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The specification of hedonic indexes for duplexes in Lekki peninsular area of Lagos metropolis

G. K. Babawale and Johnson Olusola

Department of Estate Management,University of Lagos, Akoka, Lagos. Nigeria.

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ABSTRACT

This paper explored the hedonic price model to demonstrate the effects of housing attributes on the price structure for duplexes in Lekki Peninsular area of Lagos metropolis. The hypothesis that house prices are influenced by a combination of housing attributes was tested with a standard hedonic model using a sample of 193 duplexes sold between 2008 and 2010. Each of the sixteen explanatory variables involved manifested their a priori signs and statistically significant at the required level of significance except for quality of sanitary wares, availability of shopping centers and availability of swimming pool. The results suggest, among others, that structural attributes, particularly attributes that border on convenience, comfort and display of affluence, constitute the principal predictors of duplexes' prices in the study area.

Introduction

The value of property is very key and central to decision making in almost all aspects of the built environment. Investors and developers seek to know the market values as well as potentials of a property, while vendors are interested in knowing how much their properties would command in the market. Accurate valuation of property is required for incorporation in company's Balance Sheet and in a prospectus when the company is going public; or when it is the subject of a takeover or merger bid. Banks and other financial institutions require accurate property valuations for analysis of credit and collateral for loan. According to International Association of Assessing Officers, the viability of the property taxation system also depends on the accuracy of municipal valuations, because they are the legal underpinning of the taxes levied (IAAO, 1999). Valuations as proxy for actual transaction prices provide the much needed performance indices required to support financing and investment decisions in the property market. Other stakeholders include shareholders of quoted companies, future pensioners whose savings are invested by funds; individual property buyers and sellers; and the whole economies that depend on stable banking system (Gilberton and Preston, 2005). All these underscore the importance of accurate property valuation and stress the grave danger that inaccuracy portends (Babawale and Omirin, 2011; Babawale, 2008).

A house is a multi-dimensional product comprising of a bundle of utility –bearing attributes such as accommodation size, type and mix; quality and location. These characteristics make the valuation of a house a rather intricate assignment. Contemporary valuation techniques employed by residential property valuers include the paired sales analysis, the contingent method, and the hedonic pricing model. Though valid under restrictive situations, the paired sales analysis is rather too speculative giving of the inherent heterogeneity of the residential market. The contingent method is based on property owners' or would-be owners' individual perceptions or intentions, thus making the approach subjective and therefore often unreliable. A substantial body of studies that have been conducted to analyse house values by reference to its individual components have invariably used the hedonic pricing model which allows the total housing expenditure to be broken down into the values of it component attributes (Tse and Love, 2000; Choy, Mak and Ho, 2007; Larsen, 2010).

The hedonic pricing model has been employed with a degree of success in housing market analysis in developed countries (Des Rosiers et al., 2005; Benefield and Weeks, 2009; Jarsen and Coleman, 2010). This paper demonstrates the potentials of the same technique to the study of housing markets in a developing country like Nigeria. In Nigeria today, documented empirical studies in hedonic pricing are scarce besides the works of Babawale and Adewunmi (2011); Otegbulu and Johnson (2011), Ajide and Alabi, (2010) and Omoogun (2010); Bello and Bello (2007); and Megbolugbe (1989).

Bello and Bello (2007) investigated the influence of consumers' behaviour on the variables determining the values of flats and duplexes in Lagos metropolis. From both the valuers and buyers perspectives, the results identified location as the most significant factor for duplexes. For flats, perceived neighbourhood security was the most significant factor from the point of view of buyers; while location was the most significant factor from the point of view of valuers. Bello and Bello (2007) however did not take into account differences between sub-markets (low-, medium-, and high-income sub-markets for flats/duplexes) within the metropolis. That is, the findings were generalised. Sanni and Akinyemi (2009) cautioned that generalising results for a city like Lagos has the tendency of glossing over sectoral peculiarities, which could be of great importance for optimum decisions.

Megbolugbe (1989) study was on Jos housing market. The main shortcoming of his findings is that the study employed property rating assessment data as surrogate for market value. Rating valuation, being a statutory valuation, is rarely based on market transactions and therefore subject to the inconsistencies inherent in non-market valuations. This is particularly so for a

Tele:

E-mail addresses: gkbabs@yahoo.co.uk

country like Nigeria where studies have consistently showed a weak correlation between valuations and transaction prices (Babawale and Omirin, 2011; Babawale, 2008; Ogunba and Ajayi, 1998).

Omoogun (2010) is criticized for its verbatim adoption of variables that were used in previous USA studies (USA and Nigeria have marked differences in socio-economic characteristics); making the conclusions spurious. Ajide and Alabi (2010) work was aimed at determining which of the three standard functional forms of the hedonic analysis is the most efficient based on data from unspecified property sub-market of Lagos State. The study adjudged the semi-log as the most efficient having the highest coefficient of determination.

