



Macroeconomic Dynamics on Domestic Production in Nigeria: A Study of the Cement Industry

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Abstract:

This research investigated the influence of macroeconomic factors on domestic output, specifically focusing on the Nigerian cement sector from 1981 to 2022. The data was first assessed using descriptive statistics and Stationarity assessment. The test revealed that several of the variables did not follow a normal distribution and were not stationary. The presence of order integration at both the level and first level difference required the use of the Autoregressive Distributed Lag (ARDL) approach. The results indicated a long-term relationship between cement production and variables such as exchange rate, inflation rate, interest rate, and unemployment rate. However, it was determined that unemployment rate did not have a significant statistical impact. In the long term, the value of cement production was shown to be negatively affected by changes in exchange rates and interest rates. Conversely, the coefficients for inflation rate and unemployment rate were found to have a positive influence. Over the long term, the currency rate, inflation rate, and interest rate had a substantial impact, although unemployment did not have a significant impact. The study revealed that both the inflation rate and interest rate had a substantial influence on cement output in the short-term. The findings suggested that the sustainability of cement production is contingent upon effective regulation of the macroeconomic economic environment. The post-estimation tests revealed the absence of serial correlation, heteroscedasticity, and irregularity in the residuals, indicating that the model is efficient and its estimator is unbiased.

Keywords: Gross Domestic Product, Cement Production, Unemployment rate, Inflation rate, Exchange rate and Interest rate.

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1. INTRODUCTION

Over time, the Nigerian government has formulated many macroeconomic policies. Some of the issues were related to fiscal matters, while others were related to monetary matters. It is quite likely that these actions have had an impact on the nation's economic output and have broader implications for the overall economy. As an example, the Nigerian currency has seen both an increase and decrease in value throughout time due to the government's dedication to the floating exchange rate system (Nwoye, Obiorah & Ekesiobi, 2015). Moreover, the implementation of interest rate policies by governments has considerably heightened the instability of loan interest rates in commercial banks in both countries. Moreover, the government's macroeconomic policies have led to substantial fluctuations in the inflation rates of both nations, resulting in a lack of stability in Nigeria's inflation rate.

(Ogbonna, 2021). Considering the dynamic nature of the country's macroeconomic policies, it is valuable to examine the influence of macroeconomic dynamics on production in Nigeria, specifically focusing on the cement sector as a case study.

The poor productivity in Nigeria may be attributed to the volatile macroeconomic conditions, characterized by elevated unemployment rates, shifting interest rates, and currency rates, among other factors. An inflated exchange rate has been seen to reduce import prices and control inflation by restricting price hikes for nations that heavily rely on imports, as supported by empirical data. Export-oriented sectors, especially manufacturing industries, faced a drawback due to their elevated export expenses, which caused a decline in the inflow of foreign capital. Consequently, this led to unsustainable deficits in the balance of payments (Jabaru & Jimoh, 2020). However, literature data also indicates that the continuous depreciation of the naira has led to higher costs of imported manufacturing inputs, which in turn has contributed to inflationary pressures (Lawal et al., 2022; Musa, 2021).

Nigeria's manufacturing sector, which is the main hub of domestic output, has consistently shown poor capacity utilization over many years. This has led to a low contribution to the country's GDP (Ogbonna, 2021). The poor manufacturing output and development may be attributed to the low capacity utilization, which is caused by an excessive dependence on the external sector for importing most of the inputs required for production in the sector (Lawal et al., 2022). The primary goal of this research is to examine the impact of macroeconomic factors on economic output in Nigeria. The research aimed to assess the effects of several factors on cement output in Nigeria, including the influence of currency rates, inflation rates, interest rates, and unemployment rates. The research aimed to examine the following hypotheses: Hypothesis 1: The currency rate does not have a substantial influence on cement output in Nigeria. Hypothesis 2: The inflation rate does not have a substantial impact on cement output in Nigeria. Hypothesis 3: The interest rate does not have a statistically significant effect on cement output in Nigeria. The unemployment rate's impact on cement output in Nigeria is not statistically significant.

Furthermore, this research specifically examined the cement sector due to its vital role as a fundamental construction material in Nigeria. The accessibility and cost-effectiveness of cement significantly contribute to the progress of infrastructure development in the country. The need for cement fuels the development of infrastructure such as roads, bridges, buildings, and other public works.

2. LITERATURE REVIEW

2.1. Conceptual Clarifications

2.1.1. Cement Production and Macroeconomic Dynamics in Nigeria: Stylized Facts

The cement business in Nigeria is known for its consistent demand, resulting in significant shortages in local supply in recent years. The primary catalysts for the increasing demand for cement in Nigeria are the growth of infrastructure projects, which constitute 8.9% of the government's budget for 2022, together with the real estate business and private retail sector. For example, it is projected that Nigeria would have a deficit of 17 million units in urban housing within the real estate sector. As a result of the ongoing scarcity of domestic cement despite strong demand, cement businesses have been compelled to continuously increase the capacity of their existing facilities. Indeed, despite the prevailing economic challenges, demand has shown remarkable resilience. During the COVID-19 pandemic, there was a significant increase in domestic cement demand, with a rise of around 40% between the months of September 2020 and April 2021. Similarly, Nigerian cement output had a growth of roughly 15% during this era. Experts have determined that Nigeria will need an extra \$5 billion in investments in order to fulfill the nation's cement demand (Adebanjo & Anegbe, 2024).

