**IMPACT OF MONETARY POLICY ON THE** **OUTPUT OF THE CEMENT INDUSTRY IN NIGERIA( 1986-2023)**

**ABSTRACT**

*Nigeria has a very high population, and this high population is accompanied by increase in demand for cement but despite the comparative advantage we have in the production of cement we still have traces of cement importation in Nigeria. Thus, this paper investigated the impact of monetary policy on cement industry output in Nigeria, focusing on the relationship between key monetary variables (exchange rate, money supply and inflation) and manufacturing output of the cement industry using annual data spanning the period 1986 to 2023. Employing Autoregressive distributed lag model (ARDL), the analysis reveals that exchange rate has a positive and insignificant influence on cement industry. While money supply has a negative and insignificant impacts on cement industry. However, inflation rate, exhibits a positive relationship with cement industry, suggesting that attention should be given to inflation rate during project budget development. The findings suggest that policymakers should not ignore inflation in many project especially that of the cement sector. Stability in the exchange rate, sufficient money supply is recommended to support robust cement industry output in Nigeria.*

**Keywords: Monetary policy, Money supply, Economic growth, Exchange rate, Inflation**

Jel Classifications: E52, E51, O47, F3, E31.

**INTRODUCTION**

“The cement industry plays a significant role in the global economy as it is used in the production of different infrastructure and construction projects. In the same vein, global cement sector is one of the largest producers of carbon dioxide emissions, contributing to some percentage of the world’s total greenhouse gas budget. The production process of cement releases large amounts of CO2, mainly due to the high-temperature firing of raw materials, such as limestone and clay, but also due to energy- and resource- inefficient production technologies. This has a significant impact on the environment and contributes to global climate change”, (Asharf *et al.,* 2020; Habert *et al.,* 2020; Miller *et al.,* 2018; & Salas, 2016). “Despite this, the cement industry continues to grow, driven by increasing demand for infrastructure development in emerging economies and urbanization in developed countries. According to the World Cement Association, global cement production is expected to reach 8.2 billion tonnes by 2030”, (Andrew 2018; Huang, 2018). “Similarly, to other regions, the cement industry has seen significant leap in recent years, driven by large infrastructure and construction projects. Major players in the region include Dangote Cement and Lafarge Holcim. Australia and Asia are among the fastest-growing regions for the cement industry, with China being the largest producer and consumer of cement in the world” (Shen, 2015; Zhang *et al.,* 2015). “Cement production takes place all around the world, however there is a concentration of production in certain regions of the world. The total cement production in 2020 was estimated to be 4.1 billion metric tons. The top five cement producing countries (China, India, Vietnam, United States and Indonesia) account for approximately 68.2% of global cement production in 2020, with China alone accounting for over 60% of the total global production” (4.2 billion metric tons in 2021, according to National Bureau of Statistics of China).

“The government is a key player in the construction sector globally, as the construction procurement-related expenditure contributes significantly to the growth of the industry. Studies reveal an apparent relationship between construction output and economic development in developing economies” (Fulford, 2019; Ruddock & Ruddock, 2019). “Likewise, monetary and fiscal policies elements exert considerable influence on the construction output in any country” (Asamoah *et al.,* 2020). “Whereas monetary policy elements include interest, inflation, and exchange rates, fiscal policy elements consist of taxation and government expenditure. The monetarists’ opinion of the relationship between the construction industry, cement and macroeconomics is that construction is treated as the core part of outcomes and employment resources for any country” (UKEssays, 2018a). “Monetary and fiscal policies are applied to achieve macroeconomic objectives. A change in these policies would have an impact on various sectors of the economy, including the cement, construction industry and its output” (UKEssays, 2018b). “In construction, the effects of exchange rates can be felt when the materials for construction are imported in large quantities” (Geraldine & Nyamagere, 2023).

“With a population of over 200 million, Nigeria has a housing deficit of approximately 20 million” (Oyediran, 2019). “To address the deficit, successive governments have formulated various housing-related policies to stimulate investment and development in the housing sector” (Alabi *et al.,* 2018; Kasim, 2018). “For example, the government policy directives on foreign exchange policies have affected the housing market” (ITA, 2019). “It is believed that the housing market is driven by institutional, foreign, local and private businesses, as well as the growth of locally established businesses” (Alabi, 2015). “The development of the housing market is dependent on the price of building materials, which are mainly imported, and exchange rates determined in a largely dollarised economy in Nigeria. Since the adoption of Second Tier Foreign Exchange Market (SFEM) in 1986, the Nigeria naira has continued to depreciate against international currencies. As a result of the continued depreciation of the naira, the prices of residential building materials, mostly imported, have been on the increase and these have, in turn, discouraged many individuals from starting or continuing the construction of new houses” (Uma *et al.,* 2019). Ugochukwu *et al.* (2017) noted that “the reliance of housing developers on the use of imported building materials has led to an increase in the cost of housing supply. With the increasing population coupled with the inability of the government to meet the widening gap of housing deficit in Nigeria, many of the citizens have been using self-help to meet their housing needs” (Taiwo *et al.,* 2018; Adegun & Olawale, 2019). “The self-help strategy has been constrained by the inadequacy of locally produced building materials and the high dependency on imported materials” (Alabi *et al.,* 2018; Uma *et al.,* 2019).

“Budget is the main parameter for any construction project. In projects with a long duration, it is normal for the budget to be revised. One of the reasons for this is that the building materials, labour and machinery cost increases annually due to inflation. Inflation plays a vital role in the price increase of materials, labours, and machinery, which results in deviating the initial and the final cost of the project. Construction costs are volatile, and the prices of materials and other costs are continuously fluctuating, creating volatility in economic growth. Not only economic growth but also the labour market and consumer price index are affected by inflation” (Elfahham, 2019; Islam *et al.,* 2017; Johnson & Babu, 2018). “Labour and material costs also influence inflation, but there is a huge change due to contractors and suppliers’ margins. Construction industry inflation is different among various sectors and varies from market to market. Even it differs from material to material” (Zarenski, 2019). The construction industry is important for any nation to build its economy, as there are huge investments involved. But inflation is becoming a major problem, having a negative impact on the construction industry. Inflation is causing an increase in the prices of materials, machinery and other inputs to construction projects. Where no other option is left to project parties than delaying the project in order to prevent cost overrun, which are primarily due to inflation Muhammad *et al.,* (2021).

