The Nexus of Monetary Variables on Construction Prices

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Keywords : monetary, variables, construction, economy, prices

SUMMARY

Increased competition amidst cash crunch calls for a better understanding of the effect of monetary variables on the prices of construction materials. This is because the success or otherwise of construction projects is largely dependent on price variations. Using a multi-method approach, this paper assesses the influence of monetary variables on prices of construction materials. An analysis of the F-statistics shows a significant relationship between variables (0.05 significant level and R^2 of 0.8) of the construction materials under review. Furthermore, the F-values show that the predictive value align with observed values at 95% confidence level for some of the materials. Based on the forgoing, the study recommends the establishment of monetary frameworks to guard against sudden changes in fiscal policy. The outcome of the study would be useful to the government in regulating the macro economy through the use of macroeconomic variables.

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1. INTRODUCTION

The role of the construction sector in the overall wellbeing and growth of global and national economies cannot be overemphasized. According to Walsh and Sawhney (2003) (cited in Best and Langston, 2005),with a contribution of 10.7%, 6.3% and between 5% to 8% to USA, Australian, and European Union countries respectively in 1996, construction activities are major contributors to the Gross Domestic Product (GDP) of industrialized countries. . Again, inferences from a a World Bank study suggest that in terms of infrastructure development, construction activitieshave direct correlation with other economic activities (Dikko, 2002).

The need to provide adequate for the ever growing human population makes the housing sub-sector of the construction market; and slight variations and or fluctuations in prices of construction material greatly affects the achievenemnt of the housing for all vision. Consequently, the performance of the housing market has a major impact on the overall performance of the economy. When there are instability in the housing sector, two factors frequently cited as being responsible for this variation/fluctuation are are rising income levels and the inflation

It is expected that the impact of government's fiscal and monetary policies, especially in developing economics where government is the largest client of construction companies would be great in the construction industry beacuse of what Dikko (2002) describes as its multiplier effect on growth in other sectors of the economy. It therefore follows that for the construction sector in particular, and the economy of a country in general to remain competitive, the economic policies of governemnt must not only be effective, efficient, and productive, but must also be seen to be favourable to the growth of the sector. There are views for instance, that economic policies which aim to control credit so as to curtail inflation, stabilize the price level and exchange rate, achieve equilibrium in balance of payment, and promote economic development is a major requirement in a developing economy (Jhingan, 2003). These policies are expressed as monetary policies, and are measured through ratios, and figures described as monetary variables. Jhingan (2003) concurs that monetary variables they are a major regulator of aggregate demand, through supply of money, cost of money, and availability of credit in the formal sector of such economies. Therefore, in developing economies where government not only procures the highest volume of construction works, but also dictates the policies of the economy, such government can determine how its various monetary policies affect the cost of procuring construction works.

The relationship among various monetary and macro-economic variables like inflation, interest rate, money supply, money demand, and exchange rate, and the construction industry has been a subject of research for some time now. Studies abound that show relationships between different aspects of construction and the dominant monetary variables. Baloi and Price (2001) studied risk factors affecting the cost performance, or the incidence of cost

overruns of construction projects identified inflation, exchange rate and market condition as some of the risks associated with poor cost performance of construction projects. Rwelamila and Lobelo (2002) also noted that monetary policies and variables have indirect effect on the construction industry, with extreme situations leading to insolvency among companies in the construction sector. Macro-economic risks and uncertainties as related to construction were examined by Okema (2002). The effect of macro-economic factors on the ability to develop predictive cost models for the construction industry was the subject of a study by Dikko (2002), who identified inflation, interest rates, exchange rates, and import duties and tariffs as major causes of change in prices and rates of construction elements. Macroeconomic variables such as the Purchasing Power Party (PPP) has also been used to compare the performance of construction projects across national boundaries (Best and Langston, 2005). The study by Oyediran (2001) on movement of construction prices and macro-economic variables in Nigeria, in addition to giving a a general view of the situation in Nigeria, also helped identify some of the difficulties associated with collation of construction price data in Nigeria. A further study by Oyediran (2003) examined the effect of micro-economic variables on building construction cost.