The present study evaluated both the predictive and relative importance of factors that influence transaction prices for duplexes in Lekki Peninsular, Lagos, Nigeria. By establishing the right price at which developers of duplex are prepared to supply, and prospective purchasers are willing to pay, the study is potentially beneficial. First, well priced properties generate competitive offers; stimulate demand, birth and sustain a healthy and functional market. The result would also facilitate optimum development or redevelopment decisions by assisting developers to identify the attributes that the market is willing to pay for.

The resultant pricing model also provides real estate valuers with an alternative to conventional valuation techniques, one that is potentially more reliable as it makes use of available information more efficiently. The hedonic model is a more affords greater flexibility in incorporating sustainability features into real estate valuation making it more relevant to the ongoing global campaign for incorporating sustainability in real estate valuation. Previous studies in the study area have identified inappropriate valuation techniques as a major cause of inaccuracy in residential property valuation with all its adverse consequences (Ayedun et al., 2011; Babawale and Ajayi, 2011; Aluko, 1998). Thus, by proffering a rational model, valuation inaccuracy induced by inappropriate method or arising from individual valuer's idiosyncrasy could be drastically curtailed. By giving particular attention to the identified critical variables, developers of duplexes in the study area would be able to build to meet purchasers' tastes and preferences thereby promoting marketability and sustainability in the sub-market under reference.

The paper is structured into five sections. This introductory section is followed by the review of relevant literature. The research methodology is presented in the next section. The penultimate section discusses the results of the study, while the final section contains the study implications and the conclusions.

Review of Literature

This study demonstrated the potentials of the hedonic price analysis in a developing country like Nigeria where the required data is not often available in the right quality and quantity. The hedonic approach with regression based techniques has been widely used in residential property market analysis and valuation. The basic idea of the hedonic approach is traced to Court (1939) who employed the model for the automobile industry. Since then, the method has been applied to other goods like cotton, computers and housing. Nevertheless, the housing market is arguably the most prominent and richest in the use of the technique. Specifically, the technique has been employed to achieve three main goals in the housing market analysis: (i) to explain the price formation of residential property assets by identifying the main determinants of property prices, (ii) to isolate and quantify the impact of different physical, locational and neighborhood characteristics on property prices, and (iii) to account for changes in the price formation process across regions or over time (Lorenz, 2006). The theoretical foundations of the hedonic price model were based on the writings of Lancaster (1966) and Rosen (1974). While Lancaster (1966) put forward his consumer theory (Lancaster preference theory), an extension of the consumer theory of classical economics; Rosen (1974) established the modeling foundation for the hedonic price theory by his equilibrium model of market supply and demand based on product characteristics. Lancaster's (1966) theory argued that demand for a product is not determined by the product itself, but by the product's utility generating characteristics. The basic premise is that a property represents a bundle of both desirable and undesirable attributes to a utility maximizing consumer, all of which contribute to the market values of the house as revealed through a market transaction. A specific functional relationship is therefore assumed to exist between the characteristics and the prices of commodities. Subject to this relation and a standard budget constraint, maximization of utility gives rise to a hedonic function relating the price of a commodity to the characteristics embodied in it (Wen, 2004).

The basic structure of a hedonic model takes the market price as the dependent variable and all the attributes of the good as the independent variables. For the housing market, the independent variables are often classified into locational, structural and neighbourhood characteristics while the independent variable is often the price or annual rent (actual or appraised). Structural characteristics refers to the physical attributes of the property such as plot size, quality of construction, number and size of bedrooms, age of building etc. Neighbourhood characteristics include the socio-economic characteristics of the people living in the neighbourhood, off-site facilities and infrastructure, and views. Locational or accessibility attributes cover such things as accessibility to CBD, recreational facilities, place of worship etc. Under the assumption that there is equilibrium of demand and supply for the housing attributes, and that the area studied lies within a single housing market, the implicit prices that are revealed indicate the buyers' valuation of each of the attributes (Sander and Polasky, 2009). Hence, the price of the property is the sum of the implicit prices for each of its attributes.

By demonstrating how the effects of housing attributes are capitalized into house prices, the hedonic model provides a valuable tool for finding prices of intangible goods where a well functioning market is non-existent. It also allows for finding the implicit willingness to pay for a variety of policies such as pollution, noise, and crime that are not traded in the markets. Des Rosiers et al., (2001) are of the opinion that the hedonic approach remains the most adequate tool for untangling the cross influences between the numerous dimensions affecting property values and for establishing the implicit price of individual attributes.

The general form of the regression model is:

$$P = f(X, \beta) + \varepsilon \dots\dots\dots\dots (i)$$

Where, P denotes the vector of observed transaction prices (or valuation data), x the matrix of exogenous variables, β the vector of coefficients and ε the error term representing the difference between the model's prediction and the actual price. For the present study, the relationship between the price of duplexes and its characteristics could be expressed as:

$$PH_{it} = \sum_{J=1}^{k} \beta_{jr} x_{ijt} + v_{it} \quad \text{..... (ii)}$$

Where,

i = property (duplex), t = time, PH_{it} = property (duplex) price at given time t; X_{ijt} = vector of characteristics; B_j = implicit prices of the k characteristics; V_{it} = error term.

