Nigerian Construction Sector, Domestic Fixed Capital Formation and Gross Domestic Product of Nigeria

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Domestic Fixed Capital (DFC) is one of the most fundamental requirements for economic diversification. The slow growth of DFC has been identified as one of the most important challenges facing sub Saharan Africa. The study empirically examined the causal relationship between the Nigerian Construction Sector (NCS) output and Gross Fixed Capital Formation (GFCF) and the Gross Domestic Product (GDP) using Nigerian Time Series Data (TSD) from 1970 through 2013. The empirical investigation is carried out using vector error correction Model (VECM) framework. Data is sourced from United Nations Statistic Department (UNSD). The results of the co-integration test suggest the existence of a long-run relationship between the NCS, GFCF and GDP. The results show that the NCS positively causes GFCF and GDP growth. The finding implies that Nigeria can accelerate its GFCF and GDP growth by increasing investment in the NCS.

Keywords: Nigerian construction sector, gross fixed capital formation, gross domestic product,

INTRODUCTION

Domestic Capital Formation (DFC) or physical infrastructure is one of the fundamental requirements for Gross Domestic Product (GDP) growth and development. Thus, the growth of human resources must be accompanied by capital accumulation for sustained growth and development (Kuznets & Jenks, 1961; Umo, 1979). The Chinese economic growth and development strategy has been characterized by a high growth rate of DFC (Okonjo-Iweala, 2010). The slow growth rate of DFC has since been identified as one of the most important challenges facing Less Developed Countries (LDCs) especially in Africa (Calderón & Servén, 2008). The poor state of DFC in Africa cuts national economic growth by two percentage points every year and reduces productivity by as much as 40 percent (Foster & Briceño-Garmendia, 2010). Thus, virtually all strategies for African economic development list DFC as a top priority (Calderón & Servén, 2008). The debate on the role of DFC in economic development has been inspired by the increasing pressures of fiscal adjustment in most economies resulting in decreasing public sector participation in DFC; and the increasing Private (sector) Participation in Infrastructure (PPI). This reflects an increasing reliance on market mechanisms leading to Public Private Partnerships (PPPs) in public DFC for example roads, rail and ports (Calderon, 2009).The construction sector (CNS) is the single largest contributor to the DFC, and it is responsible for at least 50 percent of the DFC in LDCs including Nigeria. Thus, the slow rate of growth of construction goods and by extension the DFC is responsible for the slow GDP growth rate, unemployment and poverty elongation of most LDCs (see BBC, 2013; Doumbia-Henry, 2003; DPW, 2001; Hillebrandt, 1984, Ofori, 2000; Pietroforte & Gregori, 2006; Rwelamila, 2006; Seaden & Manseau, 2001; UNCHS, 1984; Wells, 1984 ; World Bank , 1984 etc.). In contrast to the extant literature focus which dwells on the impact of DFC on GDP growth (See for example Prest and Stewart, 1953; Hawkins, 1959; Aboyade, 1966; Hooley, 1967; Umo, 1979; Akpokodje, 2000; & Ebajemito *et al.*, 2004), this study examined the impact of the CNS on the DFC and GDP growth. Studies on the effect of the CNS on the Gross Fixed Capital Formation (GFCF) are hard to find in the body of literature. It is against the backdrop that this study examined the impact of the Nigerian Construction Sector (NCS) on the GFCF and the GDP using the Vector Autoregression (VAR) methodology.

LITERATURE REVIEW

The roles of DFC in growth and development are critical and have been confirmed by classical, neoclassical and modern growth theories (see for example Smith 1776; Keynes 1936; Robinson, 1949). The Harrod (1939)-Domar (1946) Model delineates a functional economic relationship in which the growth rate of Gross Domestic Product (GDP) (g) directly depends on the national saving ratio (s) and inversely on the national capital/output ratio (k) so that it is written as $g = s/k$. The Solow (1956) **exogenous** growth model postulates that output is produced using labour and DFC. The New (Endogenous) Growth Models of Romer (1990) comprises four factors: capital, labour, human capital and technology. Thus, in summary, all the growth models recognised DFC as one of the pillars of economic growth. In spite of the importance of DFC, the needs for fiscal adjustment in Africa have forced cuts in public DFC spending. Unfortunately this has not been matched by a corresponding increase in private DFC, hence the insufficient provision of DFC and slow growth (see for example Easterly & Servén, 2003; Blanchard & Giavazzi, 2004 etc.). Perkins et al., (2005) and Kularatne (2005) report a bi-directional relationship between DFC and the GDP. Lederman et al., (2005) find that the efficient provision of DFC is crucial for the success of trade-liberalization strategies aimed at optimal resource allocation and export growth.

A growing body of literature focused on theoretical and empirical contribution of DFC to productivity and growth in Africa (Ndulu, 2006; Ayogu, 2007). Wheeler, (1984), Faruqee, (1994); Arbache, et al., (2008); Kingombe, (2011) identifies inadequate DFC, poor human capital, political instability and inappropriate policies as major constraints of growth in Africa. Easterly and Levine (1997) suggest that the ethnic diversity in Africa may explain inappropriate policy decisions and inefficient provision of public DFC in the region. Ayogu (1999) finds a strong association between DFC and output in Nigeria. Reinikka and Svensson (1999) find a significant negative effect of unreliable electricity on investment in Uganda. Limao & Venables (2001) Elbadawi et al., (2006) Behar & Manners (2008) find that inadequate DFC result in high transportation costs that hamper intra and inter-regional trades. Diao and Yanoma (2003) show that growth in the agricultural sector is constrained by a high marketing cost, which reflects poor transportation. Estache et al., (2005) discovered that roads, power and telecommunications DFC contributes significantly to long-run growth in Africa. Lumbila (2005) opines that inadequate DFC may negatively affect FDI impact on African economic growth.