The paper is the outcome of a study that sought to determine the effect of identified monetary variables on construction prices. Guided by the above studies, especially Oyediran (2001), this research adopts a more streamlined direction, by studying relationships between some monetary variables and the cost of construction procurement in Nigeria. It utilised macro-economic data on interest rate, money supply, credit facilities to both the private public sectors to ascertain if any relationship exists among those variables. These costs were expressed as basic prices and bill of quantity (BoQ) unit rates.

2. ROLES OF MONETARY POLICY IN ECONOMY BUILDING

Monetary policy is described as a deliberate action of the monetary authorities to influence the quantity, cost and availability of money credit in order to achieve desired macroeconomic objectives of internal and external balances, carried out through changing money supply and/or interest rates with the aim of managing the quantity of money in the economy (Central Bank of Nigeria, 2011:4). The official goals usually include relatively stable prices and low unemployment rate. The Board of Governors of the Federal Reserve System (2005:15) notes that monetary policy serves ”to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates.” Monetary policy increases the growth rate of the economy by influencing the cost and availability of credit, controlling inflation, and stabilization of price level (Jhingan, 2003). Other uses of monetary policy include the stabilization of exchange rate, maintenance of an equilibrium in balance of payment and promotion of economic development. These uses of monetary policy in the economy notwithstanding, there are suggestions of a declining use of monetary policy as an instrument of economic stabilization in developed countries (Jhingan, 2003).

In spite of the relative success of monetary policy in ensuring economic stability in the developed countries, the story in developing countries may be different as these are likely to have problems establishing an effective operating monetary policy. This is further compounded by the difficulties in forecasting money demand, as well as a fiscal pressure to

levy the inflation tax by expanding the monetary base rapidly. In general, the apex bank in many developing countries have poor records in managing monetary policy because they are not independent of government. In these countries, good monetary policies are often relegated to the background, while the political desires of the government are projected; For this and other reasons, developing countries that want to establish credible monetary policy may institute a currency board or adopt dollarization. Such forms of monetary institutions thus essentially tie the hands of the government from interference and, it is hoped, that such policies will import the monetary policy of the anchor nation. Recent attempts at liberalizing and reforming financial markets (particularly the recapitalization of banks and other financial institutions in Nigeria and elsewhere) are gradually providing the latitude required to implement monetary policy frameworks by the relevant central banks as documented by Amassona *et al* (2011)

The success of monetary policy depends on the operating environment, the institutional framework adopted, and the choice and mix of instruments used. (Basurto and Ghosh, 2001). In Nigeria the design and implementation of monetary policy is the responsibility of the Central Bank of Nigeria (CBN). This is specified among the mandates of the CBN in CBN Act of 1958. Currently the monetary policy framework of Nigeria focuses on the maintenance of price stability, while making the promotion of growth and employment its secondary goals.

2.1 Contribution of Construction Industry to Economy

The construction industry contributes substantially to global and national economic development and stability. Along this line of thought, Dikko (2002) opines that the construction industry, in form of infrastructure and housing has a multiplier effect on the growth in other sectors. In the United Kingdom for instance, in the year 2009, about 194,000 construction firms employed over 2 million people (Sharp, 2010). In 2008, Dye and Sosimi (2010) note that the construction industry contributed about £75 billion to the UK economy. In Nigeria, the industry accounted for about 5-7% improvement in the GDP growth, and over 42% of the fixed capital growth in the last forty years (Olatunji and Bashorun, 2006). It is not entirely out of place to say that a two-way relationship exists between the construction industry and the economy. The construction industry can be described as a source of capital formation and investment for the economy and it is affected by the economic decisions taken to ensure the growth of the economy.