Nigeria's domestic cement manufacturing industry is dominated by three large cement businesses. Dangote Cement Plc. is the leading cement manufacturer in sub-Saharan Africa and has a 60% share of the local market. Lafarge Nigeria, a subsidiary of the Holcim Group, holds the second position in the local market with a market share of 19.5%. BUA Cement, formed by the merger of CCCN and Obu Cement in January 2020, closely follows with a market share of 20.4%. As a result of current production deficiencies and increasing demand, new, smaller companies have joined the market. Several cement plants are currently being planned and built by various companies. Mangal Industries Ltd and Mandugu Cement are working on 3-Mt/a and 5-Mt/a plants, respectively. IBETO Group, in collaboration with Sinomas, is constructing two greenfield projects in Effium (1 Mt/a) and Enugu (2.2 Mt/a). Additionally, IBETO Group is expanding its Nkalagu plant by 3-Mt/a.

The supply and production capacity of the top three cement firms in Nigeria has also seen growth. Dangote Cement responded to increasing demand by expanding its Obajana facility in Kogi State by 3 million metric tons per year (Mt/a) in 2020. Furthermore, the company augmented its production capacity by around 40% in 2021. Dangote Cement, the biggest corporate bond issuance in Nigeria's capital markets so far, also released a ₦116 billion (\$280 million) series 2 fixed-rate senior unsecured note in May 2022. A portion of the bond's proceeds were used to finance the company's domestic growth initiatives. In 2021, BUA Cement announced its partnership with the International Finance Corporation (IFC) to fund the development of two Sokoto cement plants, with a total capacity of 6 million metric tons per year. These facilities are designed to use less energy. In June 2023, a \$500 million agreement was completed with the collaboration of European and African Development Finance Institutions (DFIs). The purpose of this transaction is to sustain local suppliers and provide cement to neighboring nations. The business is expected to increase its total cement capacity to 17 million metric tons per year by the end of 2023, due to the implementation of further projects in Guyuk and Obu.

2.2. Theoretical Literature

2.2.1. Endogenous growth model

The endogenous growth model posits that domestic output is contingent upon a crucial internal element, namely the rate of return on capital. Inflation reduces the rate of return, leading to a fall in capital accumulation and thus slowing down the growth rate. This approach incorporates the return on human capital in addition to the return on physical capital (Gok&Gok, 2016). Several empirical investigations have been done to confirm the relationship between production growth and inflation, as explained by this hypothesis. The primary aim of all the research is essentially identical: to identify any substantial correlation between the two factors and thereafter devise a strategy that may effectively facilitate the attainment of the target of maximal economic development. While the specific results may vary between research, there is a consensus that there is a negative relationship between inflation and production growth. Additionally, there is a threshold level of inflation that might have a beneficial impact on the real economy.

Endogenous growth refers to the sustained increase in production over time that is driven by internal factors, namely the macroeconomic aggregates that influence incentives and opportunities, leading to the generation of technical knowledge. The endogenous growth hypothesis, which builds upon the research of Romer (1990) and Lucas (1988), posits that government interventions are essential for an economy to attain sustained growth in the long term. The government formulates policies on several aspects, including interest rates, currency rates, money supply, capital and recurrent expenditures, unemployment rates, and inflation rates, among others. These policies are macroeconomic in nature and often result in a rise in investment, thereby contributing to economic expansion. There have been many objections directed against the endogenous growth idea. Some of these arguments include:

- 1) The use of secondary school enrollment as a measure of human capital is subject to criticism due to the fact that the accumulation of physical and human capital alone is insufficient to achieve sustained economic development in the long run.
- 2) The endogenous growth hypothesis overlooks the significance of institutions, since it excessively focuses on the function of human capital.
- 3) The premise that information is freely accessible and a public good is disputed since any knowledge that has economic value should be considered a private good, according to the endogenous theory of growth.

In addition to the critiques of the endogenous growth theory, this theory highlights the need of government intervention via macroeconomic policy measures to promote economic development. Hence, this research aligns with the endogenous growth theory since it focuses on the significance of government involvement in attaining macroeconomic stability, ultimately resulting in enhanced economic output. In Nigeria, the government is supposed to implement macroeconomic policies regarding the currency rate, inflation rate, interest rate, and unemployment in order to control the fluctuations related with these economic indicators. Additionally, these policies are aimed at using these macroeconomic instruments to attain higher levels of economic productivity.