Boopen (2006) examines the growth impacts of transportation DFC using both cross sectional and panel data estimation for a sample of 38 SSAs and a sample of 13 SIDS over the years 1980-2000. The study concludes that transportation DFC has a significant effect on the GDP. Estache (2006) finds that levels of private participation in the electricity, water and sanitation, telecoms and transportation sectors in Africa were at or above the levels in other LICs. Kamara (2006) uses data from African countries to estimate various dynamic panel effects of DFC in an aggregate production function augmented with indicators of the quality of macroeconomic policy. Estache and Vagliasindi (2007) find that an insufficient power generation capacity restricts growth in Ghana. Ndulu (2007) finds insignificant private participation in African DFC. Dinkelman (2008) finds significant impact of household electrification on employment in South Africa's rural labour markets. Calderón (2009), using data on 39 African countries from 1960–2005 estimates the impact of DFC on per capita growth in three DFC areas (i.e. telecommunications, electricity & roads) based on econometrics. The study finds that volume and quality of DFC stocks significantly and positively impact on economic growth. Kingombe (2011) asserts that DFC formation and maintenance can be very expensive, especially in landlocked, rural and sparsely populated countries in Africa.

More recently, increasing attention has been paid to the impact of DFC formation on poverty and inequality. Empirical evidence shows that DFC in rural roads reduced poverty level in Peru (Escobal & Ponce, 2002) Georgia (Lokshin & Yemtsov, 2005) Bangladesh (Khandker et al., 2006) and Vietnam (Mu & van de Walle, 2007). Estache et al., (2000, 2002); Estache, (2003); Calderón & Chong, (2004); Calderón & Servén, (2004); López, (2004); Galiani et al., (2005); Calderón & Servén, (2008a) assert that other things being equal, DFC may have a disproportionate effect on the income and welfare of the poor by raising the value of the assets they hold or by lowering the costs to access the markets. DFC plays a fundamental role in the promotion of growth and equity and helps to reduce poverty through both channels. However, for DFC to reduce income inequality, it must help expand access by the poor.

Macroeconomics and Domestic Capital Formation (Dfc)

The process of DFC formation essentially comprises three steps; increase in real savings, mobilizing savings through financial institutions and investment of the savings. DFC formation therefore fluctuates during business cycles similar to the characteristic of the savings of individuals, firms and governments. DFC formation thus represents the real savings of a nation (Kuznets & Jenks, 1961; Umo, 1979). A socially optimal quantity of DFC formation depends on the demand for and supply of funds

(Chiriniko & Morris, 1994). Thus, only high saving economies are able to achieve an optimal DFC formation level and prosperity (De Long & Lawrence, 1991). DFC thus remains a major challenge in Africa due to wide savings-investment gap and a declining savings rate (Aryeetey & Urdry, 2000). Restrictive monetary and credit policies tend to raise cost of capital by raising the real cost of bank credit, a major source of investment financing in LDCs and by increasing the opportunity cost of retained earnings, the other main source of investment financing in LDCs. Through both mechanisms, the result is a decline of investment (Servén & Solimano, 1993). However, some studies found no significant effect of interest rates on investment demand. This may be as result of the repressed financial markets that characterize many LDCs. Credit policy affects investment directly, through the credit available to firms with access to preferential interest rates, rather than indirect interest rate channel. The latter will also operate for the firms that borrow in the unofficial money market (van Wijnbergen, 1983). This direct role of credit availability is in empirical studies (Dailami, 1990). Fiscal deficits push up interest rates and/or reduce the availability of credit to the private sector and tend to crowd out private investment. Balassa (1988) reports a cross-section data (CSD) and estimates that public and private investments are negatively related. Hence, Khan and Reinhart (1990) suggest a reduction of deficit and that governments should aim at creating conditions favourable to private investment. However, empirical studies have reported complementarity between public and private investment (Greene & Villanueva, 1991). Reduced public investment, some of which tend to be complementary with private investment may result in the fall of private investment (Servén & Solimano, 1993). Public DFC formation can have a strong influence on the productivity, cost and return rate of private DFC (Munnell, 1992). Exchange rate depreciation may affect DFC through three main channels: the real cost of capital goods, the real interest rate and real output.

First, a real depreciation tends to raise the real cost of capital goods in terms of domestic goods. This is because DFC in most LDCs has a high import content whose relative price is increased by a real devaluation (Servén & Solimano, 1993). This tends to depress DFC formation in non-tradable activities (Branson, 1986). In the traded goods sector however, the opposite happens: the real cost of DFC formation in terms of final goods falls and DFC formation rises. In the short run, a real devaluation has an adverse impact on DFC through this cost-of-capital-goods effect.

Second channel is the real interest rate. If devaluation is unanticipated and interest rates are determined in the money market, devaluation raises the price level through its impact on the cost of imported intermediate inputs and wages under indexation. On the one hand, if monetary policy does not fully accommodate the increase in the price level, real money balance falls, pushing up the real interest rate for a given rate of (anticipated) inflation. Hence, the user cost of capital rises and DFC formation falls. On the other, if devaluation is anticipated and it succeeds in eliminating expectations, then it may result in an increase in DFC formation. The required return on capital would tend to fall reflecting a reduction in the anticipated devaluation. Third channel is the aggregate demand. In the short run, real devaluation adversely affects income and aggregate demand. If the net effect of currency devaluation is contractional, then DFC formation will fall. In the medium term, however, with a sufficiently strong impact of devaluation on net exports, an expansionary outcome for output and DFC formation may increase. This becomes more likely as time passes and substitution effects gradually come into play (Servén & Solimano, 1993).

