HEDONIC MODELLING OF THE DETERMINANTS OF HOUSE PRICES IN MINNA, NIGERIA

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Abstract
House price is a function of the interplay of different determinants at both micro and macro levels. This paper examines the determinants of house prices in Minna, North Central Nigeria. Particular attention was paid to the three fundamental micro determinants of house prices namely structural, locational and neighborhood attributes. Due to the thin nature of the housing market in the study area, the research utilized a sample of 91 house sales transaction data (sales price and corresponding property attributes). Hedonic based multiple regression analysis was used to determine the variables that have statistically significant influence on price of a house. The hedonic model has proved to be more useful when the sample size is not large. The results show that the type of house, its size, number of bathrooms, location, year the house was sold, condition of the house, its distance to the central business district and the availability of neighborhood facilities exert significant effect on house prices in the study area. It was recommended that henceforth, property developers should pay particular attention to these significant attributes when carrying out future developments as such attributes are believed to be appealing to the property buyers.

Keywords: Hedonic Model, House Prices, Multiple Regression Analysis

1.0 INTRODUCTION

Housing plays a fundamental role to both the society and economy. On the one hand, it caters for one of the fundamental human needs by providing shelter and also has influence on people's well-being. On the other hand, housing serves as a long term investment which accounts for a large proportion of household wealth (FTI Consulting, 2012). For many households therefore, housing serves as the single most important asset in their portfolio (Case, Quigley, and Shiller, 2001).

The property market is one in which real property are exchanged between sellers and buyers. The market is not a single entity; it can be classified by sector (residential, commercial, agricultural, recreational or industrial); by location (local, regional, national or international), or by type of demand (occupation, ownership, investment, speculation or development) (Armatys, Askham and Green, 2009; Shapiro, Mackmin, and Sams, 2013). A larger proportion of the market is made up of the residential sector (Ismail, 2005). The property market is imperfect due to its inherent characteristics such as heterogeneity, huge sum of capital involved and high cost of transaction. Its nature, the methods of conducting transactions in it and lack of information relating to the transactions due to their private nature contribute to its imperfection (Shapiro et al, 2013).

The knowledge of house prices is of great importance to different market players such as appraisers, real estate agents, tax assessors, local authorities, banks and other financial institutions, property developers, investors, financial analysts, policy makers, insurers and in fact, the general public (Joseph, 2010; Schulz and Werwatz, 2004; Pagourtzi, Assimakopoulos, Hatzichristos, and French, 2003). Hedonic regression has become the standard approach for modelling the behaviour of house prices (Schulz and Werwatz, 2004). The model postulates that a good possesses a myriad of attributes that combine to form bundles of utility-affecting attributes that the consumer values (Ching and Chan, 2003). The earliest formalized use of the hedonic model in housing studies is attributed to Rosen (1974). The model tends to estimate the price of the house as a function of its attributes. It estimates the marginal contribution of each housing attribute to the price of a house.

It is worthy of note that what affects house price in one area might not be the same in another area. A lot of studies have employed the hedonic approach in estimating house prices with the researchers arriving at different conclusions. It is therefore impossible to generalize the outcome (Abdulai and OwusuAnsah, 2011). To this, Sirmans, MacDonald, Macpherson and Zietz, (2006) noted that the estimated coefficients for some characteristics from previous studies vary significantly by geographical location. Hence, it is wise to conclude that each market or location requires a different study before any inference can be made. Against this background, this research is motivated by the need to apply the hedonic

approach in identifying the key determinants of house prices in the Minna, with a view to guide property developers and investors. The study will also provide a basis for further research in this direction.

1.1 Factors Affecting Residential Property Prices

The literature has shown that residential real estate prices can be influenced by a lot of factors. These factors have been classified differently by researchers albeit with similarities. For instance, the factors have been classified as physical, neighbourhood and locational characteristics (Watkins, 2001); internal physical (i.e. house and plot specific, structural) and external location (Kauko and d'Amato, 2008); structural, locational and market attributes (Keng, 2009). According to Gallimore, Fletcher and Carter (1996), residential property values are determined by a diverse number of locational factors such as accessibility to shopping areas, employment opportunities, and availability of public facilities; environmental concerns (e.g. noise, pollution and hazard); neighbourhood amenities; and perceived level of neighbourhood security. A broader classification was given by Mohamad (2012) as micro and macro factors that affect house price. Again, Florida Department of Revenue (2002) classified these factors as legal/regulatory, physical/environmental, economic and social forces that influence real property values. While the first group of categorizations are based on the micro factors which are somewhat house-specific, the other classifications widened the scope to include some macroeconomic variables that affect the wider economy.