Model Specification

In specifying hedonic models, cognizance must be taken of the peculiarities of the players in each sub-market since residents tend to sort themselves into different groups that may perceive and value a particular housing attributes differently. Schnare and Struyk (1976) posited that housing market segmentation occurs when households' demand for particular structural or neighborhood characteristics is highly inelastic and the preference is shared by a relatively large number of households. Tse and Love (2000) also noted that housing prices are determined by the demand for attributes, not only for the dwelling units themselves, but also of the region in which the units are located. That is, each housing market or sub-market produces its own set of hedonic prices.

Functional form

The choice of functional form that most appropriately explains the relationships between the explanatory variables and the property prices is critical in determining accurate and consistent econometric model. In particular, the problem of heteroskedasticity can be mitigated by choosing the most appropriate functional form. There is however, no strong a priori notion of the correct functional form. Selim (2008) observed that there is little guidance from economic theory about the proper functional relationship between housing price and its attributes. As neither economic theory nor previous studies provide clear guidance regarding the choice of functional form, this study employed the three models that have been most widely used in similar studies - the linear, semi-log, and the log-linear. These three standard functions are reputed as being easily interpretable, and the estimated parameters as possessing a direct economic meaningfulness (Maurer et al., 2004). The three models are of the form:

$$P = \alpha_o + \alpha_i z_i + \varepsilon \quad \text{(linear)……(iii)}$$

$$\text{Log } P = \beta_o + \beta_i Z_i + \varepsilon \quad \text{(semi – log or log-linear) ……(iv)}$$

$$\text{Log } P = \varphi_i + \varphi_i \log Z_i + \varepsilon \quad \text{(double – log)……(v)}$$

Some housing attributes exhibit diminishing marginal returns. The law of diminishing marginal utility states that an economic agent's marginal utility falls when one consumes more units of the commodity, ceteris paribus. For example, residential lot price per square meters diminishes as lot size increases. This is similarly true of floor level, age and possession of view. As such, recent studies have challenged the assumption of linearity in favor of semi-log function for housing market analysis (Ajide and Alabi, 2010; Selim, 2008).

Appendix 1 contains a summary of selected empirical housing market studies where the hedonic theory was employed showing, among others, the differences in variables (characteristics) included, the statistical tools employed, and major findings. In these studies, parameter estimates are mostly undertaken on the basis of standard functions such as linear, semi-logarithmic or log-linear functions and a few by Box-Cox transformation. These studies were deliberately chosen to reflect differences in methodology, functional forms, and choices of variables between markets in different parts of a country and between countries.

Area of Study

This study area is Lekki Peninsular, a part of Lagos metropolis. This prime residential neighbourhood is ideally suited for this study for a number of reasons. As Tse and Love (2000) argued, a feasible approach to using the hedonic regression is to choose a sample with similar locational characteristics and income groups that are supposed to have homogeneous taste so that the net effects of various structural and locational attributes on the neighbourhood are similar. Furthermore, the study area is large, predominantly residential neighbourhood with a relatively active housing market that can generate the required transaction data.

Lekki Peninsula enjoys an extensive boundary with the Atlantic Ocean and is currently witnessing one of the most extensive and intensive construction activities in the history of metropolis. The study area represents one of Nigerian's finest concentrations of residential properties, elegantly designed and tastefully finished, and in various shapes and styles including over 40 modern gated housing estates including the Victoria Garden City, Ocean Bay Estate, Crown Estate, Beach Resort Estate, and Amen city. Houses in the gated estates are predominantly twin- and free-standing duplexes and detached houses. Prices and rents represent some of the highest in the metropolis and are, in some cases, denominated in US dollar. The area is relatively quiet, secured, has good views (the Atlantic Ocean, beaches, and the lagoon, among others), enjoy ample infrastructural facilities, and is accessible by modern road network and water. The area is proposed for an international airport, Free Trade Zone, and a deep sea port, among others.

The study area is also dotted with a good number of auxiliary land uses including special schools - British-Lekki International School, Corona Schools, Italian School and Dowen College; prominent shopping centers - Mohammed Shopping Complex, the Palms, and Star Shopping Complex. Lekki Peninsular is a choice location for career men and women working in financial houses, professional offices, oil and telecommunication firms, professional offices that are highly concentrated in Victoria Island, a few kilometres away.

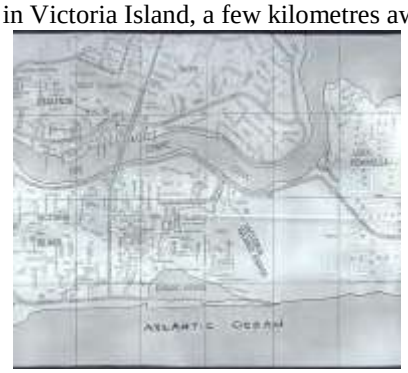

Figure 1: Part of Lagos Metropolis Showing Lekki Peninsular

Research Method

The main objective of this study is to specify and rank housing attributes that significantly influence the prices of duplexes in Lekki Peninsular area of Lagos metropolis. The main research instrument was structured questionnaires which were self-administered. Questionnaire survey was adopted because of apparent lack of reliable secondary data on property characteristics and market evidences; either with public or private sector. For the same reason of lack of relevant data on structural attributes of duplexes as well as the logistics of undertaking a census of duplexes in the area; the study

employed a combination of convenience and snowball sampling techniques by which the researchers requested respondents to refer them to other duplex owners known to them within the study area. These referrals were also asked to identify other people like them. Based on this approach, 193 of the questionnaires administered were duly completed and analyzed with the aid of the Statistical Package for Social Sciences (SPSS).

