Mathematical Theory and Modeling
ISSN 2224-5804 (Paper) ISSN 2225-0522 (Online)
Vol.3, No.12, 2013

A Hedonic Pricing Model on Factors that Influence Residential Apartment Rent in Abuja Satellite Towns

Oduwole, H. K.* and Eze, H. T.
Department of Mathematical Sciences, Nasarawa State University, Keffi, Nasarawa State, Nigeria
*E-mail of the corresponding author: kenresearch@yahoo.com [2] ezehillary91@yahoo.com

Abstract
In this paper, we propose the hedonic price model to tracks the dynamics that influence rent apartment price in three satellite towns in FCT Abuja. The premise that rent apartment prices are influenced by a combination of attributes was tested with a standard hedonic model using a sample of 289 rent apartment in three satellite town (Bwari, Karshi and Kuje). Out of the seventeen explanatory variables used in the analysis, about ten of them show positive signs of considerably impact on rent apartment price. Variables like lot size (LOTSZ), room size (ROOMSZ), number of rooms (NUMRMS), number of bathroom/toilet (NUMBRMS) major access road (MAROAD), presence of government establishment (GOVTEST) were statistically significant at 1% and 5% significance level. The findings in this work suggest that satellite towns can be classified into two groups; established and growing satellite towns. Established satellite town implies that very few of these hedonic variables actually influence rent price, except for variable like LOTSZ and ROOMSZ which are common to all satellite towns in the study area. Growing satellite towns are those that more hedonic variables influence rent apartment price. Examples of growing satellite town are Bwari, Karshi and Kuje satellite towns. The population influx in the FCT is probably is the cause high rent apartment price being greatly influence by LOTSZ than any other variable. It is further suggested that hedonic research be employed to measure the growth rate of satellite towns in terms of locational and neighbourhood characteristics.
Keywords: Hedonic model, Residential apartment, Rent, Abuja

1. Introduction

Economic price theory is the most unique theory that explains price variation in real estate market. A well-known valuation practice is the decomposition of price using valuation models which in turn aims at measuring the influence of dominant attributes in terms of a component of price (Mills, 1972, Muth, 1979). Valuation models therefore are based on the proposition that if price can be decomposed, it can also be composed. Alonso (1964), Rosen, (1974) and Lancaster, (1966) all provide rationale for microeconomic theory that support these models.

There had not been much research done on the relative impact of factors that influence property or house price in developing countries. According to Dunse et al, (2001), this is largely due to lack of available property databases. Nappi-Choulet et al (2007) noted that the USA, UK and some part of Asian countries were leading in property research. From the developed countries where much have been done, findings in such literatures varies and are conflicting due to different contextual and cultural settings as well as difference property characteristic, which make such finding inapplicable to Nigeria. (Babawale et al, 2012)

In Nigeria, we have few research literatures in the area of property research. Among these are the works of Megboluge. (1989), Bello and Bello (2008), Omogun, (2010), Ajide and Alabi (2010) and Babawale et al (2012). Bello and Bello (2008) studied the willingness to pay for good environmental services in a loosely defined sub-market that apparently lack homogeneity using the two-stage hedonic model. In their findings, residential area used in the Hedonic model should be treated as a single market for housing service, this will invariably give home buyers an assumed probability to make decisive choice among available properties in the same area.. Ajide and Alabi (2010) examined the three standard Hedonic functional forms for a sub-market of Lagos State. They concluded that the semi-log method with the highest value of coefficient of determination ($R^2 = 0.67$) is the most efficient method. Other Hedonic model application in property research included the analysis of level of contribution of each property characteristics to property value (Selim, 2009, Wang and Zhang, 2010, Ajide and Kareem, 2010), market segmentation (Dunse et at., 2001; Dunse and Jones, 2002, and Fletcher et al., 2000) and property value estimation and prediction (Goodman and Thibodeau, 2003; and Limsobunchai et al., 2004)

Hedonic model basically involves regression analysis, in which the property value (capital or rent value) is viewed as a dependent variable and the property attributes or characteristics are the independent variables. The regression coefficients of the property characteristics represent the contribution of such characteristics to the property value. Despite the wide gap that exists in the literature on property research in Nigeria, it is necessary to continue in research into more robust and comparative studies in other to fill in this gap. This paper therefore is aimed at a comparative study in assessing the impact of some characteristics on residential apartment rent using three satellite town (Kuje, Bwari and Karshi) in Abuja, the Federal Capital Territory of Nigeria.

2. An Overview of Hedonic Pricing Model (HPM)

Hedonic pricing model theory is based on the assumption that the price p of a property such as (office, house, rent price) is a direct function of a fixed number of characteristics (say k) measured by quantities z_k (Limsombunchai et at., 2004 and Hamid, 2006). Hence the hedonic pricing model decomposes the transaction price into various components or characteristics. The Hedonic price function (HPF) is normally written as

$$p = f(z_1, z_2, \cdots, z_k, \xi_k) \quad .... \quad (1)$$

where ξ_k is the random error term, also referred to as white noise. In order to be able to estimate the marginal contributions of the characteristics (z_k) using standard regression techniques equation (1) will be specified as a parametric model. There are three best use hedonic specification models in the literatures, which include linear, semi-log and double log model. These three models are expressed below:

