Determining House Price for Mass Appraisal Using Multiple Regression Analysis Modeling in Kaduna North, Nigeria

Auwal Abdullahi[1], Hamza Usman[2], and Iliyasu Ibrahim[2]

[1]Abubakar Tatari Ali Polytechnic (ATAP), Bauchi

[2]Abubakar Tafawa Balewa University, Bauchi

Abstract

The research applied Multiple Regression Analysis (MRA) in estimating house price for mass appraisal in Kaduna north, Nigeria. Two basic micro determinants of house price were considered, namely; structural attributes and location of property. Using a sample of 106 house sale transactions data which were recorded between 2011 to 2015, MRA was used to determine the structural variables and locational attributes that have statistically significant influence on the house price. It was found that among the variables included in the MRA, year of transaction, type of house, availability of swimming pool, availability of security post, type of door and location of the property were significant in determining house price in Kaduna. However, number of bedroom, number of living room, type of ceiling, condition of the house were not significant in influencing house price. Using the significant variables, a mass appraisal model was developed for the study area. The performance of the model was evaluated using the ratio study method and the model was found to be satisfactory. It was recommended that, this model be used in mass appraisal of residential properties in Kaduna north in the future, with a view to improve accuracy, objectivity, efficiency, and fairness of the property taxation system, which will lead to generating more revenue for the government and, encourage physical infrastructural development in Kaduna North.

Keywords: *Mass Appraisal, Multiple Regression Analysis (MRA), House Price, Valuation*

Introduction

Living in suitable housing condition is one of the most significant aspects of peoples' life. For many house owners, housing serves as a significant asset in their portfolio (; Liman, Sipan, Olatunji, & Afrane, 2015) Such properties are transacted in the property market. The property market has its inherent characteristics such as heterogeneity, enormous amount of capital involved, high cost of transaction as well as the method of conducting transaction; all contributing to the market's imperfection (Shapiro *et al*., 2012). These transactions would continue to remain private and confidential as the successful buyers and sellers are not willing to disclose the amount for which the property were exchanged (Blackledge, 2009).

The valuation of property is required for different purposes which include valuation for sale, purchase, letting, leasing, taxation, insurance, mortgages, balance sheet, inheritance, compensation, investment and financing (Pagourtzi *et al*., 2003; Blackledge, 2009; Ogunba, 2013). These valuations are carried out using different methods of valuation which fall under the traditional or conventional methods and the contemporary models (Ogunba, 2013; Yacim & Bashoff, 2015). Traditionally, real estates are valued using residual method of valuation, investment method of valuation, residual method of valuation, profit method and the cost approach (Selim, 2009).

Presently, the conventional methods of valuation mostly used in the study area for rating purposes are comparison method of valuation and contractor's cost method of valuation. Comparison method of valuation compares the similarities and dissimilarities between the subject property and other similar properties within same neighborhood (Kamarudin *et al*., 2014). The main problems of this method is lack of sufficient record of sales to compare with and if the subject properties are considerably much, it will be difficult for valuers to cope with the analysis of all attributes bearing in mind the heterogeneous nature of properties. Notwithstanding the shortcomings of this method, it is still the most widely used valuation method in estimating market value of properties (Scarrett, 2008).

The other conventional method that is commonly used by valuers in Nigeria is the cost approach. This is known as depreciated replacement cost or contractors method. The method is preferred due to valuers' belief that its estimates are closer to market prices.

But cost approach to valuation is a method that is built upon premises that support special properties which seldom change hand in the property market. This method does not support usage on income producing properties; yet in Nigeria, valuers use it for the purpose of property taxation (Amidu *et al*., 2008). A study by Ogunba and Ojo (2007) found that result produced by cost method is not consistent; hence using the method first requires its passing the consistency test for acceptability.

Moreover, the study of Adewunmi *et al.* (2009) on appropriateness of cost method of valuation for income producing properties in Abuja, Nigeria, found it as inappropriate. Although these approaches are still useful in the single property valuation, it is argued in the literature that they are no longer efficient for conducting mass appraisal because of large number of properties involved (Eboy & Samat, 2014; Sipan, 2012). Therefore, there is a need to look for more reliable approach in conducting mass appraisal. Thus, new approaches and techniques have been introduced.

