Monetary Policy and Cement Production in Nigeria

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Abstract
In Nigeria's quest for industrial growth and infrastructure development, the cement sector plays a pivotal role. However, its performance is intricately linked to macroeconomic conditions, especially monetary policy and exchange rate progressions. Hence, fluctuations in monetary indicators can significantly influence production costs and output levels. The specific objective of the study is to investigate how monetary policy instruments namely; rate of exchange, inflation and money supply affect the performance of Nigeria cement industry. The aim is to find out the long-run relationship between these macroeconomic variables and cement production, using the annual time-series data during 1981-2023, by applying an ARDL (Autoregression Distributed Lag) model. Result show that money supply and exchange do not have significant effect on cement output performance, while monetary policy rate, liquidity ratio and domestic credit to private sector have significant and positive effect. This suggests that an expansionary monetary policy could boost the capacity of cement production by increasing the level of liquidity. The paper suggests that stability in the exchange rate, sufficient money supply and accessibility to credit markets are the necessary conditions under which optimum output the sub-sector can be assured.

Keywords: Cement Industry Performance, Monetary Policy Instruments, Exchange Rate Dynamics, Money Supply and Credit
Jel Codes: C32, E52, F31, L61, O14

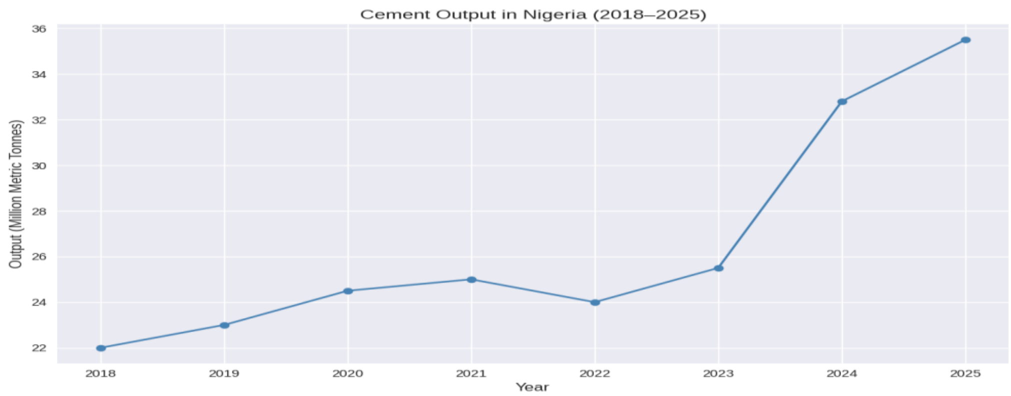
1. Introduction

On a worldwide scale, the cement sub-sector is a major producer of carbon dioxide emissions that cause the global greenhouse effect. Most are the result of heavy heating at very high temperature, at which both the limestone and clay they contain turn into cement. This has an increased effect on the environment and adds to climate change globally (Salas et al., 2016; Asharf et al., 2020; Habert et al., 2020). As a result, the cement industry will continue to expand due to rising demand for urbanisation in developing countries and forest fragmentation.

In Nigeria, apart from the compelling need for urbanization, the cement industry will continue to be a focal point of research and policy making because of it homogeneous nature, (the reason it is probably suitable for a heuristic purpose), and mainly because it is among the most tariff-protected items in the country about which little data and qualitative information abound (Akinyoade & Uche, 2018). Since the protection is at a huge public cost, there is a need to continuously evaluate the effectiveness of the protection policy based on sound qualitative premises.

In the last 20 years, the cement subsector in Nigeria doubled its capacity (production) and has surpassed the second largest producer of Africa, South Africa (see Figure 1). Across the African continent, over a quarter of total cement production capacity in Africa is located in Nigeria, and its forecasted capacity is around 43 million metric tonnes per annum, which is double the amount produced by South Africa, estimated to be 21.4Mmt (Glaeser et al., 2018). Although Nigeria did not rank among Top Ten Cement Producing country in 2017, the greatest cement producer in Nigeria is Dangote Cement Plc., and they were ranked number ten globally as well as being the only African company on that top-ten-chart (Glaeser et al., 2018). Between 2018 and 2024, it kept its top ten position while its installed capacity grew to 52 million tonnes per annum (Mta) across 10 African countries by 2024 (Dangote, 2024). And indeed, as some studies concede and recognise, the Nigerian cement industry remains a kind of success story in the use of industrial and trading protection (Akinyoade & Uche, 2018).

Figure 1.1: Cement output In Nigeria (2018-2025)



Source: Cardinal Stone Research. (2024, January 8). 2024 and 2025 are projected figures

National governments often have a significant impact on their construction sectors globally, and building procurement-related expenditure predominantly stimulates industry growth. The evidence base is compelling for an association between construction output and national wealth, particularly in developing countries (Ruddock & Lopes, 2019). Additionally, monetary policy considerations have noticeable impacts on the country's state of infrastructure in all countries (Asamoah et al., 2020). The monetary policy indices are: monetary policy rate, exchange rate, money supply and liquidity ratio, among others. Consequently, from a moderated perspective, the relationship between the construction industry–cement subsector and macroeconomics is that the construction industry represents the core of earnings as well as a resource in form of employment to any country (Abdullahi et al, 2025). Monetary policy instruments are often employed to attain macroeconomic targets, and variation in any of these policies will impact all the sectors of the economy, most especially the real sector (Nyamagere, 2023).

