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Correlation between Petroleum Pump Price Volatility and Selected Building Materials Prices of Construction Projects in Nigeria, 2011 – 2020

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Abstract:
The issue of construction material prices would never cease to exist as building projects are being carried out on regular basis. This study examined the statistical relationship that exists between petroleum crude oil price volatility and prices of selected building materials in Nigeria. These materials include cement, block, tile and reinforcement bars, and were selected via field survey owing to their cost implication to building and importation regularity. Data on Petrol Pump Price Volatility were obtained from the Central Bank of Nigeria (CBN) statistical bulletin and covered a period of 2011 to 2020. The inferential analysis carried out between petroleum pump price and the prices of cement, block, tile and reinforcement bar show the existence of strong positive relationship, with correlation coefficients of 0.872, 0.920, 0.820 and 0.864 respectively. This shows that 1 Naira increase in petrol pump price reflects a similar increase in the prices of building materials indicating that petrol pump price is a strong determinant of construction material prices. This study concludes that there is need for the formulation of appropriate fiscal policies devoid of political sentiments in mitigating the effect of petrol pump price on building material prices. The study therefore, recommends the diversification of the economy through the revitalization of the Ajaokuta Iron & Steel, Itakpe Iron Ore Mining Companies as well as other steel industries which can assist in increasing the local production of building materials and other equipment, and by so doing reducing the effect of petrol pump price as well as curtailing the upshot of other macroeconomic factors on the economy.

Keywords: *Petroleum crude oil, volatility, building materials, Nigeria*

1. Introduction

The mono-economic culture of Nigeria's economic base was brought about by the discovery of oil in the field of Oloibiri, Eastern Niger Delta in 1958 which made the country one of the highest oil producing nations of the world (Adeniran 2016). Kolawole (2009), referred to some yearly bulletins of the Organization of Petroleum Exporting Countries (OPEC) and contended Nigeria's position among the main five producers and exporters of crude oil on the planet. But the volatility experienced in the crude oil prices is a challenge to the construction sector and mostly construction material prices (Muhammed, 2021). Both the oil and construction sectors play critical roles in the advancement of any economy. As indicated by Khan *et al.,* (2013), the products of these two sectors are fundamental for industry, together with industrial processes and outputs. PricewaterhouseCoopers Limited (2017), detailed that the oil sector remains the predominant source of fiscal and export revenue, emphasizing a growing relationship between oil and non-oil sectors through the exchange rate channel. Crude oil prices were found to be a major factor that leads to the increase in construction material prices in most developing countries (Putra et. al., 2021; Danso & Obeng-Ahenkora, 2018). In Nigeria, Olatunji (2010), revealed that the high cost of construction materials was because of the high cost of finance and wild volatility that were stimulated by issues in oil price regimes. Despite the fact that various researches by Adedeji (2002); Arayela (2005) & Ogunsemi (2010), have placed building materials to represent as much as 50 - 60% of building construction, little emphasis has still been given it in the wake of the increase in petroleum prices crude oil prices. Studies have been carried out by Oladipo & Oni, (2012); Akanni et al., (2014); Ugochukwu et. al., (2017) & Muhammed, (2021) on the effect of the different macroeconomic factors such as exchange rate on building material prices but there have been little emphasis on petrol pump price volatility. The study therefore, gains an insight into the correlation between petrol pump price volatility and building materials price fluctuation of construction projects in Nigeria.

1.1. Aim and Objectives of the Study

The aim of this study is to correlate petroleum crude oil price volatility and building materials price changes in Nigeria with a view to launch the level of correlation between the variables from 2011 to 2020. The aim of this study would be achieved through the pursuance of these specific objectives are to;

- Obtain the petroleum pump price volatility for the period under review.
- Get the prices of some selected construction materials (cement, block, ceramic wall tile & reinforcement bar) for the period of study.
- Determine the correlation between petroleum pump price volatility and the selected building materials (cement, block, ceramic wall tile & reinforcement) prices from 2011 – 2020.