2.2.2. Keynesian economic theory

Keynes (1936) argued that aggregate demand, which refers to the total amount of money spent in the economy, has a significant impact on economic productivity in the near term, especially during periods of economic downturn. Aggregate demand in this scenario is influenced by a diverse set of factors and may often be unstable, affecting prices, employment, and production. It does not necessarily correspond to the level of economic productivity. Keynesian economists argue that in cases when the activities of the private sector result in inefficient macroeconomic results, it is necessary to implement proactive state policies. This encompasses the actions taken by central banks via monetary policy and by governments through fiscal policy to stimulate overall economic activity. Policies often prioritize short-term requirements and highlight the ability of macroeconomic policies to promptly address a nation's economic issues. Moreover, by implementing monetary and fiscal policies, the government aims to counteract economic downturn and stimulate overall demand to boost production levels. This is achieved by maintaining steady interest rates, which promote ongoing stability in the economy. Keynes (1936) later advocated for an alternate approach that measures the direct involvement of the government in domestic investment. He also suggested that increasing government spending may lead to financial deepening. Given that higher interest rates have a negative impact on private investment, a rise in government spending should stimulate investment and, at the same time, decrease private investment.

2.3. Empirical Review

Odili and Ezeudu (2023) conducted a research to evaluate how macroeconomic aggregates affect the growth of gross domestic product (GDP) in Sub-Saharan African nations. The study covered the period from 1981 to 2020 and aimed to give economic managers with insights into the relationship between these aggregates and the rate of GDP growth. The econometrics methods used for estimating the variables include trend analysis, unit root test, cointegration test, and the Autoregressive Distributed Lag model. The results showed that the currencies of Sub-Saharan Africa (SSA) were both feeble and unpredictable, which had a detrimental impact on the economic performance of the nations. However, there was no discernible difference in the effect of the exchange rates between the Naira-Dollar, Cedi-Dollar, and Rand-Dollar on the growth of GDP in these three countries. Inflation had a detrimental impact on the GDP of all three nations, although its significance was only seen in Nigeria and South Africa. The chosen nations had a negative discount rate. The impacts

were only statistically significant in Ghana. The unemployment rate had a detrimental and statistically insignificant influence on the economies of Nigeria and South Africa, but it had a negative and statistically significant impact on the economy of Ghana. The research found that macroeconomic indicators have a substantial role in determining the GDP growth rate in Sub-Saharan Africa. Additionally, the macroeconomic aggregates are closely related to the GDP growth rate.

Lawal et al. (2022) conducted a study to analyze the influence of macroeconomic variables, socio-economic factors, and political variables on the manufacturing sub-sector of the Nigerian economy. They used the autoregressive distributed lag model to analyze data from 1986 to 2019. The study was conducted within the framework of two macroeconomic theories: the Solow growth theory and the endogenous growth theory. The research observed that both the Solow growth theory and endogenous growth model were applicable in the short-term for the examined economy. However, in the long-term, only the endogenous growth model remained relevant. The research emphasized the need of aligning macroeconomic variables with socio-political elements in order to create sustained economic development driven by a robust manufacturing sector.

Musa (2021) conducted a study on the impact of fluctuations in currency rates on the development of inflation in Nigeria between the years 1986 and 2019. The research used the generalized autoregressive conditional heteroskedasticity (GARCH) and vector error correction model (VECM) to assess the long-term effect of exchange rate volatility on inflation. The research used the consumer price index as a proxy for inflation, whereas the explanatory variables were the nominal exchange rate, broad money supply, export, and import. The stationarity test findings indicated that the variables had a combination of different levels of integration, and the limits test proved the existence of a long-term relationship among the variables. The findings indicated a substantial correlation between broad money supply, nominal exchange rate, and the acceleration of the consumer price index. This suggests that the inflationary pressures in Nigeria were primarily driven by rises in both the exchange rate and money supply.

In a similar vein, Olusegun (2021) conducted a study that analyzed and contrasted inflation targeting in the major economies of Africa, namely Nigeria and South Africa. The study used the Fully Modified Least Squares (FMOLS) method to analyze data from 1970 to 2016. The analysis revealed a substantial correlation between inflation and the policy rate in South Africa, while no such correlation was seen in Nigeria. In contrast to Nigeria, South Africa's central bank prioritized inflation targeting as a key factor in its management of interest rates. South Africa saw a substantial production gap, but Nigeria's output gap was not considerable. The research also found that the currency rate, trade openness, and foreign reserves had substantial impacts on central bank policies in both nations.

Ugwu, Amassoma, and Ehinomen (2021) conducted a study that analyzed the impact of currency rates on prices in Nigeria using data spanning from 1960 to 2018. The chosen approach was the VECM treatment. The findings indicated a partial transmission of exchange rate changes to pricing. The findings also indicated that the response of prices to changes in exchange rates decreased quickly in the short term but persisted over time, resulting in a favorable long-term impact. Furthermore, the responses of prices to changes in interest rates declined swiftly and were consistent throughout both the long and short term.