In Africa, the industry was dominated by such players, including Dangote Cement, Lafarge and Holcim, among others. It also witnessed a strong growth in the last couple of years, from large enterprise projects. Demand for cement in Nigeria has continued to increase due to the fact that its population is teeming (Itaman & Wolf, 2021). The government, in 2002, decided that it was necessary to reverse this trend closer to home through a "vertical industrial policy"—to boost production and stop imports. This policy was a trade policy tool denying import licences and granting quotas only to producers that were able to show that they were setting up cement factories in Nigeria. In a bid towards self-sufficiency, the government undertook to progressively phase out these quotas with increased local production (Akinyoade & Uche, 2016). By confining imports to just a few producers, the speculative risk faced by investors, who could count on a large guaranteed market for their product, was then reduced drastically. The government also granted a waiver of value-added tax (VAT) and customs duties on importation of plant and machinery, as well as five-year tax exemption to players in the industry (Federal Ministry of Finance, 2019).

The major players in cement production in Nigeria include Ashaka, Dangote, BUA, Ibeto, Benue, Niger and Eagle Cement. Others include West African Portland Cement (WAPCO), now called Lafarge Cement, Unicem, Cement Company of Northern Nigeria (CCNN), and PureCem. During the post-Civil War period, Nigeria was completely dependent on the importation of cement because of rapid infrastructural and residential development (Obiaje et al., 2025). However, despite the massive volume of local manufacture of cement in Nigeria today, there is still substantial importation of either cement or some of its raw materials, which has lasting effects on the economy. To correct this and bring down the cost of cement and *ipso facto*, the cost of infrastructure nationwide cannot by any means be a child's play. It requires more than mere rhetoric. It demands that appropriate policies be put in place to ensure that both the local and foreign investors are mobilised, and at affordable prices as well. Therefore, this paper seeks to investigate the linkage between monetary policy, exchange rate variation, and cement subsector performance in Nigeria. The focus is to assess the impact of monetary policy instruments, specifically changes in the rate of exchange, supply of money, and inflation, on the performance of the cement industry in Nigeria. The objective is to determine the extent to which these macroeconomic variables affect cement output in the country.

2 Literature Review

2.1 Conceptual Review

Monetary Policy

Monetary policy is one of the most important tools available to governments and central banks for managing the economy. It involves deliberate actions taken by the monetary authority—usually the central bank—to regulate money supply, interest rates, and credit availability to achieve macroeconomic stability (Mishkin, 2019). Its primary goals include: Price stability, GDP growth, price and exchange rate stability, as well as balance of payments equilibrium (Friedman, 1990).

Generally, monetary policy operates through two broad categories of instruments, which can be either quantitative or qualitative. The former includes Open Market Operations (buying/selling government securities), Reserve Requirements (cash reserve and liquidity ratios), as well as Interest Rate Adjustments (policy and discount rates), while the later include Credit rationing, Directives to banks on lending priorities and moral suasion (Jhingan, 2016).

The effectiveness of monetary policy depends on how changes in money supply and interest rates influence aggregate demand. Transmission channels include: Interest Rate, Exchange Rate, Credit Channel and Expectations Channel.

Consequently, policy formulation often has its challenges, and the results from action may not necessarily meet expectations. This provides a strong basis for research into policy actions. Some of the challenges of implementation include time lags, fiscal dominance, external shocks and structural constraints (Mishkin, 2019). Notwithstanding these constraints, monetary policy remains a cornerstone of macroeconomics, even as its success depends largely on institutional credibility, coordination with fiscal policy and adaptability to changing domestic and global conditions.

2.2 Theoretical Review

This review briefly explores key theoretical perspectives relevant to Nigeria's cement sub-sector output performance.

2.2.1 The Mundell- Fleming Model

The originators of the celebrated Mundell-Fleming model are Robert Mundell and Marcus Fleming. The assumption of a closed economy led to the open-economy extension to the IS-LM model, also referred to as the Mundell-Fleming (IS-LM BP) model. This superior version versus the non-viable closed economic system, assumed by the IS-LM model, describes an open economy characterised by perfect capital mobility and full asset substitution between foreign and domestic holdings. From this model, it could be seen that there is a possible existence of both short and long run relationships between interest rate, nominal rate, and output. The structure shows that there is a trade-off between a fixed exchange rate and free capital mobility together with autonomous monetary policy. The model implies the foreign exchange regime is a major determinant of the efficacy of money market policy instruments. From the model, monetary policy is less effective under a fixed exchange rate than under a flexible or market-determined exchange rate regime due to loss of monetary autonomy (Mundell, 1963; Fleming, 1962; Mankiw, 2022).