Nigerian Domestic Fixed Capital (DFC) Formation

Prest and Stewart (1953) and Hawkins (1959) are the earliest studies of DFC in the Nigerian economy. These studies were limited and concentrated only on imported capital goods to the detriment of important indigenous components of DFC. These studies excluded African styled dwellings which were the most visible contribution of the citizens to DFC; this invariably means a gross underestimation of Nigerian DFC. Aboyade (1966) did the first objective DFC study tailored toward Nigerian environment as most of the concepts and measurement were modified to suite local realities. Hooley, (1967) asserts that estimates of the DFC are considered an integral part of national accounts statistics (NAS) and useful estimate of DFC in LDCs can only be achieved where the method of estimation adopted are appropriate to the economic system they are purport to describe. Umo (1979) concludes that Nigeria must grow and optimally utilize DFC especially in critical areas of the economy. Akpokodje (2000) finds that exports earnings fluctuation in Nigeria adversely affects DFC formation in the short run and that changes in the official interest rate appear not to affect DFC formation. The study therefore suggests export stabilization schemes as likely stimulant to DFC formation. However, the impact of such stabilization schemes on DFC may not be very large. This implies that other fiscal policy instruments may have stronger impact on DFC under the assumption that they affect output directly. Ebajemito *et al.*, (2004) find that impediments to Nigerian DFC formation include capital income tax, government budget deficits and externalities. Capital income taxation distorts the savings and private DFC and cause the amount of DFC determined by the market to fall. Government deficits create a shortfall in private DFC formation by reducing the pool of savings available for private sector, thus crowding out private DFC formation. If the deficits are not used for DFC formation total DFC formation falls. This has been the case with Nigeria since the 1980s oil glut and the subsequent fiscal deficits. Servén and Solimano (1993) assert that most LDCs experienced investment slowdown following the outbreak of the debt crisis in 1982 and remained depressed for the rest of the decade. Faruqee (1994) finds that Nigeria particularly had difficult economic problems which led to adoption of Structural Adjustment Programmes (SAPs) in 1986 and a significant decline in both public and private DFC formation.

The Nigerian Construction Sector (NCS)

The Nigerian Construction Sector (NCS) is a major sector in the Nigerian economy; available statistics (though inadequate) reveals that the NCS have significantly contributed to the growth and development of the national economy. The NCS share of GDP has fluctuated between 4 percent and 10 percent since the 1960s. The contributions of the NCS to total employment have also been very significant fluctuating between 10 percent and 20 percent since the 1960s. The NCS decline in the 1980s is due to the fall in oil revenue, the implementation of SAPs and the forced suspension of many construction projects (Faruqee, 1994). The NCS stands out as the most important single contributor to DFC in Nigeria. In the pre-independent era, the NCS accounted for about 40 percent of the DFC formation and in the post independent era the proportion increased to more than 50 percent. The NCS, has however not made commensurate impact on growth and development, through backward and forward linkages to other economic sectors. One reason is that the NCS showed a residential building bias rather than other engineering DFC.

Additionally, the NCS is associated with misallocation and wastage of resources through corruption and inefficiency. Finally, there is a growing dependency on imported construction contents including technology and materials (Aboyade, 1966). Multinational Construction Contractors (MNCCs) dominate the NCS due to their superior technology and credibility in public DFC projects. This has adversely affected local content development of the NCS with the direct result that most Nigerian Indigenous Construction Contractors (NICCs) are stunted in growth and development. Other challenges of the NCS include the dominance of government, instability, time and cost overruns etc. However, the NCS is fairly large. The annual growth rate is among the highest in Nigeria. The NCS is projected to continue to grow as long as the international oil price remains high and the development of DFC remains a government priority. Nigeria has the potential to become one of the largest construction markets in Africa. The NCS is forecast to have one of the fastest growth rates in the world. There is also a growing participation of the private sector in the provision of important DFC (Dantata, 2008).

RESEARCH METHOD

The basic work horse of multivariate time series analysis (MTSA) is the Vector Autoregression (VAR) model. This is a direct generalization of the univariate Autoregression (AR) model to dynamic multivariate time series data (MTSD). The VAR model has proven to be especially useful for describing the dynamic behaviour of economic and financial time series data (TSD) and for forecasting. It is also used for structural inference and policy analysis (Hall, 1994; Patterson, 2000). Following the Granger representation theorem VAR can easily be transformed into the Vector Error Correction

Model (VECM). When the I (1) variables are co-integrated, the approach of formulating the VAR model in first difference is inappropriate. The correct model is a co-integrated VAR in levels or a VECM i.e. a VAR in first differences together with the vector of co-integrating residuals (Robertson & Wickens, 1994). According to Engle and Granger (1987), when a set of variables I (1) are co-integrated then short run analysis of the system should incorporate an Error Correction Term (ECT) in order to model the adjustment for the deviation from its long run equilibrium. The VECM is therefore characterised by both differenced and long run equilibrium models thereby allowing for estimates of short run dynamics as well as long equilibrium adjustment process. The VECM is used for correcting disequilibrium in the co-integration relationship captured by the ECT, as well as to test for short and long run causality among co-integrated variables. The VECM is specified as follows:

$$\Delta LCNS_t = \emptyset_1 + \sum_{i=1}^{p-1}\beta_{11i}\Delta LCNS_{t-i} + \sum_{i=1}^{p-1}\beta_{12i}\Delta LGFCF_{t-i} + \sum_{i=1}^{p-1}\beta_{13}\Delta LGDP_{t-i} + \alpha_{11}ECT_{t-1} + \varepsilon_{1t} \quad (1)$$

$$\Delta LGFCF_t = \emptyset_2 + \sum_{i=1}^{p-1}\beta_{21i}\Delta LCNS_{t-i} + \sum_{i=1}^{p-1}\beta_{22i}\Delta LGFCF_{t-i} + \sum_{i=1}^{p-1}\beta_{23}\Delta LGDP_{t-i} + \alpha_{21}ECT_{t-1} + \varepsilon_{2t} \quad (2)$$

$$\Delta LGDP_t = \emptyset_3 + \sum_{i=1}^{p-1}\beta_{31i}\Delta LCNS_{t-i} + \sum_{i=1}^{p-1}\beta_{32i}\Delta LGFCF_{t-i} + \sum_{i=1}^{p-1}\beta_{33}\Delta LGDP_{t-i} + \alpha_{31}ECT_{t-1} + \varepsilon_{3t} \quad (3)$$

Where i=1…. N denotes the lag, t=1….T denotes the time period; ε_t is assumed to be serially uncorrelated error term; ECT is the lagged error term derived from the long term cointegrating relationship. According to Ang and McKibbin (2007) three types of Granger causality tests can be performed through the VECM framework: the short run Granger causality and the long run weak exogeneity test. The VECM is used to perform the Johansen co-integration tests.

