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RESEARCH ARTICLE

Empirical estimation of the impacts of inflation on the construction sector in Nigeria

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Abstract

The construction sector is one of the largest single industries in the world contributing to the economy through its backward and forward linkages as well as aggregate demand. However, despite its importance to the development of the economy, it is severely hampered by instability or inflation. This study investigates the effect of the inflation rate on the construction sector through the econometric methodology to analyze time series data obtained from the year 2020 statistical bulletin (volume 30) of the Central Bank of Nigeria. The result indicates that inflation significantly impacts the construction sector. The study concludes that the construction sector is significantly affected by seasons and the Gross Domestic Product (GDP) whereas the construction sector significantly affects the price level. The study recommends the de-seasonalisation of the construction sector through industrialization. The government must implement fiscal and monetary measures to manage inflation to stabilize the construction sector. Finally, to stem the tide of the high cost of construction, the government should implement a policy to improve local content in the sector to immune construction from the vagaries of the foreign exchange market.

1. Introduction

Inflation is a monetary phenomenon construed as the increase in the price level of goods and services for a specific period due to excess money in circulation. Inflation can be tracked through the Consumer Price Index (CPI), which captures the annual change in the price of consumer goods and services in a given geographical area and at a particular period [2]. However, inflation decreases the purchasing power of the domestic currency and standard of living [1]. Globally, inflation has been a challenge since the global economies are integrated and the effect of monetary policy in a country often spills to other countries. This is evident in the recent increase in the prices of goods, energy, etc. due to global crises and its effects felt in most developing countries [3]. Specifically, Nigeria's economy has a history of instability due to some factors such as political instability, volatile international commodity market, economic growth and interest rate [4, 5]. One of the critical economic issues is inflation which changes the dynamics of the economy as it inhibits saving and investment which thus slows economic growth. The reverse of inflation i.e. deflation is also not good for the economy as it discourages or delay expenditure in the expectation of cheaper product/services which implies slower economic growth. Thus, the

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growing consensus in the extant literature supports low, stable and predictable inflation as compatible with sustainable growth.

Structural economists postulate that inflation may be important for economic growth while monetarist economists suggest that inflation is harmful to economic growth. However, there is an emerging consensus among economists that the effect of inflation on economic growth is varied and dependent on the level of inflation. In Nigeria, inflation has been a persistent malaise as inflation impedes Nigeria's drive for economic recovery following the Covid-19 pandemic. In 2022, Nigeria is projected to have one of the highest inflation rates in the World [6] due to the inimical deployment of monetary policy and fiscal instruments [7, 8]. Towards the last quarter of the year, precisely November 2022, the prediction was actualised and the inflation rate rose to 21.47% for 10 consecutive months, the highest in the last 17 years. The Customer price index report by the National Bureau of Statistics attributed the increasing inflation rate to the increase in importation and production costs due to currency depreciation and energy costs.

Consequently, inflation has a far-reaching effect on the environment and the internal dynamics of the construction sector which may be analysed according to how it affects project critical success factors (CSFs) including cost, time and quality of projects [9]. Also, it affects construction resources (labour, material and technology) and project stakeholders including clients, contractors, consultants construction industrial complexes, etc. High inflation rates have been a major challenge to the construction sector in Nigeria with thousands of projects abandoned across the country as a result of high building material prices, machine cost, labour cost, etc. Inflation is associated with the recurring incidence of construction risks with the high possibility that the cost and time of the construction process may experience overruns, the project may be delayed or abandoned and the quality of construction may be compromised. The possibility of disputes and conflicts among the parties may also become another high-risk factor for an unstable inflation rate. In addition, inflation undermines the very basis of the smooth operations of the construction sector. Consequently, a high inflation environment makes successful construction project delivery a huge challenge in developing economies. However, construction activities and the construction sector contribute significantly to economic development in terms of housing and infrastructure development, employment creation and so on [10]. Hence, it is important to ascertain the influence of inflation on the construction sector.

There is a fundamental importance of expected inflation in project decision-making for both public and private institutions for sustainable project delivery to cost, time and quality. As such, inflation is one of the most important research in macroeconomics and a growing number of studies focus on the effects of inflation on growth [11, 12]. However, there is no consensus in the studies on the effect of inflation on economic growth. To have a more in-depth understanding of the relationship between inflation and growth, there is a need for a deeper investigation. Thus, the importance of the relationships between inflation and some important economic sectors may not have been addressed in the extant literature in enhancing better policy on economic management [7, 13]. Successive governments in Nigeria over the years initiated various policies to manage inflation and the growth of Nigeria's economic sectors including the construction sector. Nevertheless, the effectiveness of these policies on inflation and growth remains in doubt, inconsistent and controversial. Besides, literature using Nigerian data to evaluate the relationships between inflation and the construction sector are few and far between years. It is against this backdrop that this study investigates the impact of the inflation rate on the construction sector in Nigeria.

2. Review of Literature

2.1. Concept of inflation

Inflation is the case when demand grows faster than supply leading to fall or loss in the purchasing power of the domestic currency. This is normally captured by the Consumer Price Index (CPI), Retail

Price Index (RPI) or the implicit price deflator for Gross Domestic Product (GDP). The GDP deflator is an agglomeration of all prices of the aggregate output (GDP) used to calculate the GDP less inflation. The inflation rates are the rate of change in price levels or indices such as CPI normally quoted per annum [14].