2.2.2 Balance of Payment Theory of Exchange Rate

The balance of payment theory of exchange rate, also known as the demand-supply theory of exchange, explains how a country's exchange rate is influenced by its balance of payments position. The theory argues that rates of exchange are determined by the demand and supply of foreign exchange, which in turn are shaped by a country's balance of payments. A deficit in the balance of payments leads to a fall or depreciation in the rate of exchange, while a surplus in the balance of payments strengthens the foreign exchange reserves, causing an appreciation in the price of the home currency in terms of foreign currency. A deficit balance of payment indicates that demand for foreign exchange is exceeding its supply, which results in rise in the price of foreign currency in terms of domestic currency. Conversely, a balance of payments surplus implies greater demand for a local currency with the resultant appreciation in terms of foreign currencies (Iortyer & Onuh, 2022; Stern, 1973).

This theory helps to explain how trade imbalances affect currency value, why exchange rates fluctuate and what interventions might stabilise a currency. For example, when the Central bank adjusts monetary policy rates (interest rates), it impacts the cost of borrowing, which can influence investment decisions and ultimately affect the volume of exports and imports, thereby influencing the balance of payments. A strong domestic currency makes exports more expensive and imports cheaper, leading to a potential trade deficit and a negative balance of payments, while a weak currency has the opposite effect of stimulating exports and improving the balance of payments.

2.3 Empirical Review

Monetary policy variables and exchange rate variations are critical drivers of cement sub-sector output performance, especially in emerging economies like Nigeria. Recent studies have explored how monetary policy variables and exchange variations enhance the output performance of the cement sub-sector. This empirical review examines key findings on the relationship between monetary policy variables and exchange rate variation on cement sub-sector output performance.

Obiaje et al. (2025) examined the impact of monetary policy on cement production in Nigeria using time series data from 1986 to 2023, employing the Autoregressive Distributed Lag model (ARDL). Their findings revealed that the rate of exchange exerts a positive and insignificant influence on the cement industry, while money supply has a negative and insignificant impact on the cement industry. However, the inflation rate exhibits a positive relationship with the cement industry, suggesting that attention should be given to the inflation rate during project budget development.

Babalola (2023) specifically examined the impact of a select macroeconomic variable on the cost of some building materials in Lagos for a period spanning 12 years (2008-2019), opted for Ordinary Least Squares (OLS) and Auto-Regressive Distributed Lag (ARDL) model. The findings indicated that interest rate, inflation and rate of exchange are positively related to building material price. The study suggested a reduction in import duties, exchange rate and interest on bank loans.

Seyed et al. (2023) investigated the effect of economic factors on cement prices and predicted its price tendency with monthly data for the period 2019:03 to 2023:02, through utilising a vector autoregression model (VAR). Results of the variance decomposition indicated that the construction input price index, energy cost and exchange rate are the significant variables in influencing the price of cement.

Ifeanyi et al. (2023) examined the impact of macroeconomic factors on the cost of building materials in Nigeria, with quarterly data spanning over ten years, from 2012 to 2021. Multiple regression analysis was adopted. Results show that GDP, inflation and interest rates had a positive and significant impact on the cost of building materials during the period under review.

Isyaka et al. (2022) examined the effect of economic environment on the performance of Cement Manufacturing companies in Nigeria. The paper employed a descriptive and explanatory design with a survey method. The period of observation was ten years and there were twenty-four basic types of construction materials. The outcome shows that movement in the monetary market policy instruments are associated with the rate of inflation. Conversely, interest rate indicates an insignificant effect on building material price.

Abdullahi et al. (2025) investigated the influence of macro-economic variables on the financial performance of listed cement firms in Nigeria between 2011 and 2019. The result also revealed that macroeconomic variables plays vital role in the financial performance of the listed cement manufacturing companies in Nigeria.

Menyelim et al. (2021) also worked on how liquidity affects the performances of quoted corporations in Nigeria between year 2000 and 2019 using a fixed panel regression model. Their findings recommended, among others, that the industry should prioritise its liquid capital in order to maintain top-notch performance.

Mark et al. (2016) focused influencing of macroeconomic variables on cement production in Ghana over time horizon spanning fifteen years (2000 to 2014). The inferential statistical data was interpreted by means of a multiple regression analysis, which indicated that the cost of cement was insensitive to changes in inflation and rate of monetary policy. The research advocated finding means to make local materials like bricks and calcined clay pozzolan which do r.

Omale (2016) assessed the influence of macroeconomic indicators on the performance of cement companies in Nigeria between 2011 and 2015), using the OLS multiple regression analysis. Results reveal a positive relationship between interest rate, inflation rate, GDP and exchange rate with return on equity. But the interest and exchange rates exert positive and significant on return on equity (ROE).