Oke and Onyokwonu (2021) investigated the relationship between inflation, exchange rate, and sectorial production in Nigeria. An analysis was conducted using a multivariate cointegration approach. The results indicated that inflation, coupled with a falling currency rate, had a contractionary impact on the output of Nigeria's industrial, agricultural, and commerce sectors. Nevertheless, inflation had a little impact on the service, building, and construction industries. The inflation threshold for Nigeria was determined to be 9 percent. Therefore, implementing inflation anchoring measures in Nigeria would be significant

provided the exchange rate remains steady and the key economic sectors are adequately developed.

Once again, Idris (2021) examined the connections between inflation, unemployment, and economic development in Nigeria using annual data from 1986 to 2020. The research used the Ordinary Least Squares (OLS) method for data analysis. The findings revealed that the increase in unemployment had a substantial negative impact on domestic output, whereas inflation had a growing influence. Therefore, it was suggested that policies be developed to promote self-employment and reduce the expenses associated with doing company.

OlaleyeandOjomolade (2019) conducted a study to evaluate the impact of fluctuations in currency rates on the industrial sector in Nigeria between 1985 and 2015. The data were derived using the Autoregressive Distributed Lag (ARDL) technique. The findings indicated that fluctuations in the currency exchange rate significantly hindered industrial output as a consequence of the continuous importation of raw materials and equipment for manufacturing. Furthermore, it was shown that fluctuations in exchange rates were weakened by factors such as loan and inflation rates, as well as per capita income. In summary, the ARDL estimate demonstrated a significant long-term relationship among the variables in the model at a 5% level of significance.

Onakoya (2018) conducted a research to analyze the influence of macroeconomic aggregates on Nigeria's manufacturing sector throughout the period of 1981 to 2015. The order integration initially exhibited disparity, as shown by the unit root test, which required the implementation of VECM. There was no immediate connection in the model. A negative correlation was observed between inflation, interest rate, exchange rate, broad money supply, and manufacturing output. However, while inflation and interest rate were not statistically significant, a significant and positive connection was discovered between the previous year's GDP, unemployment, and manufacturing output.

Johnson, Onakoya, and Akeju (2018) conducted a research that investigated the importance of macroeconomic aggregates in relation to national income from 1975 to 2015. The analysis of the research used the VECM approach. The results indicated that inflation had a detrimental impact on economic growth. Despite the increasing exchange rate, interest rate, and unemployment, there was a notable expansion in the economy. There was no immediate correlation among the factors.

Ushie (2018) conducted an analysis on the relationship between unemployment and economic development in Nigeria from 1990 to 2016. The ARDL technique was used for time series analysis. The findings revealed that the unemployment rate among males had no substantial impact on short-term economic growth, but it became positive and significant in the long term. The female unemployment rate has a substantial negative impact on short-term economic growth. Despite the growing young unemployment rate, there was a significant jump in economic growth.

Utile, Okwori, and Ikpambese (2018) conducted a study on the impact of interest rates on Nigeria's economic performance from 1980 to 2016. The economic growth was approximated by the GDP, whereas the explanatory factors included the deposit rate, inflation, and exchange rate. The data was estimated using the Ordinary Least Squares (OLS) approach. The findings indicated that both the exchange rate and inflation rate had a negative impact on economic growth, albeit the effect was not statistically significant. Furthermore, the increase in deposit rate contributed to the economic development in Nigeria throughout the examined period.

Gatawa, Abdulgafar, and Olarinde (2017) conducted a study to examine the influence of money supply and inflation rate on the economic development of Nigeria. The research included the time frame from 1973 to 2013. The data obtained was analyzed using the Vector Error Correction Mechanism (VECM) approach. The study's findings revealed that in the

short term, both broad money supply and interest rate had a negligible and adverse effect on economic development in Nigeria. Conversely, the inflation rate had a negligible but favorable influence on economic growth in Nigeria. The research demonstrated that over time, the inflation rate and interest rate had a detrimental and substantial effect on economic development, but wide money supply had a beneficial and substantial effect on economic growth in Nigeria.

Okonkwo and Chigbu (2016) conducted a study to examine the influence of inflation and exchange rate on the industrial production in Nigeria between 1981 and 2013. The study's results indicate that an inflation rate shock initially had a detrimental effect on manufacturing capacity utilization in the near term. However, over time, it started to have a beneficial influence on manufacturing capacity utilization in Nigeria. Fluctuations in foreign currency rates are mostly influenced by short-term inflation and long-term manufacturing capacity utilization. On the other hand, changes in the inflation rate are predominantly driven by manufacturing capacity utilization.

Ozekhome (2016) conducted a research that analyzed the relationship between inflation, investment, and economic development in Nigeria. The study used the neo-classical growth model and data from 1980 to 2014. The findings indicated a non-linear correlation between inflation and economic growth, with two distinct thresholds at 6 percent and 12 percent. Economic growth is favorably but insignificantly impacted by inflation that is below the initial barrier. Inflation, occurring at a moderate pace, had a detrimental effect on the economy. Additionally, the influence of greater inflation on economic growth decreased, but nevertheless remained highly unfavorable. The findings further demonstrated a curvilinear correlation between these two factors, with a single threshold occurring at 7 percent. When inflation was below the threshold level, it had a small but favorable effect. However, when inflation was beyond the threshold, it had a strong and detrimental impact.