The sample size of 193 purchasers is considered reasonably adequate considering the fact that Nigerian property market is still evolving and sale evidences, even in the most active sector of the market, are scanty and scattered over time and space. Other reasons include the cross sectional homogeneity of the respondents. Purchasers of duplexes belong to the upper-middle and the lower-upper segment of the socio-economic profile which are supposed to have homogenous tastes such that the net effects on neighborhood attributes are similar. Secondary data were obtained from journal articles, technical reports, and previous studies.

Hedonic Variables Specification for the Study Area

Table 1 describes the variables used in this study with their respective codes and measurements. The list is by no means exhaustive of the housing attributes which affect values, but was limited by the information typically found in the area under reference. That is, only those attributes which affect the prices paid for duplexes, or the supply prices in the surveyed sub-market are included.

Given the peculiarity of the study area, especially the paucity of secondary data on accommodation dimensions, the lack of GIS resource in the area covered; and the uphill task of getting majority of the respondents either to provide accurate measurement of their accommodation or to allow field staff to do the same; a number of variables that should ordinarily be measured as continuous variables were represented in a rather crude manner either by approximation or by reducing them to binary variables. Thus, distances were approximated to driving time - a most convenient and easiest way respondents could provide estimate for such information in the absence of actual measurement. The effects of using such dummy variables is to allow the regression technique itself to estimate the varying influence of the affected variables rather than have them imposed by an interval scale of measurement.

Findings and Discussions

A summary of the descriptive statistics of the hedonic variables are as presented in Table 2. The mean sales price (in Nigerian currency) of duplex in Lekki Peninsular, Lagos, is ₦77,358,000, the minimum is ₦45, 000, 000, while the maximum is ₦150, 000,000 and the standard deviation ₦27, 114,000 implying a wide disparity owning probably to marked differences in attributes. Number of bedrooms ranges from 3 to 8 with a standard deviation of 1.00302 suggesting narrow dispersion around the mean of 4.4259. Duplexes in the study area are provided with between 3 and 8 bathrooms with an average of 4.6218. Plot sizes vary widely with a mean of 847.2539m², a range of 2550m^2, and a standard deviation of approximately 460m^2. Built area also vary significantly with a mean value of 450.8808m², a minimum area of 350m², a maximum of 750m², and a standard deviation of 95.72315 m². About 90% of the duplexes have balcony, 80% have boys quarters, while 55% have built-in garages. Swimming pools are to be found in only 4% of the properties, while 31% of them are equipped with modern sanitary wares.

Evaluation of the Model

Evaluating the model, the semi-log provides the best fit with the highest R^2 statistics of 80.2%. This corroborates several previous studies (Selim, 2008; Ajide and Alabi, 2010). Both the explanatory and predictive performance of the model is good as indicated by R^2 and adjusted R^2 statistics of 80.2% and 79.5% respectively. This is particularly good for the present study giving the sample size. This result suggests that about 80% of the variation in duplexes' prices in the study area is explained by the sixteen explanatory variables employed. That is, the model reasonably fits the data. The computed F-statistics (F=155.300) indicates that the fitness of the model is high; while Durbin Watson = 1.775, depicts non-serial autocorrelation. Therefore the model appears adequate for predicting sales value of duplexes in the study area.

The high value of the adjusted R^2 (0.795) achieved with a small number of independent variables shows that the duplexes are homogenous, which is a desirable requirement for the application of hedonic price model (Tse and Love, 2000). The computed F-statistics (F=155.300) at 95% significant level, demonstrated that the variables were significantly different from zero and relevant altogether. The high value of the adjusted R^2 does not necessarily ensure that the model is stable.

Diagnostic tests were performed to examine the robustness of the model further. The variance inflation factor (VIF), Durbin Watson statistics and the White's test were performed to ascertain that the model is free from multicollinearity and heteroscedaticity, respectively. Table 4 shows maximum VIF value of 2.372, which is lower than the maximum value of 3 suggested by Hair et al. (2005). This suggests the absence of multicollinearity in the model. The high Durbin Watson statistics of 1.775 also indicates that the model is free from auto-correlation. The model clearly passes the White's heteroscedasticity test with F-statistics of 1.6216, p = 0.2813 (p at 0.2813 signifies probability that the errors are homoscedastic is not lower than 10 percent) implying that the variance of the errors does not increase or decrease over time. Thus, our estimated parameters are unbiased. The model can therefore be reasonably employed to predict prices of duplexes in the study area.