MRA Model has become the standard approach for estimation of house prices because of its objectivity, low cost involved and accuracy in assessing the value of a large number of properties very quickly (Sipan, 2012). There are other techniques that are being used in order to improve valuation accuracy which include hedonic model, artificial networks, spatial analysis, fuzzy logic (Abidoye & Chan, 2017). The MRA is used to determine house price which can be influenced by both macro and micro factors (Manganelli, Pontrandolfi, Azzato, & Murgante, 2014). The macro factors that can affect house price are interest rate, unemployment, taxes as well as government policies (Avramis, 2016).

The micro factors include house specific structural, locational and neighborhood attributes each with its sub-items (Bozic, MiliceviC, Pejic, & Marošan, 2013; Eboy & Samat, 2014; Ligus & Peternek, 2016; Yacim & Bashoff, 2015). The MRA model is used to estimate the extent to which each of these attributes affect the price of a house from a model to appraise other properties in mass is developed (Eboy & Samat, 2014; Yacim & Bashoff, 2015).

Mass appraisal is the process in which large number of properties is valued at a given date and using common data, standardized methods, and statistical testing (International Association of Assessing Officers, 1990). It normally involves large

number of properties as against individual property (D'Amato, 2008). Mass appraisal of properties started as early as the 1920s in the United State of America and, still thriving today (The Florida Department of Revenue, 2012). The developed countries such as United Kingdom, United States of America, France and Germany have adopted mass appraisal. The research concerning mass appraisal have gained a lot of attention in the developing countries like Malaysia (Sipan, 2012).

However, there is very minor evidence in the application of multiple regression analysis model in house price estimation, especially in the context of mass appraisal in the Nigerian property market. Past research efforts in Nigeria using MRA in house price adopted hedonic price modeling (Abidoye & Chan, 2017). The pioneer study was that of Megbolugbe (1986). Afterward came the studies of Arimah (1997), Babawale and Adewunmi (2011), Iroham, Oloyede and Oluwunmi (2011), Gambo (2012), Babawale and Johnson (2012), Babawale (2013), Famuyiwa and Babawale (2014), Bello and Yacim (2014) and (Liman, Sipan, Olatunji, & Afrane, 2015). These studies, although used MRA in form of hedonic price modeling, were mostly focused in determining the specific influence of property attributes on the price not developing model that can be used for mass appraisal of properties. Similarly, the studies were not fairly distributed across the divides of Nigeria as the chunk of them were conducted in Lagos metropolis, Nigeria property market (Abidoye & Chan, 2017). Therefore, it will be erroneous to generalize the findings to other property markets (Abdulai & OwusuAnsah, 2011) because estimated coefficients vary significantly by geographical locations (Sirmans *et al*., 2006) due to different socio-economic setting and level of property market development.

Consequently, the fact that no research work applied MRA in house price determination for mass appraisal in Kaduna metropolis, this paper attempts to bridge the gap by developing mass appraisal model for determining house price in Kaduna metropolis using MRA. The work provides the estate surveyors and valuers with a model to undertake mass appraisal of residential properties in Kaduna metropolis. It equally simplies the onerous task of assessing house prices individually thereby saving enormous time and resources.

Literature Review

The use of multiple regression analysis

(MRA) in determining house price abounds in real estate research. It is commonly featured in the form of hedonic price modeling (Abidoye & Chan, 2017).

MRA is capable to model and explore relationships, to better understand the factors behind observed spatial patterns, and to predict outcomes based on that understanding; thus, it is used to develop mass appraisal model (Eboy & Samat, 2014). This is because multiple regression analysis (MRA) allows various components of a property to be incorporated into it to arrive at its market value thereby ensuring flexibility that allows the estimation of parameters, usually linear; with resultant benefits of improvement to manual property valuation, cost effectiveness and less subjectivity (Ligus & Peternek, 2016; Yacim & Bashoff, 2015).

The MRA is not without some issues. One of these issues is it may result to prediction errors when nonlinear relationship exist between variables (Yacim & Bashoff, 2015). Another issue is that of collinearity among the predictors which cause possible errors violate one of the basic requirements of MRA (Manganelli, Pontrandolfi, Azzato, & Murgante, 2014).
The MRA links the house price with property characteristics (Liman et al., 2015). Various studies empirically established the relationship between price and the property characteristics (Bozic et al., 2013; Eboy & Samat, 2014; Gambo, 2012; Ligus & Peternek, 2016; Liman et al., 2015; Noor, Asmawi, & Abdullah, 2015). The various studies conducted in Nigeria using MRA in form of hedonic price modeling were critically reviewed by Abidoye & Chan (2017).

