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Estimation of Informal Sector of the Nigerian Construction Industry

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ABSTRACT

The study estimated the output of informal sector of the Nigerian Cement Industry through the consumption of cement by the Nigerian Construction industry. The research was conducted using secondary data. The study adopted the statistical model of informal sector estimation, Nigeria construction industry being cement intensive, cement consumption approach was used for the estimation of the informal sector of the industry by using annual cement consumption as an independent variable against the annual construction output in a time series regression analysis, treating the informal sector output as an omitted variable in the ordinary least square method of estimation. Annual value added tax (VAT) pool data set was chosen as an instrumental variable. Using the instrumental variable method of estimation, the informal sector proportion of the Nigeria construction industry was therefore estimated. The study concluded that the informal sector of the Nigerian construction industry is 4.07 percent of the industry's output.

Keywords : Estimation, Construction Industry, Informal Sector, Cement Consumption Approach, Instrumental Variable

I. INTRODUCTION

The building industry includes both upstream and downstream industry sectors, such as the building materials industries and the property development sector. One of these material industries is cement industry. Building construction is the dominant market sector for the Nigerian cement industry. Being rooted in the domestic economy, investments in construction provide direct momentum in other fields of industry and are thus one of the keys to sustainable growth [1]. Most construction sectors around the world have high percentage of output being produced informally [2]. According to [3], informal economy is a market-based production of goods and services whether legal or illegal, that escapes detection in the official estimate of gross domestic product (GDP). GDP per capital is a measurement of average national standard of living can be a contributing factor to cement demand [4]. Also [5], described shadow or informal economy as all market-based legal production of goods and services that are deliberately concealed from public authorities to avoid payment of income, value added or other taxes, social security contribution, having to meet legal labour market standard, such as minimum wages, maximum working hour, safety standard and so on. Also complying with certain administrative obligation. [6] established that Nigerian construction industry contributes about 3 per cent to national GDP which is

below a range of 5 to 10 per cent of GDP as envisage by the United Nations (UN).

Construction industry is one of the largest employers of informal sector workforce [7], and one of the largest industries in the United States [8]. In the past, the informal construction sector of the construction industry was modest in size, in recent years it has grown in size and important in many African countries [9, 10].

Construction firms may be small, medium or large. Some small unregistered construction enterprises were previously involved in building maintenance and repair of individual residential houses, now they are increasingly involved in the construction of complex and much larger commercial buildings [10].
As the informal sector of the construction industry is growing, some undesirable features of the subsector are sources of concern. There was absence of regulation in terms and conditions of employment as well as in the construction process of the informal sector in developing economics [11]. [11] argued that the informal part of the construction industry is generally ignored and received little attention from the government. They further stated that policies to develop the construction industry of developing countries should address the needs of the informal sector, where the bulk of labour forces is found. [12] emphasized the poor impact of informal sector on construction output. However, to address the issues raised on informal construction sector. [13] stated that statistics on informal sector are needed as a tools for evidence based policy making and advocacy. In the case of Nigeria,, such statistics are not available [14]. Therefore, this study aims at estimating the output of informal sector of the Nigerian construction industry, especially Nigerian cement industry, with a view to determining the significance of the subsector. In achieving this, the specific objective was to estimate the time series data of Nigerian annual cement consumption against annual construction output and annual value added tax pool between 2000 and 2017. As at the time of this study, the Nigerian construction industry was made up of formal and informal sectors.

II. METHODS AND MATERIAL

To achieve the objective of this study, the research framework is based on secondary data. The study adopts the statistical model of shadow economy estimation to estimate the informal sector of the Nigerian construction industry. The study utilizes the cement intensiveness of the Nigerian construction industry and relies on the fact that all cement consumption were from the formal sector with the required data readily available. A time series regression analysis evaluating the correlation between the Nigeria annual cement consumption with the Nigerian construction output, while treating the informal sector output as an unobservable error or and omitted variable, under Ordinary Least Square (OLS) method of estimation.

Cement consumption (CC) = f (construction output) $_{\text{formal}}$ + (construction output)$_{\text{informal}}$

$$y = \beta_0 + \beta_1 x + \mu$$

Cement consumption = y, β_0 = regression intercept; β_1 = regression coefficient, x formal constant output, μ = informal construction output.