Linear model: $$p = \beta_0 + \sum_{k=1}^{N} \beta_k + \xi_k \quad .... \quad (2)$$

Semi-log model: $$Log\, p = \beta_0 + \sum_{k=1}^{N} \beta_k z_k + \xi_k \quad .... \quad (3)$$

Double-log model: $$Log\, p = \beta_0 + \sum_{k}^{N} \beta_k Log z_k + \xi_k \quad .... \quad (4)$$

where β_0 and β_k are the intercept term and the characteristics parameters to be estimated, p is the dependent variable and z_k are the independent variables (explanatory variables). In real life such explanatory variables will be categorical rather than continuous and are represented by a set of dummy variables which takes the value 1 if a variable or characteristics belong to the category in question and the value of 0 otherwise

Hedonic price function (HPF) model become inefficient when the correct functional form is not used. From the work of Linneman (1980), housing market researchers have generally used the Box and Cox technique to search for the best functional form. A two parameter Box-Cox transformation as shown in equation (5) below on a general Hedonic function as a specification of an HPF has been widely advocated (Horng and Yueh, 1999).

$$\frac{p^{\lambda}-1}{\lambda} = \beta_0 + \beta_1 \frac{L^{\theta}-1}{\theta} + \beta_2 \frac{S^{\theta}-1}{\theta} + \beta_3 \frac{N^{\theta}-1}{\theta} + \xi \quad .... \quad (5)$$

where λ is the parameter used to perform a transformation on price variable, θ is a parameter to transform the independent variables, L is the location characteristics, S is the structural characteristics and N is the neighbourhood characteristics. The $\beta_0's$ are the market determined parameters in the model and ξ is the vector of error terms which is normally distributed with mean zero and variance σ^2. If (λ, θ) corresponds to (1, 1), the hedonic equation (5) is equivalent to the linear specification and when (λ, θ) corresponds to (0, 0), the equation approximate the natural logarithm. In practice, the linear regression of HPF which implies that (λ, θ) corresponds to (1,1) is not always reasonable under the hedonic price theory since its assumed that inherent prices of characteristics/attributes is constant. Hence the linear form should be excluded from the hedonic price function, since the characteristics parameters β_k are allow to change over time when demand and supply conditions changes. It can assume that the only allowance for the linear from should be that price is constant for a very short time and for reasons best implied by the researcher.

In determining the correct value of λ and θ, Linneman (1980) and Halvorsen and Pollakowski, (1981) used the maximum likelihood estimate method, while Megbolugbe, (1989) and Mok, Chan and Cho, (1985) used the Box-Cox technique to search for the best functional form with the explicit condition that $\lambda = \theta$

In this paper, the hedonic pricing model takes the following general form:

$$p_k = f(SC_k, NC_k, LC_k, \xi_k) \quad .... \quad (6)$$

$$\log_e p_k = f(SC_k, NC_k, LC_k, \xi_k) \quad .... \quad (7)$$

where

p_k : the rent price of Residential apartment k in Nigerian currency (i.e. naira)
$\log_e p_k$: the natural logarithm of rent price of residential apartment k
SC_k : a vector of structural characteristics of residential apartment k
NC_k : a vector of neighbourhood characteristics of residential apartment k
LC_k : a vector of locational characteristics of residential apartment k
ξ_k : a vector of random error term with respect to any form of property characteristic of residential apartment k

The log transformation was used since it reduces the problem of heteroskedasticity associated with the use of the highly-skewed residential apartment rent price variable. This study considers some neighbourhood and locational characteristics that are not found in previous models. These include neighbourhood characteristics like availability of pipe borne water and provision of electricity within the given area. All these listed characteristics are expected to be provided by the local and federal government authorities/agencies. There are some apartments that already have borehole installed in the estates or a group of residential apartments in a fenced area.

3. Research Method

3.1 The Study Area

The study area is Abuja, which is the Federal Capital Territory (FCT) of Nigeria. The Territory was formed in 1976 from parts of former Nasarawa, Niger, and Kogi States. The territory is located just north of the confluence of the River Niger and Benue River. It is bordered by the states of Niger to the West and North, Kaduna to the northeast, Nasarawa to the east and south, and Kogi to the southwest. Lying between latitude 8.25^0 and 9.20^0 north of the equator and longitude 6.45^0 and 7.39^0 east of Greenwich Meridian, Abuja is geographically located in the center of the country. The FCT is currently made up of six local councils, comprising the City of Abuja and five Local Government Areas, namely Abaji, Gwagwalada, Kuje, Bwari and Kwali.

The three satellite towns in the study area are Bwari, Kuje and Karshi. The three satellite towns chosen for this research have the same homogeneous properties in term of the hedonic characteristics under study. Bwari Area Council is located at the North East of the Federal capital territory (FCT). Kuje Area Councl is about 40 km south west of Abuja, the Capital of Nigeria. It has an area of 1,644 km^2 and a population of 97,367 at the 2006 census. Karshi area council is located south east of the FCT having boundary with Nasarawa State.

3.2 Variable Definition

Table 1 shows the description of variables used in the study. There are three hedonic variables types; neighbourhood , locational and Structural characteristics. These variables could be dummy or continuous. The dependent variable is the rent price per year (RENTPR), while others are the independent variables or predictor variables.