Over the years a number of theories have been developed to explain the concept of inflation. Most of these theories relate to the demand or supply side of the economy. The classical economic theory led by Adam Smith postulated the classical growth model which held that economic growth is a function of labour (B), Capital (K) and Technology (T). The classical model assumes flexibility of prices and wages and of course no money illusion in the long run. In this model, the markets for goods, money and labour are in equilibrium. Thus fiscal or monetary policy expansion can only change the equilibrium price and cannot expand output [15]. For the Phillips Curve, the short run Phillips Curve describes inverse relationships between the inflation rate and unemployment rate which means that as wages and the inflation rate increase unemployment rate reduces.

2.2. Empirical review on inflation impacts

A growing number of studies investigate the relationships between economic growth and inflation though no consensus has been reached. Globally, studies have been conducted to investigate the effect of inflation on the economic growth of most especially developing economies. Mamo [16] investigates the impact of economic growth on inflation using panel data from thirteen sub-Saharan African countries for the period 1969 through 2009. The study finds a negative relationship between growth and inflation rate. The panel Granger causality test estimate indicates that inflation can be used to influence growth except in two of the thirteen countries. Kasidi and Mwakanemela [7] investigated the effect of inflation on economic growth using Tanzanian TSD for the period 1990 through 2011. The study employs correlation coefficient, coefficient of elasticity and co-integration technique for data analysis. The study finds a negative effect of inflation on economic growth. In addition, the study finds no significant cointegration between inflation and growth which implies no long contemporaneous relationships between inflation and growth. Sultan and Shah [17] examine the relationships between inflation and growth using Pakistani TSD for the period 2005 through 2015. The study finds moderate and significant relationships between inflation and growth. The study recommends the control of inflation at a low and steady rate by the monetary authorities of Pakistan for the sustainable growth of the economy.

More recently, [18] investigated the relationship between inflation and investment using Jordanian TSD for the period 1980 through 2016. The study finds that the inflation rate is deleterious on investment at a critical threshold of 10%. The study thus recommends an inflation rate of less than 10% for sustainable investment and growth. Kryeziu and Durguti, [19] examined the effect of inflation on growth using Eurozone annual TSD for the period 1997 through 2017. The study uses the least square regression model to analyse the data. The study finds that the inflation rate has a positive on growth for the Eurozone. Ahmad and Aworinde [20] examined the effect of fiscal deficits on inflation using selected African countries' quarterly TSD for the period 1980:1 through 2018:4. The study uses the Enders and Siklos methodology. The study finds long-run relationships between the series in the countries. Fiscal deficits affect inflation suggesting the need for fiscal consolidation. Uddin [12] investigates the effect of inflation on growth using Pakistani TSD for the period. The study finds a positive and significant effect of inflation on growth.

In Nigeria, quite a number of extant studies have explored the effects and relationship between inflation and economic growth. Ogun et al. [4] evaluated the effects of inflation on construction material prices using Lagos state, Nigeria TSD for the period 1998 through 2007. The study extracts the TSD from the journal of the Nigerian Institute of Quantity Surveyor (NIQS), CBN statistical bulletins and the National Bureau of Statistics

(NBS) document. The study deploys a regression model for the analysis. The study finds third-order polynomial equation relationships between cumulative inflation rate and construction material prices. The study thus concludes that the cumulative inflation rate is an efficient predictor of construction material prices. The study recommends the involvement of construction stakeholders in policy making; import substitution; local content development; and the development of a national construction database for the enhanced development of the construction industry. Enejoh and Tsauni [1] examined the effect of the inflation rate on economic growth using Nigerian TSD for the period 1970 through 2016. The study deploys a test of stationarity, ARDL and Error Correction Model (ECM). The study finds that the inflation rate has a positive effect on economic growth. The Granger test estimate shows that the inflation rate does not Granger cause economic growth. The study suggests a policy of single-digit inflation targeting. Onwubuariri et al. [21] examined the impact of inflation on growth using Nigerian TSD for the period 1980 through 2019. The TSD (inflation rate, interest rate, FER and government expenditure) were sourced from the World Bank's World Development Indicators (WDI). The study employs ARDL and ECM for analysis. The study finds the negative impact of inflation on the economy through reducing purchasing power and competitiveness. The study concludes that inflation and FER harm growth, the interest rate had a positive effect on growth and finally government expenditure had no significant effect on growth. The study suggests monetary policy for managing inflation towards stable and sustainable growth of the economy.

2.3. Impact of inflation on Nigeria's construction sector

In Nigeria, construction investment demands have been highly volatile depending on a number of factors including inflation, oil exports, business cycle and government policy on the economy [22, 23, 9]. More recently, there has been a growing internationalization of the construction sector through foreign investment making indigenous companies less effective [24]. Few studies have explored the effects of inflation rate on construction projects but are limited in the use of descriptive and inferential statistics. Musarat et al. [25] investigated the effect of the inflation rate on the construction industry. The study highlights a framework that stresses the relationship between the inflation rate and the construction industry and concludes that the lack of integration of inflation into construction projects is a major predisposition to project cost overrun as input prices change frequently. Alaloul et al. [26] examined the effects of inflation on labour wages in the construction industry in Malaysia and found through correlation analysis that there exists a relationship between labour wages and the inflation rate. This current study adopted the econometric methodology with the use of vector autoregression in contrast to extant studies on inflation in Nigeria.