3. Research Methodology

3.1 Theoretical Framework and Model Specification

This work is anchored on the Mundell- Fleming model as modified by Agbonrofo and Ajibola (2023); Saibu and Nwosa (2011), and it is preferred for this study because it shows how output is influenced by monetary policy and exchange rates, both in the short and long run. The Mundell-Fleming model posits that output is positively related to monetary policy and exchange rates, while further modifications by Agbonrofo and Ajibola (2023) and others allow us to include credit to the private sector, money supply, liquidity ratio and other control variables in our specification. The functional relationship is stated as

$$QQ = f(WP, ZP) \quad (3.1)$$

Q Q= Output of cement sub-sector
WP = Vector of policy variables
ZP= Vector of control variables

Based on the above function, QQ is measured by cement output (CEMO). WP represents monetary policy rate, exchange rate, credit to the private sector, money supply and liquidity ratio, while ZP represents inflation rate, unemployment rate. The functional relationship of the model is stated as:

CEMO Model

$$CEMO_t = f(MS_t, MPR_t,, LR_t, EXR_t, DCP_t, IFL_t) \quad (3.2)$$

Where:

CEMO	= Cement output performance
MS	= Money supply
MPR	= Monetary policy rate
LR	= Liquidity ratio
EXR	= Exchange rate
DCP	= domestic credit to the private sector
IFR	= Inflation rate

Hence, the long-run regression specifications are expressed as follows:

CEMO Model

$$CEMO_t = \phi_0 + \phi_1 MS_t + \phi_2 MPR_t + \phi_3 LR_t + \phi_4 EXR_t + \phi_5 DCP_t + \phi_6 IFR_t + \mu_t \quad (3.3)$$

Where (ϕ_i) represent the coefficients of the explanatory variable.
The log specification of the model is given as**:**

$$ln\,(CEMO_t) = \phi_0 + \phi_1 \ln(MS_t) + \phi_2 MPR_t + \phi_3 LR_t + \phi_4 \ln(EXR_t) + \phi_5 \ln(DCP_t) + \phi_6 IFR_t + \mu_t \quad (3.4)$$

Where the coefficients ($\phi_i: i = 1 - 6$)) now represent elasticities of the variables (i) in relation to the dependent variable.

The final estimation will adopt the Autoregressive Distributed Lag (ARDL) as stated:

Long-run levels form:

$$Y_t = \phi_{0_0} + \phi_1 \ln(M2_t) + \phi_2 MPR_t + \phi_3 lnLR_t + \phi_4 \ln(EXR_t) + \phi_5 \ln(DCP_t) + \phi_6 lnIFR_t + \mu_t \quad (3.5)$$

The conditional specification of the ECM-ARDL model is as stated below:

$$\Delta Y_t = \beta_0 + \sum_{i=1}^{p} \beta_i\, \Delta Y_{t-i} + \sum_{j=0}^{q_1} \gamma_j\, \Delta \ln(M2)_{t-j} + \sum_{k=0}^{q_2} \delta_k \ln\Delta(MPR)_{t-k} +$$

$$\sum_{l=0}^{q_3} \mu_k\, \Delta \ln(LR)_{t-l} + \sum_{m=0}^{q_4} \mu_k\, \Delta \ln(EXR)_{t-m} + \sum_{n=0}^{q_5} \psi_m \ln \Delta DCP_{t-n} + \sum_{r=0}^{q_6} ⋔_l \ln \Delta INF_{t-r}$$

$$+\lambda_1 Y_{t-1} + \lambda_2 \ln(M2)_{t-1} + \lambda_3 \ln(MPR)_{t-1} + \lambda_4 \ln(LR)_{t-1} + \lambda_5 \ln(EXR)_{t-1} + \lambda_6 lnDCP_{t-1} + \varepsilon_t + \lambda_7 INF_{t-1} \quad (3.6)$$

The above model in 3.6 is a framework that combines the Autoregressive Distributed Lag (ARDL) approach with an Error Correction Mechanism (ECM) to capture both short-run dynamics and long-run equilibrium relationships among variables. It is "conditional" because The ECM is derived from the ARDL specification only if cointegration exists, ensuring that deviations from the long-run equilibrium are corrected over time. Finally, the ECM specification is given as:

$\Delta Y_t = \beta_0 + \cdots + \eta \cdot ECM_{t-1} + \varepsilon_t$, (3.7) where: $ECM_{t-1} = Y_{t-1} - \hat{\alpha}_0 - \hat{\alpha}_1 \ln(M2)_{t-1} - \hat{\alpha}_2 \ln(MPR)_{t-1} - \hat{\alpha}_3 \ln(LR)_{t-1} - \hat{\alpha}_4 ln\, EXR_{t-1} - \hat{\alpha}_5 lnDCP_{t-1} \quad \hat{\alpha}_6 lnINF_{t-1}$

A significant negative (η) indicates a valid short-run adjustment toward the long-run equilibrium.

Variable definitions and notes

- Y_t**:** Real output (e.g., real GDP or industrial/cement output index).
- $\ln(M2_t)$**:** Log of broad money supply (M2).
- MPR_t**:** Monetary Policy Rate (policy interest rate).
- $\ln(EXR_t)$**:** Log of nominal exchange rate
- DCP_t**:** Domestic Credit to Private Sector
- INF_t**:** Inflation rate (year-over-year CPI).

The *a priori* expectation

The variables encompass output of Cement, as the dependent variable, *MS*, *MPR*, *LR*, *EXR*, *DCP* and *IFR* are the independent variables. Following the theoretical framework, the *a priori* expectations are defined as follows:

$$\phi_1 > 0, \phi_2 < 0, \phi_3 < 0, \phi_4 < 0, \phi_5 > 0, \phi_6 >< 0$$

Based on the above theoretical statements, the anticipated relationship posits that money supply (MS), liquidity ratio (LR) and domestic credit to the private sector (DCP) as explanatory variables would exhibit indirect and direct relationships, respectively, with the target variable (CEMO), while the monetary policy rate is expected to be possibly associated with the target variables. An increase in the exchange rate is expected to increase the cost of input and hence decrease output, same goes for inflation.