Table 1 Description of Rent apartment Hedonic Variables for three satellite towns in the FCT, Abuja.

S/N	Variable Name	Variable Types	Variable Code	Description & Variable Measurement
1	Rent Price	Dependent	RENTPR	Rent price per year in Nigerian currency (Naira) [1USD $ = ₦160]
2	Lot size	SC (Continuous)	LOTSZ	The size of the whole residential apartment measured in m^2
3	Number of Rooms	SC (Dummy)	NUMRMS	Total number of rooms excluding bathrooms and kitchen
4	Number of Bathrooms	SC (Dummy)	NUMBRMS	Total number of Bathrooms in the apartment
5	Packing space	SC (Dummy)	PARKSP	Availability of packing space for vehicles (Available =Yes, 0 = otherwise)
6	Floor Tiles Marble	SC (Dummy)	FLMARBLE	Presence of tiled floor (Marble) in the residential apartment. (Available =Yes, 0 = otherwise)
7	Size of Rooms	SC (Continuous)	ROOMSZ	The size of the room measured in m^2
8	Position of apartment	SC (Dummy)	PSTORIES	For residential apartment in stories buildings.
9	Government Establishment	LC (Dummy)	GOVTEST	The presence of government establishment (1=Yes, 0 = No)
10	Private Establishment	LC (Dummy)	PRIVEST	The presence of private establishment. (1=Yes, 0 = No)
11	Schools	NC (Dummy)	PSCHOOLS	The presence of schools (primary, secondary & Tertiary) in the neighbourhood. (1=Yes, 0 = No)
12	Recreational Site	LC (Dummy)	RECREAT	The presence of recreational sites (parks, zoos, beaches etc). (1=Yes, 0 = No)
13	Central Business District (CBD)	LC (Dummy)	DISCBD	Proximity to the CBD (businesses, markets etc) (Available within 15 minutes' walk=Yes, 0 = otherwise)
14	Major access road	NC (Dummy)	MAROAD	The availability of major access road in the neighbourhood. (Available =Yes, 0 = otherwise)
15	Minor access road	NC (Dummy)	MIROAD	The availability of minor access road in the neighbourhood. (Available =Yes, 0 = otherwise)
16	Electricity	NC (Dummy)	ELECTR	The presence of electricity installation in the neighbourhood. (Provided = 1, Otherwise = 0)
17	Pipe borne Water	NC (Dummy)	PIBORNE	The presence of pipe borne water (or borehole) installation in the neighbourhood. (Provided = 1, Otherwise = 0)
18	Crime Rate	NC (Dummy)	CRIMERT	Frequent cases of crime reported (1=high. 0= low)

Note: SC: Structural characteristics NC: Neighbourhood characteristics LC: Locational characteristics

3.3 Methodology

This study employed hedonic regression analysis to examine the impact of structural, neighbourhood and locational characteristics on rent apartment price in the three study areas (Kuje, Bwari and Karshi). The independent variables originally consisted of 17. Data were collected using structured questionnaire. This method was adopted due to apparent lack of reliable secondary data on property and rent market in Nigeria. With this approach, a sample of 300 questionnaires was administered, with 100 questionnaires samples for each satellite town. A total of 96 questionnaires from Bwari, 99 from Karshi and 94 from Kuje, making a total of 289 questionnaires were duly completed and analysed with the aid of Statistical Package for Social Sciences (SPSS).
The three major hedonic specifications were run to obtain estimates for the various hedonic parameters. Stepwise regression was used with the double log model specification. The initial variables that were entered into the stepwise regression procedure include RENTPR which is the dependent variable and the independent variables (LOTSZ, NUMRMS, PARKSP, NUMBRMS, ELECTR, FLMARBLE, PSTORIES, ROOMSZ, PIBORNE, GOVTEST, PSCHOOLS, PRIVEST, RECREAT, DISCBD, MAROAD, MIROAD and CRIMERT)

4. Results and Discussion

Table 2 presents the summary of descriptive statistics for each of the variables use in the analysis. Normally it is expected that for each of the impact of the explanatory variables on rent price to be significant, the data collected must be normally distributed.

Table 3 shows the result of the regression analysis for the linear model with respect to the three satellite towns. From the table it can be observed that 12 out of 17 estimated coefficient have expected positive sign at the Bwari satellite town, while 8 out of 17 estimated coefficient have expected positive sign at the Karshi satellite town and 10 out of 17 estimated coefficient have expected positive sign at the Kuje satellite town, Bwari has the highest number of hedonic variables influencing rent apartment price, followed by Kuje and Karshi been the least. In the linear model, the coefficient of determination R^2 (0.851, 0.837 and 0.812) for the three satellite towns indicates that the model captures a very reasonably share of the variation in the dependent variable (RENTPR). The F-values are all significant implying overall strength of the model. LOTSZ, ROOMSZ, PRIVEST and CRIMERT are common variable that influence rent apartment prices in all the locations. The following estimated coefficient (Gwari: LOTSZ, NUMBRMS, ELECTR, MAROAD, Karshi: LOTSZ, ROOMSZ, PSCHOOL, Kuje: LOTSZ, NUMBRMS, ROOMSZ) are statistically significant at 90% significant level