3. Research Methods

To achieve the aim of this study, an econometric method was adopted where mathematics, statistics and economic theory were applied in the rigorous procedure for solution. The study employs the Vector Auto Regression (VAR) to analyse time series data. The time series data for this study include quarterly data from 2010Q1 through 2020Q4 covering a total of 44 quarters in the period (years). They are extracted from the volume 30 of the 2020 central bank statistical bulletin. Although studies suggested 50 data points for time series analysis, it is argued that the middle two-digit range of 40 observations is the minimum data points sufficient for analysis [27, 28] The data covers five series including construction sector Output (CNS), Gross Domestic Product (GDP), Consumer Price Index Aggregate (CPIA), Consumer Price Index-Food (CPIF) and Consumer Price Index-Less food (CPIL). The VAR model has become one of the successful techniques of choice in analyzing multivariate time series data. Also, VAR being developed from auto regression model, has been used for forecasting, structural inference and policy analysis of economic and financial time series data

[29, 30]. For non-stationary time series data that are co-integrated, the application of the VAR is transformed to include an error correction term called Vector Error Correction Model (VECM). The VECM integrate an error correction model (ECM) which captures deviations from the long run as one of the regressors. The ECM corrects for disequilibrium and adjusts towards long-run equilibrium and the VECM uses the difference of the variables [31].

3.1. Test for stationarity (Unit Root Analysis)

The OLS regression with nonstationary time series data could be spurious with good model fit (R^2) even when the variables are not related. For time series, an OLS regression estimate can only be valid if the error term is invariant with time, in other words, the error term must be stationary. A time series data is stationary if it is a product of a stochastic process and its mean and variance do not change with respect to time and the covariance between two time periods is the function of only the distance between the two time periods [32]. The study used the unit root test of the Augmented Dickey-Fuller (ADF) test and Philips-Perron (PP) tests to test the stationarity of the variables. The ADF test was done by estimating the time series (γ_t) from Eq. (1):

$$\gamma_t = \rho\gamma_{t-1} + x_t\,\delta + \varepsilon_t \quad (1)$$

where ρ and δ are parameters, x_t is optional exogenous regressors and ε_t is a stationary process/error term.

3.2. Cointegration analysis

The invalidity of the OLS regression model with time series inspired many studies including [33] and [34] to suggest the concept of cointegration. Two non-stationary time series data are said to be co-integrated if their linear combination is stationary. The stationary linear combination is a notion of the long-run contemporaneous relationship between 2 or more time series. The Engle and Granger cointegration test was residual-based which tests the residual of a cointegration OLS regression equation for unit root. Two-time series data are said to be cointegrated when both are non-stationary, but a linear combination of those time series data is stationary. The stationary linear combination is called the cointegrating equation which is a long-run equilibrium relationship between the variables. This study performs a cointegration test using the methodology of Johansen as given in Eq. (2);

$$y_t = \mu + A_1\gamma_{t-1} + \cdots + A\rho\,\gamma_{t-p} + \varepsilon_t \quad (2)$$

where y_t is a vector of variables that are integrated in order one.

3.3. Granger causality test

This test is used to examine if a time series data could be used to forecast another. The test was introduced by [35] and consists of a system of tests that may give an inkling of causality. A data X significantly Granger causes data Y, if X has a significant statistical relationship with the future values of Y. Granger causality, is a statistical representation of causality based on timing. The test is handicapped because it can only handle pairs of time series data and the relationships between the data must be linear. The finding may be spurious if the relationship includes a third data. The estimate is affected by the choice of lags and the stationarity of the time series data. Hence, Granger causality cannot be a definite proof of causation.

3.4. Model specification

The effect of inflation on the construction sector was explored by checking how some variables like Gross Domestic Product (GDP), food (CPIF) and other parameters without food (CPIL) affect the inflation rate. In this case, Eqs. (3)-(5) were proposed as hypotheses to determine the extent to which they affect the economy (in terms of inflation) to construction outputs. The CPIF and CPIL were adopted because energy and food are the drivers of change in price level and cause significant changes to the inflation rate and Nigeria's economy as a whole.

$$\Delta LCNS_t = \emptyset_1 + \sum_{i=1}^{2} \beta_i \Delta LCNS_{t-i} + \sum_{j=1}^{2} \beta_j \Delta LINF_{t-j} + \sum_{k=1}^{2} \beta_k \Delta LGDP_{t-k} + \alpha_1 ECT_{t-1} + \varepsilon_t \quad (3)$$

$$\Delta LINF_t = \emptyset_1 + \sum_{i=1}^{2} \beta_i \Delta LCNS_{t-i} + \sum_{j=1}^{2} \beta_j \Delta LINF_{t-j} + \sum_{k=1}^{2} \beta_k \Delta LGDP_{t-k} + \alpha_2 ECT_{t-1} + \varepsilon_t \quad (4)$$

$$\Delta LGDP_t = \emptyset_1 + \sum_{i=1}^{2} \beta_i \Delta LCNS_{t-i} + \sum_{j=1}^{2} \beta_j \Delta LINF_{t-j} + \sum_{k=1}^{2} \beta_k \Delta LGDP_{t-k} + \alpha_3 ECT_{t-1} + \varepsilon_t \quad (5)$$

where $\emptyset_1$ represents constant; LCNS represents logged construction sector output; LINF represents logged inflation; LGDP represents logged GDP, ECT means error correction term and εt represents error term.