Time Series Data (TSD)

The annualized TSD for the study was extracted from the United Nations Statistics Division (UNSD) available at http://unstats.un.org/unsd/economic. The data were based on GDP/breakdown at constant 2005 prices in US Dollars. The data covers a twenty-five year period between 1970 and 2013. This includes the Gross Domestic Product (GDP), Gross Fixed Capital Formation (GFCF) and Construction Sector (CNS). Table 1 presents the descriptive statistics of the series.

Definition of Terms

Gross Domestic Product (GDP): This entry in the national account statistics (NAS) is the aggregate monetary value of final goods and services produced in a country within a given year (in 2005 USD)

Gross Fixed Capital Formation (GFCF); This entry in the NAS includes current construction, flow of producers' durable equipment to users, net additions to inventories of business units and other agencies (but not households) and net changes in claims against foreign countries (Kuznets & Jenks, 1961).

Construction Sector (CNS) Output: This entry in the NAS is the total expenditure on new constructed facilities and on the maintenance of constructed facilities within the economy in a given year. This entry in the national account also includes money expended (Adamu, 1996).

Causality and Exogeneity

Causality concerns actual links between variables in the economy, whereas exogeneity is the property of being 'determined outside the model under analyses, so concerns the analysis of models conditional on putative exogenous variables without loss of relevant information. Concepts of weak, strong and super exogeneity relate contemporaneous explanatory variables to parameters of interest, to sustain valid conditional inference, forecasting and policy analysis respectively (Hendry, 1980). The various tests of exogeneity are important because weak exogeneity is needed for estimation purposes and for testing, strong exogeneity for forecasting and super-exogeneity is required for policy analysis (Caporale, 1996).

The Granger causality test is a statistical hypothesis test for determining whether one time series is useful in forecasting another (Granger, 1969). A time series X is said to Granger-cause Y if it can be shown, usually through a series of t-tests and F-tests on lagged values of X (and with lagged values of Y also included), that those X values provide statistically significant information about future values of Y. In practice, testing for Granger causality is carried out by testing for the significance of past values of the dependent variable in the marginal equation. However, conclusions drawn from granger test are affected by the number of lags, the sample period, choice of variables, and invalid weak exogeneity assumptions. Indeed, empirical findings of Granger causality, or its absence, need not entail an actual link (or its absence) in the DGP once non-stationarity is allowed (Hendry & Mizon, 1997).

The Weak exogeneity in a co-integrated system is a notion of long-run causality (Hall & Milne, 1994). However, the restrictions are meaningful if the adjustment coefficients or the loading factor which simply measures the speed of adjustment of variables is statistically significant and negatively signed (Wickens, 1996). Additionally a weak exogeneity is simply a variable in a co-integrated system that does not respond to discrepancy arising from long-run relationship. In other words, a variable is weakly exogenous if the coefficient of the speed of adjustment is zero i.e. $\alpha_i=0$, and this indicates that there is no feedback response from the system (Enders, 2004).

Thus, a test of zero restriction (i.e. $\alpha=0$) is a test of weak exogeneity (Johansen, 1992; Johansen & Joselius, 1992). Hall and Wickens (1993) and Hall and Milne (1994) showed that the long-run causality is more efficient because it does not require two-steps procedure of estimating the co-integration relationship and the test of non- causality in ECM framework. Luintel and Khan (1999) suggest that long run causality is slightly different from the normal Granger causality as it does not take into account the short run dynamics. Strong exogeneity is the joint hypothesis of weak exogeneity and Granger's non causality. Strong exogeneity requires weak exogeneity plus the absence of Granger causality (Hunter, 1992; Cerqueira, 2009). The concept of super exogeneity combines weak and the invariance of conditional parameters to interventions changing marginal parameters (Hendry, 1980). In the present study using eqn 2 to test short run causality from ΔCNS to ΔGFCF, the study use the null hypothesis Ho: the null hypothesis $\beta_{21i}=0$, if this is rejected then it suggest that CNS causes GFCF. To test the long run causality i.e. the weak exogenous test, we use the null hypothesis Ho: $\alpha_{21}=0$ by using likelihood ratio test with χ^2 distribution. The overall causality in the system is tested through the strong exogeneity test. To perform the strong exogeneity test $\Delta LCNS_t$ does not cause $\Delta LGFCF_t$, we use the null hypothesis Ho: $\beta_{21i}=0=\alpha_{21}=0$, if the hypothesis is rejected it means LCNS significantly causes GFCF. The VECM procedure however involves modelling the series after stationarity and co-integration status of the series has been determined.

Test for Stationarity and Co-integration

Co-integration analysis necessitates that variables under consideration are integrated in the same order. Hence, it is necessary to undertake unit root tests before co-integration analysis (Ghirmay, 2004). The formal method to test the stationarity of a TSD is the unit root test. Augmented Dickey Fuller (ADF) test (Dickey & Fuller, 1979) and Philips-Perron (PP) tests (Phillips & Perron, 1988) are applied to test the time series data (TSD) for unit root. Yule (1926) suggests that regressions based on trending TSD could be spurious. The problem of spurious regression led to the concept of co-integration (Granger & Newbold, 1974; Granger, 1981). Two time series are said to be co-integrated, when both are non-stationary, but a linear combination of those time series is stationary (Engle & Granger, 1991). The stationary linear combination is called the co-integrating equation and may be interpreted as a long run equilibrium relationship between the variables. The co-integration analysis is performed with a VAR co-integration test, using the methodology developed by Johansen (1988 &1991) and Johansen and Juselius (1992).