The relationship between money supply and Gross Domestic Product (GDP) involves a multitude of factors that contribute to the complexity of this economic dynamic. As noted by Bara and Mudzingiri (2016), an increase in the money stock can lead to a chain reaction of positive economic outcomes, including the availability of credit, increased consumer spending, and higher investments, ultimately resulting in GDP growth. However, this relationship is far from linear, as factors such as inflation, interventions by central banks, and external risks introduce nuances and challenges. One notable challenge is the timing speed associated with the effects of changes in money supply. Time lags and the influence of external factors, such as corruption and unfavourable government policies, contribute to a discrepancy between the timing of changes in money supply and their real-time impact on the economy (Oliva *et al.,* 2022). Consequently, the correlation between money supply levels and GDP growth rates may vary, depending on the interplay of these complex factors. The construction sector emerges as a significant player in this intricate economic landscape.

“As the most populous country in Africa, Nigeria has experienced growing demand for cement” (Itaman & Wolf, 2021). “In 2002, the government decided to increase production and halt imports through a vertical industrial policy. This policy involved the use of a trade policy tool restricting import licences and granting quotas only to traders/producers who could demonstrate that they were building cement factories in Nigeria. Aiming for self-sufficiency, the government committed to gradually phasing out these quotas as local production increased” (Akinyoade & Uche, 2018). Limiting imports to a handful of such traders/producer reduced the risk of investment because investors were assured of a large, ready market for their product. As further support for local cement manufacturing, the government also provided waivers for VAT and custom duties on the importation of cement production equipment, along with tax exemptions.

“It is therefore important to place serious attention on cement prices, considering the way they fluctuate (change), the factors that cause those changes, and the effects of those changes. The growing population, inflation rate, energy, exchange rate, GDP, and transportation cost among others have always been serious issues for engineers, contractors, private and government developers to contend with when it comes to procurement of construction materials, especially that of cement” (Lawal, 2016). Therefore, there is a dire need for one to be equipped and be proactive in the planning of future construction projects that would utilise cement. In Nigeria, there had been several cement producing companies in the past. However, some have left the scene, while some new ones have emerged. Some of the past and present cement companies in Nigeria include Dangote cement, West African Portland Cement Company (WAPCO) now called Lafarge cement, Unicem, Ashaka cement, Cement Company of Northern Nigeria (CCNN), Eagle Cement, Rock Cement, Ibeto Cement, Niger Cement, Benue Cement Company (BCC), Eastern Bulk Cement, Purecem, and Bua Cement. During the post-civil war, Nigeria was completely dependent on importation of cement Kenneth, (2019) because of rapid infrastructural and residential development. However, despite the massive volume of local manufacture of cement in Nigeria today, there is still a significant trace of importation of either cement or some of its raw materials, which still has a huge effect on the economy. Therefore, this paper seeks to examine the impact of monetary policy on cement output in Nigeria; investigate the impact of money supply on cement output in Nigeria; assess the impact of inflation on cement output in Nigeria; determine the impact of exchange rate on cement output in Nigeria. The hypotheses of this paper are stated as follows:

H01: Money supply has no significant impact on cement output in Nigeria

H02: Inflation rate has no significant impact on cement output in Nigeria

H03: Exchange rate has no significant impact on cement output in Nigeria.

**CONCEPTUAL REVIEW**

**Monetary Policy**

Okafor *et al.,* (2016) defined monetary policy as the process by which monetary authorities of a country regulate the supply of money in the economy to foster price stability and stimulate economic growth. Timothy (2022) described monetary policy as one of the methods used by monetary authorities to control the money supply in a country's economy to attain the desired level of economic growth. Nwobia *et al.,* (2020) described monetary policy as the specific actions taken by the monetary authority to regulate the value, supply and cost of money in the economy with a view to achieving predetermined macroeconomic goals.

Therefore, monetary policy variables are key indicators that provide insight into the economy which comprises of money supply, exchange rate, inflation. Broad money (M3) measures the total volume of money supply in the economy. It is defined as narrow money plus savings and time deposits with banks including foreign denominated deposits. M2 is an economic index that is used to predict inflation (Nwuju *et al.,* 2024). Almalki & Batayneh (2015) opined that inflation is conventionally defined as a persistent rise in the general level of prices of goods and services in an economy over a while. When the general price level rises, each unit of currency buys fewer goods and services, thus eroding the purchasing power of money. However, exchange rate can be described as the rate at which one currency is exchanged for another. Mbusi *et al.,* (2015) define the exchange rate as the cost of a nation’s currency when expressed in terms of another country’s currency. Exchange rate also impacts on the prices of export, import and balance of payment. It also works as a great opportunity for domestic investor to earn high profit by investing in foreign currency. The investors and traders like that system where there is very small inconsistency difference, between actual and expected value of exchange rate (Murtala, 2017).

Cement manufacturing subsector is a complex process that involves several stages, including quarrying (raw materials like limestone, clay, and sand are extracted from the quarry), crushing ( the rock is broken into pieces the size of a baseball); grinding (the rock fragments are ground into a fine powder); mixing (the ground materials are combined with other ingredients like chalk, marl, shale, slate, sand, and iron ore); preheating ( the mixer materials are heated in a preheater tower to start chemical reaction); kiln firing (the ground materials are fed into a large, cylindrical kiln where they undergo a series of reactions to form clinker); cooling (the clinker comes out of the kiln red-hot and lava-like); pulverizing (the clinker is pulverized) and adding gypsum (about 5% of gypsum is added to control the time it takes for the cement to set) (Thomas & Frederick, 2024).

**Empirical Review**

Nye *et al.,* (2024) investigated “macroeconomic dynamics on domestic production in Nigeria: a study of the cement industry for a time series period of 41 years (1981 to 2022). The study employed Autoregressive Distributed Lag (ARDL) approach for the analysis. The results indicated a long-term relationship between cement production and variables such as exchange rate, inflation rate, interest rate, and unemployment rate. The findings suggested that the sustainability of cement production is contingent upon effective regulation of the macroeconomic economic environment”.