Operational Description of Variables:

Construction Sector Output (CNS): this is the monetary value of all activities for the provision and maintenance of all construction works within a given economy and quarter at 2010 market prices.

Gross Domestic Product (GDP): this is the market value of all goods and services produced within a country and a given quarter at a market price of 2010 irrespective of the nationality of the labour force.

Consumer Price Index- All items (CPIA): this is the quarterly rate of change of all item (aggregate) consumer price index.

Consumer Price Index- Food (CPIF): this is the quarterly rate of change of food items in the consumer price index.

Consumer Price Index- Less Food (CPIL): this is the quarterly rate of change of all items less food in the consumer price index.

4. Result of Empirical Estimation

4.1. Descriptive statistics

Table 1 shows the result of the mean and standard of time series data on the Construction Sector (CNS), Gross Domestic Products (GDP), Consumer Price Index for all items (CPIA), Consumer Price Index for less food (CPIL) and Consumer Price Index for food items (CPIF) between year 2010 and year 2020. The mean values are 583.4707, 16529.77, 2.883607, 2.597846 and 3.189438 respectively while their standard deviations are 107.8940, 1756.464, 1.143839, 1.368416 and 1.237794 respectively. This implies that food prices (CPIF) are the fastest-changing inflation index in Nigeria. Thus, the main driver of inflation in the Nigerian economy is the food price basket (CPIF).

4.2. Line graph

The line diagram for the series indicates the elements of random error, seasonality and trend in the data. . The line graph was plotted using the mean values as y and the period (*t*) in years as *x*. The most trended is the GDP and the least trended is the Consumer Price Index for less food (CPIL). The highest and lowest point in CNS are 2019Q2 and 2010Q3 respectively while the highest and lowest point in GDP are 2020Q4 and 2010Q1 respectively. Similarly, the highest and lowest point for CPIA are 2016q2 and 2013q3 respectively; CPIL 2012q1 and 2013q2 respectively and, CPIF 2017q2 and 2010q4 respectively (Fig. 1).

Table 1. Descriptive statistics for the series

	CNS	GDP_2010MP	CPIA	CPIF	CPIL
Mean	583.4707	16529.77	2.883607	3.189438	2.597846
Median	589.4067	16413.36	2.603845	2.755870	2.302748
Maximum	752.8337	19753.16	6.196212	6.712978	8.253205
Minimum	369.1909	12790.38	1.352494	1.228070	0.542560
Std. Dev.	107.8940	1756.464	1.143839	1.237794	1.368416
Skewness	-0.447927	-0.111124	1.118737	1.034100	2.198851
Kurtosis	2.135160	2.362353	3.669968	3.577219	9.116223
Jarque-Bera	2.842588	0.835976	10.00110	8.452821	104.0379
Probability	0.241401	0.658370	0.006734	0.014605	0.000000
Sum	25672.71	727309.9	126.8787	140.3353	114.3052
Sum Sq. Dev.	500568.1	1.33E+08	56.25982	65.88173	80.52017
Observations	44	44	44	44	44