Table 4 shows the result of the regression analysis for the semi log model with respect to the three satellite towns. From the table it can be observed that 10 out of 17 estimated coefficient have expected positive sign at the Bwari satellite town, while 9 out of 17 estimated coefficient have expected positive sign at the Karshi satellite town and 8 out of 17 estimated coefficient have expected positive sign at the Kuje satellite town, Bwari has the highest number of hedonic variables influencing rent apartment price, followed by Karshi and Kuje been the least. In the semi log model, the coefficient of determination R^2 (0.890, 0.859 and 0.779) for the three satellite towns indicates that the model captures a very reasonably share of the variation in the dependent variable (LnRENTPR). The F-values are all significant implying overall strength of the model. LOTSZ, is a common variable that influence rent apartment prices in all the locations, while NUMBRMS are common to Bwari and Kuje satellites towns and MAROAD is common to Bwari and Kuje satellite towns. The following estimated coefficient (Bwari: LOTSZ, NUMRM, NUMRMS, ELECTR, MAROAD, Karshi: LOTSZ, ROOMSZ, MAROAD, Kuje: LOTSZ, NUMBRMS, ROOMSZ) are statistically significant at 90% significant level.

Table 5 shows the result of the regression analysis for the double log model with respect to the three satellite towns. From the table it can be observed that 11 out of 17 estimated coefficient have expected positive sign at the Bwari satellite town, while 9 out of 17 estimated coefficient have expected positive sign at the Karshi satellite town and 8 out of 17 estimated coefficient have expected positive sign at the Kuje satellite town, Bwari has the highest number of hedonic variables influencing rent apartment price, followed by Karshi and Kuje been the least. In the double log model, the coefficient of determination R^2 (0.885, 0.864 and 0.808) for the three satellite towns indicates that the model captures a very reasonably share of the variation in the dependent variable (LnRENTPR). The F-values are all significant implying overall strength of the model. LOTSZ, is a common variable that influence rent apartment prices in all the locations, while NUMBRMS are common to Bwari and Kuje satellite towns and ROOMSZ is common to Karshi and Kuje satellite towns The following estimated coefficient (Bwari: LOTSZ, NUMBRMS, ELECTR, MAROAD, Karshi: LOTSZ, ROOMSZ, PSCHOOLS, MAROAD, Kuje: LOTSZ, NUMBRMS, ROOMSZ) are statistically significant at 90% and 95% significant level. The result obtained from the semi log and double log model are quite similar.

The percentage contributions from the coefficient of the parameters of these models were measured. In a translog functional form with the dependent variable being expressed in natural log terms, a one-unit change in a non-binary independent variable is interpreted as a percentage effect on the dependent variable that is given by one hundred percent multiplied by the estimated coefficient. LOTSZ contributed about 147%, 103% and 55% to rent apartment price at the Bwari, Karshi and Kuje satellite towns respectively. ROOMSZ contributed 20.5%, 119% and 39.3% to rent apartment price at Bwari, Karshi and Kuje respectively.

Table 6, 7 and 8 shows the result obtained from stepwise regression perform on the double log model. The stepwise procedure summarizes the measure of the most effective hedonic variable on rent apartment price (RENTPR). From the result, the increment in the coefficient of determination (R^2) at successive steps and decrease in the standard error of estimate are all indications of improvement in each step. The following contributions were significant at 1% and 5% level – Bwari (LOTSZ), Karshi (LOTSZ, ROOMSZ, MAROAD, GOVTEST) and Kuje (LOTSZ. NUMBRMS, ROOMSZ).

The findings of this work show that rent apartment price is mostly influenced by the following LOTSZ, ROOMSZ, NUMBRMS, NUMRMS, MAROAD and GOVTEST. The result is in line with the work of Babawale *et at* (2012) who found that number of bedroom was the strongest apartment price predictor and was significant at 99% confidence level, followed by average size of bedroom and number of toilet/bathrooms.

In the current work, except for the linear model that should strong contribution of crime rate (CRIMERT) to rent apartment price, there is not much statistical evidence that CRIMERT affect rent price in the FCT. This is in contract to the work of Flippen, (2004), and Yusuf (2012) who observed that neighbourhoods with high profile crime experience decrease demand from home buyers which subsequently affect the prices residential property in the neighbourhood.

These satellite towns can be classified into two groups; established and growing. In established satellite town very few hedonic variables actually influence rent price greatly, except for variable like LOTSZ and ROOMSZ, while in growing satellite more hedonic variables influence rent apartment price. All the three cases in this work are examples of a growing satellite town is the Karshi satellite town. With more provision of road, electricity, pipe borne water and other government infrastructures, it is certain that rent apartments prices will be greatly influence in these areas.