Babalola (2023) investigate “the effect of selected macroeconomic variables on the price of selected building materials in Lagos State for a time series period of 12 years (2008 to 2019). The paper statistical tools used for the study were the ordinary least square method, correlation and auto-regressive distributed lag model. The result showed that interest, inflation, and exchange rates positively affect building materials prices. The study recommended a reduction in import duties, an exchange rate reduction, and a reduction in the interest rate on bank loans”.

Seyed *et al.,* (2023) examined “effects of economic variables on the price of cement and forecasting its price trend using monthly data from 2019:03 to 2023:02 and a vector autoregression (VAR) model. The results of variance decomposition also showed that the construction input price index, energy cost, and exchange rates are important in explaining the price of cement. Finally, the authors estimated in-sample and out-of-sample forecasts. Based on the forecast evaluation criteria, our founding research model can accurately predict the price trend of cement”.

Ifeanyichukwu *et al.,* (2023) analysed “effects of macroeconomic indicators on cost of building materials in Nigeria using quarterly data over a period of ten years, from 2012 to 2021. The paper main finding is that the prices of building materials are not much impacted by these macroeconomic indices. Multiple regression was the analytical approach utilized, and the findings indicated that the GDP, inflation, and interest rates all had a positive, substantial impact on the cost of building materials”.

Isyaka (2022) investigated “influence of economic environment on the performance of cement manufacturing companies in Nigeria. The paper utilised descriptive and explanatory design and survey methodology for the paper. For the 398-sample size considered, primary data were gathered using a standardized questionnaire. Therefore, it is recommended that cement manufacturing businesses, among other things, should be more aware of the economic indicators that could affect their performance through ongoing feasibility studies on alternative economic indicators in the industry”.

Abdullahi *et al.,* (2021) examined “effect of macroeconomic variables on financial performance of listed cement manufacturing companies in Nigeria for the 2011 to 2019. The paper concluded that macroeconomic variables have significant effect on financial performance of listed cement manufacturing companies in Nigeria. The authors recommended that the government should check inflation rate and devise strategies to reduce it by way of setting price control or providing subsidy on essentials commodities amongst others”.

Menyelim *et al.,* (2021) analysed “the influence of liquidity on the performance of the Nigerian cement companies for a period of 10 years (2010 to 2019) on the Nigeria Stock Exchange using fixed effect panel regression model. The research recommends, among other items, on the basis of the analysis, that cement businesses should sustain a progressive financial success by adeptly controlling their liquid capital”.

Mark *et al.,* (2016) analysed “the impact of macroeconomic indicators on cement prices in Ghana for the period of 15 years (2000 to 2014). The study used multiple linear regression analysis for the interpretation of the inferential statistical data. The regression results showed that cement cost was not responsive to the trends in inflation and monetary policy rates. The study recommended an effort to use local materials such as burnt bricks and calcined clay pozzolan which do not need so much of foreign exchange for any form of importation”.

Omale (2016) examined the “impact of macroeconomic variables on the firm performance of cement firms in Nigeria from 2011 to 2015. The paper utilized Ordinary least Square (OLS) regression to test the hypothesis. The results of the statistical analysis reveal that positive relationships exist between the independent variable (INT, INF, GDP, and EXR) and the dependent Variables (ROE). But interest rate, exchange rate found highly significant and having a positive impact on ROE”.

Joseph *et al.,* (2015) examined “monetary policy and its price stabilization effects on the prices of building materials in Nigeria. The study covers a period of ten years and considered twenty-four (24) major construction materials. The result shows that there is a significant relationship between the movement of the monetary policy rate (MPR) and the inflation rate. MPR did not show to have an effect on movement of building material price; hence MPR may not be an effective tool for price stabilization in the building materials market”.

**Theoretical Review Framework**

**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. Thus, increase in government spending will boost production in the cement sector”.

**METHODOLOGY**

**Sources of Data**

The research design for this study is ex-post facto research and the secondary annual time series data from 1986 to 2023 was sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin December 2023 and National Bureau of Statistics, 2023.

**Model Specification**

Following the example of Nye *et al.,* (2024), this research constructed an empirical model to investigate the influence of macroeconomic dynamics on domestic production in Nigeria. The equation 1 presents the model used by Nye *et al.,* (2024).

𝐶𝐸𝑀𝑃 = (𝐸𝑋𝐶𝐻𝑅, 𝐼𝑁𝐹𝐿𝑅,𝐼𝑁𝑇𝑅𝑇,𝑈𝑁𝑀𝑃𝑅) Eqn. (1)

Where,

CEMP is the value of cement production; EXCHR is the exchange rate; INFLR is the inflation rate; INTRT is the interest rate and UNMPR is the unemployment rate. The present work established a unique model by implementing certain alterations to Equation 1. The research included money supply and replaced unemployment and interest rate with inflation and exchange rate. Therefore, the mathematical expression employed for this investigation is precisely defined in Equation 2.

𝐶𝐸𝑀𝑃 = (EXR, INF, MS) Eqn. (2)

Where,

EXR is the Exchange rate; INF is the Inflation rate; MS is the Money supply; CEMP is the 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.

 (3)

*However, the ARDL model is thus;*

 (4)

*Below is the ARDL ECM model*

 (5)

The model above is used to adjust the estimation until the ECM turned negative. The negative sign of coefficient of the error correction term ECM (-1) shows the statistical significance of the equation in terms of its associated t-value and probability value. Where **∆** is the first differencing operator; Ut is thewhite noise or disturbance term, LOG is the logarithmic notation 𝛽0 is the constant 𝛽1 –𝛽3 is the coefficients µ is the 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 Pesaran'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.

RESULT

**DATA PRESENTATION AND ANALYSIS**

This section presents the data utilized in the paper and the results of the analysis conducted to understand the impact of monetary policy on cement output in Nigeria. The analysis includes descriptive statistics, unit root tests, the specification of the ARDL model, and the interpretation of the estimated short-run and long-run relationships.