Other studies looked at the influence of physical and location on property prices. For instance, Limsombunchai (2004) analyzed some of the housing attributes affecting the house price which include internal and external features of the home as well as orientation and location. Land was found to be the most important attribute that determine the house price, followed by location and then common expenses, the building age, though slightly correlated with the price, has a negative relationship.

In a similar study carried out in Ghana by Owusu-Ansah (2012) using a sample of 1670 datasets, he proved that the most significant housing attributes that affect house price are; number of rooms, floors, Age of the property, location, availability of garage, fence wall, swimming pool and land

registration. However, the study did not consider any environmental attribute among the independent variables.

Abdulai and Owusu-Ansah (2011) also analyzed house price determinants in Liverpool UK using a large data set of 103,730 covering the period of 1990 -2008. It was established from the analysis that the number of floors, public rooms, bedrooms, bathrooms, showers and time on the market, condition and type of property and availability of glazing garden, garage and central heating all influence house price in Liverpool city. They noted, however, a variation in the determinants when analyzed on different periods. This shows the relevance of including the transaction period in home price analysis.

Methodology

The study adopted quantitative research approach, utilizing secondary data collected from registered estate surveying and valuation firms in Kaduna North. Five registered estate surveying and valuation firms practicing in the study area were used. The firms provided data on residential property transactions, especially the sales prices and the corresponding property physical attributes covering the period of (5) years from 2011- 2015. The properties involved were mostly detached bungalows and duplexes in majorly low density and medium density areas.

One hundred and six (106) valid residential transactions and their corresponding attributes were obtained for the said period and formed the sample size of the study. One hundred and six residential transactions were considered enough to run for the MRA approach. This is because there is no common rule of thumb for the minimum sample size, however, the sample size should be more than the number of variable (Yacim & Bashoff, 2015). For the purpose of this study which focuses on mass appraisal model, only the micro determinants of house price which involves houses physical attributes and location were considered because mass appraisal is localized in nature. The reason was that MRA approach has the advantage of incorporating the different physical attributes of the property (Kilpatrick, 2011).

Macro-economic factors were not included since they are variables that are concerned with the larger economy of the country as a whole. The physical attributes of the houses that were used in the research for estimating house price, adapted from various researches, include house type, bedrooms,

condition of the house, years of transaction, location of the property, floor, roof, ceiling, doors, windows, security post and boys quarters (Limsombun *et al*., 2004; Ismail, 2005; Hamid, 2008; Bello & Bello, 2008; Selim, 2009; Teck-Hong, 2010; Babawale *et al*., 2012; Owusu-Ansah, 2012; Babalola et al., 2013; Tabales et al., 2013; etc.).

The collected information on residential properties transactions was analysed using MRA. The model was specified using house price as the dependent variable and the residential properties attributes as the independent variables. The selection of the MRA for the purpose of this research was because it performs better when small number of samples was used and its ability to allow several physical attributes to be incorporated.

Regression analysis is perhaps unquestionably the most important tool for the real estate analysis particularly housing market studies in which its use is quite extensive. It practically dominates the empirical modeling of real estate markets (Brooks & Tsolacus, 2010). According to), 'the multiple regression analysis has been considered as a classical techniques in the mass valuation of properties in the United States.

The estimation is based on the following equation:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + \text{------} b_nX_n + e$$

Where;

Y= House price

'a' is the regression constant,

X_1 ----X_n are the housing attributes

b_1 ------b_n are the regression coefficient, and

e is error term

Results

The result of descriptive statistics of house price, the dependent variable, is presented in table 1.

Table 1: Descriptive Statistics of the Dependent Variable

MEASURES	VALUES
Mean	46681132.08
Median	45000000.00
Mode	60000000
Std. Deviation	28418052.992
Skewness	.554
Std. Error of Skewness	.235
Kurtosis	-.261
Std. Error of Kurtosis	.465
Minimum	5000000
Maximum	120000000

The result shows a computed mean of ₦ 46,681,132.08 and the mode is ₦ 60,000,000 while the median, standard deviation, minimum, maximum of the house price has the values of ₦4,500,000.00, ₦28, 418,052.992, ₦5,000,000

₦ 120,000,000 respectively. The table also shows that the data is normally distributed as indicted by skewness and kurtosis values of 0.554 and -0.261 respectively below the recommended maximum of -/+2 (George & Mallery, 2010; Pallant, 2011). This indicated that the dependent variable satisfied the requirement of using regression analysis.