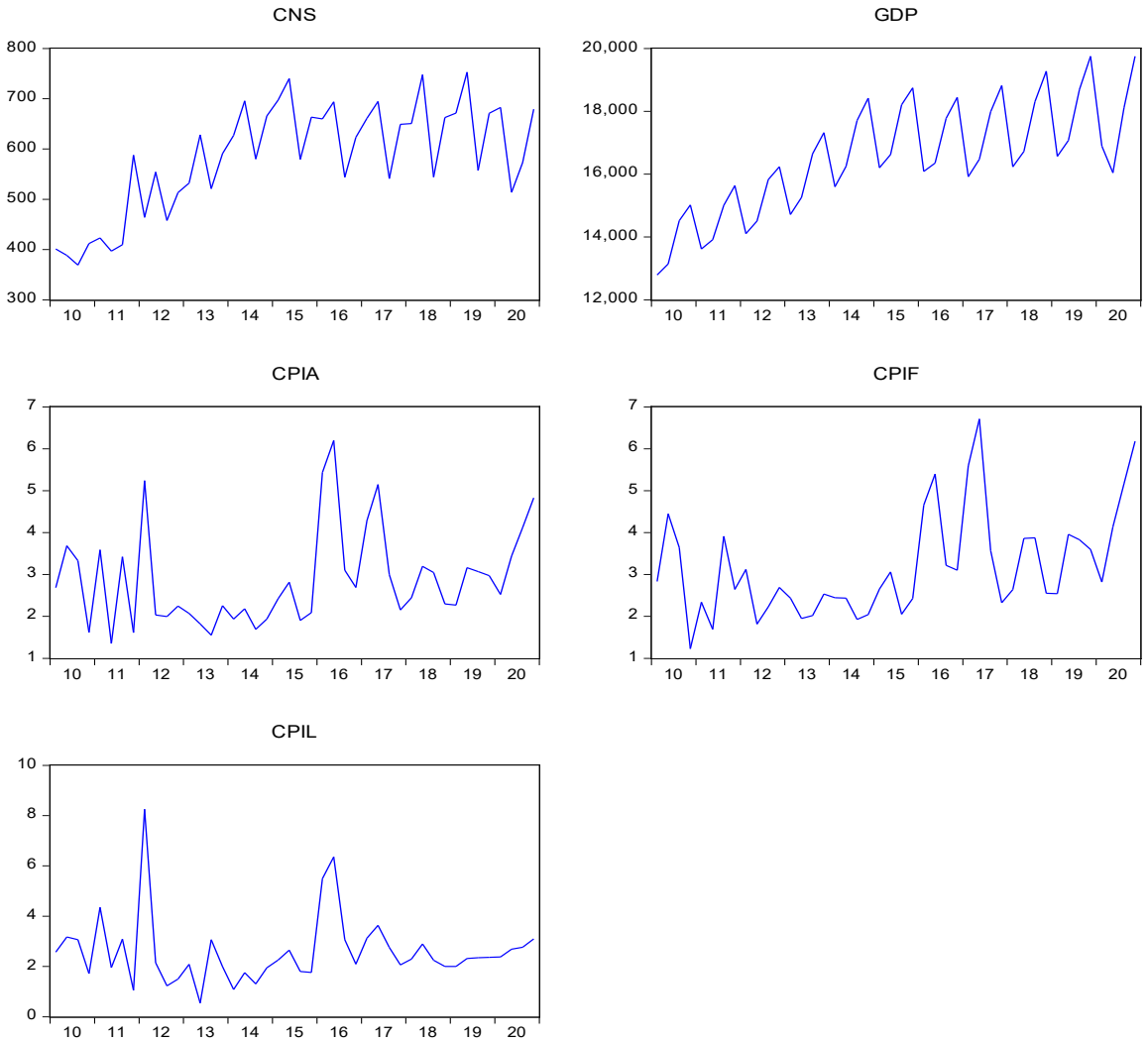

Fig. 1. Line graph for the series

4.3. Test of stationarity

The Time series data were tested for stationarity or unit root using the Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) tests. The p values at 5% of the ADF and the PP estimates indicate that all the series except the Consumer Price Index for less food (CPIL) and Consumer Price Index for food (CPIF) are stationary at first difference. The time series data were thereafter transformed to their log and the test was re-run. The p-values of the ADF estimate thereafter indicate that all the series in their respective log are stationary at the first difference except for CPIL (stationary at level) and the LGDP (which is not stationary at the second difference) (Table 2).

4.4. Test for cointegration

The Johansen test of cointegration estimate indicates that both trace and Max-Eigen value reject the null hypothesis at 0.05 level for at most 2 numbers of cointegrating equations. This implies three cointegrating equations at 5% alpha level respectively for both trace and Max Eigen test. The summary of the estimate is the confirmation of long-run contemporaneous relationships among the TSD. Simply put the series have long-term relationships (Table 3).

4.5. VAR lag order selection

The VAR lag order selection estimate indicates that all the criteria of lag order selection including LR, FPE, AIC and HQ support two lags except SC for the estimate (Table 4).

Table 2. Test for stationarity for the series (in log)

	ADF		ADF 1st diff		PP		PP 1st diff.		Concl.
	No trend	With trend	No trend	With trend	No trend	With trend	No trend	With trend	
LCPIL	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	I(0)
LCPIF	0.7646	0.6177	0.0000	0.0000	0.0043	0.0062	0.0000	0.0000	I(1)
LCPIA	0.3297	0.2558	0.0000	0.0000	0.0001	0.0002	0.0001	0.0000	I(1)
LGDP	0.3111	0.8902	0.3936	0.3935	0.0229	0.0004	0.0000	0.0000	I(2)
LCNS	0.0583	0.9691	0.0102	0.0000	0.9409	0.0088	0.0000	0.0000	I(1)

Table 3. Johansen Cointegration Test for LGDP2010MP, LCNS, LQIFRCPIA, LQIFRCPIF and LQIFRCPIL

		Trace	0.05		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**	Statistic	Critical Value	Prob.**
None *	0.908077	179.0038	69.81889	0.0000	100.2458	33.87687	0.0000
At most 1 *	0.586492	78.75793	47.85613	0.0000	37.08926	27.58434	0.0022
At most 2 *	0.524639	41.66867	29.79707	0.0014	31.23462	21.13162	0.0014
At most 3	0.146213	10.43405	15.49471	0.2488	6.639083	14.26460	0.5327
At most 4	0.086394	3.794968	3.841466	0.0514	3.794968	3.841466	0.0514

Both the Trace and Max-eigenvalue tests indicate 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values

Table 4. VAR lag order selection criteria for LGDP2010MP, LCNS, LQIFRCPIA, LQIFRCPIF and LQIFRCPIL

Lag	LogL	LR	FPE	AIC	SC	HQ
1	-589.0611	NA	3461777.	29.24101	30.27533*	29.62013
2	-546.2210	65.28020*	1542133.*	28.39148*	30.46013	29.14972*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level) FPE: Final prediction error.
AIC: Akaike information criterion SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

