}$$

3.9 Operational definition of variables

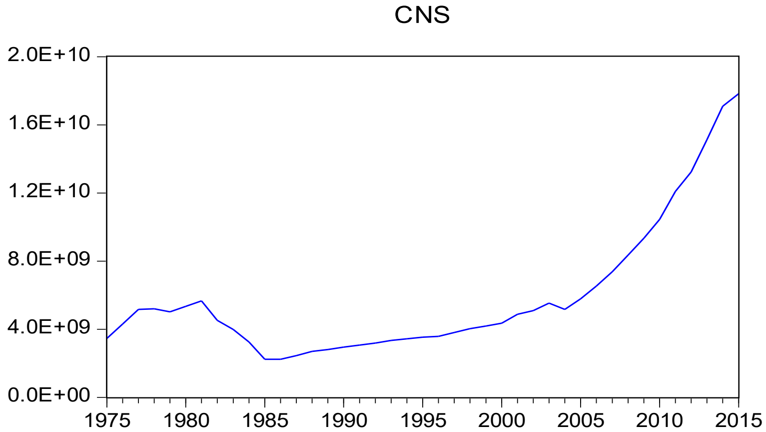
Construction Sector this is the sum or aggregate monetary or market value (price) of all construction products and services within a given country during the accounting period i.e. quarter free from the nationality of labour (SNA, 1993; Fernando, 2021). This implies that data was gotten from the archive.

Gross Domestic Product (GDP) this is the sum or aggregate monetary or market value (price) of products and services within a given country during the accounting period i.e. quarter free from the nationality of labour (SNA, 1993; Fernando, 2021).

4. EMPIRICAL ESTIMATION

4.1 Line graph

Figure 1 indicates the pattern of each of the TSDs. The graph indicates an upward growth in the GDP between 1970 and 1977. From 1978 the graph shows a period of downward growth up until 1984; it however switched to an average rate of growth up till 2015. The construction sector showed an upward pattern of growth between 1970 and 1982 and a then a downward growth trend between 1982 and 1999. The growth however rose between 1999 and 2015. The graph shows that there is a faster growth of the GDP than the construction sector all through the duration under review; that is 1970 through 2016.



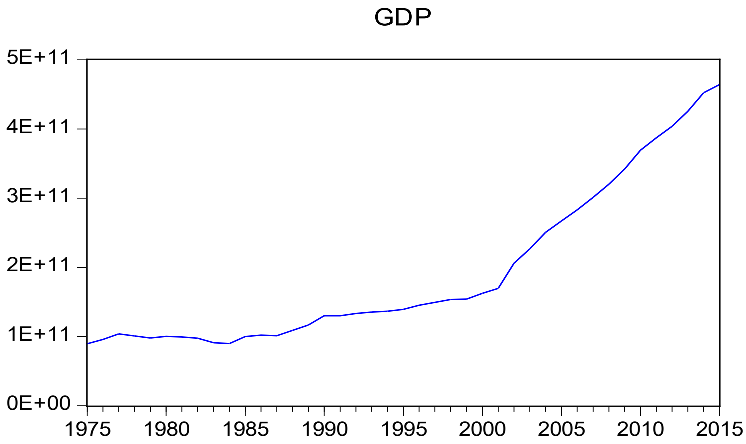


Figure 1: Pattern of each of the TSDs

4.2 Descriptive Statistics

The mean (standard deviation) of CGD and CGR are 0.0326(0.0101) and 0.0475(0.1040); whereas the mean (standard deviation) of the GDP and construction sector are 1.86E+11(1.21E+11) and 5.82E+09(4.14E+09) respectively. The sum of the GDP and construction sector are 8.76E+12 and 2.74E+11 respectively.