3 RESEARCH METHODOLOGY

The study to evaluate the influence of monetary variables on construction cost involves the collation and analysis of data on both macro- and micro-economic variables over a period of time. The methodology adopted for this study includes the use of survey research method. This study relies heavily on secondary sources of data for information on monetary variables and construction prices. The sampling design adopted for this is a non probabilistic purposive sampling method. This is necessary in order to avoid the accidental inclusion of cases that will affect the outcome of the study, thereby affecting the relaibility and validity of the research outcome. In sampling data on interest rate, the monetary policy of the Federal

Government of Nigeria, was put into consideration. A review of the monetary policy of Nigeria revealed that the policy of fixing interest rates was stopped in 1993, and a regime of indirect control adopted where interest rate is left to market forces, with the minimum rediscount rate adjusted as market indicators improved or deteriorated. Consequently, sampling period was restricted to 1994 upwards, in order to ensure that all variables fall within the period of indirect monetary policy. No inconsistency is expected in this sample due to the fact that it is not manipulated.

The absence of a regular construction databank in Nigeria affected the sampling of construction price data. The absence of Construction Price Index led to the adoption of one price level for sampling this data. The basic price of selected materials was used, and the construction price items were restricted to structural frame components. This is because these items have very little variation in specification across different prices. The data collected for research were processed using E-view (Economic view) software/application. The graphical output allows for viewing of trends which are not readily seen in tabulated data. The data were subjected to trend observation (a trend analysis of the monetary variables and construction cost), as well as regression analysis, which was used to determine the relationship between monetary variables and construction cost.

3.1 Model Specifications

It is posited here that fluctuations in monetary variables could affect construction prices. relationship with monteary variables of contructions. The mathematical model of this can be derived as follows:

$$\text{Price of an item} \propto \text{monetary variables}$$

$$\text{P} \propto \text{monetary variables}$$

$$\text{Prices} = \text{F(monetary variables)}$$

$$= F\ (interest\ rates, credit\ to\ private\ sector, credit\ to\ public\ sector, money\ supply)$$

Solving the above mathematcal function yields,

$$P = \beta + \infty I + \mu C_{pr} + \propto C_{pu} + \varphi t + e$$

Where:
P = the price of an item of the selected construction price
β = regression constant
∞ = **i**nterest rate coefficient
μ = credit to the private sector,
α = the coefficient of public sector credit, while
φ = associated with the total money supply

3.2 Types of Data Used

The data used for thia study can be categorised into two broad type; monetary variables, and construction price.

3.2.1 Monetary Variables

These are macro-economic data on money supply and credit to the private sector compiled by the Federal Office of Statistics (FOS), and the Central Bank of Nigeria (CBN). The interest rate is available on a quarterly basis, and is subject to government monetary policy at any point in time. A major determinant of interest rate is the Central Banks Minimum Rediscount Rate (MRR) - the rate at which banks borrow from the Central Bank. This, in turn, is affected by trends in the market. Adjustments to MRR are done based on level of inflation in the market, and other government monetary policy components.

3.2.2 Construction Price

This is a microeconomic data, which is not available in the national statistics publications. The absence of a National Construction Price Index (CPI) or Tender Price Index (TPI) means that there is no central source of data for the price of construction materials, which would have, put it on the same level of aggregation with the interest rate data. The price for selected construction items are only available at primary sources which include material manufacturers, material suppliers and Bill of Quantities.

3.3 Data Collection Instrument

The data collected for this study is quantitative in nature, thus ensuring the validity of data collected. Forms were designed to capture the data on a quarterly time frequency. These items chosen are common materials used in construction projecs (irrespective of size or nature) found in a typical Bill of Quantities. **Table 3.3**below shows the nature of data collected for construction works.

Table 3.3: Nature of data collected

Description of material	Price
Cement	₦/50kg bag
225mm hollow block	₦/piece
High yield tensile reinforcement bars	₦/tonne
China W.C Suite	₦/unit
PVC pipe	₦/3.6m length
$1m^2$ ceramic floor tiles	₦/carton
50 x 50 x 3600mm hardwood	₦/3.6m length
$1mm^2$ twin core cable	₦/roll
4 litre emulsion paint	₦/tin