4.6. VECM estimates for LCNS model

The VEC model estimates in Table 5 reveal that the three ECTs are not significant with the respective t-statistics 0.26491, -0.67598 and -1.43984. In other words, the changes or corrections to make the series remain in equilibrium in the model in the long run are not significant for the three ECTs. The estimate indicates that the construction sector (CNS) is negative but significant for both lags 1 and 2 with a respective t = -3.73988 and t = -2.07276; the GDP is positive and significant for only lag 2 with t = 2.53375; the CPIA is positive but not significant for lags 1 and 2 with t = 1.08393 and t = 0.49093; the CPIF is negative and not significant for the both lags 1 and 2 with t = -0.86994 and t = -0.59221 respectively; the CPIL is negative and not significant for both lags 1 and 2 with t = -0.83943 and t = -0.53117 respectively. In summary, the CNS is negative but significant for both lags; the GDP is positive and significant for lag 2; the CPIF is positive but not significant for both lags; and finally, the CPIF and CPIL are negative and not significant for both lags 1 and 2. This implies that inflation may not be a significant factor in the construction sector.

4.7. VEC granger causality

The VEC granger estimates in Table 6 reveal that the Gross Domestic Product (GDP) granger causes the construction sector (CNS), Consumer Price Index-All items (CPIA) and Consumer Price Index-Food (CPIF) whereas the CNS granger causes the GDP, CPIA, CPIF and Consumer Price Index- Less food (CPIL).

4.8. Discussion of results

The ADF test estimate reveals that among the three indices of inflation rate used for this study, the most trended is LCPIF and the least trended is LCPIL (stationary at level). This implies food items are the most significant driver of change in price levels or inflation rates in Nigeria. Food accounts for around 40% of the CPI basket and exerts a significant influence on CPI inflation in sub-Saharan Africa and hence adverse effect on the welfare of citizens [36, 37]. The Johansen test of cointegration estimate indicates significant long-run contemporaneous relationships among the time series data with three cointegrating equations. Inflation is an integral part of any economy especially developing economies where most of the economic sectors are underdeveloped. Virtually all consumer goods are normally volatile, seasonal and trended in the economy. This behaviour of consumer goods tends to influence saving and investment (including construction) and hence the economy. There exists a long-run relationship between the construction (investment), inflation and growth [38]. The VEC model estimates reveal that the three ECTs are not significant with the respective t-statistics of 0.26491, -0.67598 and -1.43984. In other words, the changes or corrections of the ECT to make the series remain in equilibrium are not significant. For CNS → CNS, the estimate indicates that the CNS is negative but significant for both lags 1 and 2 with respective t-statistics = -3.73988 and -2.07276. This implies that the construction output seasonal behaviour is primarily responsible for negative or inverse relationships between the current construction and lagged (1 and 2) construction. The seasonal nature of the economy and the construction activities affect the relationships between lagged and current construction. At least two seasons are in counter-movement. For GDP→CNS, the GDP is positive and significantly related to the CNS for only lag 2 with t = 2.53375. The economy is the main driver of income, saving and thus investment including construction. However, there is a quarter lag between economic activities and construction output through income, saving and investment. In other words, it takes at least 90 days for economic activities to generate income and then save before construction output can occur. The relationship between the economy and construction in other developing countries is documented in the literature [39, 40].

For CNS→ GDP, the VECM estimates indicate that the CNS is significant on the GDP for both the first and second lags but only positive for the second lag.

Table 5. Vector Error Correction Estimates Standard errors in ( ) and t-statistics in [ ]

Cointegrating Eq:	CointEq1	CointEq2	CointEq3		
LCNS(-1)	1.000000	0.000000	0.000000		
LGDP(-1)	0.000000	1.000000	0.000000		
LCPIA(-1)	0.000000	0.000000	1.000000		
LCPIF(-1)	-721.8626	-9638.700	-0.450637		
	(142.402)	(1511.28)	(0.07533)		
	[-5.06918]	[-6.37785]	[-5.98249]		
LCPIL(-1)	613.6095	6607.940	-0.447756		
	(116.074)	(1231.86)	(0.06140)		
	[5.28639]	[5.36421]	[-7.29257]		
C	-329.8463	-11831.98	-0.116864		
Error Correction:	D(LCNS)	D(LGDP2010MP)	D(LQIFRCPIA)	D(LQIFRCPIF)	D(LQIFRCPIL)
CointEq1	0.077403	1.532408	-0.004492	-0.003791	-0.007446
	(0.29218)	(2.76231)	(0.00154)	(0.00124)	(0.00220)
	[0.26491]	[0.55476]	[-2.91589]	[-3.05921]	[-3.38374]
CointEq2	-0.017627	-0.251453	0.000409	0.000398	0.000630
	(0.02608)	(0.24653)	(0.00014)	(0.00011)	(0.00020)
	[-0.67598]	[-1.01998]	[2.97529]	[3.59604]	[3.20871]
CointEq3	-318.8884	-858.4276	-1.002833	0.306313	1.008041
	(221.475)	(2093.84)	(1.16785)	(0.93935)	(1.66800)
	[-1.43984]	[-0.40998]	[-0.85870]	[0.32609]	[0.60434]
D(LCNS(-1))	-0.952475	-4.927537	0.003419	0.002502	0.006938
	(0.25468)	(2.40777)	(0.00134)	(0.00108)	(0.00192)
	[-3.73988]	[-2.04652]	[2.54556]	[2.31618]	[3.61699]
D(LCNS(-2))	-0.523155	4.829584	0.001792	0.001285	0.005169
	(0.25240)	(2.38617)	(0.00133)	(0.00107)	(0.00190)
	[-2.07276]	[2.02399]	[1.34658]	[1.20015]	[2.71948]
D(LGDP(-1))	-0.007353	0.181959	-0.000267	-0.000279	-0.000219
	(0.01495)	(0.14134)	(7.9E-05)	(6.3E-05)	(0.00011)
	[-0.49186]	[1.28741]	[-3.39107]	[-4.40117]	[-1.94318]
D(LGDP(-2))	0.039650	-0.503251	-0.000158	-0.000184	-0.000196
	(0.01565)	(0.14794)	(8.3E-05)	(6.6E-05)	(0.00012)
	[2.53375]	[-3.40161]	[-1.91200]	[-2.77912]	[-1.66269]
D(LCPIA(-1))	183.4672	574.3249	-0.154368	-0.755157	0.231319
	(169.260)	(1600.20)	(0.89252)	(0.71789)	(1.27476)
	[1.08393]	[0.35891]	[-0.17296]	[-1.05191]	[0.18146]