Table 1 Descriptive statistics of CGD, CGR, Const. Sector and GDP

	CGD	CGR	Const. sector	GDP
Mean	0.032595	0.047450	5.82E+09	1.86E+11
Median	0.027305	0.049999	4.30E+09	1.35E+11
Maximum	0.057143	0.243180	1.78E+10	4.64E+11
Minimum	0.020580	-0.311123	2.23E+09	6.17E+10
Std. Dev.	0.010133	0.104010	4.14E+09	1.21E+11
Skewness	0.781375	-1.184373	1.732029	1.105754
Kurtosis	2.399106	5.443959	4.920441	2.836575
Jarque-Bera	5.489721	22.20246	30.72192	9.630053
Probability	0.064257	0.000015	0.000000	0.008107
Sum	1.531980	2.182700	2.74E+11	8.76E+12
Sum Sq. Dev.	0.004723	0.486814	7.90E+20	6.75E+23
Observations	47	46	47	47

4.3 Unit root test estimates

The estimates of the DF test at 5percent critical level shows the construction sector and the GDP to be non-stationary at level even with log data (see table 2).

Table 2 Unit root test for Construction sector and GDP at level with DF

	DF test		DF test	
Test critical values:	No trend	With trend	No trend	With trend
Unit root test for at level	Construction Sector		Lconstruction sector	
1% level	-2.617364	-3.770000	-2.617364	-3.770000
5% level	-1.948313	-3.190000	-1.948313	-3.190000
10% level	-1.612229	-2.890000	-1.612229	-2.890000
test statistic	-1.266940	-1.919532	-0.317422	-1.616695
Unit root test for at level	GDP		LGDP	
1% level	-2.617364	-3.770000	-2.617364	-3.770000

5% level	-1.948313	-3.190000	-1.948313	-3.190000
10% level	-1.612229	-2.890000	-1.612229	-2.890000
test statistic	-0.040232	-1.495130	1.170240	-1.582406

Table 3 presents the estimates of unit root test of the TSD using the ADF and PP tests with the raw and the log data. The estimates indicate non stationarity at level but stationary at first difference. All the TSD are therefore I (1). Since all TSD are stationary at first difference I (1), test for co-integration is necessary.

Table 3 ADF and PP at level and first difference

	ADF at level		ADF at 1st difference		PP test at level		PP test at 1st difference		Conclusion
	No trend	With trend	No trend	With trend	No trend	With trend	No trend	With trend	
Construction Sector	0.7484	0.7312	0.0859	0.1312	0.9997	0.9978	0.0705	0.2238	I(1)
GDP	0.9897	0.9005	0.0880	0.0975	1.0000	0.9943	0.1024	0.1178	I(1)
LConstruction Sector	0.8693	0.8287	0.0075	0.0305	0.9554	0.9469	0.0075	0.0305	I(1)
LGDP	0.9860	0.8200	0.0005	0.0023	0.9700	0.8847	0.0006	0.0023	I(1)

4.4 Cointegration Test Estimates

Table 4 presents the estimates of the Johansen cointegration tests. The estimates indicate significant cointegration with one cointegration equation at 0.05 levels with the MacKinnon-Haug-Michelis (1999) p-values =0.0212. The estimates confirm long–term contemporaneous relationship between the TSD, rules out spurious relationship problem and suggests a causal relationship in at least one direction.

Table 4 Cointegration test estimates

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.212505	14.50487	12.32090	0.0212	10.75041	11.22480	0.0605
At most 1	0.080047	3.754452	4.129906	0.0625	3.754452	4.129906	0.0625

* denotes rejection of the hypothesis at the 0.05 level; **MacKinnon-Haug-Michelis (1999) p-values

4.5 Model One (Simple Regression with Trend) Estimates

The estimates of model one indicates that the Lconstruction sector have significant effect on the LGDP with t=7.403615; p=0.0000. The constant is also significant which indicates that there is significant LGDP without the L construction sector. The trend variable is significant with t=14.39802; p=0.0000. The goodness of fit of the model is significant with adjusted R^2 =97.73percent (see table 5).

4.6 Model Two (Distributed Lag Model with trend) Estimates

To determine the optimum lag of this DLM, several lags of L construction sector were tested. The optimal DLM selected i.e. the optimum lagged model is the one with 4lags of the L construction sector which is presented in table 5. Unfortunately lags -1 and -3 are negatively related to the LGDP. Only the current L construction sector is positive and significant with t= 2.797213; p=0.0083. Additionally, the trend variable is also significant. The goodness of fit of the model is significant with an adjusted R^2= 97.48percent.