1.2. Research Hypotheses

The following hypothesis were postulated and validated

- Ho_1: There exist no significant relationship between petroleum pump price volatility and cement price changes.
- H_{02}: There exist no significant relationship between petroleum pump price volatility and block price changes.
- H_{03}: There exist no significant relationship between petroleum pump price volatility and ceramic wall tile price changes.
- H_{04}: There exist no significant relationship between petroleum pump price volatility and reinforcement bar price changes.

2. Literature Review

2.1. Overview of the World Oil Market

The global oil market incorporates great actors who work with the advancement of oil from where it is produced, to where it is refined into products, and furthermore from that point to where those products are eventually sold to customers. (Levine, *et. al,* 2014), detailed that the market worth of crude oil is driven by interest for refined oil based commodities, especially in the transportation sector, basically all engine vehicles, airplane, marine vessels, and trains throughout the planet are driven by petroleum products. Products obtained from oil, like engine gas, jet fuel, diesel fuel, and heating oil, supply all the energy devoured by household, organizations, and manufacturers around the world. Crude oil is likewise the world's most effectively exchanged item, representing about 10% of the total world exchange (Namit, 1998). The monetary meaning of oil isn't just gotten from the sheer size of the market, yet in addition from the pivotal, practically essential job it plays in the economies of oil-exporting and oil-consuming nations (Garcia et. al., 2019). Oil prices drive incomes to oil-exporting countries in a large number of which, oil trades comprise more than 20% of the GDP. Then again, oil import costs (naturally more than 20% of the total import bill) have a considerable impact on growth trends in developing countries. The organization of oil exporting countries (OPEC) which holds greater part (77%) of worldwide proved reserve, has not gained market share in recent times, OPEC's market share of about 51% in 1973 has fell fundamentally to 41% in 2010 (Putra et al., 2021). The decrease in OPEC's market share is credited to persistently increasing production level of Non-OPEC countries like U.S, Russia, brazil and so forth, coastal creation in the U.S. has been on the expansion because of advancements in the improvement of shale assets (both oil and natural-gas related fluids); biofuels have been another key source of liquid supply growth (basically the U.S. and Brazil, both empowered by rising prices of oil in recent times with the U.S. likewise getting a lift from tax breaks and commands).

2.2. The Nigerian Oil Sector

Until early 1990s, the sector has been controlled by multinational corporations. Indigenous companies' participation in the oil sector was induced by the creation of the Nigerian National Petroleum Corporation (NNPC) as well as the operation of the Nigerian Oil and Gas Industry Content Development (NOGIC) Act. The Nigerian Oil industry is structurally divided into the upstream and the downstream sector (KPMG, 2014). But the Petroleum Industrial Bill (PIB) signed into law by President Muhammadu Buhari on the 16th of August 2021, seeks to change the landscape by making new provisions for the country's petroleum sector. One of such is the intended creation of Upstream Regulatory Commission for upstream operations, including the granting of petroleum exploration licenses which would be for three year and renewable for an additional three years subject to the fulfilment of the prescribed conditions (PIB, 2021). Another provision is the establishment of the Midstream and Downstream Regulatory Commission with many departments which is expected to follow the structure of the Nigerian Communications Commission (NCC) (PIB, 2021).

2.3. Volatility

The ideas behind volatility many times are misunderstood with the constant increase in commodity prices. In as much as volatility could mean an increase in prices, it could mean a reduction in prices (Adeniran 2016). According to Algieri, (2012), volatility is a measure of the inconsistency of prices that happens on a daily, weekly, month or annual basis. Ogiri, *et al.,* (2013), opined that volatility is the measure of the inclination of oil price to rise or fall sharply within a period of time, such as a day, a month or a year. Volatility however does not estimate the course of price fluctuations, but computes price variation around the mean. Sauter & Awerbush, (2003) stated that there are large price increases and decreases reflecting a substantial rise in the volatility of the real oil price which creates market uncertainties that persuade companies to postpone their investments. Mustapha & Sulaiman (2015), posited that the pattern of constant fall in oil prices has been a significant worry in the comity of oil producing nations, which incited the agitation for a decrease in

production quota because of the political assembling of the Organization of Petroleum Exporting Countries (OPEC). Shaari, *et. al.,* (2013), expressed that oil price increase impact the construction sector by raising the cost of raw materials. They further posited that suppliers unavoidably increase the prices of raw materials for contractors to take care of higher transportation costs, thereby escalating the cost of raw materials for contractors.