**Table 1:** Summary of Descriptive Statistics for the Variables

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | CEM | EXCH | INF | MS |
| Mean | 305.7412 | 138.2229 | 19.71895 | 7.597405 |
| Median | 237.5057 | 127.2424 | 13.40000 | 7.771237 |
| Maximum | 695.8386 | 425.9811 | 73.10000 | 10.78854 |
| Minimum | 87.12829 | 2.020575 | 5.400000 | 3.169954 |
| Std. Dev | 192.4961 | 124.6215 | 17.20151 | 2.456822 |
| Skewness | 0.771684 | 0.851495 | 1.747207 | -0.340634 |
| Kurtosis | 2.185186 | 2.764490 | 4.868393 | 1.771736 |
| JarqueBera | 4.822686 | 4.679768 | 24.86122 | 3.123534 |
| Probability | 0.089695 | 0.096339 | 0.000004 | 0.209765 |

***Source:*** *Researcher’s computation, using E-views 12, 2025*

The descriptive results presented in Table 1 indicate that cement (CEM) in Nigeria during the period of 38 years (1986-2023) has minimum and maximum values of 87.12829% and 695.8386% respectively. Skewness, which measures the shape of the distribution revealed that coefficient of 0.771684 (which is greater than zero) implied that though CEM is positively skewed, it is not symmetrical around the mean and thus deviating from normal distribution. Kurtosis, value of 2.185186, it implied that CEM is platykurtic (fat or short tailed) meaning that the distribution is not peaked relative to the normal distribution. The descriptive normality results also showed that CEM is normally distributed. This was captured by the Jarque-Bera probability value of 0.089695, found to be greater than 0.05.

Exchange Rate (EXR) shows a mean of 138.2229, with skewness (0.851495) indicating a nearly symmetric distribution of values around the mean. The range is also relatively small, with the minimum value being 2.020575 and the maximum at 425.9811. This is reflected in a standard deviation of 124.6215, indicating that exchange rates are relatively consistent with limited variation over time. The kurtosis of 2.764490, being less than 3, suggests a platykurtic distribution, meaning there are fewer extreme values and a flatter peak compared to a normal distribution. The normality results also showed that EXR is normally distributed. This was captured by the Jarque-Bera probability value of 0.096339, found to be greater than 0.05.

Further, inflation, the mean value is 19.71895, indicating the average level of inflation over the period under study. The distribution is positively skewed, as seen by the skewness of 1.747207, meaning that there are more observations with values lower than the mean. The data shows a wide range, with a minimum of 5.400000 and a maximum of 73.10000. This suggests significant variability in inflation levels, which is further supported by the standard deviation of 17.20151, indicating that INF values often deviate considerably from the mean. The kurtosis of 4.868393, being greater than 3, implies that the distribution is leptokurtic distribution, meaning the distribution is peaked relative to the normal distribution. The probability value of Jarque-Bera captured to be 0.000004, also implied that the Gausian distribution assumption of the normal data on INF was not met; and thus; indicates that the data on INF did not follow the normal curve, since the null hypothesis of normally distributed is not accepted at 5% level of significance.

Money supply (MS) has a mean of 7.597405, with a negative skewness of -0.340634, implying a concentration of values below the mean and some higher values pulling the mean downward. The range from 3.169954 to 10.78854 suggests some variation in money supply during the period, with a standard deviation of 2.456822 indicating moderate variability around the mean. The kurtosis of 1.771736 being less than 3, suggests a platykurtic distribution, meaning there are fewer extreme values and a flatter peak compared to a normal distribution. The normality results also showed that MS is normally distributed. This was captured by the Jarque-Bera probability value of 0.209765, found to be greater than 0.05.

**Table 2:** Summary of Unit Root Test Results

|  |  |  |  |
| --- | --- | --- | --- |
| Variables | ADF |  |  |
|  | ADF Values | Critical Values | Order of Int. |
| CEM | -4.847421 | -3.540328 | 1 |
| EXCH | -4.170301 | -3.540328 | 1 |
| INF | -4.187595 | -3.557759 | 1 |
| MS | -4.957281 | -3.540328 | 1 |

***Source:*** *Researcher’s computation, using E-views 12, 2025*

Table 2 shows the stationary test of the variables used in this study and the results revealed that all the variables were integrated at order one 1(1). Inflation rate shows unit roots at first difference and cement (CEMP), exchange rate (EXCH) and money supply (MS) show at first difference. This implies that they were stationary at the first difference. Therefore, the paper went further to test for the long-run relationship by testing the co-integration using the autoregressive distributed lag model error correction test

**Table 3:** Summary of Bound Test

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| F-Bounds Test | | Null Hypothesis: No levels relationship | | |
| Test Statistic | Value | Signif. | I(0) | I(1) |
| F-statistic | 8.063554 | 10% | 2.01 | 3.1 |
| k | 3 | 5% | 2.45 | 3.63 |
|  |  | 2.5% | 2.87 | 4.16 |
|  |  | 1% | 3.42 | 4.84 |

***Source:*** *Researcher’s computation, using E-views 12, 2025*

The co-integration test result shows that F-statistic value of 8.063554 is greater than the lower (I(0) and upper bound (I(1) critical values 2.45 and 3.63 respectively at the 5% significance level. Thus, the null hypothesis of no long run relationship is rejected at the 5% level. It can therefore be inferred that the variables are co-integrated, and as such there is a long run equilibrium relationship between monetary policy and cement output between 1986 and 2023.