The Multiple regression analysis was conducted using enter method with all the 12 variables included in the model at once. The result of the MRA is presented in Table 2 and 3 showing the model summary and the regression coefficients respectively.

Table 2: Model Summary and ANOVA

R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.
.922	0.879	0.849	11663458.26	49.122	.000

Table 2 is the model summary of the multiple regression analysis which produced an R-square value of 0.879 which means the model is strong enough (Hair *et al*., 2010). The table equally shows the AVOVA result which produced F- statistics value of 49.122 which is significant at 0.01 significance level. The result indicated that about 87.9 percent of the variation of house prices in Kaduna North is jointly explained by house type, bedrooms, condition of the house, years of transaction, location of the property, floor, roof, ceiling, doors, windows, security post and boy's quarters. This finding is closely similar to that of Liman, Sipan, Olatunji, & Afrane (2015) who found the attributes to explain about 92 percent of the variance in house prices in Minna, Nigeria.

The individual contribution of the house characteristics in the prediction of the house price in Kaduna North was determined using regression coefficients as presented in Table 3 below.

Table 3: Regression Coefficients

	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	-74100842.175	9540917.674		-7.767	.000
Year of Transaction	2690463.381	865708.358	.150	3.108	.002
Type of House	9784941.444	3682312.937	.167	2.657	.009
Number of Bedrooms	2384072.374	1520357.383	.088	1.856	.120
Number of Living Rooms	4547475.317	3306753.467	.090	1.985	.172
Availability of Boys Quarters	6569661.127	3111821.385	.108	2.111	.037
Availability of Swimming Pool	23576276.174	5225972.551	.193	4.511	.000
Availability of Security Post	8787170.901	2918096.802	.154	3.011	.003
Type of Ceiling	675784.999	1487982.118	.033	2.075	.651
Type of Door	6604620.586	1693008.081	.242	3.901	.000
Condition of House	4701321.450	2191037.321	.157	2.146	.004
Location of Property	11148916.729	1719919.862	.291	6.482	.000

Table 3 shows the B- coefficient, Beta-coefficient and significant variables having the value below 0.05. The variables that have values above 0.05 are considered insignificant. The B- coefficient tells how much a dependent variable (in this case house price) changes with a unit change in each of the independent variables (Pallant, 2011). Each variable has its own B coefficient. From Table 3 above for example, it can inferred from the coefficient of the house type (₦9784941.444) that a better house type will increase the house price by ₦9784941.444 just as each increase in one unit of bedroom will bring about additional of ₦ 2,384,072.374 to the price of the house. A house that is in good location is expected to be higher in terms of price than those in a fair location by ₦ 11,148,916.729.

In Kaduna north presently location of the property plays a vital role in predicting the house price. People are willing to pay a higher amount for a property in good location. The coefficients found in this study are higher than those found by Liman, Sipan, Olatunji, & Afrane (2015) in Minna. This is because the property market in Kaduna is more matured than in Minna and the properties involved were mainly from low density area thereby commanding higher prices than those in the high density area. The Beta coefficients show that location of the property, having a coefficient of 0.291, has greatest influence on house price followed by type of door with 0.242 beta coefficient.

The result also shows that type of ceiling has the least influence with 0.33 beta coefficient. T- Statistics and P-value show the degree of significance of each independent variable in determining the dependent variable. Again it can be inferred from Table 3 that, year of transaction, availability of swimming pool, security post, type of door, location of the property, and condition of house are all significant variables in predicting the house price in Kaduna North. This is because they all p-values below 0.05 and t-statistics above 1.96. This finding is similar to that of Manganelli, Pontrandolfi, Azzato, & Murgante (2014) Yacim & Bashoff (2015), Noor, Asmawi, & Abdullah (2015) and Ligus & Peternek (2016) who found location of property, year of transaction and condition of the house to be significant determinants of house price in Italy, Malaysia and Poland.

In Nigeria, similarly, Liman et al. (2015) found most of the factors to be significant. The implication of this is that buyers in

Kaduna north do consider all these factors before deciding on the amount to pay for a house.