2.4. Causes of Building Materials Price Fluctuation

Building materials are those materials needed for the construction and erection of edifices; no field of engineering is indeed possible without their utilization (Udosen & Akanni, 2010). The following are the causes of building materials price fluctuation;

2.4.1. Import Duties

Import duty charges are specified on the construction industry and building material prices which affected them in countries like Malaysia, India, Uganda, Kenya and Oman (Master Builders Association of Malaysia (MBAM), 2011; Hamsawi, 2011). Goods and services imported into South Africa experience import duties in order to protect domestics' manufacturers from customers who vested interest in trade in goods from outside (National Treasury of South Africa, 2008).

2.4.2. Exchange Rates

According to Darlington (2014), exchange rate is the local currency price in terms of other nation's currency and important aspect in comparing trading between one country and the other. The country has the ability to survive without relying heavily on the importation of building materials. There is continuous downward spiral in the value of naira which invariably caused the continuous increase in the prices of building materials (Muhammed, 2021).

2.4.3. Instability of Crude Oil Prices

Mustapha & Sulaiman (2015), clarified that oil prices slithered from US$112.27 in June 2014 to US$78.4 in November 2014 and further decrease to US$ 59.5 in December 2014 and has kept on falling. Global oil prices are accepted to be the main external economic factor for the Nigerian economy; subsequently Nigeria has been named an oil economy (Igberaese, 2013). Arinze (2011), expressed those upward changes of oil products have brought about inflation, high cost of living, and biased income distribution in Nigeria and these has caused instability in the costs of goods and services in the country. At whatever point there is an increase in the prices of oil products, it influences transportation, prices of goods and other services (Muhammed, 2021).

2.4.4. Interest Rate

The reduced availability of the resources for exchanges occasioned by the inconsistent bank interest rate is one of issues affecting the construction raw materials prices which make up 60 per cent of importation (Jagboro & Owoeye, 2004). Increase in the cost of borrowing will naturally induce people to save. Central Bank of Nigeria (CBN) interest rate stood at 11.35% as at December 2020 and slightly reduced to 11.25% in April 2021 (CBN, 2021).

2.4.5. Inflation

According to Badreldin (2014), inflation reveals an absolute fall in the purchasing power or unit of money – which amount to a loss in the real value of the unit of account and medium of exchange within a nation's economy. As a result, building materials increased at an alarming rate.

2.4.6. Inadequate Production of Raw Materials

Ogunlana, *et. al.,* (1996), argued that the reason behind the building materials scarcity was brought about by the ineffective material supply as a result of shortage in the activities of industries, poor head office and site communication, sub-standard purchase planning and poor material coordination. This is one way that brought about increased cost of building materials.

2.4.7. Supply and Demand of Building Materials

The demand and supply is a factor that influences building material prices. Delay in supplying building materials and demand in housing occasions increase in the prices of building materials (Windapo, *et. al.,* 2012). They further exposed that market condition in which the building materials are produced is factor that can increase its cost. Researches are of the position that building materials are expected to be cheap in a market where many producers are involved rather than a market involving one or two producers. Therefore, demand and supply is a causative factor that influences building materials prices (Muhammed, 2021).

2.4.8. Weather Conditions

Climate change is a factor that directly or indirectly affects the construction material usage before or during the project life. According to Windapo *et al.,* (2013), the atmospheric emission of CO_2 by the building under construction and in use contributes to challenge of climate change. Subsoil conditions may be changed by an unfriendly weather condition and in many cases site conditions are not usually determined until the start of construction work (EU Framework, 1998).

2.4.9. Government Policies

Government in any nation practically influence the construction sector through the policies that affect the construction material prices (Mansfield, *et. al.,* 1994) and Obadan (2001). Importation, tax regimes and budget policies greatly influence the output of the construction industry. Government's initiation power could also be invoked on political, social and environmental grounds (Mansfield *et. al.,* 1994).