**Table 4:** Autoregressive Distributed Lag Model

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variable | Coefficient | Std. Error | T. Statistics | Probability |
| CEM(-1)\* | -0.405774 | 0.183458 | -2.211806 | 0.0491 |
| D(EXCH) | -0.504363 | 0.564475 | -0.893507 | 0.3907 |
| D(INF) | 1.640636 | 1.127351 | 1.455303 | 0.1735 |
| D(DMS) | -100.7707 | 68.53534 | -1.470346 | 0.1695 |
| CointEq(-1)\* | 0.020154 | 0.003146 | 6.407091 | 0.0001 |
| R-squared | 0.830061 |  |  |  |
| Adjusted R-squared | 0.611568 |  |  |  |
| Prob(F-statistic) | 0.000000 |  |  |  |
|  |  |  |  |  |
|  |  | Long Run ARDL |  |  |
| Variable | Coefficient | Std. Error | T. Statistics | Prob. |
| EXCH | 43.86955 | 352.0795 | 0.124601 | 0.9031 |
| INF | 58.95160 | 398.3404 | 0.147993 | 0.8850 |
| DMS | -2234.671 | 18379.40 | -0.121586 | 0.9054 |

***Source:*** *Researcher’s computation, using E-views 12, 2025*

From the ARDL-ECM results in Table 4, it could be observed that ratio of cement (CEM) contributed positively and insignificantly to economic growth, in the period as captured by its coefficient value of 0.020154 and a p-value of 0.9044, the economic implication of this is that the loans needed by the investors did not trickle down to the people who actually needed it to boost this sector, thus, by having an insignificant impact on the economy during the period of investigation. Exchange rate with a negative coefficient of -0.504363 and a p-value of 0.3907 means that there is a negative and insignificant relationship with CEM during the period. The variable of inflation rate (INF) was found to have a positive association with coefficient value of 1.640636 and a p-value of 0.1735 with CEM meaning that there is a positive relationship between CEM and INF. Thus, the coefficient value of money supply showed that it has a negative relationship with CEM and contributed insignificantly to CEM evident in this is the negative coefficient of -100.7707 and a p-value of 0.1695 being statistically insignificant during the current period. Also, the P-value of the F-statistics of the model is significant indicating a goodness of fit of the model. Furthermore, R-squared of 0.830061 suggests that about 83% of variation in CEM is explained by the model while 17% is explained by variables outside the model. From the above result ECM is statistically significant, less than one and although not negative which shows that there is a high speed of adjustment from the short run to the long run of the model. The ECM found to be positive could be as a result of inconsistent policies that characterized different administration.

**Post-Estimation Checks (ARDL Diagnostic Test)**

The results from the ARDL diagnostic checks captured in Table 5 are crucial for validating the robustness and reliability of the regression model that investigates the impact of monetary policy on cement industry outputin Nigeria. These post-estimation tests assess various assumptions underlying the ARDL regression analysis, ensuring that the model's inferences are statistically sound.

**Table 5:** Results of ARDL Diagnostic Checks

|  |  |  |  |
| --- | --- | --- | --- |
| Tests |  |  | Outcomes |
| Tests |  | Coefficient | Probability |
| Breusch-Godfrey-Serial-Correlation Test | F- stats. | 0.104590 | 0.9018 |
| Heteroscedasticity-Breusch-Pagan-Godfrey Test | F-stats. | 1.128764 | 0.4399 |
| Normality Test | Jarque-Bera | 0.800129 | 0.670277 |
| Linearity Test | F- stats. | 0.243310 | 0.6325 |

**Source:** Authors compilation, 2025 (Eviews-12)

Table 5 is the Breusch-Godfrey Serial Correlation LM Test checks for autocorrelation in the residuals of the regression model. Autocorrelation occurs when residuals are not independent of each other, which can lead to inefficient estimators and biased standard errors. The outcome of this test, with an F-statistic of 0.104590 and a probability of 0.9018, suggests that there is no serial correlation in the model. A high p-value indicates that the study fails to reject the null hypothesis of no serial correlation, thus confirming that the residuals of the model are independent across time, which is a desirable property in time series analysis. Also, the Heteroscedasticity Breusch-PaganGodfrey Test is used to detect the presence of heteroscedasticity, a condition where the variance of the errors is not constant across all levels of the independent variables. Heteroscedasticity can render the standard errors inaccurate, leading to unreliable hypothesis tests. The test yields an F-statistic of 1.128764 with a probability of 0.4399, indicating that there is no significant evidence of heteroscedasticity within the model. This means that the variance of the error terms is constant, allowing for confidence in the estimated standard errors and the statistical tests that rely on them.

The Normality Test, specifically the Jarque Bera test, is employed to determine whether the residuals of the model are normally distributed. Normality of residuals is an important assumption, as it underpins the validity of various statistical tests, including the t-tests, on the estimated coefficients and the F-test on the overall model. The Jarque Bera statistic is 0.800129 with a probability of 0.670277, which indicates that the residuals are normally distributed. With a high p-value, the null hypothesis that the residuals are normal cannot be rejected, satisfying another critical assumption of the classical linear regression model.

Finally, the Linearity Test checks if the relationship between the independent variables and the dependent variable is correctly specified as linear. A non-linear relationship may indicate that the model is specified, which can lead to biased estimates. The F-statistic for the linearity test is 0.243310 with a probability of 0.6325. This result implies that there is no significant evidence against the linearity assumption of the model. Hence, the linear specification between the monetary policies on the output of cement industryin Nigeria appears to be appropriate.

**DISCUSSION**

From the result presented in Table 4 of the estimated long-run coefficients using the ARDL approach, it showed that the coefficient of broad money supply is negative and insignificant at the 5% level of significance. Hence, a decrease in broad money supply would reduce cement output. Broad money supply as earlier defined includes currency in circulation, demand deposit, savings and fixed deposits as well as other assets that are in spendable form. Economic theory posits that an increase in money supply will raise the domestic price level to a larger degree in the long-run, thus lowering the cement unproductively. The result of this study is in sharp contrast with the findings of Abdullahi and Karatu (2021) that showed that the relationship between broad money supply and cement industry is positive and insignificant. However, the results show that money supply plays a vital role and showed that there is an insignificant pass-through effect of the money supply growth to cement output in the long-run, this is in collaboration with the submissions of Abdullahi and Karatu (2021). In real terms, once the amount of money supply in circulation is higher than the level of total output of the economy, it is seen as excess money supply; it does so through the control of the base money made up of currency and coins outside the banking system and deposits of banks with the Central Bank of Nigeria. In addition, the Central Bank of Nigeria regulates money supply based on the knowledge that there is a stable relationship between the quantity of money supply and economic activity.