Evaluating each of the independent variables

All parameter estimates display signs and magnitude that are in line with theoretical expectations and corroborate previous research (Sirmans et al., 2005). Number of bedrooms, quality of construction, provision of boys' quarters, provision of built-in garage, and availability of quality schools for children are significant at 99% level while others were significant at 95% level except for availability of shopping centre, quality of sanitary wares, and availability of swimming pool that were statistically insignificant.

All the structural attributes entered the model with impressive coefficients. From the standardized beta column (not shown here), provision of boys' quarters has the strongest positive influence on duplex prices in the area, followed by number of bedrooms. The proportion of built-up area to total land area occupies the third place, while the number of bathrooms/toilets is fourth. Next in order of priority is the quality of construction, provision of in-built garage, plot size, provision of balcony, quality of sanitary wares, and provision of swimming pool. The five neighborhood variables entered the model with a priori signs, and large coefficients. These are, in order of priority, perceived neighborhood security, views,

availability of quality schools within 15 minutes walking distance, availability of shopping complex within 15 minutes walking distance, and availability of recreational facilities within 15 minutes walking distance. The only locational variable , distance to place of work, registered a priori negative signs, significant at 95%, but was least of the sixteen predictors in order of influence.

The unstandardized beta (B) column provides the coefficients for the construction of the regression equation thus:

PRICE = 7.8955 + 0.1317(NUMROOM) + 0.0944(NUMBATH) + 0.0253(BUILTAREA) + 0.0552(BALCONY) + 0.1645(CONSQUA) + 0.1034(GARAGE) + 0.1951(BQ) + 0.914(SPOOL) + 0.0170(PLTSZ) + 0.0135(BATHWARE) – 0.0169 (DISTWK) + 0.0601(WTRVIEW) + 0.0007(AVASCH) + 0.0006 (AVASHOP) + 0.0007(AVAREG) + 0.0653(NEIGHSEC) ……..…… (ii)

The coefficients of the above hedonic function can be interpreted as the approximate percentage change in the property prices relative to a per unit change in the given variable. Thus, additional bedroom would add 13% to the sale price of duplexes. Likewise, additional bathroom adds 9.4% to the sale price of duplexes while a square meter increase in the size of the built area would add 2.5% to duplex prices. The provision of garage contributes 10%, provision of balcony contributes 5.5%, provision of boy's quarters contributes 19.5% provision of swimming pool contributes 9% to the price of duplexes in the study area. Every one kilometer increases in distance to work decreases price of duplex in the area by 1.7%. Availability of quality schools, shopping centers, and recreational facilities contribute 0.7%; 0.6% and 0.7%, respectively, to the prices of duplexes in the area.

Conclusions and Recommendations

This study used a standard hedonic price model with transaction-based data to demonstrate that structural attributes and particularly, those that border on convenience, comfort, and display of affluence, have strong influence on the prices of duplexes in Lekki Peninsular area of Lagos metropolis. Specifically, the study showed that provision of boys' quarters, number of bedrooms, quality of construction, number of bath/toilets, size of the sitting room, provision of locked-up garage, plot size, views (ocean/lagoon), and neighborhood security are the first ten foremost attributes valued by prospective purchasers of duplexes, and are capitalized into prices for duplex accordingly. R^2 is approximately 80 per cent suggesting that both the explanatory and predictive performance of the model is reasonably good.

The study affirms that the housing attributes that are significant in a study area and their relative impact on house prices generally reflect the calibre of prospective purchasers in the market. Households in the study area apparently placed high premium on convenience, comfort, and elegance as reflected in the number, size and quality of accommodation required, and the priority given to availability of boys' quarters. For the career people that are predominant in the study area, availability of boys' quarters for driver and house maid is of particular importance as both spouses often go to work, have more than one car, and can afford to hire driver and house helps.

Given the relative homogeneity of the study area in terms of the socio-economic characteristics of residents as well as the locational and neighborhood characteristics; structural attributes remains the principal determinants of prices for duplexes. Prospective purchasers are willing to pay good premium for modern and tastefully finished duplexes with ample accommodation and modern facilities. Developers would do well to recognize the implicit contribution of each of these housing attributes and give them adequate consideration in their supplies to this fast growing sub-market of metropolitan Lagos.

This paper demonstrates the potentials of the technique to the study of housing markets in a developing country like Nigeria. In spite of the limitations posed by paucity of relevant property data and transaction details, scarcity of GIS resource and the relatively newness of the application of multiple regression analysis; the results point to the feasibility of the hedonic model in housing market analysis in a typical Nigerian city. The model has the potential for improving the understanding of the relative impact of the implicit housing attributes and how they are capitalized into house prices. It provides an alternative property valuation technique which is potentially reliable, efficient and statistically defensible.

The application of hedonic model in the study area however calls for further refinement. There is need for more precise measurement of the housing attributes, as well as improvement in the quality and quantity of transaction data which is only possible as the property market gets more matured and transparent; and as computer-based GIS resource becomes more readily available.

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Table 1: Housing Hedonic Variables for Duplex in Lekki Peninsular, Lagos.