2.4.10. Force Majeure

The cases of force majeure could also be labelled as an 'Act of God' which encompasses happenings such as war, revolution, riot, political volatility, riot, earthquake, landslide and other related risks (Nega, 2008). An occurrence of any of the events would lead a significant increase in the prices of building materials.

2.4.11. Human Factors

Typical, three resources are associated with construction. These include material, manpower and machinery. The study of Hanna *et al.,* (2005) emphasized the importance of manpower over machinery and materials. Whereas, Windapo & Cattell, (2012), desired to measure respondents' perception in countering actual agents may have an effect on the building material prices in South Africa. Labour cost correlated highly with construction material prices which were closely followed by transportation cost. Improper communication mode and channel between management and labourers is a factor that can inhibit productivity and increase production factor. Mustapha & Rashid (2012), emphasized the importance of communication management in human resources improvement. This is a necessary requirement for a Project Manager to be able to liaise properly and efficiently between management and labourers.

2.4.12. Improper Planning

Plan is a future course of action and the lack of plan provide poor performance. The improper planning of material cost affect contractors general effectiveness. Eshofonie, (2008), emphasized the necessity of planning and scheduling to proper utilization of resources. Lack of effective planning and scheduling would invariably lead to delay in project completion (Assaf & Al-Hejji, 2006).

2.4.13. Supplier Default

Limit of one supplier can lead to market monopoly through interest and output restriction. Researchers are of the position that high demand of construction materials causes delay by supplier in order to amass high order which brings about raw importation issues culminating into increased exchange rates. The study of Elinwa & Silas, (1993) exposed kickbacks and fraudulent practices as the second most important factor that bring about building cost increase in their interview with construction experts.

2.5. Theoretical Review

2.5.1. The Economic Theory

This theory postulated that oil price changes have significant effect on the economic activities of any nation especially those importing and exporting countries in the area of supply and demand (Adegbie, et. al., 2019). Supply of oil is crucial to the manufacturing and production process as well as in the transportation of construction materials from one place to the other. Therefore, an increase in the prices of oil will lead to reduced demand of oil causing a reduction in the production of other products which would have effect on the output level of the country. Conversely, a reduced construction material usage is influenced by the rise in petroleum crude oil prices (Arinze, 2011). This shows that an increase in the cost of crude oil prices lead to an escalation in the cost of infrastructural project investment. In other words, there seems to be a correlation between the petroleum crude oil price volatility and construction materials price fluctuation which is the topic of the study.

2.5.2. The Linear/Symmetric Relationship Theory

The theory postulated by Hamilton (1983), reinforced by Gisser (1985), Hooker (1996) and Laser (1987) posited that GNP (Gross National Product) growth is induced by the volatility in oil prices. The theory was based on the event in the oil market between 1948 and 1972, and its influence on the economy of oil exporting and importing nations. After studying empirically, Hooker (2002) validated that between 1948 and 1972 oil price level fluctuation influenced GDP growth significantly. Laser (1987), reiterated the symmetrical relationship between oil price volatility and economic growth. In a simpler term, the volatility of petroleum crude oil prices affects investment in the construction sector and thereby reducing its contribution to the GDP of the nation which have overall effect on the economic growth. This theory is related to the objectives of the study in that regard.

3. Research Methodology

Survey design was adopted for this study with a deliberate sampling frame of 10 years ranging from 2011 to 2020. This is because, Nigeria witnessed an unprecedented increase in the prices of petrol pump prices within this period as well as the country twice entered recession owing to the fall in the international oil market prices which significantly affected the economic stability of the nation. The materials (cement, block, tiles and reinforcement) was selected while their prices (average) were obtained via market survey at the three major commercial cities of Nigeria; Namely Lagos, Kano and Onitsha. Furthermore, data on petrol pump price volatility were retrieved from Central Bank of Nigeria (CBN) statistical

bulletin. The results were presented using Tables and Line graphs for pictorial elucidation, while correlation was used in analysing the data; to determine the relationship between the variables.