4.7 Model Three (Autoregressive Distributed Lag Model with Trend) Estimates

Model three includes one year lag of the regressand as one of the regressors to model two. The model estimates indicate that only LGDPt-1 is significant with t= 14.56083; p=0.0000, all the lags of L construction sector and the trend variable were not significant. The goodness of fit of the model is significant with adjusted R^2=99.32percent (see table 5).

Table 5: Estimates of models 1, 2 and 3

Model 1: Dependent Variable LGDP						
Variable	Coefficient	Std. Error	t-Statistic	Prob.	R-squared	0.978337
LCS	0.358018	0.048357	7.403615	0.0000	Adjusted R-squared	0.977329
C	17.11628	1.044987	16.37943	0.0000	S.E. of regression	0.086335
@TREND	0.029182	0.002027	14.39802	0.0000	Durbin-Watson stat	0.379402
Model 2: Dependent Variable LGDP						
Variable	Coefficient	Std. Error	t-Statistic	Prob.	R-squared	0.978460
LCS	0.614041	0.219519	2.797213	0.0083	Adjusted R-squared	0.974767
LCS(-1)	-0.281926	0.391650	-0.719842	0.4764	S.E. of regression	0.087971
LCS(-2)	0.169648	0.412400	0.411368	0.6833	Durbin-Watson stat	0.702217
LCS(-3)	-0.319064	0.387359	-0.823690	0.4157		
LCS(-4)	0.200690	0.222522	0.901890	0.3733		
C	16.52478	1.314233	12.57371	0.0000		
@TREND	0.029778	0.002352	12.65969	0.0000		
Model 3: Dependent Variable LGDP						
Variable	Coefficient	Std. Error	t-Statistic	Prob.	R-squared	0.994369
LGDP(-1)	1.006253	0.069107	14.56083	0.0000	Adjusted R-squared	0.993210
LCS	0.052997	0.064381	0.823182	0.4161	S.E. of regression	0.045635
LCS(-1)	-0.011016	0.098008	-0.112397	0.9112	Durbin-Watson stat	1.498651
LCS(-2)	0.006367	0.102224	0.062289	0.9507		
LCS(-3)	-0.168197	0.095636	-1.758721	0.0876		
LCS(-4)	0.094122	0.054938	1.713242	0.0958		
C	0.424859	1.209769	0.351191	0.7276		
@TREND	0.000915	0.002112	0.433178	0.6676		

Note: Lag Construction Sector (LCS)

4.8 Model four (Polynomial Distributed Lag Model) Estimates

The optimal model selected i.e. the optimum lagged model is the one with four (4) lags of the L construction sector and two degree polynomial which is presented in table 6. PDL01 is positive and significant while PDL02 is negative but significant. Additionally, only three lags of L construction sector are positive and significant viz 0, 1 and 2. Lags 3 and 4 are not significant at 5 percent. The total sum of lags of the L construction sector indicates significance at 1percent. The goodness of fit of the model is significant with an adjusted R= 70.87 and F =52.09047; p=0.0000 (see table 6).

Table 6: Model Four (Polynomial Distribution Lag Model) Estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.356792	2.311878	3.182171	0.0028
PDL01	0.165443	0.020851	7.934663	0.0000
PDL02	-0.157252	0.063046	-2.494223	0.0169

R-squared	0.722571	Akaike info criterion	0.498062
Adjusted R-squared	0.708699	Schwarz criterion	0.620936
F-statistic	52.09047	Hannan-Quinn criter.	0.543374
Prob(F-statistic)	0.000000	Durbin-Watson stat	0.080611

Lag Distribution of LCS	I	Coefficient	Std. Error	t-Statistic
. *|	0	0.47995	0.11885	4.03820
. * |	1	0.32269	0.05749	5.61281
. * |	2	0.16544	0.02085	7.93466
* |	3	0.00819	0.07426	0.11031
* . |	4	-0.14906	0.13617	-1.09466
	Sum of Lags	0.82721	0.10425	7.93466

4.9 Model five (Autoregressive Polynomial Distribution Lag Model) Estimates

When the lag of GDP is added as a regressor to model four the result is similar to model three as only the lag of GDP is significant see table 7. PDL01 is significant while PDL02 is not significant. The coefficients of the various lags of L construction sector do not only became insignificant but also became negative. The goodness of fit of the model is very significant with an adjusted R^2 =99.35 and F =2137.581; p-value=0.0000(see table 7).