Forecast Error Variance Decomposition (FEVD)

With ECM, it is possible to dictate a variable which is either endogenous or exogenous to the system but the relative degree of its endogeneity or exogeneity can only be effectively determined through the FEVD. The FEVD in essence shows the portion of the forecast error variance for each variable that is attributable to its own innovations and to innovations from the other variables in the system (Lütkepohl, 2007; Brooks, 2008; Olusegun, 2008). Therefore, if a variable is mainly explained by its own shocks and less by the other variables in the system, it can be said that such variable is exogenous (Masih *et al.*, 2009). This forecast error is a result of the variation in the current and future values of shocks. In line with what is expected, most of the forecast error variance of a variable is usually explained by its "own" innovations. The order of the variables is important while performing both IRFs and FEVD. The FEVD depends on the recursive causal ordering used to identify the structural shocks. Different causal orderings will produce different FEVD values. The VAR technique is used to estimate the FEVD.

Impulse Response Functions (IRFS)

The IRFs play an important role in describing the impact that shock has on economic variable and their propagation mechanism. The IRFs are used to analyse the response of current and future value of economic variables to a one-standard deviation increase in the current value of the VAR identified shocks. The IRFs describe the reaction of endogenous macroeconomic variables such as output, consumption, investment and employment at the time of the shock and over subsequent points in time (Lütkepohl, 2008). Shock is used to denote a change or an unexpected change in a variable or perhaps simply the value of the error term during a particular time period. A shock to the i-th variable not only directly affects the i-th variable but it is also transmitted to all other endogenous variables through the dynamic (lag) structure of the VAR (Brooks, 2008). Existing methods for constructing IRFs and their confidence intervals depends on auxiliary assumption on the order of integration of the variables. The estimate of the IRFs and their confidence interval are commonly based on Lutkepohl (1990) asymptotic normal approximations or bootstrap approximations to that distribution (Kilian, 1998).

Empirical Estimation

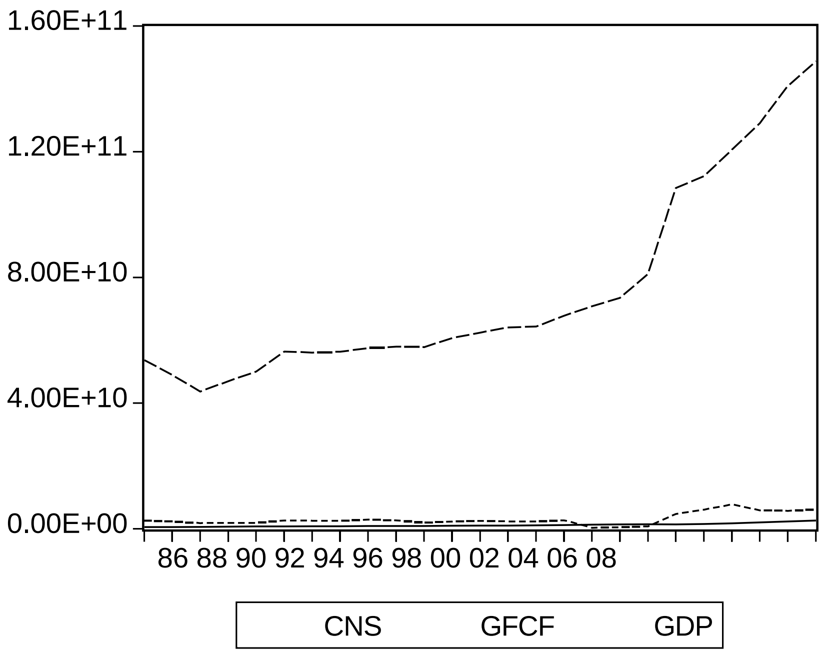

Figure 1 line graph of LCNS, LGDP and LGFCF

Fig. 1 shows the changing trends for each of the TSD for Nigeria. The line graph shows that the GDP had a downward growth between 1985 and 1987. From 1987 it begins an era of fast growth up to 1990; it then begins a moderate growth up to 2009. For the GFCF there was a downward growth between 1985 and 1987 and an upward growth between 1987 and 1993. The growth took a downward direction between 1993 and 1995. Thereafter, a positive growth ensues from 1995 through 2000, then a downward growth in 2001. From 2002 begins another era of positive growth leading to 2006 and then downward growth up to 2008 and another positive growth up to 2009. For the CNS the line indicates a slow growth between 1985 and 2003 and then a downward growth to 2004 afterwards a fast growth began leading to 2009.

Table 1 Descriptive Statistics of the Series

	CNS	GFCF	GDP
Mean	1.25E+09	3.08E+09	7.56E+10
Median	1.08E+09	2.57E+09	6.24E+10
Maximum	2.66E+09	7.83E+09	1.49E+11
Minimum	6.35E+08	4.20E+08	4.37E+10
Std. Dev.	5.39E+08	1.91E+09	3.13E+10
Skewness	1.114692	0.965800	1.180091
Kurtosis	3.520245	3.085039	2.986884
Jarque-Bera	5.459175	3.894071	5.802740
Probability	0.065246	0.142696	0.054948
Sum	3.13E+10	7.71E+10	1.89E+12
Sum Sq. Dev.	6.98E+18	8.74E+19	2.35E+22
Observations	25	25	25

Table 1 presents the descriptive statistics of the three TSD CNS, GFCF and GDP. The statistics shows that the CNS has a mean of 1.25E+09 and a standard deviation of 5.39E+08, the Jacque-Bera value of 5.459175 with a p value <0.10 suggest a normal distribution. The statistics shows that the GFCF has a mean of 3.08E+09 and a standard deviation of 1.91E+09, the Jacque-Bera value of 3.894071 with a p>0.10 suggest not a normal distribution . Finally, the statistics shows that the GDP has a mean of 7.56E+10 and a standard deviation of 3.13E+10, the Jacque-Bera value of 5.802740 with a p<0.10 suggest a normal distribution.

