Application of Economic Indicators in Predicting Construction Cost Escalation for Residential Buildings in Nigeria

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ABSTRACT

In an effort to estimate cost of construction, estimators and contractors have attempted to utilize a variety of prediction models. Most models have proven either too complex or unreliable in application of construction pricing. Often estimators are left to their own "best guess" when forecasting escalating cost of materials, labour and equipment. The unreliability of these models are due in part to the fact that projects are short in duration and there are too many factors that can demonstrate a high relational significance to construction cost if they are to be useful variables in a prediction model. By the division of construction (building) cost of adopted building types against selected floor areas from selected States in the six geographical zones of Nigeria, the mean construction cost per meter square over time were computed. These costs shared a relational significance to selected macroeconomic indicators. With the aid of a multiple regression analysis, a model was formulated. The results of the Multiple Regression equation, $Y = 1206.035 + 6.030X_1 - 4.732X_2 + 118.151X_3$, suggest that 88% of the variation in Y values can be explain by the variation in the values of X_1, X_2, X_3 (where Y is the mean Construction Cost per meter square, X_1 is the Inflation Rate, X_2 is the Interest Rate and X_3 is the Exchange Rate). Application of the knowledge of this relationship in the prediction of cost escalation can be useful. It could also be considered a marketing tool for the contractor that applies the technique.

Keywords: Construction cost, estimators, residential buildings, economic indicators

INTRODUCTION

Cost is a vital element in every development. Both government and other owners of construction projects, contractors and construction workers are all interested in construction costs because it affects them in one way or another. Cost consideration guides the developer on the type and magnitude of development and resources to use out of available ones and that together with the prospect of benefit cost consideration helps to dictate the purpose for which land may be developed, the location and timing of development. Today, project cost often increase beyond their original estimates (Achuenu, 1994), (Achuenu and Gundiri, 1998) and (Davey, 2003). Capano and Karshenas (2003) observed that the causes of

construction cost escalation are many and complex. They include labour, equipment and material inflation, construction demand and major events. The ability of contractors to forecast reasonable estimates for construction is often considered the life-blood of a successful project execution. The estimate is generally compiled by assembling fairly, comprehensive quantity surveys and quotes for vendor and multiplier items. Overhead and profit are added based on the firm's requirements. Contingency is finally added to cover the cost of unknowns. A contractor attempts to mitigate these cost increases by the use of a cost multiplier. This cost adjustment is often based on little deterministic factors often developed through experience. Estimating formula and mathematical models have attempted to modify this practice. Traditional business forecasting models for predicting costs increases are being considered and applied to construction estimation. These business models involve extrapolation of past data into the future by using linear and non-linear curves or mathematical relationships.

The ability to successfully predict the cost of escalation of labour and materials most widely used in construction is also required by a number of other industries. These industries often utilize economic indicators to develop business strategies and goals. Economic indicators are also used in determining the prices of products. Economic indicators are statistical data, charts, which show production, output, employment and many other economic variables in the phases of the economy and Gross National Product (GDP) (Kennedy and Olsen, 1972). Achuenu (1994) observes that one of the major problems facing the Nigerian Construction Industry is the fact that almost all projects are completed at sums higher than their initial contract sum. The rising trends can be attributed to government policies, inflation in the economy and design variables (Abimbola, 2000). El-Rufai and Partners (1993) in a study of Building Costs noted that the rising cost makes estimates out of date and unreliable. If prices are continually changing, entrepreneurs are hesitant to enter into contracts they cannot work out the long-run results of their investments (Myers, 1994). The changing trends of cost spurred Williams (2003) to suggest that for the need to expand our understanding to the mechanisms of cost increases, especially in large construction projects, the cost must be forecasted in consideration to changes of the components costs. The declining Nigeria's economy with its effect on construction pricing has become a major problem for both public and private sectors, clients and contractors.

Thus, the aim of this study to examine the trend in selected macro-economic indicators and their impact on construction cost over time with a view to predicting future escalations in construction costs at a given period of time. The increasing incident of inflation and other attributes of the economy have severe consequences on the construction industry where very few projects are completed at their initial contract sum due to cost escalation and clients can hardly rely upon initial contract sums. Despite various models employed to predict these increases over the years, the issue under review has become a serious concern to all players in the construction industry and therefore, necessitated this research to be viewed from a different perspective by analyzing selected macro-economic indicators to determine the existence of correlation, if any, between these indicators and construction pricing over a period of time.

METHOD

Data on Building (Construction) Cost per meter square, macro-economic indicators (inflation rate, exchange rate and interest rate) were sourced from both government and private agencies within a period of twenty eight (28) years (1980 - 2009). This time frame was chosen in order to reflect a myriad of economic upturns, down turns, Political influences, economic recession and business cycles in Nigeria. The existing sub-divisions of Nigeria into six geo-political zones served as reference points for cost data sampling.

The research was limited to two (2) bedrooms, three (3) bedrooms and four (4) bedrooms bungalows spread across selected States of Nigeria. These building types were chosen among others based on the demand by the lower, medium and upper classes of people and the volume of such buildings spread across Nigeria. The cost of buildings per meter square was adopted while costs of external works were excluded from the research. This is due to the difficulty in determining the cost per meter square of external work as this depends on environmental factors. Stratified sampling technique was employed to select 12 states from the six geopolitical zone of the Country. The study was conducted in the State Capitals of selected States in Nigeria due to the concentration of people in such cities, density of buildings, volume of construction work and commercial activities and so on. The mean construction cost per meter square over time were computed and presented on tables with the Macro-economic Indicators. Regression analysis was conducted to determine the existence of relations if any between construction cost and economic indicators. Simple regression, which deals with two variables is applied here. In multiple Regressions, a given variable Y (the construction prices, taken in turns) is dependent on a set of X_1, X_2, X_3 (the economic variables).