Tabales, Caridad and Carmona (2013) analysed some set of housing attributes affecting price including internal and external features of the house as well as orientation and location. They found out that land area is the most important determinant of house price, followed by location and then common expenses. The age of the building, though slightly correlated with the price, has a negative relationship. In a similar study, Selim (2008) applied the hedonic regression model to examine the determinants of house prices in Turkey. Using a sample of 5,741 datasets, he proved that the most significant housing attributes that influence house prices are the house type, type of building, its size, the number of rooms, as well as other physical components such as availability of swimming pool, water system and natural gas. However, the study did not consider any environmental variables. Hamid (2008) also conducted a study in Taman Pelangi, Johor, Malaysia in which he employed a locational value response surface (LVRS) techniques through the application of geographic information system (GIS) and multiple regression analysis (MRA) to examine house price determinants. He found out that land area, gross floor area, ancillary building area, and building condition were the most important building physical characteristics affecting residential property prices. He concluded that incorporating GIS-generated LVRS in a regression model can lead to improvement in value predictions.

In Liverpool, Abdulai and Owusu-Ansah (2011) used a large dataset of about 103,730 covering the periods of 1990 to 2008 and established that the number of floors, public rooms, bedrooms, bathrooms, showers and WCs; time-on-the-market; condition and type of property; and availability of glazing, garden, garage and central heating all influence house prices. They noted however that there are variations in the determinants when analysed on different time periods. This shows the relevance of taking the transaction period into consideration in house price analysis. Limsombunchai, Gan and Lee (2004) revealed that in Christchurch, houses with gardens when compared to those without gardens have exhibited differences in terms of market area segmentation and their patterns of pricing. The authors observed that the differences is because the houses with gardens are usually located away from the city centre or shopping complexes, whereas those without gardens are mostly found to be in close proximity to the city centre and some higher educational institutions. It was empirically established that for houses without garden, their age and the number of garages available are in fact the most significant factors that influence house price. Whereas, for houses with gardens, age, number of bedrooms, number of garages and availability of neighbourhood facilities are the major determinants of house price.

Some studies on house price determinants have also been conducted in Africa. Owusu-Ansah (2012) examined the determinants of housing values in urban Ghana and concluded that the number of rooms, floors, and property age; location of the property; availability of garage, fence wall and swimming pool; and land registration; all influence residential property values. He noted that the residential class where the property is located has the greatest impact. There also exist some literature of house price studies in Nigeria. For instance, Babalola, Umar and Sulaiman (2013) found out that, age, tenement rate, number of houses built in the university environment and proximity to the university are the most significant factors that cause variation in house rent around the university. They argued that the closer a house is to the university, the higher the rent paid for the house, exhibiting the effect of distance on house value. Similarly, Babawale, Koleoso and Otegbulu (2012) identified number and size of bedrooms, building condition, water availability and numbers of restrooms as the major determinants of house rent in Ikeja, Lagos State. Other studies in Nigeria are those of Bello and Bello (2007), Bello and Bello (2008) as well as Bello and Moruf (2010).

The impact of neighbourhood types on residential property prices in the Klang Valley of Malaysia was also examined by Teck-Hong (2010). The results showed that the gated-guarded landscape compound neighbourhood can lead to increase in price by about 14.26%, while up to 20.68% increase in price can occur if the property is situated in the freehold neighbourhood. In addition, the structural attributes that were found to be significant include flooring and bathroom, while

distance travelled to hospital, public transport facilities and workplace are the significant locational factors that determine house price.