The coefficient of exchange rate was positive and statistically insignificant according to the findings of this paper. The result of this study is in collaboration with the findings of Babalola (2023) that showed that “the relationship between exchange rate and construction material prices is positive and statistically significant. Thus, an increase in exchange rate would increase cement output. However, policies that will directly or indirectly affect housing production are relevant to, and important for the achievement of the sustainable development goals of a nation” (UN-Habitat, 2020). “For any policy to be relevant in transforming the society where it is enacted, it should be well-thought-out, inclusive, evidence-based, and responsive to societal real needs, as well as address social challenges associated with housing. One such policy change is the foreign exchange rates. This is the presence of a trade imbalance, negatively affecting the domestic prices of building materials”(Olowe, 2009; Ugochukwu *et al.,* 2017). “The postulation of the theory of foreign exchange behaviour notes that a country experiencing inflation will have its currency devalued in terms of another country’s currency, and the purchasing power of the country witnessing inflation drops” (Manzur, 2018; Njoku, 2015; Vo & Vo, 2023).

“The devaluation of the Naira in 2015, owing to a fall in the crude oil price (glut) in the world market, impacted on the economy of Nigeria and, in return, affected the purchasing power of the Naira” (Oluwasinaayomi *et. al.,* 2023). “Thus, with the advent of the floating regime, prices of building materials and construction costs have continued to increase and the cost of construction within a period of two years can increase by about 30%. It has been documented that Nigerians depend on importing building materials” (Agbola, 2005; Ugochukwu *et. al.,* 2017) and that “foreign exchange rates affect the price of commodities such as building materials” (Njoku, 2015; Ugochukwu, 2017). Owing to the increase in prices of construction material and a result of inflation, the construction sector of the economy is negatively impacted. With several components of the construction materials imported (the locally manufactured materials still rely on foreign components), building material prices are expected to continue to increase, unless proactive measures are put in place by the government to address and/or cushion the effects of the changing foreign exchange.

The coefficient of inflation was positive and insignificant according to the findings of this paper, which is a unit increase in inflation will increase cement output by 58.95160 billion naira. The result of this study is in agreement with the findings of Nye *et al.,* (2024), that showed that the relationship between inflation and cement output is positive and statistically significant. The finding of this paper shows that increase in cement output can only be achieved through expansionary policies, as increase in inflation means an increase money supply used by the investors in the cement industry, hence, reducing unemployment, increasing the standard of living amongst others; thus this shows a clear indication that the government should strive to keep inflation in a single digit, which is good for the economy.

However, in Table 4, the short run analysis shows that all the independent variables (money supply and exchange rate) had a negative relationship with the cement sector, except for inflation which was found to have a positive association with the cement industry during the period under review; as we all know that in the short run all variables are fixed and in the long run they are varied. Thus, the possible cause of these findings can be due to the government policies enacted at that time to drive the cement sector which possibly had failed to achieve it target goals thus putting pressure on the cement industry.

**CONCLUSIONS AND RECOMMENDATIONS**

This paper examined the impact of monetary policy on cement industry output in Nigeria from 1986 to 2023. Basically, there are three major specific objectives to shape the discussion of the findings of this study- (i) to investigate the impact of broad money supply, inflation rate and exchange rate on cement output in Nigeria. From the tested hypothesis, the null hypothesis was rejected (P (0.0491). It was concluded that there is a significant impact of money supply (although at 10% percent), inflation rate and exchange rate on cement industry in Nigeria. This implies policy measure that would promote and sustain the monetary policy aggregate that will help increase cement output in Nigeria. This calls for sound monetary policy to promote macroeconomic stability, manage inflation and promote sustainable growth. This would involve designing policies to help control the fluctuations in cement output levels, prices and production. The coefficient of money supply was negative and insignificant. This implies that a decrease in money supply will reduce cement sector output. In conclusion to objective two, to investigate the impact of inflation on cement output in Nigeria, it was shown from the result that inflation rate has a positive and insignificant relationship with cement output, this implies monetary authorities to adopt a monetary stance that will stabilize inflation and/or create and sustain an enabling environment for entrepreneurs and innovation that can unlock the full potential of Nigerians by empowering to build and grow their business through availability of reduced inflation; which invariably means that investors can buy so much more with the money they have i.e, value thus, boosting the activities of the investors, hence increasing cement output in Nigeria. Inflation rate has positive and insignificant relationship with cement sector. This implies that inflation rate has the structural potential to increase cement output if kept at a stable and single digit.

In consonance to objective three, the fluctuations in exchange rate seems to escalate cement output, as this reduces or affects the amount of credit or loan available to investors who are willing to borrow money to do business, i.e importing materials. Thus, from the findings of this paper exchange rate has a positive but insignificant relationship with cement output; for EXR to be insignificant during the period of investigation implies that the monetary authorities needs to adopts policies that will stabilize EXR rate thus, bringing about certainty in the business environment of the cement industry, thus, increasing the output of the sector. The coefficient of exchange rate is positive and insignificant. This implies that an increase in exchange rate would increase cement output.

On the basis of the empirical findings the following recommendations are proffered;

1. The negative impact of money supply on cement industry underscores the need for monetary policies that ensure adequate liquidity in the economy.Central banks should consider adopting an accommodative monetary stance that supports sufficient money supply without fueling inflation. This could involve careful management of open market operations and interest rates and to maintain an optimal level of liquidity that facilitates and enabling businesses to access the funds they need for operations and expansion.
2. The government through the Central bank should approximately release the quantity of money that the economy needs so that it won’t exceed the economic activities thus leading to inflation.
3. The government through the central bank of Nigeria should stabilize the exchange rate or adopt policies that promote a more predictable and steady exchange rate environment.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

**REFERENCES**

Abdullahi I. & Karatu A, S. (2021). Effect of macroeconomic variables on financial performance of listed cement manufacturing companies in Nigeria. *Creative Business Research Journal*, 1(1), 162-171.

Adegun, O. & Olawale O. 2019. Self-help housing: Cooperative societies’ contributions and professionals’ views in Akure, Nigeria. *Built Environment*, 45(3), 332-345. DOI: 10.2148/benv.45.3.332.