Data Analysis and Discussion

The study employs the time series data technique. Therefore, preliminary analysis (as the first data evaluation), model estimation, and post-diagnostic testing are the stages of empirical data analysis. The preliminary analysis stage includes descriptive statistics, stationarity test using the Augmented Dickey Fuller (ADF) test and the ARDL bound test to determine co-integration among the variables. At the model estimation stage, the ARDL technique was employed to reveal the short and long-run relationship between the dependent and the independent variables. The serial correlation test (using the Breusch- Pagan LM test), the heteroscedasticity test (using the autoregressive conditional heteroscedasticity [ARCH] test), and a normality test (Jarque-Bera statistic) were used as post-estimation tests. Besides, the CUSUM test was used to perform a stability test as part of the validity testing.

4.1 Descriptive Statistics

The descriptive analysis provides the statistical properties of the variable as summarised in Tables 4.1 and 4.2. Output of cement production (CEMO, ₦' billion), monetary policy rate (*MPR*, %), liquidity ratio (*LR*, %), Naira/Dollar exchange rate (*EXR*, ₦/$), money supply (*MS*, ₦' billion), domestic credit to private sector (*DCP*, ₦' billion) and inflation rate (*IFL*, %).

Table 4.1-: Summary Statistics
Realisation-: *T* = 43 (1981 – 2023)

	CEMO	MS	MPR	LR	EXR	DCP	IFL
Obs.	43	43	43	43	43	43	43
Mean	290.03	10353.70	13.215	49.271	128.054	8402.27	19.081
Maximum	717.25	63512.40	26.000	104.200	645.190	52884.78	72.840
Minimum	49.850	14.4700	6.000	26.390	0.6100	8.5700	5.3900
Std. Dev.	191.86	15527.13	3.995	14.348	142.743	12658.15	16.281
Skewness	0.9197	1.6587	0.6047	1.4477	1.5464	1.6795	1.8676
Kurtosis	2.5779	5.1286	4.1378	6.5665	5.5533	5.3676	5.4736
Jarque-Bera	6.3815	27.836	4.9401	37.8103	28.8184	30.259	35.959
p-value	0.0411	0.0000	0.0846	0.0000	0.0000	0.0000	0.0000

***Source**: Researchers' computation (2025)*

In Table 4.1, the variables CEMO, MPR, LR, and IFL show low variability, with standard deviations lower than their averages, indicating high forecasting capacity. In contrast, MS, EXR, and DCP exhibit high variability, with standard deviations above their averages, suggesting low forecasting capacity. The distributions of all variables are positively skewed, and the kurtosis coefficients reveal that the cement subsector output performance variable is platykurtic, while the monetary policy variables are leptokurtic. Most variables show non-normal distribution, except for MPR, based on the Jarque-Bera statistics.

After transforming the variables into natural logarithms (Table 4.2), the results show low variability for all variables, with standard deviations below their averages. Additionally, all variables demonstrate normality, with insignificant Jarque-Bera statistics, making them suitable for classical linear regression analysis. Therefore, the log-transformed variables are used for subsequent analyses.

Table 4.2-: Summary Statistics with Logarithm Transformation
Realisation-: *T* = 43 (1981 – 2023)

	Variable						
Statistics	**CEMO**	**MS**	**MPR**	**LR**	**EXR**	**DCP**	**IFL**
Obs.	43	43	43	43	43	43	43
Mean	5.455	7.059	2.535	3.860	3.724	6.721	2.699
Maximum	6.575	11.059	3.258	4.646	6.470	10.876	4.288
Minimum	3.909	2.672	1.792	3.273	-0.494	2.148	1.684
Std. Dev.	0.679	2.781	0.315	0.271	2.036	2.882	0.665
Skewness	-0.0989	-0.1852	-0.4922	0.2865	-0.8066	-0.1553	0.8109
Kurtosis	2.3441	1.6077	3.4474	3.7484	2.4548	1.5862	2.9496
Jarque-Bera	0.8409	3.7187	2.0945	1.5916	5.1950	3.7535	4.7175
p-value	0.6568	0.1558	0.3509	0.4512	0.0745	0.1531	0.0945

***Source**: Research's computation (2025)*

4.2 Unit Root Tests

To prepare for model estimation, a unit root test was conducted to assess the stationarity of the variables. Stationarity determines whether a variable's statistical properties, such as mean and variance, remain constant over time. A stationary variable has a non-trending pattern and is less affected by shocks, with any impacts being temporary. In contrast, non-stationary variables can be heavily influenced by shocks, such as economic crises or policy changes, with persistent effects.