A departure from the above literature is the study by Keng (1999) which examined the determinants of house price from a different perspective. He used macroeconomic variables as predictors of house price index (HPI) in Malaysia and noted that macroeconomic indicators have a number of implications on the housing market. The results showed that the four significant determinants of HPI are real per capita income, unemployment rate, total loans to housing and Kuala Lumpur Stock Exchange Composite Index (KLSE CI). While the financial indicators (loan to housing and lending rate) are positively correlated to HPI, some economic indicators such as unemployment and CPI have negative correlation. A similar approach was adopted by Ojetunde, Popoola and Kemiki (2012) to examine the relationship between the Nigerian residential property market and the macro economy in Nigeria. They revealed that real GDP and changes in exchange rates are strongly and positively correlated with house rents, while short–term interest rates as well as inflation have negative weak relationship with house rents. These findings were supported by Ojetunde (2013). Kariuki (2012) focused on other government policies affecting residential property value rather than the housing attribute and economic indicators that have been repeatedly seen in the literature. It was established that increased credit facilities from the financial institutions, improvements and construction of new roads and the new constitution and new land related laws all resulted in increase in property values in Nairobi, Kenya.

To summarize it all, Sirmans and Macpherson (2003) listed out the housing attributes that are most frequently included in previous studies on hedonic house price modelling. They include lot size, square feet, brick, age, number of storeys, number of bathrooms, number of rooms, bedrooms, full baths, fireplace, air conditioning, basement, garage spaces, deck, pool, distance, time on market and time trend. It must be noted however that some of these variables are not found in the present study area. This may be due to the differences in contextual, idiosyncratic and cultural settings as well as nature of the property market characteristics as noted by Bello and Bello (2008) and Ching and Chan (2003). This will obviously limit the application of some of these variables to the Nigerian situation in general and particularly the case study area, Minna. More so, the unavailability of data on some variables will equally constrain the number of variables to be included in the study.

1.2 Hedonic Price Model

The term “hedonics” is derived from the Greek word hedonikos, which simply means pleasure. Hedonic models are based on Lancaster’s (1966) theory of consumer demand which measures the relative importance of each component of a complex

good. It was applied in the analysis of the implicit price of differentiated products by Rosen (1974). Rosen defined hedonic prices as "the implicit prices of attributes and are revealed to economic agents from observed prices of differentiated products and the specific amounts of characteristics associated with them." A review of previous studies by Limsombunchai et al. (2004) shows that hedonic price theory had been utilised in the real estate economics to value agricultural properties, residential amenities and wildlife related recreational resources. They identified other applications of the theory to include the estimation of the benefits of environmental improvements, assessment of the effect of neighbourhood amenities such as access to hospitals, schools, air quality, and airport noise level and traffic noise. Therefore, the hedonic price model is proposed to express "an econometric relationship between the price and the property characteristics particularly in the residential context" (Kauko and d'Amato, 2008).

Housing is a composite commodity that is made up of different attributes namely physical, locational and neighbourhood characteristics. The house is treated, sold and consumed as a whole because these attributes cannot be unbundled such that each part can be traded or consumed explicitly (Tabales et al, 2013; Owuso-Ansah, 2012; Keng, 1999). Hedonic pricing models attempt to model the relationship between the attributes of a complex object and the object's price (Tabales et al. 2013; Wezel, Kagie, and Potharst, 2005). For a house, such attributes may include type, size, structural components, as well as locational and neighbourhood factors. Thus, the hedonic pricing model can be used to measure the influence of these attributes on the overall transaction price (Monson, 2009).

It has been noted that for the past three decades, the hedonic-based MRA has been widely adopted in the real estate literature to study the relationships that exist between house prices and housing attributes (Selim, 2008; also see Abdulai and Owusu-Ansah, 2011). The attributes to be included in the hedonic model in assessing the house price usually depend on the type of property being studied (Beekmans, Beckers, Krabben and Martens, 2013). They however argued that property specific characteristics are the most important. The hedonic pricing model regresses housing attributes against the price to show how change in each attribute affects the house price, thereby giving an estimate of the relative monetary contribution of each factor (Joseph, 2008). The process involves prior identification of the attributes that are believed to affect house price. The hedonic model based on micro economic theory has been widely used in real estate valuation and housing market studies, particularly in analysing residential property prices and rental values (Selim, 2008). The model is particularly useful when there is no enough statistical information especially the property transaction details (Tabales et al., 2013). Other approaches such as the artificial neural networks usually require quite large samples for analysis.