Table 5. Cont'd

D(LCPIA(-2))	50.42057	1319.391	0.178728	-0.262472	0.989215
	(102.704)	(970.967)	(0.54156)	(0.43560)	(0.77349)
	[0.49093]	[1.35884]	[0.33002]	[-0.60255]	[1.27889]
D(LCPIF(-1))	-93.98835	-163.1324	0.384289	0.880209	0.301007
	(108.040)	(1021.41)	(0.56970)	(0.45823)	(0.81368)
	[-0.86994]	[-0.15971]	[0.67455]	[1.92088]	[0.36993]
D(LCPIF(-2))	-52.51140	-1444.925	0.351957	0.374647	-0.072325
	(88.6705)	(838.298)	(0.46756)	(0.37608)	(0.66781)
	[-0.59221]	[-1.72364]	[0.75274]	[0.99619]	[-0.10830]
D(LCPIL(-1))	-63.08693	-59.16556	-0.279613	-0.121086	-0.391566
	(75.1543)	(710.514)	(0.39629)	(0.31875)	(0.56601)
	[-0.83943]	[-0.08327]	[-0.70557]	[-0.37987]	[-0.69180]
D(LCPIL(-2))	-23.28592	31.42576	-0.254393	-0.085867	-0.475435
	(43.8392)	(414.459)	(0.23117)	(0.18594)	(0.33017)
	[-0.53117]	[0.07582]	[-1.10048]	[-0.46181]	[-1.43998]
C	10.85627	158.6796	0.027741	0.043235	-0.010907
	(10.0074)	(94.6108)	(0.05277)	(0.04244)	(0.07537)
	[1.08482]	[1.67718]	[0.52570]	[1.01862]	[-0.14472]
R-squared	0.737933	0.890146	0.680714	0.687753	0.682805
F-statistic	5.848231	16.82928	4.427978	4.574625	4.470867

Table 6. VEC granger causality/block exogeneity wald tests

Excluded	Chi-sq	df	Prob.	Remarks
ΔLGDP → Δ LCNS	15.28403	2	0.0005	S
ΔLCPIA → ΔLCNS	1.524788	2	0.4665	N
ΔLCPIF → ΔLCNS	0.771423	2	0.6800	N
ΔLCPIL → ΔLCNS	0.806079	2	0.6683	N
All	29.64306	8	0.0002	S
ΔLCNS → Δ LGDP	56.91425	2	0.0000	S
ΔLCPIA→ Δ LGDP	3.188927	2	0.2030	N
ΔLCPIF→ Δ LGDP	3.951326	2	0.1387	N
ΔLCPIL→ Δ LGDP	0.078688	2	0.9614	N
All	66.24021	8	0.0000	S
ΔLCNS→ Δ LCPIA	9.022355	2	0.0110	S
ΔLGDP→ Δ LCPIA	11.75485	2	0.0028	S
ΔLCPIF→ Δ LCPIA	0.657412	2	0.7199	N
ΔLCPIL→ Δ LCPIA	1.371500	2	0.5037	N

Table 6. Cont'd

All	25.38055	8	0.0013	S
Δ LCNS→ Δ LCPIF	7.612151	2	0.0222	S
ΔLGDP→ Δ LCPIF	19.43443	2	0.0001	S
ΔLCPIA→ Δ LCPIF	1.242645	2	0.5372	N
ΔLCPIL→ Δ LCPIF	0.213467	2	0.8988	N
All	39.58825	8	0.0000	S
Δ LCNS→ Δ LCPIL	13.59254	2	0.0011	S
Δ LGDP→ Δ LCPIL	4.004341	2	0.1350	N
Δ LCPIA→ Δ LCPIL	3.443708	2	0.1787	N
Δ LCPIF→ Δ LCPIL	0.285446	2	0.8670	N
All	22.59672	8	0.0039	S