Unit Root Test Estimates

Table 2 presents the result of the unit root showing that the null hypothesis of unit root for the series in level form with and without time trend is rejected at all conventional levels of significance when the calculated ADF and PP test statistics associated with the numerical coefficients of CNS, GDP and GFCF are compared with their critical values as given in Engle and Granger (1987). For this reason, it is assumed that all of the series are non-stationary based on the raw data series. The series were then transformed into natural logarithm and the unit root test rerun, the ADF and PP tests statistics then reject the hypothesis of a unit root at conventional levels of significance for all the series after first difference (i.e. I (1) series). The ADF and PP test statistics (p values) for log level of CNS (LCNS), GFCF (LGFCF) and GDP (LGDP) are reported in the table 2. It can be observed that the ADF and the PP tests lead to almost the same conclusion regarding the integration properties of the series. All the series are therefore taken as difference stationary i.e. I (1).

Table 2: Result of Unit Root Tests for LCNS, LGDP and LGFCF

	ADF	ADF 1st dif	PP	PP 1st dif	Conclusion

	No trend	With trend	No trend	With trend	No trend	With trend	No trend	With trend	
LCNS	0.9650	0.9985	0.0265**	0.0577*	0.0095**	0.0095**	0.0208	0.0653*	I(1)
LGDP	0.9988	0.9989	0.0053***	0.0057***	0.9098	0.9098	0.0052***	0.0053***	I(1)
LGFCF	0.3468	0.2685	0.0018***	0.0089***	0.4764	0.4764	0.0018***	0.0092***	I(1)

The asterisks *, ** or *** denotes rejection of the hypothesis at the10%, 5% or 1% level respectively p values are shown

Co-Integration Test Estimates

Table 3 reports the results of co-integration tests, the null hypothesis is that there is no co-integrating vector and the alternative is that there is one co-integrating vector. The results reveal that both the trace tests and the maximum Eigen value test reject the null hypothesis of zero co-integrating vectors in favour of one co-integrating vector at the conventional 5 per cent significance level. The establishment of co-integration confirms the existence of a long-term equilibrium contemporaneous relationship between the series and that they have a common trend. This rules out the possibility of a spurious relationship between the variables and suggests that a causal relationship must exist in at least one direction. However, although co-integration suggests the presence of Granger causality between the variables, it does not provide information on the direction of causal relationships. Therefore, the direction of causality is identified using the VECM derived from the long run co-integrating vectors.

Table 3 Johansen Co-integration Tests: LCNS, LGFCF& LGDP

Null Hypothesis	Alternative Hypothesis	Trace λ	0.05 critical values	Prob.**	Max λ	0.05 critical values	Prob.**
R=0	r≥1	42.8833**	29.7971	0.0009	29.6016**	21.1316	0.0025
R≤1	r≥2	13.2817	15.4947	0.1049	12.1064	14.2646	0.1067
R≤2	r≥3	1.1753	3.8415	0.2783	1.1753	3.8415	0.2783

r indicates the number of co-integrating vector. (**) and (*) indicate statistical significance at 1% and 5% levels of significance. Trace test indicates 1 co-integrating eqn (s) at the 0.05 level

Co-Integrating Vectors Estimates

The long run coefficient elasticities of the co-integration vectors are examined by the long run structural modelling of Pesaran and Shin (2002). Thus, the study imposes normalisation restriction only given that there is just one co-integrating vector from the Johansen co-integration test. Normalisation restriction is imposed on the LGFCF with respect to β_{22}, since the main focus of this study is on the long-run causality between LCNS, LGFCF and LGDP. Table 4 presents the estimated coefficients associated with the identified co-integrating vector. The co-integrating vector shows that the co-integrating coefficient of LCNS is statistically significant at 1% level while the coefficient of the LGDP though significant carries a negative sign. An examination of the results of the loading factors indicate that the null hypothesis that the loading factor α_{21}=0 is rejected at the 5 percent level of significance. It also carries the appropriate sign (i.e. negative). The adjustment speed is 43% which is quite good. This statistically indicates that DFC formation is significantly and positively caused by construction sector output and negatively by the GDP. In the overall, the results provide evidences of positive long-run causal effects from LCNS to the GFCF.

Table 4: Long-Run Coefficient of the Co-Integrating Vector

s/no	Normalising on LGFCF	Loading factor (α)
1	LGFCF= 38.70909 +5.253459LCNS(-1) -6.806465LGDP(-1)	-0.432060
	[8.62319] [-10.4504]	[-1.43344]

(*) (**) and (***) show the rejection of null hypothesis at 10% 5% and 1% respectively and all figures in parentheses are t-statistics.

Causality and Exogeneity Test Estimation

The short-run causality estimates are presented in table 5. The result indicates significant short-run causality between LCNS and LGDP. The LCNS significantly causes LGDP χ (7.389716) p value (0.0249) while LGDP does not cause the LCNS significantly. Thus, a unidirectional cause and effect relationship exists between the LCNS and LGDP. There is no short-run Granger causality between LCNS and LGFCF or between LGDP and LGFCF.

Table 5 Result of Causality and Exogeneity Tests

Variables	Null Hypothesis	Chi-sq	Prob.
a. Granger Causality test			
ΔLGDP → ΔLCNS	$B_{13}=0$	0.626450	0.7311
ΔLCNS →ΔLGDP	$B_{31}=0$	7.389716	0.0249**
ΔLGFCF→ΔLCNS	$B_{12}=0$	2.682067	0.2616
ΔLCNS→ ΔLGFCF	$B_{21}=0$	1.384921	0.5003
ΔLGFCF→ ΔLGDP	$B_{32}=0$	0.746227	0.6886
ΔLGDP→ ΔLGFCF	$B_{23}=0$	1.135604	0.5668
b. Weak exogeneity test			
LCNS	Ho: $\alpha_{11}=0$	7.585692	0.005883***
LGFCF	Ho: $\alpha_{21}=0$	2.340604	0.126041
LGDP	Ho: $\alpha_{31}=0$	0.000376	0.984527
c. Strong exogeneity test			
LCNS → LGFCF	$B_{21}=\alpha_{21}=0$	24.63711	0.000004
LGDP →LGFCF	$B_{23}=a_{21}=0$	24.65913	0.000004
LGFCF → LCNS	$B_{12}=\alpha_{11}=0$	29.50153	0.000000
LGDP→ LCNS	$B_{13}=a_{11}=0$	22.29742	0.000014
LCNS →LGDP	$B_{31}=a_{31}=0$	32.02034	0.000000
LGFCF →LGDP	$B_{32}=a_{31}=0$	25.92069	0.000002

(*) (**) and (***) show the rejection of null hypothesis at 10% 5% and 1% respectively and all figures in parentheses are t-statistics.