2.0 METHODOLOGY

Data for this research were sourced from registered estate surveying and valuation firms that are practicing in Minna. The firms provided data on residential properties, particularly the sales prices and corresponding property attributes. It was observed during the process of data collection that some of the estate firms do not keep proper records of their property transactions. In addition, a lot of property transactions were carried out by non-registered estate surveyors/ agents who do not keep records at all. As a result, only a total of 91 transaction data were found to be useful for analysis after data screening was done. Hence, they were adopted for the study. Most of the recorded transactions (46%) within the sample period of 5 years (2009 - 2013) took place in 2013 with the other samples almost evenly distributed throughout the previous year. This indicates that there is improvement in the habit of property transaction data record keeping by the estate firms. Considering the number of predictor variables included in the regression (10 variables in this case) and the level of probability of 0.05, these samples were considered adequate for the researchers to draw reasonable conclusion. This study will be based on residential properties within Minna residential neighbourhoods, consisting of Chanchaga and some parts of Bosso Local Government Areas. The neighbourhoods selected for the study are Minna City Centre, Tunga, Shango, Bosso, Kpakungu, Dutsen Kura, and F/Layout. The estate firms were able to provide transaction data for these areas.

Table 1: List of variables, description and expected signs

DEPENDENT VARIABLE	**DESCRIPTION**		**MEASUREMENT**
LOG_PRICE	Log of Price of the house		Nigerian Naira (N)
INDEPENDENT VARIABLES	**Description**	**Expected Sign**	**Measurement**
TYPE	Type of House	+ve	Nominal
SIZE	Size of House	+ve	Scale (Sqm)
ROOMS	Number of Rooms	+ve	Scale
BATH	Number of Bathrooms	+ve	Scale
AGE	Age of House	-ve	Scale (Years)
CONDITION	Condition of the House	+ve	Nominal
YEAR	Year House was Sold	+ve	Scale
LOCATION	Location of House	+ve	Nominal
DISTANCE	Distance of House to CBD	-ve	Scale (KM)
FACILITIES	Availability of Neighbourhood Facilities	+ve	Nominal

The study employs the use of statistical technique particularly the hedonic price modelling approach of MRA to empirically identify the significant factors that determine house price in the study area and the level of effect exerted by each factor. The analysis involved regressing observed house sales prices against the house attributes which the researchers perceived to be determinants of the price. Based on the available data on the property characteristics, the attributes hypothesized to influence the price of a house are presented in table 1. A prior hypothesis of the relationship between each variable and price is also stated (indicated by the expected signs). The hypothesis is based on the findings from previous researches.

The descriptive statistics in table 2 show details of computed minimum, maximum and mean values as well as the standard deviations of all the MRA variables. The minimum house price among the samples in the study area is N1,200,000 while the maximum price stands at N10,000,000. The mean rent and the standard deviation were computed as N4,349,450.55 and N2711923.21 respectively. The number of rooms in a house ranges between 2 and 21, with a mean of 5.88 and a standard deviation of 5.625.

Table 2: Descriptive Statistics

VARIABLES	MIN.	MAX.	MEAN	STD. DEV.
PRICE	1,200,000	10,000,000	4,349,450.55	2711923.21
TYPE	1	6	3.14	1.644
SIZE	77.00	263.00	171.7670	54.45335
ROOMS	2	21	5.88	5.625
BATHS	1	5	2.79	1.197
AGE	1	33	12.58	8.694
CONDITION	1	5	3.23	1.034
YEAR	1	5	3.67	1.491
LOCATION	1	3	2.40	.728
DISTANCE	1.50	7.00	2.9398	1.28924
FACILITIES	1	5	3.13	.957

3.0 RESULTS AND DISCUSSION

Residential real estate prices are indeed influenced by a myriad of physical, locational and neighbourhood attributes. However, as mentioned earlier, these attributes and their effects vary significantly across regions, countries and even localities due to difference in cultural settings and market situation inter alia. This research will therefore identify the determinants of house price in Minna, Nigeria.