Table 7 Polynomial model of L construction sector and lag of LGDP

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.128674	0.389159	-0.330646	0.7427
LGDP(-1)	1.061222	0.025362	41.84378	0.0000
PDL01	-0.012687	0.005276	-2.404607	0.0210
PDL02	-0.005524	0.010098	-0.547043	0.5875
R-squared	0.993955	Akaike info criterion		-3.281781
Adjusted R-squared	0.993490	Schwarz criterion		-3.117948
F-statistic	2137.581	Hannan-Quinn criter.		-3.221364
Prob(F-statistic)	0.000000	Durbin-Watson stat		1.592421
Lag Distribution of LCS	I	Coefficient	Std. Error	t-Statistic
*.|	0	-0.00164	0.02117	-0.07741
* .|	1	-0.00716	0.01166	-0.61419
* .|	2	-0.01269	0.00528	-2.40461
* .|	3	-0.01821	0.01112	-1.63795
* .|	4	-0.02374	0.02058	-1.15358
	Sum of Lags	-0.06344	0.02638	-2.40461

5. DISCUSSIONS OF RESULT

The estimates of the models show that in Model One, which is simple regression with a trend, the construction sector significantly predict the performance of the GDP. The model supports the opinion that the construction sector plays a fundamental role in the growth and development of the Nigerian economy. The estimates of model two (a DLM with a trend) indicates that only the current construction sector is significant. The estimates of model three (an ADL with the inclusion of the lag of the regressand (GDP)) indicates that only the one-year lag of the GDP significantly causes the GDP. The estimate of Model four (a PDL of two degrees and four lags) indicates that the first three lags i.e. 0, 1 and 2 have significant effect on the GDP. The estimates of Model five (an autoregressive PDL with the addition of lag of the GDP) indicate that only the lag of the GDP is significant. The summary of the model estimates 1 through 5 shows that the construction sector has significant effect on the GDP (models 1,2 & 4) but no significant effect (models 3 & 5) with the addition of an autoregressive term of the GDP, which indicates that the effect of construction sector on the GDP is not robust.

The significant effect of the construction sector on the GDP can be explained by using the classical, endogenous, and neoclassical growth theorems. All growth theories make investment including construction as one of the drivers of growth in the output function (Grifiths & Alan, 1999; Begg, Fischer, & Dornbusch, 2000; Samuelson & Nordheus, 2005). The sector contributes up to 10percent to the GDP, at least 50percent to Gross Domestic Fixed Capital Formation (GDFCF) and up to 10percent of employment (Hillebrandt, 1988). A number of reasons may be adduced for the non-robustness of the construction sector effect on the GDP: firstly, the construction sector /GDP ratio has a mean of 3.26percent and ranges between 2.05percent and 5.71percent (less than 10%). This shows that construction contribution to the GDP is low compared to a typical MIC economy as explained by the Bon curve (see for example Bon, 1988, 1990, 1992, 2000 & 2001). Bon finds that the construction sector follows an inverted U-shaped pattern of development both in terms of total construction sector output and construction sector share in total GDP as an economy develops from LICs to MICs and eventually to HICs. This implies that the share of construction sector in the GDP is highest around the MIC stage (around 10percent). Nigeria as a lower MIC economy ought to have a construction sector GDP ratio tending towards 10percent on the average in order to make robust impact on the GDP. Additionally, the average annual construction growth rate (CGR) range from -31.11percent to 24.32percent during the period under review (1970 through 2016) which is too volatile to have consistent impact on the GDP growth. In other words, the performance of the construction sector over the period under review may have been abysmally low, volatile and declining in contributions to the GDP (Ukwu, Obi & Ukeje, 2003; UNSD, 2018).