Variables Definition	Variables Code	Variable Measurements
Transaction price of duplexes: Dependent Variable	PRICE	Measured in (₦)*
Number of bedrooms in the duplex	NUMROOM	Number of bedrooms available
Number of bath/toilets	NUMBATH	Number of bathroom/toilet available
Built up area	BUILTAREA	Measured in m^2 (approximately)
Balcony	BALCONY	Provided = 1, Otherwise = 0
Construction quality	CONSQUA	Good = 1, Otherwise = 0
In built Garage	GARAGE	Provided = 1, Otherwise = 0
Boys' quarters	BQ	Provided = 1, Otherwise = 0
Swimming pool	SPOOL	Provided = 1, Otherwise = 0
Plot size	PLTSZ	Measured in m^2 (approx.)
Quality of bath/toilet ware	BATHWARE	Good = 1, Otherwise = 0
Distance to place of work	DISTWK	Measured in kilometers (approx.)
View of the Atlantic Ocean or the Lagoon	WTRVIEW	Has View (partial or full) = 1 Otherwise = 0
Availability of schools	AVASCH	Available within 15 minutes walking distance=1,Otherwise = 0
Availability of shopping center(s)	AVASHOPS	Available within 15 minutes walking distance=1,Otherwise = 0
Availability of recreational facilities	AVAREC	Available within 10 minutes walking distance=1,Otherwise = 0
Neighborhood security	NEIGHSEC	Good = 1, Otherwise = 0

***1US$ = ₦155.**

Table 2: Descriptive Statistics of Variables

Variables	Minimum	Maximum	Mean	Standard Deviation
PRICE (₦)	45000000.0000	150000000.0000	77358000.0000	27114000.0000
NUMROOM	3.0000	8.0000	4.4259	1.00302
NUMBATH	3.0000	8.0000	4.6218	1.11193
BUILTAREA(m^2)	350	750	450.8808	95.72315
BALCONY	0.0000	1.0000	0.8964	0.30557
CONSQUA	0.0000	1.0000	0.7016	0.29869
GARAGE	0.0000	1.0000	0.5492	0.19835
BQ	0.0000	1.0000	0.7979	0.40259
SPOOL	0.0000	1.0000	0.04113	0.068631
PLTSZ(m^2)	675	3225	847.2539	460.15761
BATHWARE	0.0000	1.0000	0.3101	0.60259
DISTWK(km)	0.8000	1.8000	1.4378	0.31766
WTRVIEW	0.0000	1.0000	0.3990	0.49096
AVASCH	0.0000	1.0000	0.6321	0.48348
AVASHOP	0.0000	1.0000	0.7461	0.43637
AVAREC	0.0000	1.0000	0.2228	0.41721
NEIGHSEC	0.0000	1.0000	0.7017	0.38979
No of observation	193			

***1US$ = ₦150.**

Table 3: Results of the Regression Analysis

	Linear model		Semi-log model		Log-log model	
Variables	Coefficient	t-statistics	Coefficient	t-statistics	Coefficient	t-statistics
Constant	7307815.206	18.970*	7.8955	22.306*	8.505	20.119*
NUMROOM	5080499.405	12.985*	0.1317	14.609*	0.1125	12.608*
NUMBATH	3005605.310	9.808*	0.0944	10.315*	0.0754	7.453*
BUILTAREA	53000.418	23.505*	0.0253	21.602*	0.0318	18.909*
BALCONY	650308.000	5.029**	0.0552	7.209**	0.0442	4.983**
CONSQUA	6155115.900	18.920**	0.1645	24.007**	0.1390	19.075**
GARAGE	4076100.750	11.505*	0.1034	11.980*	0.0946	12.980*
BQ	7800320.300	29.450*	0.1951	32.606	0.1755	26.540
SPOOL	6035400.120	1.087	0.0914	1.261	0.0198	1.122
PLTSZ	49410.920	6.604*	0.0170	5.204**	0.0151	3.863**
BATHWARE	2500845.000	3.912**	0.0135	4.793**	0.0126	2.945**
DISTWK	-615300.101	-1.005	-0.0169	-1.165	-0.0147	-1.269
WTRVIEW	4635300.117	3.085**	0.0601	5.448*	0.0645	2.978**
AVASCH	650854.200	2.785**	0.0007	2.984**	0.0004	2.650**
AVASHOP	690308.110	1.098	0.0006	1.167	0.0006	1.198
AVAREC	566080.305	1.125	0.0007	1.487	0.0006	1.160
NEIGHSEC	845800.150	2.972**	0.0653	3.087**	0.0555	2.817**
R^2	0.795		0.802		0.791	
Adjusted R^2	0.765		0.795		0.762	
F-Statistics	119.275	0.0000	155.300	0.0000	105.116	0.0000
D-Watson	1.60		1.775		1.508	
Observations	193		193		193	

White Test

***F* - Statistics (Prob) 1.6216(0.2813)**
Obs*R-squared 245.2870(0.5585)
(*) indicates 0.0 5% level of significance; (**) indicates 0.01% level of significance