Table 2: Descriptive statistics of variables in all the satellite towns

	Satellite Towns								
	BWARI			KARSHI			KUJE		
Variables	**Mean**	**S.E. Mean**	**Std. Dev.**	**Mean**	**S.E. Mean**	**Std. Dev.**	**Mean**	**S.E. Mean**	**Std. Dev.**
RENTPR	148937.500	4250.460	41645.838	11.8796	4830.284	.35488	169648.936	4200.994	40730.152
LOTSZ	77.660	1.314	12.875	76.570	1.704	16.958	82.320	1.674	16.232
NUMRMS	3.040	0.100	0.983	2.850	0.084	0.837	3.310	0.103	0.995
PARKSP	1.330	0.048	0.474	1.550	0.050	0.500	1.350	0.049	0.480
NUMBRMS	2.980	0.089	0.870	2.690	0.071	0.709	3.630	0.093	0.904
ELECTR	1.350	0.049	0.481	1.090	0.029	0.289	1.310	0.048	0.464
FLMARBLE	1.080	0.028	0.278	1.110	0.032	0.316	1.180	0.040	0.387
PSTORIES	1.590	0.050	0.494	1.750	0.044	0.437	1.450	0.052	0.500
ROOMSZ	5.354	0.051	0.50185	5.438	0.050	0.501	5.332	0.058	0.562
PIBORNE	1.040	0.021	0.201	1.060	0.024	0.240	1.200	0.062	0.601
GOVTEST	1.540	0.051	0.501	1.680	0.047	0.470	1.440	0.051	0.499
PSCHOOLS	1.660	0.049	0.477	1.790	0.041	0.411	1.490	0.052	0.503
PRIVEST	1.580	0.051	0.496	1.810	0.040	0.396	1.510	0.052	0.503
RECREAT	1.650	0.049	0.481	1.810	0.040	0.396	1.320	0.048	0.469
DISCBD	1.300	0.047	0.462	1.260	0.044	0.442	1.240	0.045	0.432
MAROAD	1.500	0.051	0.503	1.540	0.050	0.501	1.190	0.041	0.396
MIROAD	1.700	0.047	0.462	1.750	0.044	0.437	1.590	0.051	0.495
CRIMERT	1.530	0.051	0.502	1.480	0.050	0.502	1.480	0.052	0.502
Observations		96			99			94	

S.E. Mean – Standard Error of mean : **Std. Dev.** – Standard Deviation

Table 3: Result of the [a]Regression analysis for the Linear model

	Satellite Towns											
	BWARI				KARSHI				KUJE			
Variables	**β Coeff**	**Std. Error**	**t-stat.**	**p-value**	**β Coeff**	**Std. Error**	**t-stat.**	**p–value**	**β Coeff**	**Std. Error**	**t-stat.**	**p-value**
Constant	-108247.435	30678.284	-3.528	0.001	-116679.245	37424.497	-3.118	0.003	-77269.925	29094.806	-2.656	0.010
LOTSZ	2718.359	237.302	11.455	0.000	1999.671	295.519	6.767	0.000	1051.243	188.586	5.574	0.000
NUMRMS	123.909	2387.144	0.052	0.959	-1022.539	4265.053	-0.240	0.811	1238.555	2824.411	0.439	0.662
PARKSP	1561.846	4529.978	0.345	0.731	-432.591	4798.925	-0.090	0.928	-3713.108	4769.913	-0.778	0.439
NUMBRMS	4615.773	2586.228	1.785	0.078	-1908.259	4434.351	-0.430	0.668	17178.101	3572.146	4.809	0.000
ELECTR	8010.173	4590.011	1.745	0.085	-10758.180	8161.648	-1.318	0.191	4668.834	5218.053	0.895	0.374
FLMARBLE	-1169.458	7478.545	-0.156	0.876	-10736.304	7798.282	-1.377	0.172	2983.643	6303.151	0.473	0.637
PSTORIES	420.690	5964.692	0.071	0.944	8742.628	5482.322	1.595	0.115	-4124.892	5506.515	-0.749	0.456
ROOMSZ	5445.739	4550.497	1.197	0.235	25860.749	7344.910	3.521	0.001	17583.670	4844.677	3.629	0.001
PIBORNE	-10082.220	10741.282	-0.939	0.351	-2284.933	10812.981	-0.211	0.833	-1450.327	3750.950	-0.387	0.700
GOVTEST	-6234.771	6489.762	-0.961	0.340	8692.005	7479.057	1.162	0.249	3050.891	6255.847	0.488	0.627
PSCHOOLS	3939.751	6753.865	0.583	0.561	-13745.170	8028.911	-1.712	0.091	3763.526	5609.764	0.671	0.504
PRIVEST	1255.750	6547.544	0.192	0.848	2052.407	8567.656	0.240	0.811	5256.610	6597.736	0.797	0.428
RECREAT	6872.354	6278.150	1.095	0.277	6689.641	7838.297	0.853	0.396	-3468.972	5909.905	-0.587	0.559
DISCBD	-1653.736	4528.845	-0.365	0.716	-3281.276	5963.863	-0.550	0.584	-409.896	5942.009	-0.069	0.945
MAROAD	-8694.919	4972.168	-1.749	0.084	-9016.922	5651.002	-1.596	0.114	-6629.004	6277.527	-1.056	0.294
MIROAD	1383.755	5242.780	.264	0.793	1804.513	6096.852	0.296	0.768	-2021.684	4771.715	-0.424	0.673
CRIMERT	2356.560	3840.551	.614	0.541	2879.889	4728.552	0.609	0.544	1059.330	4775.245	0.222	0.825
R	0.922				0.915				0.901			
R^2	0.851				0.837				0.812			
Adjusted R^2	0.818				0.803				0.770			
F-statistics	26.185				24.426				19.285			
Std Error of Estimate	17746.789				21357.771				19545.621			
Probability	0.000				0.000				0.000			
Durbin-Watson	2.116				2.033				1.710			
Observations	96				99				94			