Secondly, unfriendly political economy. Politically over 60percent of construction works are public works which directly implies that budgeting of public works is a major factor for the sustainable development of the construction sector. Thus when government adopts unfriendly economic programme e. g. SAPs with tight fiscal and monetary policy with the construction sector is at the receiving end. This unfortunately has been problematic for the Nigerian construction sector. Public projects are riddled by corruption, delays, cost and time overrun and abandonment which remain intractable. In summary the low performance of the Nigeria's construction sector is often blamed on the low budgeting and poor implementation of the annual budget for many years (Isa et al. 2013).

Thirdly, the Nigerian economy has been unstable owing to the heavy dependence on oil export led growth. Thus volatility in the international oil market is often replicated in the Nigerian economy. Another factor is the low saving rate and investment rate of the Nigerian economy (Ross, 2003). Thus, the construction sector had poor growth for many years, especially between 1990 and 2001. Therefore, Nigeria has a much higher infrastructure deficit than other emerging markets of Asia and South America especially in terms of paved roads, railway routes, and airport infrastructure capacity (Oluwakiyesi, 2011).

Fourthly, the growing overdependence of the construction sector on foreign resources. The construction sector is heavily dominated by few large multinational construction contractors (MNCCs) from Western Europe and Asia that control the lion share of the of construction works. The low local content of the construction sector adversely affects the linkages of the construction sector to other sectors of the economy (see for example Aniekwu, 1995; Aniekwu, 2007; Baukley, Faulky & Olajide, 1993; Husseini, 1991; National Industrial Revolution Plan (NIRP), 2014; Ogbebor, 2002; Olugbekan, 1991; Oseni, 2002; & Wahab, 2005).

Fifthly, the NCS is also notorious for its plethora of project delays; cost and time overrun and project abandonment. This is a major challenge to managers of the NCS, because project delays and abandonment are economic waste and diminish the construction sector contribution to the GDP (see for example Akinsola, 1996; Aniekwu, 1995; Elinwa & Joshua, 2001; Okpala & Aniekwu, 1988; & Olomolaiye, Wahab & Price, 1987 etc.).

6. CONCLUSION

The study concludes that the Nigerian construction sector has a positive significant impact on the GDP during the period under review. However, the impact of the sector on the GDP is not robust which may be as a result of a number of factors: firstly, low, volatile and declining GDP contribution. The construction sector contributions to the GDP range between ranges between 2.05percent and 5.71percent and on the average 3.26percent(less than 10%) during the period under review; poor government budget allocation and implementation given that government is responsible for at least 60percent of annual construction sector output; instability in macroeconomics due to the volatility of international commodity market; overdependence on foreign resources; and finally the plethora of project delay, cost and time overrun and abandonment in the construction sector.

7. RECOMMENDATIONS

As a developing economy, Nigeria needs massive investment in physical infrastructure for sustainable development. One fundamental way of overcoming the low and declining input of construction to the GDP is the level of development of the national financial system most especially the capital market to access fund for infrastructure development. Politically, the government is responsible for at least 60percent of the construction sector output and thus the single largest driver of the construction sector output and contribution to the construction sector. It is important for the construction sector, that government (federal & states) sustains a consistent and growing budgeting for housing and transport construction. Additionally, government fiscal and monetary policy and other policy on the economy may have significant effect on the construction output.

Economically, volatility in the economy due to international commodity market must be managed through diversification of export and the economy. Stability in the economy will enable both private and public sectors to have a friendly environment for planning and implementation of construction projects.

Local content and linkages: the construction sector over dependent on foreign construction resources including contracting, machinery/equipment and materials etc. this makes the sector an enclave in the economy and severe negative effects on balance of payments (BOPs) account. Government local content policy on the construction will improve the NCS backward and forward linkages and contribution to the GDP. Project cost and time overrun-managers of the NCS must improve their project management capability to minimize or eliminate project time and cost overruns.

Finally, the paper advocates for a fresh construction policy on housing and transport for the sustainable development of the Nigerian constructed infrastructure.

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