4. RESULTS, ANALYSIS AND DISCUSSION

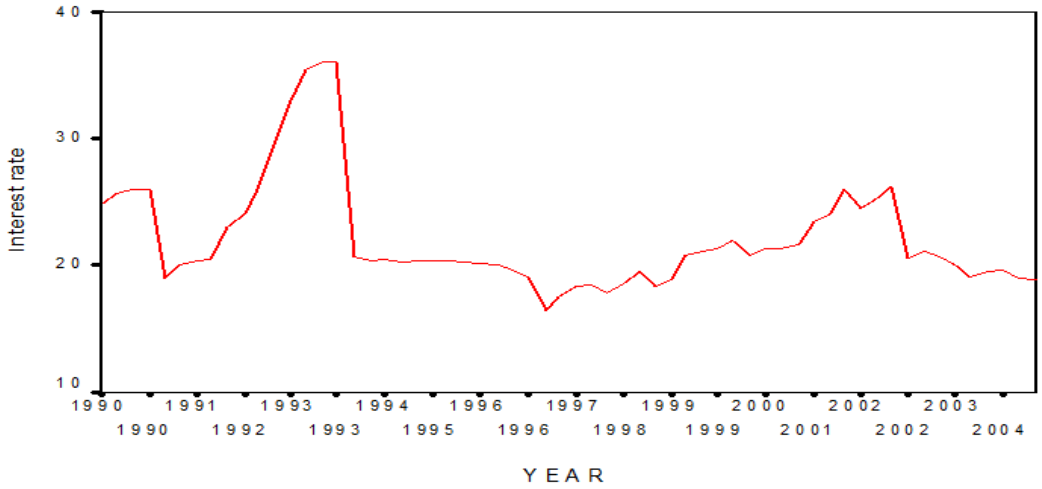
4.1 Trend of Monetary Variables and Material Price

4.1.1 Trend of Monetary Variables

Figures 4.1 to 4.4 below show the observed trends in monetary variables covered in this study. It could be noticed that the interest rate trend contains a mixture of both negative and positive slopes. The positive slopes, which reflect increases, occur towards the end of direct

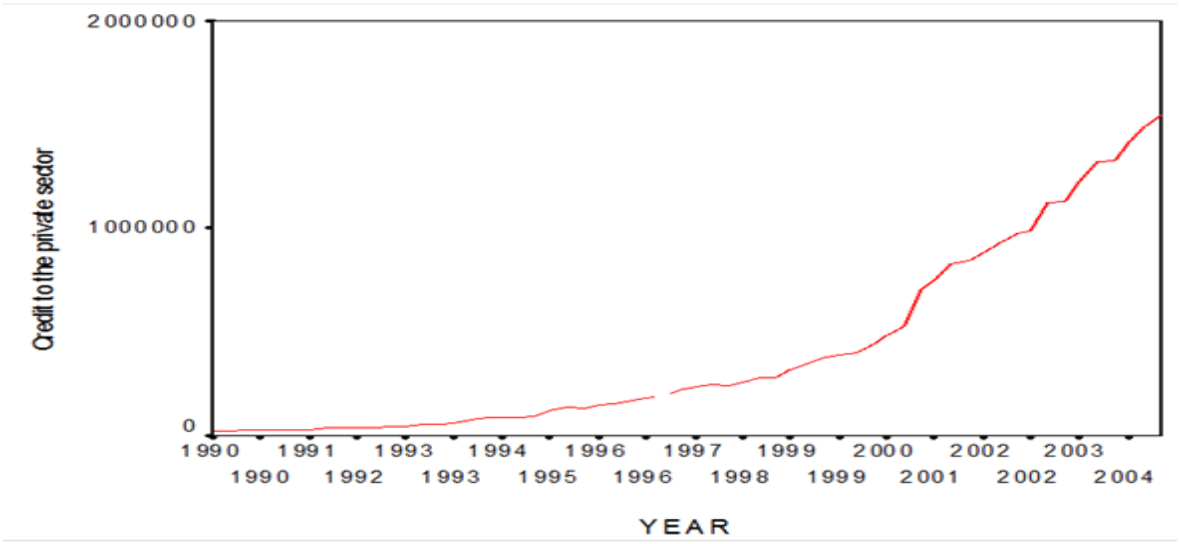
monetary control period in 1993 as explained by Nnanna (2001), and then between 1997 and 2002. It could also be observed that while the highest value of prime lending rate occurred in 1993 just before the transition to indirect monetary control, there has been a continuous reduction in the interest rate since 2002.