The long run weak exogeneity estimate provides statistical evidence that the LCNS is significant in the system χ (0.704711) p value (0.191673). However, both the LGDP and LGFCF are insignificant in the system with χ=0.000376, p value=0.984527 and χ=2.340604, p value=0.126041 respectively. Thus, there exists a unidirectional causality starting from LCNS to the GFCF and LCNS to the LGDP in the system. It is observed that there is no feedback effect from LGFCF and LGDP (see table 5). The long run strong exogeneity tests estimates indicate that the all conceivable null hypotheses are rejected at 1% level of significance. This means that the CNS, GFCF and GDP are not strongly exogenous of each other. In this VECM, though series may be weakly exogenous, no two series are strongly exogenous (see table 5).

FEVD Estimates

Table 6 present the result of the FEVD estimates. The forecast horizon is 10 years and the contribution of each variable own shocks and to the shocks of other variables in the system are explained. For the LCNS, the result indicates that between 92 and 100 percent of its FEVD is explained by its own shocks. The result also indicates that LCNS explains between 22 and 63 percent of the error variance in the LGDP through the 10 year time horizon, which suggest that the impact of LCNS on the LGDP is significant. Similarly the LCNS also explains between 58 and 76 percent of the variance in LGFCF. For the LGDP, the LGDP explains between 37 and 54 percent of its own variance with the strength of the explanation increasing along the time. The LGDP explains a relatively less significant proportion of error variance of between 1.5 and 3 percent in the LCNS, suggesting that the LGDP has lesser significant impact on the LCNS in long run. LGDP explains between 0 and 25 percent of the variance in LGFCF. Finally for the LGFCF, the LGFCF is responsible for between 13 and 41 percent of its own variances. However, the LGFCF is only able to account for an insignificant variance of LGDP of between 0 and 24 percent worse still it explains only between 0 and 5 percent of the error variance in the LCNS. The result also indicates that the contribution of each variable to its own shock in explaining the proportion of forecast error variance at the end of 10 years horizon are 96 percent for the LCNS , 54 percent for the LGDP, and 15 percent for the LGFCF . Furthermore, the result shows that at the end of year 10 the LCNS explains 22 percent and 60 percent of error variance in LGDP, and LGFCF respectively. These confirm LCNS as the most exogenous in the system contributing more to the error variance of LGDP and LGFCF while the LGFCF is the most endogenous in the system with the least explanation of variances in the system.

Table 6 Forecast Error Variance Decomposition

Variance Decomposition of LCNS:

Period	S.E.	LCNS	LGDP	LGFCF
1	0.082033	100.0000	0.000000	0.000000
2	0.137459	95.04058	1.736955	3.222467
3	0.179190	92.33178	2.688276	4.979946
4	0.205530	92.75977	2.494628	4.745603
5	0.223677	93.86261	2.106267	4.031121
6	0.239905	94.40427	1.979631	3.616099
7	0.256463	94.71871	1.935453	3.345837
8	0.273371	95.14971	1.817393	3.032902
9	0.290022	95.62637	1.658155	2.715477
10	0.305789	96.04052	1.512084	2.447399

Variance Decomposition of LGDP:

Period	S.E.	LCNS	LGDP	LGFCF
1	0.071204	62.89855	37.10145	0.000000
2	0.116597	57.03219	37.32939	5.638420
3	0.154053	43.49477	44.25529	12.24995
4	0.189201	35.71741	47.32424	16.95835
5	0.218827	30.88857	49.57500	19.53643
6	0.244124	27.82462	51.00657	21.16881
7	0.266419	25.70653	52.09721	22.19626
8	0.287090	24.19616	52.85112	22.95271
9	0.306759	23.03745	53.40948	23.55308
10	0.325625	22.11612	53.82235	24.06153
Variance Decomposition of LGFCF:				
Period	S.E.	LCNS	LGDP	LGFCF
1	0.567891	58.43954	0.129527	41.43093
2	0.853738	79.55641	1.974763	18.46882
3	1.171484	75.52092	11.16986	13.30922
4	1.512097	68.33811	17.04435	14.61754
5	1.761863	63.52632	20.71672	15.75696
6	1.936622	61.36140	22.53945	16.09915
7	2.067117	60.55811	23.55973	15.88216
8	2.185354	60.35028	24.12262	15.52710
9	2.305101	60.21618	24.55324	15.23058
10	2.429001	59.96901	24.94935	15.08163
Cholesky Ordering: LCNS LGDP LGFCF				

Results of the IRFS

Figure 2 shows that at the responses of LCNS, LGFCF and LGDP are largely due their own shocks , while the LCNS and LGDP remain positive, the LGFCF line crosses the horizon at period 2 from positive to negative. The response of LCNS to LGDP is negative but later positive, the response of LCNS to GFCF is positive up to period when it turns negative. The response of GFCF to LCNS indicates that it remains negative throughout, while LCNS response to LGDP indicates positive all the way. For the LGDP response to LCNS is negative throughout, the situation is replicated for the response of LGDP to LGFCF. These results of the IRFs are consistent with the earlier VECM, Granger Causality and FEVD results that the LCNS changes lead the LGFCF.