Table 4: Collinearity Statistics

S/N	Variables	VIF	Tolerance
1.	NUMROOM	1.635	0.612
2.	NUMBATH	1.837	0.544
3.	BUILTAREA	1.642	0.609
4.	BALCONY	1.953	0.512
5.	CONSQUA	1.544	0.648
6.	GARAGE	2.372	0.422
7.	BQ	1.409	0.710
8.	SPOOL	1.562	0.640
9.	PLTSZ	1.649	0.606
10.	BATHWARE	1.812	0.552
11.	DISTWK	1.742	0.574
12.	WTRVIEW	2.235	0.447
13.	AVASCH	1.534	0.652
14.	AVASHOP	1.728	0.579
15.	AVAREC	2.309	0.433
16.	NEIGHSEC	1.569	0.637

Appendix 1: Samples of Empirical Studies in Hedonic Price Modeling

S/No	Author(s), Year, Country and sample characteristics	Classification of Variables	Methodology/Model Specification	Results/Findings
1	Magbelugbe I.F. Jos Urban Area, Nigeria, 1989. 1,310 appraisal data from property tax assessment; made up of 1124 multifamily and 186 single family units– occupied mainly by low– income and moderate – income households.	*Dependent variable:* Appraised annual value(rating assessments) *Independent variables:* – Building age, roof cover, ceiling material, nature of area and the building floor (earth or clay), building wall (sand or concrete), roof type; number of kitchens, floors; building floor area, building gross area; if building contain flats, has fence, share essential facilities; use zoning, zoning density.	Hedonic pricing model; Box – Cox transformation; separate analysis for single family, multi – family and both combined; market segmentation based a prior on the type of design of the houses.	Box-Cox λ transformation parameter is 0.2 for the multi-family and -0.1 for the single-family submarket. The hedonic parameters of these functional forms are significantly different from log-linear and linear functional forms, and those most commonly found in literature. The author justifies this claim by making comparison with results of similar studies in a number of other developing countries.
2	M.O. Bello & V.A. Bello, Lagos metropolis, 2007. Survey involved buyers and valuers which participated in the sale of some properties within Lagos metropolis.	*Dependent variable* = transaction prices *Dependent variables*: (1)Location (2) Security (3) Plot size (4) State of repairs (5) Age (6) Number of bedrooms (7) Size of room (8) Electricity (9) Number of toilet/bath (10) Nearness to work (11) Water (12) Finishes (13) Parking space (14) Telephone.	Relative Importance Index employed to assess the significance of each housing attributes; while the Kendall's Coefficient of Concordance (W) was used to measure the level of agreement between the rankings of buyers and sellers at each variable level and when the variables are combined. Tested at .05 level of significance using chi-square approximation.	Study revealed that both valuers and buyers agree that prices of blocks of flats are influence principally by location, state of repairs and water supply. For duplex there is both partial and high level of agreement between buyers and valuers. Regressing the attributes of each property against the actual price paid, the significance of each attribute was determined; which was then compared with the ratings of both the valuers and the buyers. Study concluded that the valuation methods used by Nigerian valuers do not take into consideration the buyers preference.