Figure 4.1: Interest Rate Trend



Over the same period of study (1990 -2004), credit facility to the private sector increased steadily. A closer analysis of the gradient of Figure 4.2 shows that the rate of increase between 2000 and 2004 is notably higher than for the period 1994-1999.

Figure 4.2: Credit to Private Sector Trend



Again, while Figure 4.3 below suggests that the total money supply increased, Table 4.4 below shows that credit to the public sector actually declined from 2003.

Figure 4.3: Total Money Supply Trend

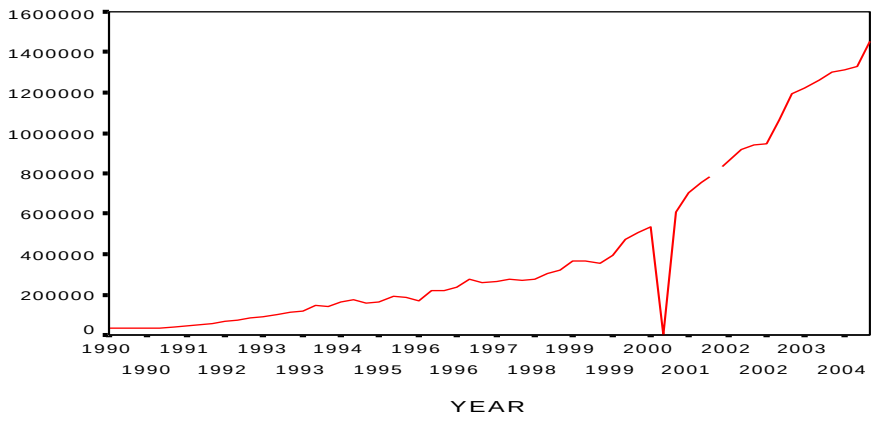


Figure 4.4: Credit to Public Sector Trend

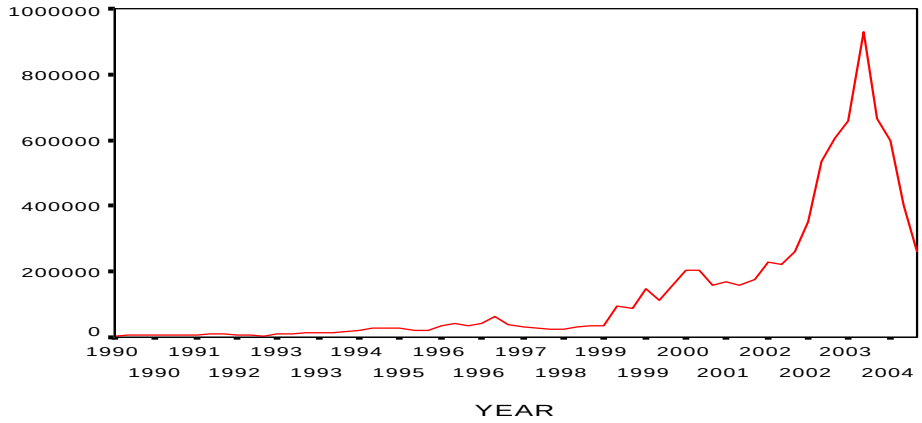


Table 4.1 shows the time series regression statistics, with the associated **ANOVA** F-values. It could be observed that the F-values are significant at above .05 level, implying agreement between the predicted value and the actual value of all the monetary variables.

Table 4.1: Regression Statistics for Monetary Variables Trend

Monetary Variable	adjusted R^2	d.f.	F	Sigf	Intercept	Gradient
Interest Rate.	.126	56	8.04	.006	24.8382	-.0878
Credit to Private Sector	.811	56	239.56	.000	-293332	23193.1
Credit to Public Sector	.572	56	74.89	.000	-132209	8903.87
Total Money Supply	.788	56	207.84	.000	-228427	21262.3

Again, a comsderation of the regression statistics shows that while the F-statistics for these models show a significant agreement between the variables, acceptance of the models were affected by the R^2 values. The models that showed significant fittness with the population

were those of credit to the private sector and total money supply, whose values were above 0.7. When the criteria for model acceptance are taken into consideration, it is only the model for credit to the private sector, with an R^2 value of 0.811 that is acceptable.