a.Dependent Variable: RENTPR

Table 4 Result of the [a]Regression analysis for the Semi Log model

	Satellite Towns											
	BWARI				KARSHI				KUJE			
Variables	**β Coeff**	**Std. Error**	**t-stat.**	**P-value**	**β Coeff**	**Std. Error**	**t-stat.**	**p–value**	**β Coeff**	**Std. Error**	**t-stat.**	**p-value**
Constant	10.011	0.195	51.451	0.000	9.733	0.257	37.840	0.000	10.590	0.216	49.129	0.000
LOTSZ	0.022	0.002	14.595	0.000	0.015	0.002	7.631	0.000	0.008	0.001	5.459	0.000
NUMRMS	-0.027	0.015	-1.787	0.078	-0.043	0.029	-1.463	0.147	0.007	0.021	0.330	0.743
PARKSP	0.000	0.029	0.006	0.995	-0.014	0.033	-0.430	0.668	-0.026	0.035	-0.731	0.467
NUMBRMS	0.030	0.016	1.848	0.068	-0.015	0.030	-0.484	0.629	0.124	0.026	4.702	0.000
ELECTR	0.050	0.029	1.710	0.091	-0.092	0.056	-1.643	0.104	0.032	0.039	0.836	0.406
FLMARBLE	-0.004	0.047	-0.075	0.940	-0.071	0.054	-1.318	0.191	-0.018	0.047	-0.393	0.695
PSTORIES	0.019	0.038	0.506	0.614	0.055	0.038	1.469	0.146	-0.027	0.041	-0.666	0.507
ROOMSZ	0.035	0.029	1.207	0.231	0.223	0.050	4.409	0.000	0.071	0.036	1.974	0.052
PIBORNE	-0.099	0.068	-1.459	0.149	0.023	0.074	0.305	0.761	-0.003	0.028	-0.094	0.925
GOVTEST	-0.042	0.041	-1.011	0.315	0.072	0.051	1.409	0.163	0.000	0.046	-0.015	0.988
PSCHOOLS	0.001	0.043	0.026	0.979	-0.087	0.055	-1.574	0.119	0.046	0.042	1.116	0.268
PRIVEST	0.005	0.042	0.109	0.913	0.029	0.059	0.497	0.621	0.028	0.049	0.569	0.571
RECREAT	0.066	0.040	1.655	0.102	0.026	0.054	0.488	0.627	-0.038	0.044	-0.864	0.390
DISCBD	-0.016	0.029	-0.541	0.590	-0.031	0.041	-0.761	0.449	0.011	0.044	0.246	0.806
MAROAD	-0.054	0.032	-1.716	0.090	-0.095	0.039	-2.447	0.017	-0.022	0.047	-0.483	0.631
MIROAD	0.011	0.033	0.321	0.749	0.044	0.042	1.039	0.302	-0.030	0.035	-0.847	0.400
CRIMERT	-0.003	0.024	-0.116	0.908	0.023	0.032	0.700	0.486	-0.004	0.035	-0.113	0.910
R	0.944				0.927				0.883			
R^2	0.890				0.859				0.779			
Adjusted R^2	0.866				0.829				0.730			
F-statistics	37.250				28.927				15.793			
Std Error of Estimate	0.11256				0.14679				0.14481			
Probability	0.000				0.000				0.000			
Durbin-Watson	1.987				1.968				1.861			
Observations	96				99				94			

a.Dependent Variable: LnRENTPR

Table 5 Result of the [a]Regression analysis for the Double Log model

	Satellite Towns											
	BWARI				KARSHI				KUJE			
Variables	**β Coeff**	**Std. Error**	**t-stat.**	**p-value**	**β Coeff**	**Std. Error**	**t-stat.**	**p–value**	**β Coeff**	**Std. Error**	**t-stat.**	**p-value**
Constant	5.041	0.372	13.568	0.000	5.487	0.427	12.851	0.000	8.310	0.402	20.649	0.000
LOTSZ	1.474	0.105	13.998	0.000	1.033	0.137	7.549	0.000	0.559	0.096	5.847	0.000
NUMRMS	-0.025	0.046	-0.545	0.588	-0.080	0.085	-0.937	0.352	0.045	0.062	0.729	0.468
PARKSP	0.010	0.042	0.236	0.814	-0.020	0.047	-0.433	0.666	-0.040	0.048	-0.848	0.399
NUMBRMS	0.088	0.049	1.800	0.076	-0.031	0.083	-0.371	0.711	0.426	0.081	5.253	0.000
ELECTR	0.073	0.043	1.700	0.093	-0.119	0.080	-1.498	0.138	0.048	0.052	0.924	0.358
FLMARBLE	-0.013	0.070	-0.178	0.859	-0.119	0.076	-1.563	0.122	-0.001	0.064	-0.021	0.984
PSTORIES	0.008	0.056	0.137	0.892	0.087	0.053	1.623	0.109	-0.040	0.055	-0.725	0.471
ROOMSZ	0.205	0.153	1.337	0.185	1.199	0.258	4.647	0.000	0.393	0.171	2.304	0.024
PIBORNE	-0.117	0.101	-1.157	0.251	0.019	0.105	0.184	0.854	-0.003	0.052	-0.065	0.948
GOVTEST	-0.054	0.061	-0.884	0.380	0.113	0.073	1.555	0.124	0.027	0.063	0.432	0.667
PSCHOOLS	0.026	0.064	0.407	0.685	-0.133	0.078	-1.701	0.093	0.055	0.056	0.981	0.330
PRIVEST	0.006	0.061	0.100	0.921	0.014	0.083	0.171	0.865	0.039	0.066	0.603	0.548
RECREAT	0.072	0.059	1.231	0.222	0.044	0.077	0.573	0.569	-0.050	0.059	-0.843	0.402
DISCBD	-0.017	0.043	-0.406	0.686	-0.037	0.058	-.639	0.525	-0.003	0.059	-0.043	0.966
MAROAD	-0.083	0.047	-1.774	0.080	-0.121	0.055	-2.193	0.031	-0.037	0.063	-0.588	0.559
MIROAD	0.013	0.049	0.262	0.794	0.059	0.059	1.001	0.320	-0.024	0.048	-0.503	0.616
CRIMERT	0.016	0.036	0.436	0.664	0.028	0.046	0.597	0.552	-0.008	0.047	-0.163	0.871
R	0.941				0.929				0.899			
R^2	0.885				0.864				0.808			
Adjusted R^2	0.861				0.835				0.765			
F-statistics	35.257				30.167				18.854			
Std Error of Estimate	0.11534				0.14417				0.13398			
Probability	0.000				0.0000				0.000			
Durbin-Watson	2.072				1.984				1.779			
Observations	96				99				94			