3.1. Pearson's Product Moment Correlation Coefficient - Pearson's r

In accordance with Kothari (2004), Pearson correlation analysis is the method that is widely used in measuring the extent of relationship between two or more variables and used for both interval and ratio scales. The Pearson's r can have a value between -1 and 1 and is a measure of two intervals or ratio variables linear relationship. It's a measure of relationship existing between a dichotomous (female or male, no or yes) and a ratio/interval variables (Cramer, 1998). A simple way to assess the relationship between two factors whether they share variance such that if a positive or negative relationships exist and their correlation extent are the advantages of Pearson's r. The disadvantage is that it cannot identify a non-linear relationship and may show zero correlation when there exists a non-linear relationship. The formula for Pearson correlation coefficient is expressed as:

$$\mathbf{r} = \frac{\mathbf{n(\Sigma XY) - (\Sigma X)(\Sigma Y)}}{\sqrt{\mathbf{[n(\Sigma X^2) - (\Sigma X)^2][n(\Sigma Y^2) - (\Sigma Y)^2]}}}$$

r = Pearson's correlation coefficient
n = number of paired scores
X = score of the first variable
Y = score of the second variable
XY = the product of the two paired scores

3.2 Significant Testing of Pearson's r

The performance of statistical analysis must be done to determine whether there is significant different in the coefficient from zero in order to infer that the estimated r is appropriate from preferred sample. It may be computed by calculating *t*:

$$\mathbf{t} = \frac{\mathbf{r\sqrt{n-2}}}{\sqrt{\mathbf{1-r^2}}}$$

Where:
r = Pearson's product-moment correlation coefficient
n = sample size of paired scores
df = *n* - 2

4. Data Presentation and Analysis

Year	Petrol Pump Price Volatility Average (₦)	Cement 50kg Bag Dangote (₦)	Block 9 Inches Hollow Sandcrete (₦)	Ceramic Wall Tiles 25 X 40mm (₦)	Reinforcement 12mm Per Length, 40ft (₦)
2011	65.90	1,300	84	439	1,082
2012	97.00	1,350	91	454	1,186
2013	97.20	1,354	96	489	1,243
2014	97.50	1,479	109	514	1,404
2015	87.00	1,986	121	550	1,650
2016	145.00	2,082	147	604	1,825
2017	145.56	2,564	163	900	1,975
2018	145.92	2,664	177	1,036	2,311
2019	145.92	2,689	182	1,186	2,482
2020	147.30	2,925	190	1,250	2,704

Table 1: Petroleum Pump Price Volatility & Annual Aggregate Prices of the Selected Building Materials from 2011 – 2020. Source: Central Bank of Nigeria (CBN) Statistical Bulletin and Author's Field Survey, (2021)

4.1 Descriptive Analysis

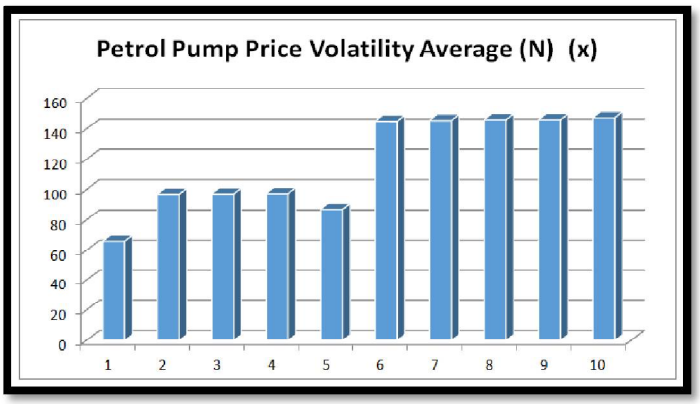

Figure 1: Trend in Petrol Pump Price Volatility from 2011 – 2020
Source: Author's Computation (2021)

Figure 1 depicted the trend in petroleum pump price volatility in Naira for the period under review. In the chart, years are horizontally depicted with 1-10 representing year 2011 to 2020. The chart shows that persistent increase in the pump prices of petroleum has been witnessed in Nigeria throughout the period under study. Initially, from 2011 to 2015, there was consistency in the prices as the differences were not much. But from 2016 upwards, the prices became higher and steady from that year to the year 2020.