4.2.3 Trend of Material Prices

Figures 4.5 to 4.13 below show the observed trend for material prices.. The trend shows a general upward increase in the prices of building materials from the base year to end of the study period. The trend is almost linear in nature except for except for occasional departures seen in the prices of cement and high tensile steel which rose steeply between 2002 and 2004.Similarly, there was a a sharp rise in the price of sandcrete block between 2002 and 2004. Although there was a sudden surge in price of China W. C. between 2002 and 2003, this trend reverted to the trend before that period. for PVC pipe, there was with a haphazard but generally increasing trend.

Figure 4.5: 50kg Cement Price Trend

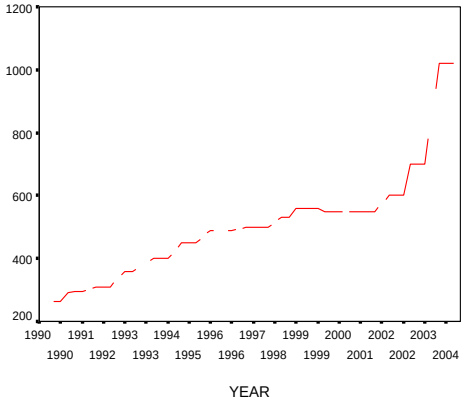


Figure 4.6: High Tensile Bar Price Trend

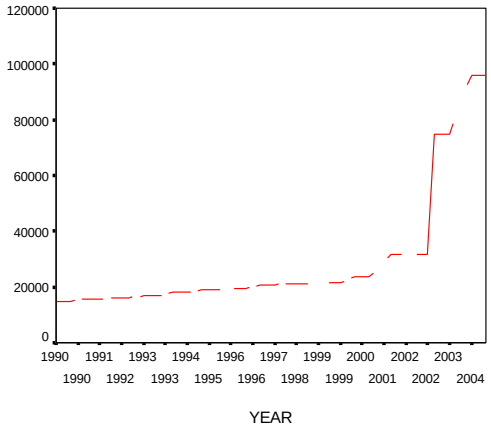


Figure 4.7: 225mm Sancrete Block Price Trend

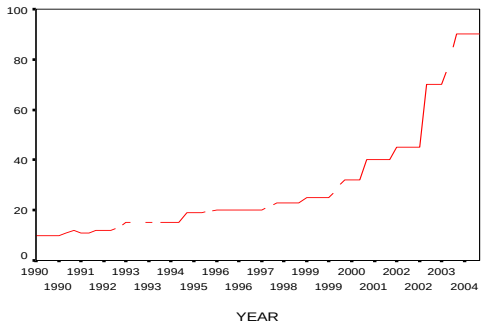