Table 4.3-: Augmented Dickey Fuller Unit Root Test Results
Realisation-: *T* = 43 (1981 – 2023)

Level Form								
Specification		**CEMO**	**MS**	**MPR**	**LR**	**EXR**	**DCP**	**IFL**
Constant	*t*-stat.	-1.3596	-0.9206	-3.1404	-3.4392**	-1.9603	-0.7995	-3.5205**
	p-value	(0.5927)	(0.7719)	(0.0311)	(0.0150)	(0.3026)	(0.8089)	(0.0122)
Constant & Trend	*t*-stat.	-2.1356	-0.4385	-3.0816	-3.4909*	-1.6538	-0.9378	-3.4834*
	p-value	(0.5117)	(0.9827)	(0.1238)	(0.0534)	(0.7539)	(0.9417)	(0.0543)
None	*t*-stat.	0.3968	2.3748	0.3887	-0.0353	2.2334	2.5803	-0.7094
	p-value	(0.7938)	(0.9950)	(0.7917)	(0.6653)	(0.9930)	(0.9970)	(0.4034)
First Difference Form								
Specification		**Δ(CEMO)**	**Δ(MS)**	**Δ(MPR)**	**Δ(LR)**	**Δ(EXR)**	**Δ(DCP)**	**Δ(IFL)**
Constant	*t*-stat.	-6.4865***	-4.2360***	-7.6953***	-	-5.4960***	-4.6450***	-
	p-value	(0.0000)	(0.0018)	(0.0000)	-	(0.0000	(0.0005)	-
Constant & Trend	*t*-stat.	-6.5114***	-4.2961***	-7.5920***	-	-5.7329***	-4.6161***	-
	p-value	(0.0000)	(0.0078)	(0.0000)	-	(0.0001)	(0.0033)	-
None	*t*-stat.	-6.5276***	-1.7272*	-7.7149***	-	-4.2999***	-2.4992**	-
	p-value	(0.0000)	(0.0796)	(0.0000)	-	(0.0001)	(0.0137)	-
Order: I(d)		I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(0)

Source: Researchers' computations (2025)

*Note: ***, ** & * indicate statistical significance at 1%, 5% and 10%* at levels. Δ = First difference operator

Table 4.3 presents the result of the Augmented Dickey-Fuller (ADF) unit root test. It can be noticed that CEMO and MS, MPR, EXR and DCP seem to be integrated of order one (I(1) process because variables are insignificant in level form specification of the unit root tests. Thus, the method used is by taking first differences to get them stationary. From the above, it is observed that the influence of impulse actions on the variables might exist when dealing with non-stationarity. But the LR and IFL series were found to be cointegrated of order zero, i.e. they are following an I(0) process since variables indicate significant stationarity while in the level specification. The above implies that spikes or bursts to the variables had little effect. The results of the unit root tests conducted on the models confirm the conditions for applying bounds testing, as suggested by Pesaran, Shin, and Smith (2001), to examine whether a long-run relationship exists among the variables in each model.

4.3 Cointegration Test

Table 4.4 demonstrates the result of the bounds tests. Evidently, the variables demonstrate a long-run relationship in the presence of non-stationarity for the variables of interest. The CEMO model (cement subsector) yielded the strongest significant test statistics ($F = 8.3592$) exceeding the critical value at the upper bounds, *I(1)*, at 1% level of significance, thus suggesting a very strong linear combination of the variables. Thus, the response and policy variables in the model have the propensity to converge equilibrium in the long run, in which economic units in the fiscal sector and real sector operate at optimum capacity.

Table 4.4: Bounds Co-Integration Test Results

Model	*F*-stat.	Sig.	I(0)	I(1)
CEMO	8.3592***	1%	2.88	3.99
		5%	2.27	3.28
		10%	1.99	2.94

*Note: ***, ** & * indicate statistical significance at 1%, 5% and 10%* at levels. I (0): lower bound; I (1): lower bound
Source: Authors' computation, 2025

4.4 Model Estimation

This study examines the impact of monetary policy measures and exchange rate fluctuations on the cement subsector's output performance in Nigeria. The analysis uses an Autoregressive Distributed Lag (ARDL) model to estimate the effects of variables such as monetary policy rate, liquidity ratio, exchange rate, money supply, and domestic credit to the private sector on cement output. The results in Table 4.5 show that the error correction term is negative and statistically significant, indicating that the system adjusts to equilibrium at a speed of 89.01% per period. This suggests that the cement subsector's output responds relatively quickly to changes in monetary policy and exchange rate variables, with about 78.02% of deviations from long-run equilibrium being corrected in each period.

Table 4.5: Model Estimation Results
Sample: *T* = 43 (1981 – 2023)

Response Variable	CEMO
Model Selection Criterion	**AIC**
	-0.7802
Optimum Lags	(1,4,3,3,2,4,4)
Short-run Estimates	
Speed of Adjustment:	
ECT_{t-1}	-0.8901*** (0.0000)
Adjusted R-Squared (short-run)	0.8663
Long-run Estimates	
C	2.0208** (0.0188)
MS	-3.3464*** (0.0000)
MPR	1.0043** (0.0131)
LR	0.2665* (0.0823)
EXR	-0.8464*** (0.0001)
DCP	3.8897*** (0.0000)
IFL	0.3652** (0.0145)
Model Diagnostics	
Serial Correlation Test (BG-LM)	
F-Stat.	2.2813 (0.3387)
LM-Stat. (*T**R-squared)	2.2444 (0.1471)
Heteroscedasticity Test – ARCH (1)	
F-Stat.	1.6160 (0.1826)
LM Stat. (*T**R-squared)	8.9639 (0.1756)
Normality Test	
Jarque-Bera	0.7286 (0.6947)