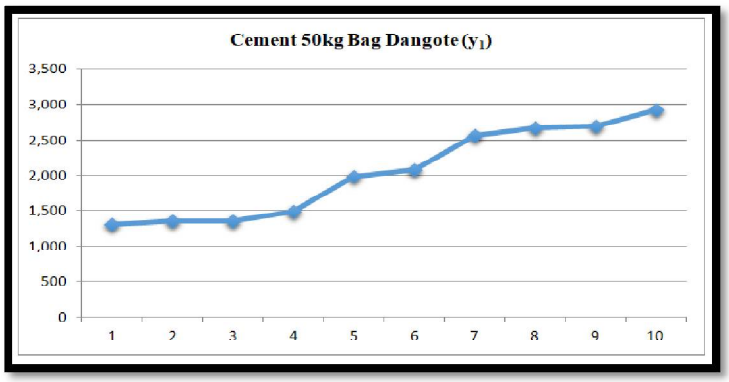

Figure 2: Trend in 50kg Dangote Cement for the Study Period
Source: Author's Computation (2021)

Figure 2 shows a generally consistent increase in the pattern of Cement prices. It is seen that the first year of study has the lowest price rate while the last year of study has the highest price level. Dangote cement has the largest market share in Nigeria and the cement is most used in the nation.

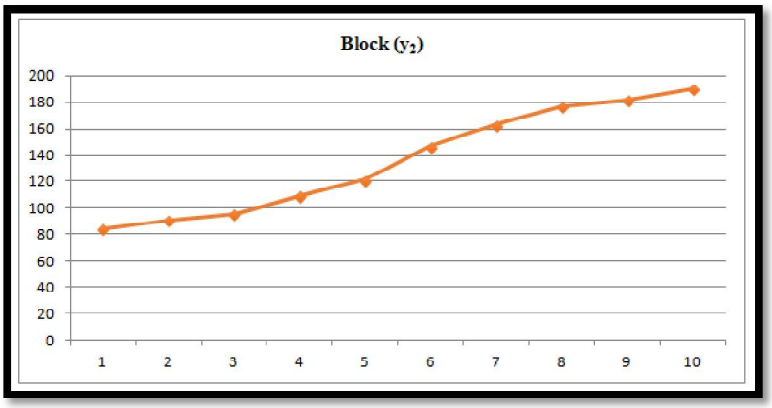

Figure 3: Trend in Price of Block for the Period under Review
Source: Author's Computation (2021)

There is no doubt that block is one of the most essential materials for building construction projects. Without blocks, no barrier and no wall coverings can be made. Figure 3 shows the price pattern of block for the study period. This depicts a consistent increase in the prices of blocks for the period under review with the lowest aggregate annual price of ₦84 experienced in 2011 and the highest of ₦190 witnessed in 2020 in north central for the study period.

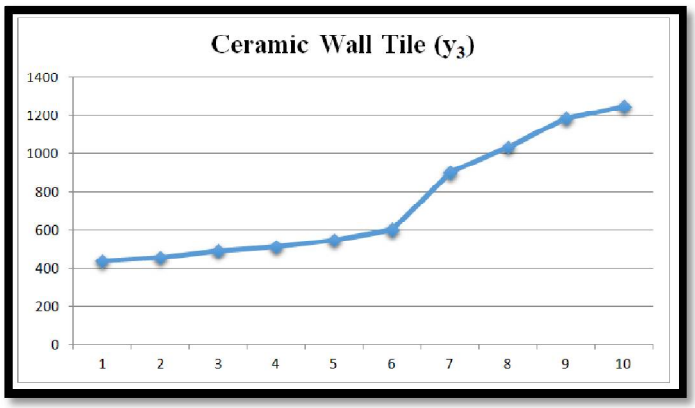

Figure 4: Trend in Price of Ceramic Wall Tile for the Study Period
Source: Author's Computation (2021)

A consistent upward trajectory in the price of ceramic wall tile was experienced by the country from 2011 – 2020 as the study period delineated as stated by the figure 1.4 above. This posit that from 1 which represent 2011 to 10 which replaced 2020 in the chart, there was continuous rise in the prices of tiles as there was insistency and reduced price level in petroleum crude oil prices.