Figure 4.8: China W.C Suite Price Trend

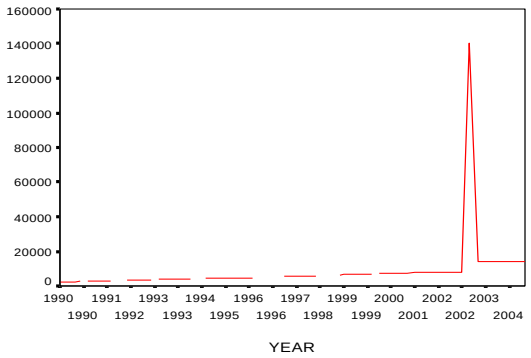


Figure 4.9: 13mm diameter PVC Pipe Price Trend

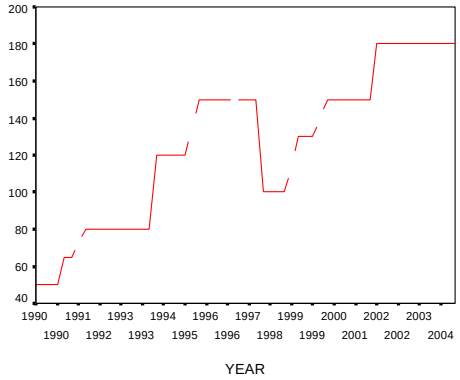


Figure 4.10: 1m^2 Ceramic Floor Tiles Price Trend

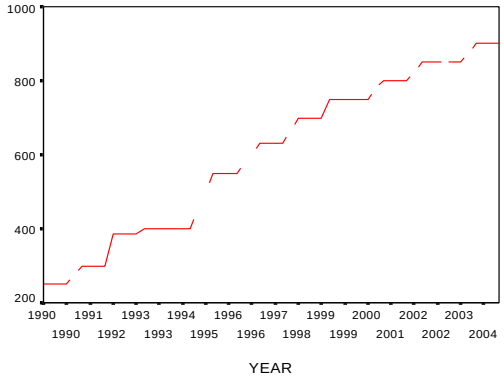


Figure 4.11: 50 x 50 x 3600mm Hardwood Price Trend

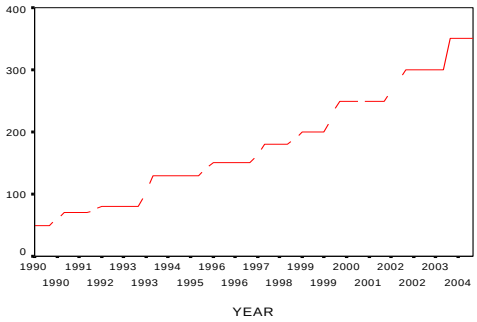


Figure 4.12: 1mm2 Twin Cable Price Trend

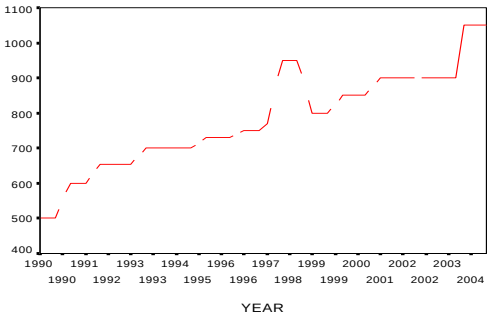
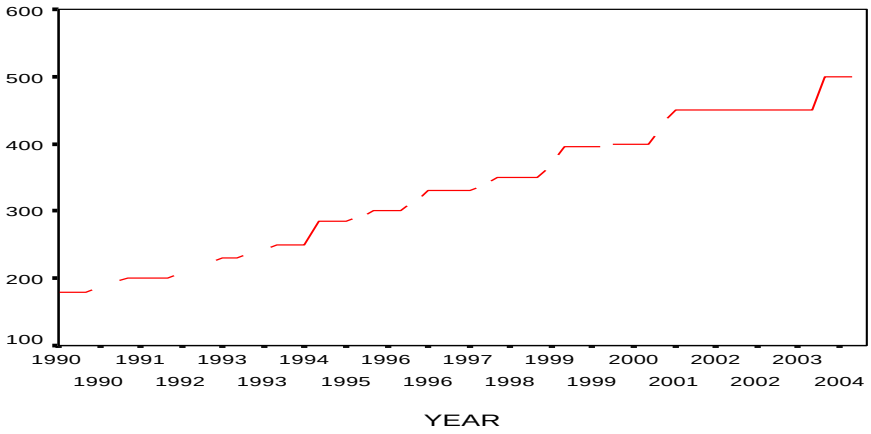


Figure 4.13: 4 Litre Emulsion Paint Price Trend



The regression statistics however leads to the rejection of some of the models. For instance, information on **Table 4.2** below shows that the models can only be accepted for five materials - PVC pipe, ceramic floor tiles, hardwood, electric cables, emulsion paints - which have coefficient of determination (R^2) above 0.8. This implies that for the rejected models there will be significant variation between the predicted and actual values.