3.1 Correlation Analysis

Table 3: Correlation Matrix

	Price	Type	Size	Rooms	Baths	Age	Con	Year	Location	Distance	Facilities
Price	1										
Type	.407**	1									
Size	.207*	-.332**	1								
Rooms	-.087	-.603**	.560**	1							
Baths	.672**	-.041	.416**	.450**	1						
Age	-.338**	-.294**	.167	.460**	-.083	1					
Condition	.779**	.438**	.068	-.278**	.363**	-.351**	1				
Year	.224*	-.130	.353**	.434**	.384**	.366**	.216*	1			
Location	.402**	.296**	-.240*	-.322**	.058	-.193	.099	.004	1		
Distance	-.429**	.087	-.026	-.256*	-.363**	-.031	-.174	.667	-.408*	1	
Facilities	.805**	.362**	.045	-.179	.451**	-.252*	.575**	.716	.610**	-.520**	1

**Correlation is significant at the 0.01 level *Correlation is significant at the 0.05 level\

A two-tailed Pearson's correlation analysis shows that all the variables, except the number of rooms, are significantly correlated with price at varying degrees. The variable with the strongest correlation is the availability of neighbourhood facilities, having a correlation index of 0.805 and significant at 0.01, while the number of rooms has the least correlation of -0.087 which is insignificant. This implies that any increase in the number of facilities available in a neighbourhood will result in a significant increase in house price. The condition of a house is another factor to which the price is very sensitive with a correlation index of 0.779 indicating that the better the condition of the house, the higher the price. While age and distance exhibited relatively weak, negative correlation with price, all other variables are positively correlated.

3.2Collinearity Test

Multicollinearity (or collinearity) is a statistical problem that occurs in a regression analysis whereby there is high correlation between two or more of the independent variables included in the regression, to the extent that such correlation can affect the reliability of the results. Where such problem exists, some of the variables have to be removed from the model. It is usually indicated by a high variance inflation factor (VIF) or a low tolerance. The VIF quantifies the severity of multicollinearity in a regression. Ordinarily, when the VIF is greater than 5, it exhibits high multicollinearity. The tolerance is the reciprocal of VIF. It usually indicates the presence of high multicollinearity if the value is less than 0.2. A multicollinearity diagnostics was conducted and the results are presented in Table 4. The VIF and tolerance for all of the variables are within acceptable limits, indicating that multicollinearity does not exist in the sample.

Table 4: Collinearity Statistics

Variables	VIF	Tolerance
Type	1.968	.508
Size	1.808	.553
Rooms	4.622	.216
Baths	2.571	.389
Age	1.771	.565
Condition	2.678	.373
Year	1.954	.512
Location	2.454	.407
Distance	2.204	.454
Facilities	3.876	.258

3.3The Hedonic Price Regression

The results of the regression analysis is presented in table 5. The linear and semi-log functional forms were used. The semi-log model provided the best fit, having the highest coefficient of determination (R^2) of 0.934 as against the linear model which has an R^2 of 0.924. This finding is in line with previous studies such as Babawale, Koleoso and Otegbulu (2012). The literature has shown that the semi-log is the most common functional form that is recommended in the hedonic price analysis (Selim, 2008).

Table 5: Regression Results

Independent Variables	Linear			Log-Linear		
	Coefficients	**T-Stat**	**Sig.**	**Coefficients**	**T-Stat**	**Sig.**
(Constant)	-5396229.601	-6.951	.000	12.998	76.442	.000
Type	231235.108	3.240	.002	.034	2.151	.034
Size	6829.955	3.308	.001	.002	4.784	.000
Rooms	-35319.207	-1.105	.272	-.025	-3.564	.001
Baths	783476.898	6.997	.000	.165	6.708	.000
Age	-26345.869	-2.058	.043	.004	1.585	.117
Condition	985923.630	7.448	.000	.235	8.104	.000
Year	166789.962	2.128	.036	.052	3.040	.003
Location	636969.751	3.542	.001	.124	3.138	.002
Distance	-233285.594	-2.423	.018	-.125	-5.932	.000
Facilities	498261.128	2.897	.002	.118	3.128	.002
R^2	0.924			0.934		
Adjusted R^2	0.914			0.926		
F-Statistics	97.200			112.930		
F-Significance	0.000			0.000		