a.Dependent Variable: LnRENTPR

Table 6. Stepwise Regression: Double Log for BWARI Satellite Town

Model Summary					ANOVA							Coefficients					
Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Model		Sum of Squares	df	Mean Square	F	Sig.	Model		B	Std. Error	t	Sig.
1	0.926[a]	0.857	0.856	0.11706	1	Regression	7.723	1	7.723	563.638	0.000[a]	1	(Constant)	5.129	.284	18.055	0.000
						Residual	1.288	94	0.014								
						Total	9.011	95					LnLOTSZ	1.554	.065	23.741	0.000

a. Predictors: (Constant), LnLOTSZ
b. Dependent Variable: LnRENTPR

Table 7. Stepwise Regression:Double Log for KARSHI Satellite Town

Model Summary					ANOVA							Coefficients					
Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Model		Sum of Squares	df	Mean Square	F	Sig.	Model		B	Std. Error	t	Sig.
1	0.886[a]	0.786	0.783	0.16514	1	Regression	9.697	1	9.697	355.58	0.000[a]	1	(Constant)	6.259	0.299	20.969	0.000
						Residual	2.645	97	0.027								
						Total	12.342	98					LnLOTSZ	1.304	0.069	18.857	0.000
2	0.906[b]	0.821	0.817	0.15187	2	Regression	10.128	2	5.064	219.55	0.000[b]	2	(Constant)	5.860	0.290	20.232	0.000
						Residual	2.214	96	0.023				LnLOTSZ	0.959	0.102	9.407	0.000
						Total	12.342	98					LnROOMSZ	1.116	0.258	4.323	0.000
3	0.911[c]	0.830	0.824	0.14874	3	Regression	10.240	3	3.413	154.29	0.000[c]	3	(Constant)	5.919	0.285	20.777	0.000
						Residual	2.102	95	0.022				LnLOTSZ	0.950	0.100	9.511	0.000
													LnROOMSZ	1.125	0.253	4.448	0.000
						Total	12.342	98					LnMAROAD	-0.098	0.043	-2.255	0.026
4	0.916[d]	0.839	0.832	0.14527	4	Regression	10.358	4	2.590	122.71	0.000[d]	4	(Constant)	5.958	0.279	21.376	0.000
						Residual	1.984	94	0.021				LnLOTSZ	0.924	0.098	9.403	0.000
													LnROOMSZ	1.143	0.247	4.625	0.000
													LnMAROAD	-0.112	0.043	-2.624	0.010
						Total	12.342	98					LnGOVTEST	0.109	0.046	2.364	0.020

a. Predictors: (Constant), LnLOTSZ
b. Predictors: (Constant), LnLOTSZ, LnROOMSZ
c. Predictors: (Constant), LnLOTSZ, LnROOMSZ, LnMAROAD
d. Predictors: (Constant), LnLOTSZ, LnROOMSZ, LnMAROAD, LnGOVTEST
e. Dependent Variable: LnRENTPR

Table 8. Stepwise Regression: Double Log for KUJE Satellite Town

Model Summary					ANOVA							Coefficients					
Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Model		Sum of Squares	df	Mean Square	F	Sig.	Model		B	Std. Error	t	Sig.
1	0.807[a]	0.651	0.647	0.16559	1	Regression	4.701	1	4.701	171.456	0.000[a]	1	(Constant)	7.494	0.345	21.719	0.000
						Residual	2.523	92	0.027								
						Total	7.224	93					LnLOTSZ	1.028	0.079	13.094	0.000
2	0.883[b]	0.779	0.774	0.13242	2	Regression	5.628	2	2.814	160.499	0.000[b]	2	(Constant)	8.560	0.312	27.397	0.000
						Residual	1.596	91	0.018				LnLOTSZ	0.649	0.082	7.942	0.000
						Total	7.224	93					LnNUMBRMS	0.479	0.066	7.271	0.000
3	0.891[c]	0.794	0.787	0.12861	3	Regression	5.735	3	1.912	115.584	0.000[c]	3	(Constant)	8.159	0.342	23.854	0.000
						Residual	1.489	90	0.017				LnLOTSZ	0.615	0.080	7.652	0.000
													LnNUMBRMS	0.420	0.068	6.193	0.000
						Total	7.224	93					LnROOMSZ	0.372	0.146	2.543	0.013

a. Predictors: (Constant), LnLOTSZ
b. Predictors: (Constant), LnLOTSZ, LnNUMBRMS
c. Predictors: (Constant), LnLOTSZ, LnNUMBRMS, LnROOMSZ
d. Dependent Variable: LnRENTPR