3	M.O. Bello and V.A. Bello, 2008, Akure, Nigeria. Sample survey of 190 households living in rented houses in randomly selected from two communities of Akure.	*Dependent variables*: Annual rent *Independent variables*: Wall, ceiling, roof, window, room size; availability of kitchen, toilet, water, fence, conditions of access, electricity drainage, crime, number of approved private schools and number of public schools, income of household heads, number of dependents, number of years spent on formal education, gender, length of stay in the developing and distance away from offensive refuse dump.	Study used a two-stage hedonic model. First stage to model property values as a function of housing attributes, while the second stage model willingness to pay.	The study identified households income, distance away from waste dump site and regularity of electricity supply as the major significant factors influencing household willingness to pay for better environmental services.
4	Ajide K. B. and Alabi, M. Lagos, Nigeria. 2010. Sample of 983 households through survey using Lagos statae Household Survey as sample frame.	*Dependent variable*: Monthly rent. *Independent variables*: Room size, age, floor level, kitchen, wall material, toilet facilities, ceiling, fencing, window, water, drainage, crime rate, pollution level, accessibility to employment, children school, hospital, market, recreational centre, and public transport.	Hedonic price model using the three functional forms - linear, semi-log and double-log – for purpose of comparison. The study showed that semi-log is the best of the three.	Of the three functional forms, semi-log gives the best fit with $R^2 = 0.67$, while the linear and double-log is 0.56 and 0.63, respectively. This confirms the number of earlier stud,,es that a non-linear functional form performs better than a linear form. Furthermore, structural attributes were found to be more statistically more significant than locational and neighborhood attributes in influencing house prices in Lagos, Nigeria.
5	Tse R.Y.C. & Love, P.E.D., Hong Kong, 2000. 139 sale prices selected from Class B (40-70 sq.m.) huoses. covering four housing estates (70%) and several non-estate type properties (30%).	*Dependent variable* = Transaction prices *Independent variables* = Floor area; age; availability of car park, shopping centre, sport facilities, cemetery view, whether estate type housing units.	Log -linear with (log) house prices In order to improve efficiency of the model in the face of heteroscedasticity, the study employ both heteroscedascity consistent convenience matrix estimator and weighted least squares method.	All variables except shop are significant. The explanatory power of the model is approx. 85% which decreased to 47% when location variables were removed. All the signs of the coefficients are usual except for SPORT. Estate type housing units and neighbourhood amenities have considerable influence on house prices in the study area.
6	Lennon H.T., Stephen W.K., Winky K.O., Hong Kong , 2007. 749 samples from Quarry Bay District made up of several small & one mega – scale housing estate occupied mainly by middle-income earners.	*Dependent variable* = Inflation adjusted transaction prices. *Independent variables* = total gross floor area, age, floor level, garden view, sea view, bad view, transport accessibility, luck number	Linear form; White's test used to detect possible heteroskedasticity; used Newey – West Heteroskedasticity consistent conveniences to correct observed heteroskedacity and correlations among observations in cross sectional data. Prices adjusted using the "Monthly Price Indices for Selected Popular Private Domestic Developments".	Most variables are statistically significant at conventional levels: and exhibited conventional signs. R^2 = 85% approx. Larger size, higher floor level, and better view commands a higher transaction prices. Property closer to the mass transit railway station commands a premium. Non- linear effect of floor level exerts an impact on prices. Feng Shui (luck number) also has influence on house prices.
7	Mishra , S.K. & Ngullie M.C., Kohima, capital city of Nagaland, India, 2008. Sample survey of 109 households living in rented houses randomly selected from residents of 19 wards(11 from each ward) in Kohaima capital city of Nagaland, India In 2008	*Dependent variable*: House rent *Independent variables*: House type, plot size, floor area, No of rooms, no of occupants, nature of ownership, distance from the nearest building, receiving enough sum share, parking space, waste disposal, facilities, drainage, public garden/ park nearby, water supply, regularity and source of water supply, nature of toilet, power connection, load-shedding or power failure, noise pollution, air pollution, water pollution, nature of water pollution, respondents feeling of satisfaction with the house, safety, income, family size and rent.	All variables (dependent and independent) are transformed into their (natural) logarithmic values.	Study suggests that consumers of rented house consider floor area, water supply and power supply complimentary to each other while other characteristics of house as substitutes of the floor area. Rented house is an inferior commodity and its income elasticity for the overall sample is negative, though statistically insignificant.

8	Selim, S., Turkey, 2008. 5,741 from 2004 Household Budget Survey Data which provides information on the socio-economic status, household composition, income, employment status, consumption a prediction, for rural and urban settlements and for Turkey as a whole.	*Dependent variable:* House Price *Independent variables*: House type, location characteristics, age, building type, saloon bathroom floor, living room floor, heating system, number of rooms, size, and other structural characteristics like toilet, water system, garage, pool, cable television, water system, elevator, sauna-Jacuzzi, garbage grinder and natural gas.	Hedonic pricing model, semi-log form; OLS employed to estimate the hedonic model; observed heteroscedasticity corrected by using the White's (1980) heteroscedasticity Consistent Coefficient Covariant Matrix.	Results suggest that water system, pool, type of house, number of rooms, house size, location characteristics and type of building are the most significant variables that affect house prices.
9	Wen Hai – zhen JIA, Sheng – huc Guo Xiao –ye, Hangzhou City, China, 2005. 2,473 housing samples from field survey of 290 housing communities in 5 old districts of China comprising of multi – storey all litter – tall – storey (above 7 floors) buildings.	*Dependent variable* : House price *Independent variables*: 18 independent variables including floor area, garage, attic, decoration degree, no of storey, environment, inner environments, community management, university nearby, entertainment facility, distance form CBD, distance to West lake, traffic condition, transaction time.	Hedonic pricing model; Linear functional forms; Model estimation method was OLS; Index of VIF (Variance Inflation Factor) was used to monitor the multicollinearity between independent variables.	14 out of 18 housing attributes had significant influence on housing price. $R^2 = 0.851$; D – w = 1.991 suggesting fitness of the model was high. F = 787.431 and p value = 0.000 suggesting fitness of samples data and an effective regression equation. The impact of market segment on the hedonic price model was not considered. Used on linear functional form: further improvement of the functional relation of some housing characteristics and housing prices.
10	Maurer R., Pitzer M., Sebastian S., Paris (France), 2004. 84,686 prices of houses characterized by heterogeneity in age and structural condition and vary from medieval quarters in the city centre, to newly built sections. .	*Dependent variable*: Transaction prices *Independent variables:* Area, number of toilets, no. of garage, number of service rooms, floors, elevator, garden, terrace, construction period, occupancy (vacant, partly occupied etc.)	Box – cox function	$R^2 = 89.1\%$; Produced a monthly index values based on the Box-Cox function which was compared with stock and bond indices with low correlations. Regarding the monthly frequencies, the standard deviations of apartments is higher than that of bonds, but less than half of the standard deviation of stock returns. For the value changes of the quarterly calculated index, the standard deviation is lowest for apartments. Contrary to stock and bonds, apartment shows significant first order autocorrelation for both, monthly and quarterly frequencies and significant third order auto correlation for monthly frequencies.