However, number of living rooms, type of ceiling, and number of bed rooms, type of house are found not to be significant in predicting house price in Kaduna North. This finding is contrary to that of Ligus & Peternek (2016), Liman, Sipan, Olatunji, & Afrane (2015), Manganelli, Pontrandolfi, Azzato, & Murgante (2014) Noor, Asmawi, & Abdullah (2015) and Yacim & Bashoff (2015) except for number of bedroom who Liman, Sipan, Olatunji, & Afrane (2015) found not to be significant predictor of house prices in Minna, Nigeria. This may be due to the fact that the geographical locations of the studies differ (Sirman *et al*., 2006) and due to the fact that the area of study is mainly low density area with little variation in the housing types.

From the above, a model for estimating house price for mass appraisal using MRA is developed as stated below.

$$\textbf{PRICE} = -74100842 + 2690463(\textbf{YEAR}) + 23576276(\textbf{ROOM}) + 9784941(\textbf{TYPE}) + 23576276(\textbf{POOL}) + 8787170(\textbf{POST}) + 6604620(\textbf{DOOR}) + 11148916(\textbf{LOCATION}) + 2384072(\textbf{BEDROOM}) + 4547475(\textbf{LIVING}) + 6569661(\textbf{BOYS QUATERS}) + 675784(\textbf{CEILING}) + 4701321\ (\textbf{CONDITION}) + 9540917$$

Where;

PRICE = Price of the house; YEAR = Year of transaction; TYPE = Type of house; BEDROOM = Number of bedroom; LIVING = Number of living room; BQ = Availability of boys quarters; CEILING = Type of ceiling; CONDITION = Condition of the house; POOL=availability of swimming pool; POST = Availability of security post; DOOR = Type of door; LOCATION = Location of the property; Constant = -74100842.175

The above model specification is considered enough to be used in estimating house price in Kaduna north, Nigeria (Hair *et al.*, 2010). However, having a good regression model is not good enough for mass appraisal purpose. Such model needs to undergo a performance evaluation.

Typical of this evaluation is ratio study. Thus, a ratio study, using measure of appraisal level, was conducted for the estimation of price model developed in this research and the results of the evaluation are presented in Table 4 below.

Table 4 : Summary of performance of appraisal level indicators

S/N	Measure	Result	Performance
1	Median	0.9959	Good
2	Arithmetic Mean	1.0409	Good
3	Weighted Mean	1.00	Good
4	Geometric Mean	1.046004514	Good

Appraisal level refers to the overall ratio of appraised values to market values (IAAO, 2013b). The appraisal level is expected to be 1. However, the range of 0.9-1.1 is acceptable (Antipov & Pokryshevskaya, 2012). The ratios computed above have been found to be within the acceptable standard for mass appraisal performance. All the measures of appraisal level including the median, mean, weight mean and geometric mean are within 10% variation from 1 and therefore valid for mass appraisal including property tax assessment (Eckert *et al*., 1990).

Conclusion

The paper analyzed the determinant of house price for mass appraisal using MRA in Kaduna North. The relationship between micro house price determinant and the house price itself were established. The paper also developed a mass appraisal model using MRA approach for estimating house price in Kaduna North. The model was evaluated and was found to be adequate in estimating house price for property taxation purposes. The finding of this study will assist Kaduna North local authorities in mass property assessment for rating purposes. Estate surveyors and valuers will find it easier to value houses using the MRA model which will improve the objectivity, efficiency and accuracy of the valuation process. The MRA model can be used by real estate developers and marketers in developing a better marketing plan which will be guided by the identified attributes that appeal to the target customers in a particular market. Identifying these attributes will give the property developers idea of what the customers desire and willing to pay for in a house.

The study is limited to using MRA model in determining the market value of houses for mass appraisal in Kaduna North, Nigeria. It does not determine the rate payable for taxation purposes. The study, also, was able

to analyze data that is mainly for low density and medium density areas of Kaduna North where documented evidence of sales transaction is available. This limits the generalization of the study findings to the high density area. It is therefore recommended that similar study should be replicated in the study area with wider coverage both in terms of the sample size, property types and the densities. Finally, it is recommended that the model should be used in estimating house price in Kaduna north in order to improve objectivity and accuracy as well as greater revenue generation for the government.

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