UjujuandEtale (2016) investigated the correlation between the dynamics of macroeconomic factors (such as gross domestic product, prime lending rate, exchange rate, and consumer price index) and the lending activities of commercial banks in Nigeria. The time series data collected for the variables spanned from 1985 to 2014. The research used the Ordinary Least Squares (OLS) approach for its analysis. The findings indicated a favorable association between GDP, exchange rate, and consumer price index and commercial bank lending in Nigeria. Conversely, there was an inverse correlation between the prime lending rate and commercial bank lending in Nigeria.

Imoisi, Chika, and Moses (2015) conducted a study to determine the influence of exchange and interest rates on Nigeria's economic well-being between 1975 and 2008. The research used the Ordinary Least Squares (OLS) approach for its analysis. It was shown that an increase in interest rates impeded investments and economic production, whereas a decrease in exchange rates impacted growth. Therefore, the impact of interest and exchange rates on economic development in Nigeria was reduced.

Ismaila and Imoughele (2015) conducted a research on the macroeconomic factors that influence economic development in Nigeria. The research included the time frame from 1986 to 2012 and used the real gross domestic product as a measure of economic growth. The research used the error correction mechanism (ECM) as the empirical method to examine the acquired data. The research revealed that gross fixed capital creation, foreign direct investment, and government spending had a favorable and substantial impact on economic development in Nigeria. The research revealed that the labor force and openness had a positive but statistically negligible impact on economic development in Nigeria. On the other hand, the inflation rate had a negative and statistically insignificant effect on economic growth.

Babalola, Danladi, Akomolafe, and Ajiboye (2015) conducted a study to evaluate the relationship between inflation, interest rate, and economic growth from 1981 to 2014. The

analysis of the research was conducted using the Ordinary Least Squares (OLS) technique. It was suggested that inflation and interest rates had a negative impact on economic production, however neither inflation nor interest rates were shown to have a causal relationship with economic output according to Granger causality. The report ended by recommending that the government prioritize the maintenance of single-digit inflation and the establishment of stability in interest rates.

3. METHODOLOGY

This research used secondary data acquired from the Central Bank of Nigeria (CBN) Statistical Bulletin and National Bureau of Statistics. The cement production and macroeconomic statistics were obtained from the CBN statistical bulletin, with the exception of the unemployment rate, which was acquired from the National Bureau of Statistics. The yearly data spanned from 1981 to 2022. Following the example of Odili and Ezeudu (2023), this research constructed an empirical model to investigate the influence of macroeconomic factors on domestic output. The equation 1 presents the model used by Odili and Ezeudu (2023).

$$GDP = f(EXCHR, INFLR, INTRT, UNMPR) \quad \text{Eqn. (1)}$$

Where,

GDP = gross domestic product

EXCHR = exchange rate

INFLR = inflation rate

INTRT = interest rate

UNMPR = unemployment rate

The present work established a unique model by implementing certain alterations to Equation 1. The research replaces the measure of Aggregate GDP with the value of cement output, since the focus of the study is on the cement sector. Therefore, the mathematical expression employed for this investigation is precisely defined in Equation 2.

$$CEMP = f(EXCHR, INFLR, INTRT, UNMPR) \quad \text{Eqn. (2)}$$

Where,

CEMP = value of cement production

The equation in econometrics was converted to a natural logarithmic form in order to mitigate the impact of extreme skewness and outliers in the data set. The econometric form of this study's empirical model is stated in Equation 3.

$$LOGCEMP = \beta_0 + \beta_1 LOGEXCHR + \beta_2 LOGINFLR + \beta_3 LOGINTRT + \beta_4 UNMPR + \mu \text{Eqn. (3)}$$

Where,

LOG = logarithmic notation

β_0 = constant

$\beta_1 - \beta_4$ = coefficients

μ = error term

Data estimation was conducted using the autoregressive distributed lag (ARDL) model in multiple regression analysis. The ARDL model used the boundaries test to ascertain the existence of a long-term connection between the dependent variable and the independent variables, in accordance with the bound limitations specified by Pasaran's criterion. An advantage of the bound test is its ability to account for potential structural breakdowns that might have negative repercussions for the presence of a long-term relationship between the

variables being explained and the explanatory variables. ARDL allows for the simultaneous estimation of long-run and short-run coefficients, which may be used to test for cointegration even when the variables have different levels of integration, such as $I(1)$ and $I(0)$. Put simply, the assumption is that the variables may have a combination of first-order integration ($I(1)$) and no integration ($I(0)$), but none of them are integrated at second differencing ($I(2)$) (Pesaran, Shin and Smith, 2001). Therefore, the ARDL model is formulated only when these requirements are satisfied.

Prior to doing ARDL estimation, the time series data underwent stationarity testing. The Augmented Dickey-Fuller (ADF) unit root test will be used to determine whether the data is stationary. This step is crucial since the majority of macroeconomic time series exhibit unit root, and any regression that includes non-stationary series tends to show a substantial link even when there is no actual relationship between the variables.