*Note: ***, ** & * indicate statistical significance at 1%, 5% and 10%* at levels. Values in parentheses are *p-values* of the respective coefficients and statistics.
Source: Authors' computation, 2025

4.4.1 Tests of Individual Significance

MS → ($\emptyset_1$) CEMO: As shown in Table 4.5, long-run estimation results show that changes in money supply (*MS*: $\emptyset_1$ = -3.3464; *p* = 0.0000 < 0.01) exert negative or inverse and statistically strongly significant effect on *CEMO* (cement subsector output performance) in Nigeria in the long-run when the economic agents in the cement sector and financial sector are operating at optimum capacity. Theoretically, the increase in money supply is expected to increase output of the cement subsector. The negative impact of money supply on cement manufacturing output may be due to inflationary pressures that reduce purchasing power when the money supply increases. In other words, rapid growth in the money supply can result in high inflation levels, which may raise manufacturing costs. The statistical significance level of the empirical test indicates the rejection of the null hypotheses $H_0: \emptyset_1 = 0$ is rejected. Moreover, it could be observed that the absolute partial slope coefficients ($\emptyset_1$ = -3.3464) indicate that the responsiveness of *CEMO* is significantly elastic with respect to *MS,* having partial coefficients being greater than one.

MPR → ($\emptyset_2$) CEMO: Changes in monetary policy rate (*MPR*: $\emptyset_2$ = 1.0043; *p* = 0.0131 < 0.05) exert a positive and statistically significant effect on *CEMO* (cement subsector output performance) in Nigeria in the long-run when the economic agents in the financial and cement sectors are operating at optimum capacity. Hypothetically, an increase in MPR is expected to have a resultant decline in cement manufacturing output due to a decline in borrowing capacity. However, the resultant positive effect on output observed from the empirical analysis could be ascribed to the central bank's steadfastness in keeping inflation under control, which can enhance confidence in the manufacturing sector, thus raising the output level. The statistical significance condition of the above test indicates the rejection of the null hypotheses- $H_0: \emptyset_2 = 0$ is rejected. It could be observed that the partial slope coefficients ($\emptyset_2$ = 1.0043) indicate that the responsiveness of *CEMO* is significantly elastic with respect to *MPR,* with partial coefficients being above one.

LR → ($\emptyset_3$) CEMO: Changes in liquidity ratio (*LR*: $\emptyset_3$ = 0.2665; *p* = 0.0823 < 0.1 or 10%) exert a positive and statistically significant effect on *CEMO* (cement subsector output performance) in Nigeria in the long-run when the economic agents in the financial and cement sectors are operating at optimum capacity. Raising the liquidity ratio enhances the liquidity position of the deposit money banks, thereby improving the access to funds by the cement manufacturing sector, which in turn jacks up the output performance of the sector. The statistical significance condition of the foregoing test suggests the rejection of the null hypotheses- $H_0: \emptyset_3 = 0$ is weakly rejected. Nevertheless, it could be observed that the partial slope coefficients ($\emptyset_3$ = 0.2665) indicates that the responsiveness of *CEMO* is not elastic with respect to *LR,* having partial coefficients being less than one.

EXR → ($\emptyset_4$) CEMO: As shown in Table 4.5, long-run estimation results show that changes in the exchange rate (*EXR*: $\emptyset_4$ = -0.8464; *p* = 0.0001 < 0.01) exert inverse and statistically strongly significant effects on *CEMO* (cement subsector output performance) in Nigeria in the long-run when the economic agents in the cement sector and financial sector are operating at optimum capacity. The foregoing suggests that an appreciation in the Naira significantly improves cement manufacturing output performance, while depreciation could lead to an adverse effect on the output performance. The statistical significance condition of the above test suggests the rejection of the null hypotheses- $H_0: \emptyset_4 = 0$ is rejected. Moreover, it could be observed that the absolute partial slope coefficients ($\emptyset_4$ = -0.8464) indicates that the responsiveness of *CEMO* is significantly not elastic with respect to *EXR,* a less than one partial coefficient.

DCP → $(\emptyset_5)$ CEMO: Changes in domestic credit to the private sector (*DCP*: $\emptyset_5$ = 3.8897; p = 0.0000 < 0.01) exert a positive and statistically significant effect on *CEMO* (cement subsector output performance) in Nigeria in the long-run when the economic agents in the financial and cement sectors are operating at optimum capacity. This suggests that as more credit becomes available to the manufacturing sector, cement output has the tendency to rise. The statistical significance of the foregoing empirical test suggests the rejection of the null hypotheses, *i.e.*, $H_0: \emptyset_5 = 0$ is rejected. It could be observed that the partial slope coefficients ($\emptyset_5$ = 3.8897) indicate that the responsiveness of *CEMO* is significantly elastic with respect to *DCP,* having partial coefficients above one. Meanwhile, inflation rate (*IFL*, $\emptyset_6$ = 0.3652, p = 0.0145 < 0.05) yielded a positive and statistically significant effect on cement manufacturing output performance (*CEMO*) in Nigeria. Moreover, *CEMO* appears to be inelastic with respect to *IFL,* having elasticity coefficients being less than one.