Using the Instrumental Variable IV method of estimation, (Construction output) informal was estimated by using Annual Value Added Tax (VAT pool) as a suitable instrumental viable (z) to estimate the variable; informal construction annual output.

$$Cov.\ (z,y) = \beta_1\ cov\ (z,x) + cov\ (z,u)$$

Under the assumption $cov\ (z,u) = 0,\ cov\ (z,x) \neq 0$

$$\beta_1 = \frac{\text{cov}\,(z,y)}{\text{cov}\,(z,x)}$$

Cov is the covariance between the pair of variables

$$\beta_1 = \frac{\sum_{i=1}^{n}(z_i - \bar{z})(y_i - \bar{y})}{\sum_{i=1}^{n}(z_i - \bar{z})(x_i - \bar{x})}$$

Statistical inference with the instrumental variable IV estimator is given by the asymptotic standard error of β1 which is equal to the square root of the estimated asymptotic [15].

$$\frac{\sigma^2}{n\sigma_x^2 \rho_{xz}^2} = \frac{\sigma^2}{SST_x R_{xz}^2}$$

III. RESULTS AND DISCUSSION

Table 1 presents the data for the study, which is a longitudinal data over a span of eighteen years from year 2000 to 2017. The data includes the annual cement consumption in millions of metric tonnes, annual construction output in billions of Naira as well as Annual Value Added Tax Pool also in billions of Naira.

TABLE I. FONT SIZES FOR PAPERS

Time Series Data of Nigerian Annual Cement Consumption against Annual Construction output and Annual Value Added Tax Pool (2000 – 2017)

S/N	Year	Cement consumption (Millions of Metric Tonnes)	Logarithms of Cement Consumption	Construction outputs ₦'billions	Annual VAT in (₦'billion)
1	2000	6.0	1.79	654	58.008
2	2001	8.0	2.08	733	91.741
3	2002	8.0	2.08	764	108.595
4	2003	8.5	2.14	831	136.141
5	2004	8.5	2.14	775	163.298
6	2005	9.5	2.25	869	192.700
7	2006	10.5	2.35	981	232.700
8	2007	11.00	2.40	1109	312.600
9	2008	13.5	2.60	1254	401.700
10	2009	15.0	2.71	1404	481.410
11	2010	16.0	2.77	1571	564.890
12	2011	17.5	2.86	1818	659.150
13	2012	18.5	2.92	1989	710.550
14	2013	21.5	3.07	2272	802.680
15	2014	21.0	3.05	2568	802.960
16	2015	22.0	3.09	2680	767.330
17	2016	23.0	3.14	2521	828.200
18	2017	19.0	2.94	2546	972.350

Sources: [16], [17], [18]

Table II presents the regression analysis of log of cement consumption against construction output. Correlation coefficient $R = 0.949$ which express a positive relationship between the cement consumption and annual construction output in Nigeria, that is, to every one million metric tonnes of cement consumed in Nigeria there is ₦949million of production in the Nigeria construction industry. Correlation of 0.949 firmly agrees with the presumption that Nigerian construction industry is cement intensive.

This is also reinforced with the high Coefficient of Determination R^2 of 0.951 that Nigeria construction industry is highly correlated to cement consumption and therefore gives validity to the decision to use cement consumption approach to estimation of the omitted informal sector output as the construction output data is that of the formal sector alone and the informal sector is an unobservable error. Demand for cement in the

construction industry drives production, and thus it is an important determinant of cement subsector energy consumption and CO_2 emission [19].

TABLE II. Result of Time Series Regression Analysis of logarithms of Annual Cement Consumption against Construction Output

Variable	Correlation coefficient (R)	Coefficient of Determination R^2	Adjusted R^2	Standard error of estimate
Construction output	0.949	0.901	0.895	0.13894

Table III presents the regression analysis of construction output against Value Added Tax (VAT) pool with correlation coefficient *R* of *0.975* and Coefficient of Determination of *0.951* indicating a high positive correlation between formal sector construction output and annual Value Added Tax pool. This has given validity to the choice of value added tax as the instrumental variable in the instrumental variable method of estimation for determination of the omitted variable of informal construction sector output. Also the choice of VAT pool is equally valid as the informal sector output is not expected to be correlated with the value added tax since one of the characteristics of the informal sector is non-payment of tax. Therefore, the assumption that instrumental variable is not correlated with the regression error, that is, omitted variable is equally valid.