Table 4.2: Regression Statistics for Material Price Trend

Building Material	adjusted R^2	d.f	F	Sigf	Intercept	Gradient
Cement	.757	3	9.32	.055	178.860	11.2470
High Tensile Bar	.485	3	2.82	.192	-4823.9	1134.9700
225mm hollow sandcrete block	.671	3	6.13	.090	-7.9161	1.2518
China W.C Suite	.768	3	9.92	.051	891.964	175.8930
PVC pipe	.891	3	24.59	.016	60.0625	2.1875
$1m^2$ ceramic floor tiles	.983	3	169.93	.001	257.857	11.5714
50 x 50 x 3600mm hardwood	.953	3	61.08	.004	15.1250	5.3750
$1mm^2$ twin core cable	.932	3	40.98	.008	527.083	7.9167
4 litre emulsion paint	.996	3	675.92	.000	165.113	5.6726

To fully accept the result from the ANOVA table and recommend the acceptance of the price models there is the need to see how well the model fits the population. This is achieved through a consideration of the R^2 obtained from the regression statistics (Table 4. 3 below).

Table 4.3: Summary of Regression statistics of Price & Monetary Variables Model

Building Material	R	R^2	Adjusted R^2	Std. Error of Est
Cement	.925	.855	.840	73.209
High Tensile Bar	.934	.873	.858	9324.569
225mm hollow sandcrete block	.981	.963	.960	4.676
China W.C Suite	.402	.162	.078	19398.364
PVC pipe	.836	.698	.674	24.522
$1m^2$ ceramic floor tiles	.894	.800	.781	103.144
50 x 50 x 3600mm hardwood	.952	.907	.898	29.730
$1mm^2$ twin core cable	.863	.745	.721	76.882
4 litre emulsion paint	.925	.855	.841	40.192

The R^2 value obtained for the materials are quite high except for that of China W.C Suite, which was 16.2% unadjusted and 7.8% when adjusted. An extension of the limit of acceptance of the R^2 value to 80% and above leads to an elimination of the models for PVC pipes, and $1mm^2$ cable. Increasing the R^2 level for acceptance of models to 0.9 or 90% will leave just the models for hardwood and sandcrete block qualifying for acceptance. It is worthy to note that these two materials are abundant locally and requires the least technological input to produce. This implies that the relationship between the price and monetary variables is questionable at this level.

5.2 Conclusions

After testing for the relationship between cost of construction materials and monetary variables, the following model is reported as a suitable definition of the relationship between the construction items involved and the selected monetary variables. However, it is acknowledged that that other factors may influence the prediction of the models:

Cement:

$$P=538.583-9.338I+1.934E-05C_{pr}-1.273E-04C_{pu}+4.283E-04t$$

High Tensile Bar:

$$P=12281.803-84.728I+2.630E-02C_{pr}-1.954E-02C_{pu}+1.655E-02t$$

225mm hollow sandcrete block:

$$P=16.749-0.319I+3.472E-05C_{pr}-2.386E-05C_{pu}+6.383E-06t$$

50 x 50 x 3600mm hardwood :

$$P=175.530-3.282I+2.118E-04C_{pr}-5.184E-05C_{pu}-1.471E-05t$$

4 litre emulsion paint:

$$P=341.842-4.314I+2.781E-04C_{pr}-2.087E-04C_{pu}+6.657E-06t$$

Where P = Price of material
I = Interest Rate
C_{pr} = Credit to the private sector
C_{pu} = Credit to the public sector
t = total money supply

The study therefore concludes that while there is established relationship between most items and the monetary variables, this relationship is not enough to use this models to predict future prices, except for thefive items listed above.

5.3 Recommendations

With the level of data available, this study has been able to show that there is a relationship between monetary variables and the cost of procuring construction projects. This has far reaching implications for different people and organizations in the economy, ranging from the small house owner, the big real estate investor, to the government, and need for infrastructure development through construction. This is because the final cost of construction is passed to the clients by the contractors and consultants in the industry. The predictability of price through the use of these models will therefore help in good cost planning by those that require it.

While using this models to predict cost, it is recommended that provisions are made in the final estimate for errors caused by sudden changes in other economic policies other than monetary. For instance, the sharp change in the price of materials in 2003 was caused by a change fiscal policy of Nigeria on importation, whch in turn affetecd the models for some materials (e.g a china w.c unit). This study therefore recommends that frameworksaimed at easing the effect of sudden fiscal policy changes be developed, since this affects ongoing projects and may sometimes lead to project abandonment due to cost escalation. For developing countries the author recommends a cautionary implementation of monetary

variables and policy.

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