4.4.2 Post-Estimation Diagnostics

As shown in Table 4.5, the serial correlation test using the Breusch-Pagan LM test (F = 2.2813, p = 0.3387; LM-stat = 2.2444, p = 0.1471); heteroscedasticity using the autoregressive conditional heteroscedasticity [ARCH] test (F = 1.6160, p = 0.1826; LM-stat = 8.9636, p = 0.1756), normality test using Jarque-Bera statistic (stat = 0.7286, 0.6947) yielded insignificant results (*i.e.* p-values > 0.05), suggesting, respectively, absence of serial correlation, presence of homoscedasticity and normality in the residuals of the estimated CEMO-model.

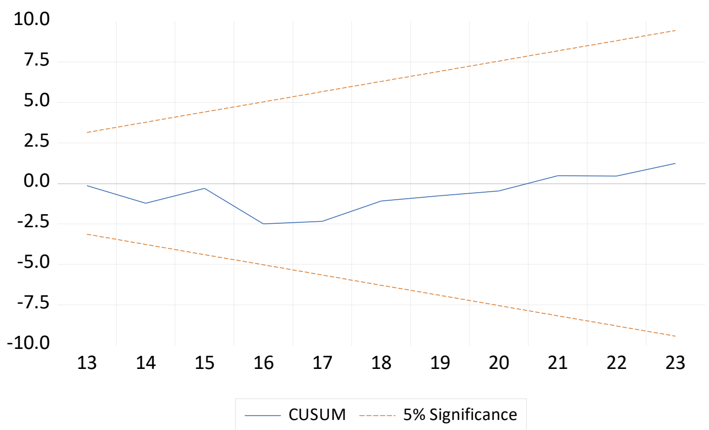


Fig. 4.1-: Model Plots of Cumulative Sum (CUSUM) of Recursive Residuals

Besides, using the CUSUM criterion, Fig. 4.1 displays the result of the stability test of the estimated CEMO-models, respectively. Evidently, the plot falls within the critical bounds throughout the realisation (sample period) at 5% level of significance. Thus, the estimated CEMO-model is considered to be structurally stable in the estimates over the sample period. Overall, the post-diagnostic tests indicate that the estimates regarding the relationship between monetary policy measures, exchange rate variation, and cement manufacturing output performance are both efficient and valid for drawing inferences and policy implications.

4.5 Discussion of Results

The study investigates the effects of monetary policy instruments and exchange rate on output performance of the cement subsector in Nigeria. The analysis indicates that the money supply has a significant negative impact on cement output performance up to a certain level, contrary to the theoretical predictions, possibly due to high liquidity leading to inflation and heightened production costs. This finding is inconsistent with prior studies (Kabir, 2022; Babangida & Khan, 2021; Osakwe et al., 2021), which documented a positive effect of monetary policy variables on the cement manufacturing subsector. On the other hand, MP and LR were found to have significant positive contributions to output performance in the cement industry. Higher liquidity ratio enhances output performance by making funds available, which supports the result of Agbonrofo and Ajibola (2023). Exchange rate appreciation also has a positive effect on cement output performance, which confirms the findings of Mlambo (2020) and Yaqub (2010). Moreover, the domestic credit to private sector has a strong positive connection with cement output performance, consistent with Ciani and Bartoli (2020) on the effects of loan restrictions on manufacturing exports.

5.1 Conclusion

This paper investigates the effects of monetary policy and exchange rate movement on the output performance in the cement sector vis-à-vis from 1981 to 2023 in Nigeria. The monetary policy indicators used are money supply, monetary policy rate, liquidity ratio, domestic credit to the private sector and exchange rate. The results indicate that the money supply exerted a negative and statistically significant impact on the cement manufacturing sub-sector, contrary to the expectation of a positive impact. This could be because a rigid supply of money provides easier money in the sector and reduces competitive and efficient usage of resources.

The variations in the monetary policy rate enhance the performance of the cement output sub- sector. Therefore, the industry is positively adjusting to monetary policy rate changes. A weak domestic currency does not favour the performance of the cement industry. With the continuous depreciation of the naira over time, it could be deduced that the cement manufacturing subsector had been subjected to unfettered distress due to the exchange policy. The industry can easily import raw material inputs for production if the Naira appreciates against the US Dollar. A softer domestic currency (stronger exchange rate) makes cement more competitive to export but more expensive for imported raw materials.

5.2 Recommendations

Following the results presented and discussed above, this study recommends that Central banks should consider adopting an accommodative monetary policy stance that supports a sufficient money supply without fuelling inflation. This could involve careful management of open market operations and maintenance of an optimal level of liquidity that facilitates and enables businesses to access the funds they need for operations and expansion. Also, the government should facilitate improved sector specific facility to the cement manufacturing industry. This will help bring down the cost of housing and, ip so facto, rents being paid by occupants.

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