TABLE III.
Results of Time Series Regression Analysis of Nigeria Annual Construction Output against Value Added Tax Pool 2000 – 2017

Variable	Correlation coefficient (R)	Coefficient of Determination R^2	Adjusted R^2	Standard error of estimate
Construction output	0.975	0.951	0.948	169.22

Table IV presents the regression analysis output of log of Annual Cement consumption against Annual Value Added Tax Pool. With the Correlation Coefficient *R* of *0.0965* and standard error of *0.11634* shows a goodness of fit between the regressants. Consequently the instrumental variable coefficient β_1 is given by the ratio of coefficient of correlation between log of cement consumption against Value Added Tax over the coefficient of correlation between the construction output against Value Added Tax which is equal to *0.9897*:

$$\beta_1 = \frac{\text{cov}(z, y)}{\text{cov}(z, x)} = \frac{0.965}{0.975} = 0.9897$$

This indicates that the actual return to construction output per one million metric tonnes of cement is *0.9897* Billion Naira. That the value of *0.949* Billion Naira return to one million metric tonnes of cement based on ordinary least square method of estimation was biased due to the error in the estimation as a result of the omitted variables of the informal sector output.

Therefore the proportion of the informal sector to the formal sector in the Nigeria construction industry is given by the difference of the instrumental variable estimation and the ordinary least square estimation = *98.97 – 94.90 = 4.07%*

The statistical inference between the two methods of estimation was checked for statistical significance by $\frac{\sigma^2}{SST_x R^2_{x^2}} = 0.000$ equally shows that the *4.07%* of informal sector output is statistically significant.

TABLE IV
Results of Time Series Regression Analysis of Logarithm of Nigerian Annual Cement Consumption against Annual Value Added Tax

Variable	Correlation coefficient (R)	Coefficient of Determination R^2	Adjusted R^2	Standard error of estimate
VAT Pool	0.965	0.931	0.926	0.11634

Table V presents the three parameters used for the test of significance of the informal sector estimation of the Nigerian construction industry; instrumental variable residual ($\sigma^2 = 0.217$), total sum of square of the annual construction output ($SST_X = 547{,}852$) and the coefficient of determination of the regression of the logarithm of construction annual output against the

annual value added tax ($R_{xz}^2 = 0.951$). These parameters were used for evaluating the statistical significance of the difference between the 'ordinary least square estimation' and the 'instrumental variable estimation'. This difference incidentally is the informal sector estimate and therefore equally states the statistically significance of the informal construction sector as given by:

$$\frac{\sigma^2}{SST_x R_{xz}^2} = 4.031\ X\ 10^{-7}.$$

Hence, the informal sector estimated value 4.07% is significant at 0.000 level of significance.

TABLE V
Statistic for Test for Significance between OLS and IV Estimates

S/N	Statistics	Value
1	IV Residual σ^2	0.217
2	Total sum of square *SSTx*	547852
3	Coefficient of Determination R^2xz	0.951

IV. CONCLUSION

The value of the informal sector of the Nigerian construction industry was estimated in this study to be *4.07* percent of the Nigerian construction output. This value was tested to be statistically significant at 0.000 level of significance. This findings has shown that the *57.9* percent estimate of the size of the informal sector of the Nigeria economy is not applicable across board. It has shown that the size of informal sector varies from sector to sector of the economy and therefore sector by sector estimation is desirable for deeper understanding of the economy for effective policy formulation.

Though the proportion of the informal sector of the Nigerian construction industry to the formal sector is modest at 4.07 percent, it is not negligible, with a value of ₦103billion for 2017. Therefore attention needs to be paid to this sector of the Nigerian Construction industry especially as the labour which is the most important input in production constitute the major part of the Nigerian construction industry informality.

Nigerian construction industry's contribution to GDP is still relatively low compared with the other economics even after adjustment for the informal sector. With the 2017 value marginally rising from *3.72* percent to *3.87* percent after adjustment. This has shown that informal sector is not the issue with the low contribution of Nigeria construction to the GDP but rather some other structural issues.

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