Agbola, T. 2005. The housing debacle. Inaugural lecture delivered at the University of Ibadan, Ibadan, Nigeria.

Akinyoade, A. & Uche C., (2018). Development built on crony capitalism: the case of Nigerian cement, *J. Bus. Hist*. 60 (6) 833–858, doi:10.1080/00076791. 2017.1341494.

Alabi, A.M., Muraina, M.A. & Kasim, O.F. (2018). Private developers’ participation in housing production and wetland encroachment along LekkiEpe corridor in Lagos, Nigeria. *Journal of Environment Protection and Sustainable Development*, 4(3), 46-54.

Alabi, O. R. (2015). Foreign exchange market and the Nigerian economy. *Journal of Economics and Sustainable Development*, 6(4), 102-107.

Almalki, A., & Batayneh, K. (2015). The relationship between inflation and financial development in Saudi Arabia. *The Journal of Developing Areas*, 49(6), 421–427.

Andrew, R. M. (2018). Global co2 emissions from cement production. Earth Syst. Sci. Data 10, 195–217, https://doi.org/10.5194/essd-10- 195-2018.

Asamoah, R., Baiden, K., Nani, G. & Kissi, E. (2020). Review of exogenous economic indicators influencing construction industry. *Advances in Civil Engineering*, vol. 2019, article 6073289, 1-8. https://doi. org/10.1155/2019/6073289.

Asharf, A., Erfanifard, Y., Amiraslani, F., Boloorani, A. D. & Mousivand, A. (2020). Quantitative assessment of forest ecosystem stress caused by cement plant pollution using in situ measurements and Sentinel-2 satellite data in a part of the UNESCO World Heritage Site. *European Journal of Environmental Sciences* 10, 22–31.

Babalola, A. J. (2023). Influence of macroeconomic variables on construction material prices in Lagos State, *Urban and Regional Planning Review* 8(1).

Dangote Cement, An Emerging Cement Major Building Shareholder Value and Prosperity in Africa, September. Dangote Group, 2014.

Elfahham Y. Estimation and prediction of construction cost index using neural networks, time series, and regression. *Alexandria Eng J* 2019.

Fulford, R.G. 2019. The implications of the construction industry to national wealth. Engineering, *Construction and Architectural Management*, 26(5), 779-793. doi.org/10.1108/ECAM-03-2018-0091.

Gok, G., &Gok, M. (2016). Emerging economies: comparative analysis of MIST and IBSA countries. *Eurasian Journal of Social Sciences*, 4(2), 1-13.

Habert, G. et al. (2020). Environmental impacts and decarbonization strategies in the cement and concrete industries. *Nature Reviews Earth Environment* 1, 559–573, https://doi.org/10.1038/s43017-020-0093-3.

Huang, L., Krigsvoll, G., Johansen, F., Liu, Y. & Zhang, X. (2018). Carbon emission of global construction sector. *Renewable and Sustainable Energy Reviews* 81, 1906–1916, https://doi.org/10.1016/j.rser.2017.06.001.

Islam R, Ghani ABA, Mahyudin E, Manickam N. Determinants of factors that affecting inflation in Malaysia (2017). *Int J Econ Financial Issues*; 7(2):355–64.

Isyaka M. S., Adama B. Y., Fatima D., & Kesmen S. M., (2022). Influence of economic environment on the performance of cement manufacturing companies in Nigeria, *Journal of Global Economics and Business*, 3(10), 69-89.

ITA (International Trade Administration), 2019. Nigeria – Country commercial guide. [Online]. Available at: [Accessed: 23 February 2021].

Itaman, R., & Wolf, C. (2021). Industrial policy and monopoly capitalism in Nigeria: lessons from Dangote Business Conglomerate. *Development and Change*, 52(6), 1473-1502.

Johnson RM, Babu RII (2018). Time and cost overruns in the UAE construction industry: a critical analysis. *Int J Construct Manage*, 1–10

Joseph, U. K., Zakka, Z. G., Godwin, U. A., Buang A., & OnuohaI. J., (2015). Monetary policy and its price stabilization effects on the prices of building materials, *Mediterranean Journal of Social Sciences*, 6(4).

Kasim, O.F. 2018. Wellness and illness: The aftermath of mass housing in Lagos, Nigeria. Development in Practice, 28(7), 952-963. https://doi.org /10.1080/09614524.2018.1487385.

Kasim, O.F., Ajayi, S.O., Omirin, O.J. & Alabi, A.M. 2023. The impact of foreign exchange rate on building materials and residential building construction cost in Nigeria. *Acta Structilia*, 30(2), 61-93.

Kenneth M. O. (2016). A Multiple Linear Regression Model to Predict the Price of Cement in Nigeria, World Academy of Science, Engineering and Technology International *Journal of Economics and Management Engineering* , 13(12).

Keynes, J.M. (1936).The general theory of employment, interest, and money. Book V: Money-wages and Prices.

Kikwasi, G.J. & Sospeter, N.G. 2023. The nexus between monetary and fiscal policies and construction output in Tanzania. *Acta Structilia,* 30(1), 34-61.

Lawal, D., “Cement Sector Update,” Equity Research (2016). Cardinalstone, 1–14.

Lucas, R.E. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, 22, 3–42.

Manzur, M. 2018. Exchange rate economics is always and everywhere controversial. *Applied Economics*, 50(3), 216-232. DOI: 10.1080/ 00036846.2017.1313960.

Mark B., Eric, O. A., & Dela A.,(2016). The impact of macroeconomic indicators on cement prices in Ghana, *Journal of Scientific Research & Reports* 9(7): 1-6.

Mbusi, E., Mbiti, T. & Wanyona, G. 2015. Monetary and fiscal policy factors that affect construction output in Kenya. *International Journal of Soft Computing and Engineering,* 5(5), 16-28.

Menyelim C., Ochei A. I., Godswill O. O., Oluwatobi F., & Segun K., (2021). The influence of liquidity on the performance of the Nigerian cement companies, *Journal of Management Information and Decision Sciences*, 24 (1).

Miller, S. A., Horvath, A. & Monteiro, P. J. M. (2018). Impacts of booming concrete production on water resources worldwide*. Nature Sustainability* 1, 69–76, https://doi.org/10.1038/s41893-017-0009-5.