Thus: $Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3$ ……………………………. (1)

Where:

the dependent variable (Y)	=	Mean Construction Cost
the independent (exogenous) variables X_1	=	Inflation Rate
X_2	=	Interest Rate
X_3	=	Exchange Rate

The models are estimated by the ordinary least squares regression technique (OLS). The Summary statistics reported and assessed include: R^2, t-values, F-values. The data collected for the research is processed using Start-view (Statistical View) software/application software.

RESULTS AND DISCUSSION

Considering the mean construction cost per meter square for 29 year period, correlation coefficient $R^2 = 0.876$ shows that there is a very strong significant relationship between y (mean construction cost) and X_1, X_2, X_3 (macro-economic indicators) having a p-value of 0.0001 which is less than 0.05 at 5% level of significance. This suggests that macro-economic indicators contribute 88% to construction cost changes among other factors

that affect the construction cost. Escalating construction cost directly relates to the financial risk in the construction sector and affects the risk an investor is ready to bear and the cost of capital for project. Financial risk in most large scale projects is associated with inaccurate knowledge of the financial resources that the project is expected to consume and the interest rate that the client or contractor should pay to obtain or service a development loan from the financial market. Contingency sum is usually included to compensate for unknown. The knowledge of construction cost increases will assist the contractor or client budget for project cost and contingencies. The results of analysis between macro-economic indicators and construction cost show a very strong significant relationship between inflation rate, interest rate, exchange rate and construction cost over the years. The multiple regression equation, $Y = 1206.035 + 6.030X_1 - 4.732X_2 + 118.151X_3$, suggest that 88% of the variation in Y values can be explain by the variation in the values of X_1, X_2, X_3 (where Y is the mean construction cost per meter square, X_1 is the inflation rate, X_2 the interest rate and X_3 exchange rate). The impact of macro-economic indicators has a major influence on Nigeria Gross Domestic Product (GDP) and other sectors of the economy.

Table 1: Trends of Macro Economic Indicators and Mean Building (Construction) Cost per meter square from 1980 to 2009

Year	Mean Cost/M² N	Inflation Rate %	Interest (Lending) Rate %	Exchange Rate N
1980	208.95	9.90	9.50	0.54
1981	268.68	20.90	10.00	0.61
1982	327.42	7.70	11.80	0.67
1983	420.27	23.20	11.51	0.72
1984	516.75	39.60	13.00	0.76
1985	664.58	5.50	11.80	0.89
1986	816.39	5.40	12.00	2.02
1987	951.33	10.20	10.20	4.60
1988	1099.50	38.30	17.60	6.05
1989	1287.33	40.90	24.60	10.70
1990	1727.56	7.50	26.50	9.50
1991	2280.29	13.00	21.00	12.81
1992	2925.36	44.50	31.20	17.30
1993	3357.63	57.20	35.00	22.05
1994	4380.62	57.00	21.00	21.89
1995	5366.74	72.80	19.74	21.89
1996	6684.08	43.50	13.54	21.89
1997	7833.30	8.50	23.32	21.89
1998	9270.19	10.00	21.34	21.89
1999	10332.46	6.60	27.19	92..34
2000	11436.97	6.90	21.55	101.70
2001	12219.32	18.90	21.34	111.23
2002	13167.45	12.90	21.70	120.5
2003	13942.18	14.00	22.47	129.36
2004	14998.91	15.00	20.62	133.5
2005	17215.54	17.90	20.04	132.15
2006	18982.48	8.20	18.41	128.65
2007	21925.51	12.5	18.36	117.97
2008	23739.83	-	-	-
2009	27827.29	-	-	-

Source: Fieldwork, 2010, Achuenu (1998); Ajalankoko (1990); Bassey (1994); Ekirigwe (1998) and Federal Office of Statistics (1998).

Regression Summary
Y vs. 3 Independents

Count	28
Num. Missing	2
R	.936
R Squared	.876
Adjusted R Squared	.861
RMS Residual	2459.944

ANOVA Table
Y vs. 3 Independents

	DF	Sum of Squares	Mean Square	F-Value	P-Value
Regression	3	1028197917.399	342732639.133	56.638	<.0001
Residual	24	145231786.149	6051324.423		
Total	27	1173429703.549			

Regression Coefficients
Y vs. 3 Independents

	Coefficient	Std. Error	Std. Coeff.	t-Value	P-Value
Intercept	1206.035	1477.295	1206.035	.816	.4223
X1	6.030	28.505	.017	.212	.8343
X2	-4.732	82.614	-.005	-.057	.9548
X3	118.151	10.273	.942	11.501	<.0001

CONCLUSION AND RECOMMENDATION

The Mean Construction Cost at any given period could be ascertained when the variables X_1, X_2 and X_3 are known. By monitoring Economic activities, Business Cycles, trends of Macro Economic Indicators by economist, Real Estate Developers, Professionals in the Built Environment, the contractor should have a greater indication of the trends and rate of changes in Construction Cost at a given period. This information could serve as an aid for estimating construction cost escalation over the life of a Project. Managers wishing to manage long terms capital projects can observe the trends of Macro-Economic Indicators and Construction Cost using models developed for such projections.-Trends in percentage change of Macro-Economic Indicators in relation to Building Construction Cost should be a barometer for measuring rising Construction Cost by Project Managers Construction Industries.

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