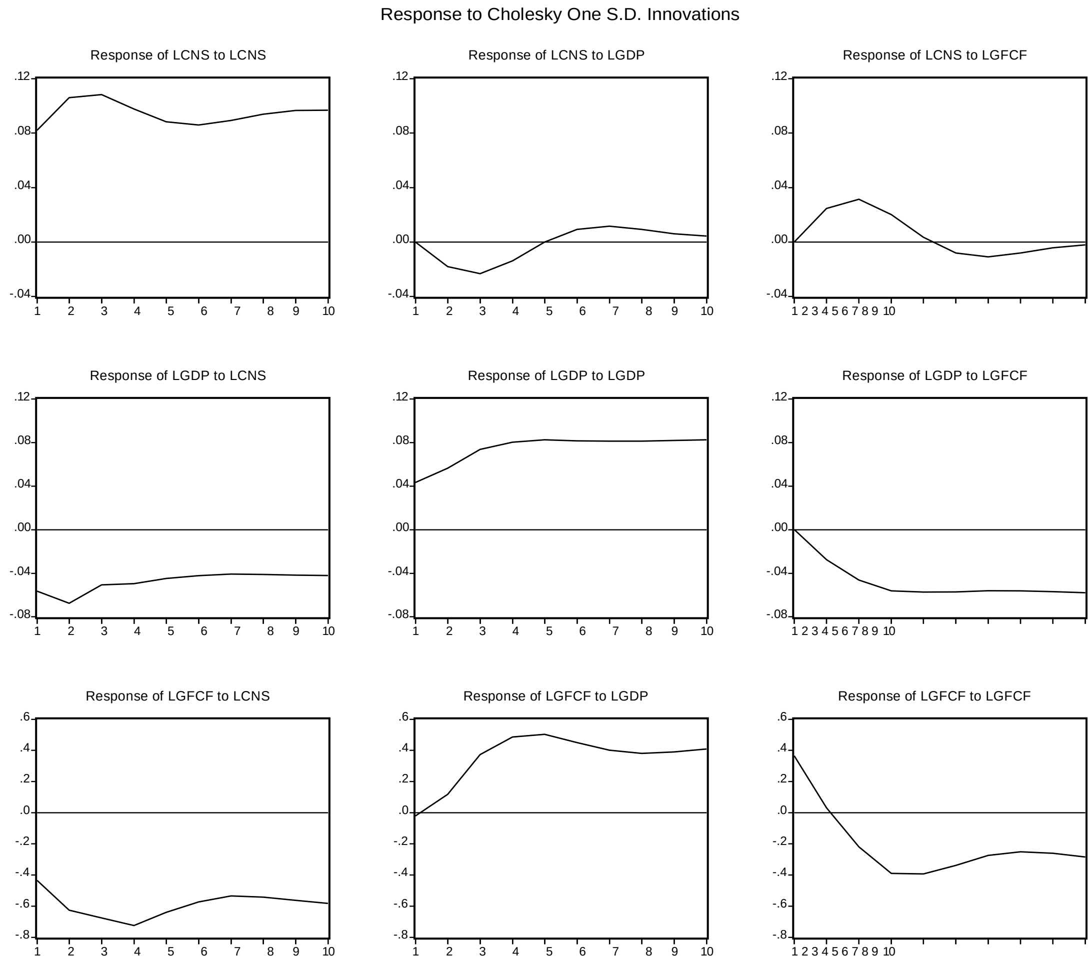

Figure 2 Responses of the series to shocks at VEC level

DISCUSSION

The study assessed the impact of construction sector on DFC formation and economic growth by using VECM framework. The model estimate indicates the following: (1) all TSD appear to be non-stationary in levels but stationary in the first differences for logarithmic form and The Johansen co-integration tests indicated significant contemporaneous co-integration between the series confirming the existence of causality among the series at least in one direction; (2) The GFCF appears to be CNS and LGDP elastic in the co-integrating vectors estimated. This elasticity suggests a high responsiveness of GFCF to construction sector output and national economic growth; (3) The result of short run Granger causality indicates the existence of a unidirectional short-run causality running from the LCNS to LGDP. (4) The result of the weak exogeneity test/long run causality indicates two unidirectional causality running from LCNS to the GFCF and from LCNS to the LGDP in the model there is no feedback effect from LGFCF and LGDP; (5) the result of the strong exogeneity test suggest no series is strongly exogenous, indicating all the series are important in the system. The results somewhat support the growth hypothesis, with CNS making significant impact on GFCF in agreement with Hillebrandt, (2000) on the one hand and the LCNS and LGFCF on the other, making significant impact on the national economic growth in agreement with Smith, (1776) Keynes, (1936) Harrod, (1939) Domar, (1946) Robinson, (1949) Solow, (1956) Romer, (1990) Estache, et al (2005) Kularatne, (2005) Perkins, et al (2005) and Boopen (2006). In spite of the findings, African, including Nigerian economy remains slow and underdeveloped due to slow rate of capital accumulation (Calderón &

Servén, 2008). To ensure fast growth and development, Nigeria must massively grow its DFC formation like China (Okonjo-Iweala, 2010).

CONCLUSION AND FURTHER STUDIES

The Nigerian Construction Sector is an important contributor to the DFC formation and GDP growth. This suggests that the construction sector is one of the vital sectors of the Nigerian economy. The cause and effect relationships between the series are unidirectional with the LCNS significantly having a long run causing effect on the GFCF and LGDP. The study recommends an aggressive public policy on the construction sector as a way of improving the DFC formation for sustained long run economic growth. In view of the deplorable state of public infrastructure in Nigeria, there is the need for an aggressive public policy on constructed infrastructure development. The complementarity theory should be adopted for infrastructure development with the government providing infrastructure that supports private investment. There is the need for a national construction and capital investment policy similar to the Chinese as well as the need for public DFC formation that is complementary to private investment. Kindly indicate areas for further studies.

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