For CPI→ CNS, the CPIA is positive but not significant for lags 1 and 2 with t=1.08393 and t= 0.49093; the CPIF is negative and not significant for both lags 1 and 2 with t= -0.86994 and t=-0.59221 respectively; the CPIL is negative and not significant for both lags 1 and 2 with t= -0.83943 and t=-0.53117 respectively. This implies that all the three CPI indices of inflation rate are not significant on construction sector output. However, the CPIA is directly proportional or positively related to construction sector output which means inflation may be favourable to the saving and investment (including construction) of households. The CPIF and CPIL are inversely and not significantly related to the CNS which agrees with the classical theory on inflation. Inflation favours consumption at the expense of saving and investment (including construction output). The insignificant effect of all indices of CPI is because of the low level of inflation rate during the period. At a low inflation rate, inflation may have insignificant or positive relationships with the economy including construction. For CNS →CPI, the first lag in the CNS is significant on the CPIA (t=2.54556), CPIF (t=2.31618), and CPIL (t=3.61699). In the second lag, however, the CNS is only significant on the CPIL (t=2.71948).

In summary, the CNS is negative but significant for both lags; the GDP is positive and significant for lag 2; the CPIA is positive but not significant for both lags; and finally, the CPIF and CPIL are negative and not significant for both lags 1 and 2. This implies that inflation may not be a significant factor in the Construction Sector output in Nigeria. In the case of the VEC Granger Causality, the Granger estimates for GDP→CNS reveal that the GDP Granger causes the CNS. The performance of the economy is an indicator of the state of the economy. An expanding economy generates saving and investment including construction [41, 42]. In the case of GDP→CPI, the GDP significantly granger causes CPIA and CPIF. The significant causal effect of the GDP on CPIA and CPIF implies that the growth of the economy increases the aggregate demand (AD) which may exert a significant effect on the price level change (CPIA and CPIF) when aggregate supply(AS) is overstretched. The significant effect of the economy on the inflation rate agrees with the extant literature. At a low GDP growth rate, the inflation rate is normally low but as the growth rate increases, the inflation rate also tends to increase.

For CNS→CPI, the CNS Granger causes the CPIA, CPIF and CPIL. For CNS→GDP, the CNS significantly granger causes the GDP in the short run (P=0.0000). The CNS Granger causal effect on the GDP is explained by the classical and neoclassical economic theories that investment (including construction) is the main driver of economic growth. Construction accounts for at least 50% of gross capital formation or investment [43]. For CNS→CPI, the CNS Granger causal

effect on inflation rate indices of CPIA, CPIF and CPIL may be a result of expectation and inertial inflation, foreign content (foreign exchange rate), contagion and aggregate demand factors. The finding of the significant effect of the construction sector on the inflation rate agrees with the extant literature through the aggregate demand, growth and contagion factors [44, 45, 46].

4.9. Implications of the study

The seasonal nature of the economy and construction poses serious challenges to the consistent development of the sector, especially its human resources. Construction labourers are forced to other types of jobs when the sector is out of season. The policy must be implemented to de-seasonalise the NCS for a better contribution to the economy. Additionally, there is the need to de-seasonalise the economy from seasonal behaviours that suggest pre-industrial characteristics. In other words, they must industrialise to be consistent throughout the year. The CPIs (of various measures) have a negative but insignificant effect on the construction sector. The government must make efforts to contain the rise of the CPI in order not to significantly affect the construction sector. In other words, low inflation and low-interest rates should be the fundamental economic policy to facilitate investment including construction and sustainable growth.

To manage foreign content-related inflation, the government must address local content development seriously to immune both construction and agriculture from the vagaries of the international commodity market and foreign exchange market and keep the cost of construction and price level low. The government must develop industrial or mass production in both the agricultural sector and the construction sector to keep prices low. For the construction sector, this would ensure that supplies exceed demands in terms of infrastructural development thereby increasing job opportunities for construction professionals. Besides, the construction sector needs to ensure that organizations engage cost experts who would sustainably consider fluctuation-prone resources in the production of the project budget (cost estimates) since the cost of construction is vital for the successful delivery of projects and the aspect of project execution predisposed to inflation effects.

5. Conclusion

The study investigates the relationships between construction, economic growth and inflation. The study uses the construction sector output, the GDP and various measures of the CPI. The study extracts quarterly TSD on the variables from the CBN statistical bulletin vol. 30, December 2020. The study deploys the time series models for example tests for stationarity and cointegration as well as VECM. The study concludes that all the series are seasonal, they are all stationary after first differenced (except CPIL), and they have long-run contemporaneous relationships. The seasonal nature of the Nigerian economy driven mainly by agriculture activities (about 25% of the GDP) implies that construction is seasonal. Thus, the previous (lagged) construction may have a negative but not significant effect on the current construction. Economic activities or the GDP have a significant effect on the construction in the second quarter (after 90 days). Furthermore, the CPI (of various measures) has a negative but not significant effect on the construction sector. Finally, the construction sector significantly affects the price level (CPI) due in part to foreign content, contagion and aggregate demand. Hence, the study provided suggestions to the government and the construction sector on the development of policies and best practices that would assist in cushioning the effects of high inflation or deflation of the economy.

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The data presented in this study are available on request from the corresponding author.

Ethics Committee Permission

Not applicable.

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