Mojekwu, J. N., A. Idowu & O. Sode (2013). Analysis of the contribution of imported and locally manufactured cement to the growth of Gross Domestic Product (GDP) of Nigeria (1986 – 2011),” *African J. Bus. Manag*., 7(5), 360–371.

Muhammad, A. M., Wesam, S. A., & Liew, M.S. (2021). Impact of inflation rate on construction projects budget: A review. *Ain Shams Engineering Journal* 12, 407–414.

Njoku, J. 2015. Soaring exchange rate unsettles the construction industry. 3 March. The Vanguard Newspaper. [Online]. Available at: [Accessed: 15 May 2020].

Nwafor I.V., Ugonabo C.U., & Christian O.N. (2023), Effects of macroeconomic indicators on cost of building materials in Nigeria. *African Journal of Social Sciences and Humanities Research* 6(4), 166-176. DOI: 10.52589/AJSSHRJBFCF7BD.

Nwobia, C. E., Ogbonnaya N., & Ezu, G. K., (2020). Effects of monetary policy on selected macroeconomic variables in Nigerian economy, *International Journal of Economics, Business and Management Research*, 4 (10).

Nwuju, O. C., Aiyedogbon O. J., & Aigbedion, M., (2024). Impact of selected macroeconomic variables on human capital development in Nigeria, *International Journal of Advanced Research in Public Policy, Social Development and Enterprise Studies*, 5(1).

Okafor I.G., OnwumereJ.U.J. ,Ezeaku, H. C., (2016). Dynamics of monetary policy targets and economic growth under the direct monetary policy regime and the market-based regime. *American Research Thoughts*, 2(11).

Oliva, F.L., Teberga, P.M.F., Testi, L.I.O., Kotabe, M., Del Giudice, M., Kelle, P. and Cunha, M.P. (2022) Risks and critical success factors in the internationalization of born global startups of industry 4.0: A social, environmental, economic, and institutional analysis. *Technological Forecasting and Social Change*, 175, 12134.

Olowe, R. 2009. Modeling naira/dollar exchange rate volatility: Application of GARCH and asymmetric models. *International Review of Business Research Papers*, 5(3), 377-398.

Omale R. C. (2016). Department of accounting, Nasarawa state University.

Oruwari , N. ., Okwudiri , A. D. ., & Chibuike , O. O. . (2024). Macroeconomic dynamics on domestic production in Nigeria: A Study of the Cement Industry. *American Journal of Economics and Business Management*, 7(6), 1–14.

Oyediran, O.S. (2019). Institution and housing development: Mirage, magic and miracle of low-cost housing in Nigeria. *Economic and Financial Review*, 57(4), 37-68.

Ruddock, L. & Ruddock, S. 2019. Wealth measurement and the role of built asset investment: An empirical comparison. *Engineering, Construction and Architectural Management,* 26(5), 766-778. https://doi.org/10.1108/ ECAM-07-2018-0290.

Salas, D. A. et al. (2016). Environmental impacts, life cycle assessment and potential improvement measures for cement production: A literature review. *Journal of Cleaner Production* 113, 114–122, https://doi.org/10.1016/j.jclepro.2015.11.078.

Seyed, S. A. M., Tayyebeh R. p., & Mansour A., (2023). Analysis of the Effects of Economic Variables on the Price of Cement and Forecasting its Price Trend, *Journal of Econometric Modelling*, 8(4): 161-195.

Shen, W. et al. (2015). Quantifying co2 emissions from China’s cement industry. *Renewable and Sustainable Energy Reviews* 50, 1004–1012, https://doi.org/10.1016/j.rser.2015.05.031.

Taiwo, D.O., Yusoff, N.B. & Abdul Aziz, N.B. (2018). Self-help approach as one of the panacea for housing delivery dilemma in Nigeria. *Journal of Computational and Theoretical Nanoscience*, 24(5), 3770-3776. DOI: 10.1166/asl.2018.11481.

Thomas O. M. & Frederick M. L., (2024). Extraction and Processing in cement raw materials.

Timothy I. A. (2022). Effectiveness of Monetary Policy in Stimulating Economic Growth in Nigeria, *International Journal of Research in Social Science and Humanities (IJRSS),* 3 (2).

Ugochukwu, S.C., Eze, G.C., Akabogu, S.C. & Abubakar, B.H. 2017. The correlation between foreign exchange rates and prices of building materials in Nigeria, 2011-2017. *The International Journal of Business & Management*, 5(10), 95-100.

Ugochukwu, S.C., Ogbuagu, G.O. &Okechukwu, F.E. (2014). An appraisal of the sources, quantities and prices of imported building materials in Nigeria. *International Journal of Advanced Research*, 2(9), 871-889.

UKEssays. 2018c. Macroeconomic policy and construction industry in United Kingdom. Economics Essay. [Online]. Available at: [Accessed: 16 January 2023].

Uma, K.E., Obidike, P.C., Chukwu, C.O., Kanu, C., Ogbuagu, R.A., Osunkwo, F.O.C. &Ndubuisi, P. 2019. Revamping the Nigerian manufacturing sub-sector as a panacea for economic progress: Lessons from South Korea. *Mediterranean Journal of Social Sciences*, 10(4), 111-123. DOI: 10.2478/mjss-2019-0057.

UN-Habitat. 2020. World cities report. Nairobi, Kenya: UN-Habitat.

Vo, H.L. & Vo, D.H. (2023). The purchasing power parity and exchange rate economics half a century on. Journal of Economic Surveys, 37(2),446-479. <https://doi.org/10.1111/joes.12504>.

Zarenski E. (2019). Inflation in construction – what should you carry? Retrieved from https://edzarenskicom/2018/02/15/inflation-in-construction-2019- what-should-you-carry, 2019.

Zhang, S., Worrell, E. & Crijns-Graus, W. (2015). Evaluating co-benefts of energy efficiency and air pollution abatement in China’s cement industry. *Applied Energy* 147, 192–213, https://doi.org/10.1016/j.apenergy.2015.02.081.