4.1. RESULTS AND DISCUSSIONS

4.2. Descriptive Statistics

The data shown in Table 1 reveals that cement production (CEMP) in Nigeria during a span of 42 years (1981-2022) ranged from ₦0.61 billion to ₦6,258.97 billion. The average value of CEMP throughout the time was around ₦574.59 billion, with a standard deviation of 1385.748. This indicates that the data vary from the mean in both positive and negative directions. This indicates that the occurrence of CEMP in Nigeria is reasonably widespread over the investigated timeframe. The discrepancy implies variations in the increase of cement production. The volatility in CEMP may also be ascribed to the erratic policy modifications that have characterized several governments in Nigeria throughout the years. The skewness coefficient of 3.153446 indicates that the distribution of CEMP is positively skewed, meaning it is not symmetrical around the mean and deviates from a normal distribution. The kurtosis value of 12.16976 indicates that CEMP has a leptokurtic (peaked) distribution, indicating that it is much more peaked compared to the normal distribution. The findings of the descriptive normality analysis also indicated that CEMP does not follow a normal distribution. The Jarque-Bera probability value of 0.00 was observed, indicating a significance level below 0.05.

Table 1 reveals that the macroeconomic variables exchange rate (EXCHR), inflation rate (INFLR), interest rate (INTRT), and unemployment rate (UNMPR) have lowest and maximum values over the period. The exchange rate ranges from ₦0.61/\$1 to ₦119/\$1, the inflation rate ranges from 5.39% to 72.84%, the interest rate ranges from 7.75% to 29.80%, and the unemployment rate ranges from 1.80% to 48.61%. The mean values of EXCHR, INFLR, INTRT, and UNMPR over the specified time are ₦115.74/\$1, 18.97%, 17.19%, and 15.51%, respectively. The standard deviations for these variables are 119.14, 16.47%, 4.65%, and 11.84, respectively. This indicates that the data for EXCHR, INFLR, and UNMPR differed substantially from the mean. This indicates that the data from the INTR variable has a smaller range of values compared to the other macroeconomic aggregates throughout the sample period. This is supported by the finding that the standard deviation is lower than the mean value. The skewness coefficients of 1.02, 1.87, 0.31, and 0.85 for the variables EXCHR, INFLR, INTRT, and UNMPR indicate that the data is positively skewed and does not meet the assumption of a symmetrical distribution. The kurtosis values of around 3.22, 5.41, 3.47, and 3.03 indicate that EXCHR, INFLR, and INTRT have leptokurtic distributions, meaning they are slender or long-tailed compared to the normal distribution. However, UNMPR does not have leptokurtic distribution and is somewhat more peaked. The p-values of CEMP, EXCHR, and INFLR for Jarque-Bera indicate that the assumption of a Gaussian distribution for normal data was not satisfied at a significance level of 5%. However, this assumption was satisfied for INTRT and UNMPR. Therefore, the variables were converted into logarithmic form in order to minimize the outliers in the distribution and to better meet the assumptions of the distribution.

Table 1. Descriptive statistics for the variables

	CEMP	EXCHR	INFLR	INTRT	UNMPR
Mean	574.5871	115.7412	18.96619	17.19024	15.50969
Median	33.70000	115.2550	12.88000	17.38000	13.40000
Maximum	6258.970	425.9800	72.84000	29.80000	48.61000
Minimum	0.610000	0.610000	5.390000	7.750000	1.800000
Std. Dev.	1385.748	119.1408	16.46796	4.646897	11.84438
Skewness	3.153446	1.021357	1.869115	0.307216	0.851217
Kurtosis	12.16976	3.221275	5.412319	3.466629	3.028405
Jarque-Bera	216.7574	7.387874	34.63888	1.041722	4.469423
Probability	0.000000	0.024874	0.000000	0.594009	0.107023
Observations	42	42	42	42	42

Source: Researcher’s computation, using EViews 10, 2024

4.3. ARDL Estimation

In order to study the behavior of a time series variable across time and make accurate predictions, it is necessary for the variable to remain stationary. Therefore, it is crucial to examine the characteristics of time series data prior to examining the correlation that exists between them. Nevertheless, it is crucial to do a unit root test on all the variables of interest to determine their characteristics and implement relevant measures to rectify any issues if needed. This is precisely the subject matter that we have scrutinized in this particular section. Table 2 displays the results of the unit root test, which shows different degrees of integration. The inflation rate exhibits unit roots at some levels, whereas others exhibit unit roots when considering the first difference. At a significance level of 5%, it is evident that only the inflation rate exhibited stationarity at the level. This is because, when compared, the critical value of the inflation rate was bigger in absolute value than the Augmented Dickey Fuller (ADF) test statistics of the other variables. Initially, the variables CEMP, EXCHR, INTRT, and UNMPR exhibited stationary behavior. Therefore, the series are both stationary and integrated, with order zero (I(0)) and order one (I(1)) respectively. The use of the Autoregressive Distributed Lag (ARDL) approach of estimate is required due to the presence of mixed integration in this circumstance. The Autoregressive Distributed Lag bounds test is used to ascertain the presence of a long-term link between the variables.