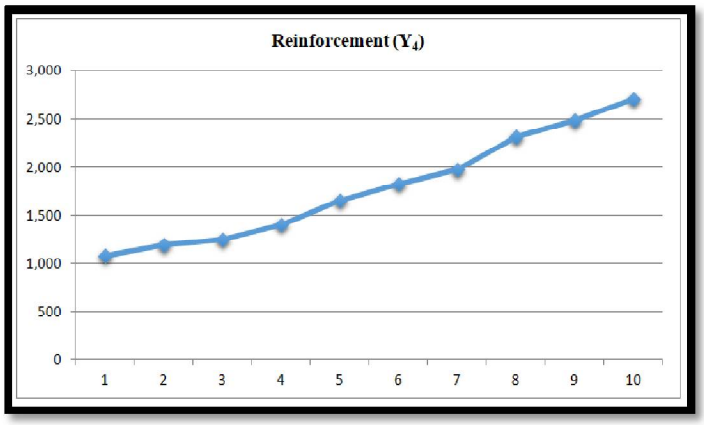

Figure 5: Trend in Price of Ceramic Wall Tile for the Study Period
Source: Author's Computation (2021)

Figure 5 describes how reinforcement price has risen over the study period. A consistent increase in the pattern of reinforcement prices was witnessed with increase in the prices of other building materials for the period under review with the lowest price experienced in 2011 and the highest in 2020.

4.2. Inferential Analysis

S/N	Variables		Analysis Type	Coefficient	Relationship	Remark	Action on
	x	y		Correlation	Strength		Hypothesis
1.	Petroleum Pump Prices	Cement	Correlation	0.872	Very Strong Relationship	Statistically Significant	Reject H_0
2.	Petroleum Pump Prices	Block	Correlation	0.920	Very Strong Relationship	Statistically Significant	Reject H_0
3.	Petroleum Pump Prices	Ceramic Wall Tile	Correlation	0.820	Very Strong Relationship	Statistically Significant	Reject H_0
4.	Petroleum Pump Prices	Reinforcement bar	Correlation	0.864	Very Strong Relationship	Statistically Significant	Reject H_0

Table 2: Analysis of the Correlation Between Petroleum Pump Price Volatility Which Is the Independent Variable and the Selected Building Materials (Cement, Block, Tiles and Reinforcement Bars) Prices Which Are the Dependent Variables
Source: Author's Computation (2021)

4.3 Interpretations

- There exist No significant relationship between petroleum pump price volatility and price of cement.
- There exist No significant relationship between petroleum pump price volatility and price of block.
- There is No significant relationship between petroleum pump price volatility and price of ceramic wall tile.
- There exist No significant relationship between petroleum pump price volatility and price of reinforcement bar.

5. Summary, Conclusion and Recommendations

The ensuing results from this study analysis suggest a very strong positive relationship between the tested variables. This is because the correlation coefficient is greater than 0.5. Therefore, the null hypotheses were rejected. The use of correlation coefficient was to determine the variables significance level which indicates the existence of a strong positive relationship indicating that petrol pump price is a strong determinant of building materials prices. Thus, petrol pump price volatility has positive correlation with the changes witnessed in the construction material prices indicating that 1 Naira increase in the pump price of petroleum products would reflect a similar increase in the prices of the selected construction materials. The study concludes that there is need for the formulation of appropriate fiscal policies that is devoid of political sentiments in mitigating the effect of petrol pump prices on building materials price fluctuation. The study therefore recommends the diversification of the economy through the revitalization of the Ajaokuta Iron & Steel, Itakpe Iron Ore Mining Companies as well as other steel industries which can assist in increasing the local production of building materials and other equipment, and by so doing reducing the effect of petrol pump price as well as curtailing the effects of other macroeconomic factors on the economy.

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