The coefficient of determination (R^2) of a regression is the proportion of the variation in a dependent variable that is accounted for by the independent variable(s). Here, it can be seen that about 93% of variation in house price is explained by the independent variables. F-test is used to determine the goodness of fit of the overall model. Usually, when the significance of F is less than 0.05, we accept the hypothesis and when it is greater than 0.05, we reject the hypothesis. In this study, F-value (112.93) and the significance of F (.000) show that in general, the variables as a whole are significant in determining the price of a house in Minna, hence the hypothesis is accepted. It is important to note that the F-statistics only show the significance of all the variables put together rather than on individual basis. It is usually possible that some of the variables may not be individually significant. Thus, a look at the P-value of the individual variables is necessary (see Sig. in Table 5).

The coefficients tell us how much a dependent variable (in this case house price) changes with a unit change in each of the explanatory variables. For instance, the coefficient of the type of house suggests that different house types will vary in prices by about 3.4%. Similarly, it is expected that each unit increase in size of a house will lead to increase in price by 0.2%. Furthermore, the condition of a house, its location and availability of neighbourhood facilities will increase house price by 23.5%, 12.4% and 11.8% respectively. The implication is that when a person buys a house that is in poor condition, the person would have to spend some amount of money to bring such house to a better condition. It follows therefore that people in Minna are willing to pay more money for a house that is in good condition. There is also tendency that people will pay more for houses in better locations or those in neighbourhoods that offer better facilities.

The sign on each of the coefficients indicates the direction of the relationship between the variable and price. As was earlier hypothesized, the coefficients of age (in the linear form) and distance are negative, indicating that the variables move in an opposite direction with price. This implies that as a property becomes older, the price of such property will reduce. Similarly, the farther a house is from the CBD, the lesser the price of such house. The inference from this is that people would rather pay more for a house in order to stay closer to the CBD probably due to accessibility advantage, proximity to certain services and/or reduced transportation costs among others. In contrast however with findings from previous researches, the number of rooms has a negative coefficient. This, the researchers believe is as a result of the nature of samples used in the study, which vary from single family homes to multi-tenanted houses.

The hedonic regression equation can therefore be presented thus:

House Price = 12.998 + 0.034(Type) + 0.002(Size) - 0.025(Rooms) + 0.165(Baths) + 0.004(Age) + 0.235(Condition) + 0.052(Year) + 0.124(Location) - 0.125(Distance) + .118(Facilities)

The model shows that house prices are made up of a combination of prices of the different components of a house. The contribution of each of the components (in terms of magnitude and direction) is indicated by their respective coefficients.

4.0 CONCLUSION

The hedonic price theory has been used to analyse the contributory effect of characteristics of complex goods on the price of the goods, especially in the residential context. In this study, we established that the type of house, its size, number of bathrooms, its condition, location, distance, availability of neighbourhood facilities as well as the year the house was sold exert significant influence on house price. Unexpectedly, the number of rooms shows a negative effect. The finding regarding the number of rooms was not quite surprising. This is believed to be due to the nature of samples utilized in the study, which contains varying types of properties including the single family houses which have less number of rooms and multi-family ones that have more number of rooms even though both are occupying almost similar total floor space. In Minna, it is typical to have a tenement building having more number of rooms that are often occupied by different families. This means that a tenement house having say 14 rooms and occupied by more than one family may be of the same size (in terms of total floor area) as a detached bungalow having just 5 rooms with more facilities and occupied by a single family. This is an indication of poor housing condition and low standard of living in some neighbourhoods of the study area. It is believed that the problem could have been solved if different regressions were run for the different property types. This was however not possible in the current study due to the problem of lack of much recorded transaction data required for the analysis.

In the future, it is recommended that adequate data should be acquired for the different house types so that each can be tested separately. We conclude that the most important features that house buyers consider in their bid to purchase a house in Minna are the physical condition of the house, the number of bathrooms, availability of facilities, location of house and type of the house. We recommend that henceforth, residential property developers in Minna should take these factors into consideration in future property development. Property market actors should also take the factors into account when setting the price of houses.

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