Table 2: Unit Root Test (ADF)

Variable	Level	First difference	Remark
LOG(CEMP)	-2.826484 (0.1965)	-6.274766 (0.0000)	I(1)
LOG(EXCHR)	-1.427347 (0.8377)	-5.815986 (0.0001)	I(1)
LOG(INFLR)	-3.596866 (0.0307)	--	I(0)
LOG(INTRT)	-3.154431 (0.1079)	-9.209608 (0.0000)	I(1)
LOG(UNMPR)	-2.727604 (0.2322)	-6.686929 (0.0000)	I(1)

Source: Researcher’s computation, using EViews 10, 2024

Note: Figures in bracket () are probability values

The results of the ARDL limits test for Co-integration in Table 3 indicate that the F-statistic value of 4.6 exceeds the lower (I(0)) and upper bound (I(1)) critical values of 3.03 and 4.06 respectively, at a significance level of 5%. Given that the estimated value exceeds both the

lower and upper bounds at significance levels of 5% and 1% respectively, we may conclude that there is really a distinct long-term association among the variables. Therefore, the null hypothesis that there is no long-term link is rejected with a significance level of 5%. Thus, it can be deduced that the variables exhibit co-integration, indicating a stable long-term link between macroeconomic dynamics and cement output from 1981 to 2022.

Table 3: Bounds test results

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	4.601392	10%	3.03	4.06
K	4	5%	3.47	4.57
		1%	4.4	5.72

Source: Researcher's computation, using EViews 10, 2024

The long-term estimates of the autoregressive distributed lag (ARDL) model are shown in Table 4. The findings indicate that the exchange rate (EXCHR) and interest rate (INTRT) have negative and statistically significant coefficients. The negative coefficient of the logarithm of the exchange rate (LOG(EXCHR)) indicates that a percentage rise in the exchange rate led to a drop of about 3.51% in cement output (CEMP) in the long-term. Furthermore, the presence of a negative coefficient for LOG(INTRT) suggests that CEMP experienced a drop of around 1.750% as a result of a percentage increase in the interest rate over the long term.

However, the inflation rate (INFLR) and unemployment rate (UNMPR) were shown to have positive coefficients. The positive coefficient of LOG(INFLR) indicates that a percentage rise in the inflation rate leads to a corresponding increase in the value of cement output in the long-run, estimated to be roughly 1.51%. Once again, the logarithm of the unemployment rate (LOG(UNMPR)) yielded a positive coefficient, indicating that a percentage rise in the unemployment rate resulted in an estimated 1.26% increase in the value of cement output in Nigeria.

Regarding statistical significance, it was observed that all the independent variables are significant except for UNMPR. The decision rule is derived from the following criteria:

- a) Accept the null hypothesis (HO) and reject the alternative hypothesis (HA) when the probability value exceeds 0.05.
- b) When the probability value is less than 0.05, the null hypothesis (HO) should be rejected and the alternative hypothesis (HA) should be accepted.

Therefore, due to the fact that the probability values of LOG(EXCHR), LOG(INFLR), and LOG(INTRT) were found to be $0.0015 < 0.05$, $0.0387 < 0.05$, and $0.0006 < 0.05$, respectively, it may be concluded that the influence of exchange rate, inflation rate, and interest rate on cement output was deemed substantial. Therefore, the long-term effects of currency rate, inflation rate, and interest rate on the value of cement output in Nigeria are significant and substantial. However, the logarithm of the unemployment rate (LOG(UNMPR)) yielded a probability value of 0.4410, which is greater than 0.05. This suggests that the long-term effect of the unemployment rate on cement production is minimal and does not have a significant impact on productivity in the cement subsector.

Based on the above information, it can be concluded that there is a positive correlation between the inflation rate and unemployment with CEMP. However, it was determined that only the inflation rate has a statistically meaningful impact, while the unemployment rate is not significant. Therefore, it was argued that the inflation rate has a positive and statistically significant influence on CEMP, contrary to the original premise that interest had no meaningful effect on the value of cement output in Nigeria. Given the negligible unemployment rate, the research dismissed the alternative hypothesis and confirmed the null hypothesis that unemployment has no effect on cement output. Conversely, the

alternative hypothesis of statistical significance was shown to be valid for the effects of exchange rate and interest rate. Therefore, fluctuations in exchange rates, inflation, and interest rates are indicative of important macroeconomic factors that account for the long-term trend in cement output. According to the coefficients, it was found that the changes in exchange rate and interest rate were the main factors that caused a decline in the macroeconomic environment, leading to a decrease in the long-term trend of cement output.

Table 4: Long-run coefficients of the ARDL estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(EXCHR)	-0.350788	0.094288	-3.720403	0.0015
LOG(INFLR)	0.151005	0.067987	2.221085	0.0387
LOG(INTRT)	-1.750239	0.422245	-4.145079	0.0006
LOG(UNMPR)	0.126484	0.160730	0.786933	0.4410

Source: Researcher's computation, using EViews 10, 2024

The Table 5 below presents the short-term correlation between macroeconomic dynamics and cement output in Nigeria, specifically focusing on the second element of the calculated ARDL model. The lag durations were chosen according to the Akaike Information Criterion (AIC). The table below presents the short-term dynamic estimations of the variables of interest.

The findings of the ARDL error correction mechanism (ARDL-ECM) are shown in Table 5. The coefficient value of 0.427490 and a p-value of 0.0141 indicate that the one period lag of LOG(CEMP) had a positive and significant impact on the current period's CEMP. The initial differenced coefficients of the explanatory factors provide the short-term coefficients that explain the influence of macroeconomic variables on cement output. The coefficient of DLOG(EXCHR) was found to be statistically insignificant, as shown by a probability value of 0.1757, which is more than the threshold of 0.05. This suggests that the effect of exchange rate on cement output is not immediate and may be considered unimportant in the short-term. Additionally, it was discovered that the estimated coefficient of DLOG(INFLR) was positively and significantly correlated ($p < 0.05$), indicating that inflation had an immediate effect on cement output in Nigeria in the near term. However, the coefficients of DLOG(INTRT) and DLOG(UNMPR) were negative, but only the coefficient of DLOG(INTRT) was statistically significant. This suggests that the effect of interest rate on cement production was immediate, whereas the effect of unemployment on cement production was not immediate.

The speed of adjustment coefficient, which measures the rate at which disequilibrium is corrected, indicates that there is a short-term imbalance, as shown by the negative sign, and that this imbalance will be rectified in the long term. The delayed coefficient of the ECM(-1) is -0.733886, indicating that about 73% of the deviation from equilibrium in the short-term is rectified during the first year of achieving balance in cement production in Nigeria, based on the fluctuations in macroeconomic variables and cement output. The long-term adjustment process is estimated to take around 1.4 years, which is calculated based on the value of the Error Correction Model (ECM).

Additionally, the P-value of the F-statistics for the model was found to be significant, suggesting that the model fits well and is resilient at a 1% level of significance. In addition, the R-squared value of 0.715128 indicates that about 72% of the variability in CEMP can be accounted for by the model, while the remaining 18% is attributed to factors that are not included in the model. The Adjusted R-squared value of 0.591271 indicates that about 59% of the dependent variable is explained by the equation, after accounting for the effect of the included explanatory variables. The Durbin Watson statistic of 1.920562 did not deviate considerably from the customary benchmark of 2.0 in the mode. Therefore, the research may infer that the model specification does not exhibit any evidence of autocorrelation or serial

correlation, and so the assumption of linearity remains valid.

Table 5: Estimated short-run error correction model [Selected Model: ARDL(2, 3, 1, 1, 3)]

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.835990	0.738196	5.196437	0.0001
DLOG(CEMP(-1))	0.427490	0.158194	2.702316	0.0141
DLOG(EXCHR)	0.170586	0.121280	1.406551	0.1757
DLOG(EXCHR(-1))	0.215568	0.137078	1.572595	0.1323
DLOG(EXCHR(-2))	0.248747	0.115379	2.155919	0.0441
DLOG(INFLR)	0.115422	0.047686	2.420472	0.0218
DLOG(INTRT)	-0.929934	0.188185	-4.941604	0.0001
DLOG(UNMPR)	-0.090970	0.088879	-1.023522	0.3189
DLOG(UNMPR(-1))	-0.301687	0.096379	-3.130214	0.0055
DLOG(UNMPR(-2))	-0.341724	0.090769	-3.764745	0.0013
ECM(-1)	-0.733886	0.139063	-5.277360	0.0000
R-squared	0.715128	Mean dependent var		0.206076
Adjusted R-squared	0.591271	S.D. dependent var		0.175312
S.E. of regression	0.112080	Akaike info criterion		-1.283013
Sum squared resid	0.288925	Schwarz criterion		-0.789190
Log likelihood	32.81122	Hannan-Quinn criter.		-1.114605
F-statistic	5.773808	Durbin-Watson stat		1.920562
Prob(F-statistic)	0.000252			

Source: Researcher's computation, using EViews 10, 2024

5. CONCLUSIONS

This research has analyzed the macroeconomic factors that affect domestic cement output in Nigeria from 1981 to 2022. The research was conducted using the Autoregressive Distributed Lag model. The cointegration test using the bounds testing technique indicated that the variables are mutually cointegrated, implying a long-term link between them in the model. The long-term estimations indicated that the exchange rate, inflation rate, and interest rate were the primary macroeconomic factors that influence the value of cement output in Nigeria. The analysis of short-term dynamics reveals a considerable relationship between changes in the initial difference of inflation and interest rate and changes in the value of cement output. Consequently, this study indicates that the cement sector in Nigeria has been significantly impacted by the oscillations in macroeconomic factors over the years, despite the government's substantial attempts to enhance domestic output in the country.

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