5. Conclusion

This study used the standard hedonic price specification models to demonstrate that structural, neighbourhood and locational attributes have strong influence on the rent apartment prices at the three study area. Specifically, the study showed that provision of major access road (MAROAD) number of rooms (NUMRMS), number of bathroom/toilets (NUNBRMS), lot size of the whole apartment (LOTSZ), provision of electricity (ELECTR), proximity to private establishment (PRIVEST) and central business district (DISCBD), the presence of schools in the neighbourhood (PSCHOOLS) and crime rate (CRIMERT) are the foremost attributes valued by rent apartment occupant in Abuja. The coefficient of determination R^2 is approximately 80 per cent for all the study area suggesting that both the explanatory and predictive performance of the model is reasonably good.

The population influx in the FCT probably is the cause of rent apartment price being greatly influence by LOTSZ than any other variable. Better and progressive housing policy must be put in place in the FCT to reduce the high rate of rent price on residential apartments. The study affirms that the satellite town can be grouped in relation to how hedonic variables influence the choice of rent apartment of individuals resident in a given area. The government should fast-track development by the provision of road, electricity, water and security for the populace. Abuja as a Federal Capital Teritory is largely influence by large population in the satellite town. According to Babawale and Johnson (2012) hedonic 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. We further strengthen this view and also add that hedonic model can be used to categorize emerging cities.

References

Ajide, K. B., and Alabi, M. (2011). Does the Functional Form Matter in the Estimate of Hedonic Price Model for Housing Market? *The Social Science*, 5(6), 559-564.

Ajide, B. K. and Kareem, I. O. (2010), Hedonic analysis of residential housing market in a third world: A preliminary investigation. *The Social Sciences:* 5(6): 520 – 524

Alonso, W. (1964). Location and Land Use: Toward a General Theory of Land Rent. Cambridge, MA: Harvard University Press.

Babawale, G.K., Koleoso, H. A. and Otegbulu, C. A. (2012); A Hedonic Model for Apartment Rentals in Ikeja Area of Lagos Metropolis. *Mediterranean Journal of Social Sciences* 3 (3) September 2012 Doi: 10.5901/mjss.2012.v3n3p109

Babawale, G. K., & Johnson, O. (2012). The Specification of Hedonic Indexes for Duplex in Lekki Peninsular Area of Lagos Metropolis. Elixir Social Science, 45, 7689-7698.

Bello, M. O. and Bello, V. A. (2007). The influence of Consumers Behaviours On the Variables Determining Residential property values in Lagos, Nigeria. American Journal of Applied Sciences, 4(10), 774-778. http://dx.doi.org/10.3844/ajassp.2007.774.778

Dunse, N. A. and Jones, C. A. (2002), The Existence of Office submarket in Cities. *Journal of Property Research;*19(2), 159 – 182

Fletcher, M., Gallimore, P. and Mangan, J. (2000); The Modelling of Housing Submarkets. *Journal of Property Investment and Finance.* 18(4), 473-487

Flippen, C. (2004). Unequal Return to Housing Investment? A Study of Real Housing Appreciation among Black. White and Hispanic Social Forces, 82, 1523-1552.

Halvorsen, R. and Pollakowski,H. O. (1981), Choice of functional form for Hedonic price equations, *Journal of Urban Economics*, Vol.10, pp.37-49, 1981.

Hamid, A. M. (2006), Price-contour-based Spatial Dummy variables for segmenting Market in the Geographic Information System Assisted Hedonic Modelling of Residential prices. *Malaysian Journal of Real Estate.* 1(1), 39-53

Horng, J. C. and Yueh, H. L.(1999). Specification of the Hedonic Price Model for Taipei Housing Market. *Information and Management Sciences* 10(4),1-13

Lancaster K. J. (1966);A New Approach to Consumer Theory. *Journal of Political Economy*.;74: 132-157.

Limsombunchai, V., Gan, C. and Lee, M. (2004), Housing Price Prediction: Hedonic Price Model versus Artificial Neural Network. *Americian Journal of Applied Sciences* 1(3), 193-201

Linneman, P. (1980); Some empirical results on the nature of the hedonic price function for the urban housing market, *Journal of Urban Economics*, 8, 47-68,.

Megbolugbe, I. F. (1989). A Heldonic Index Model: The Housing markets of Jos, Nigeria. Urban Studies, 26, 486-494. http://dx.doi.org/10.1080/00420988920080551

Mills, E. S. (1972). Studies in the Structure of the Urban Economy. *Baltimore:* Johns Hopkins Press for Resources for the Future.

Mok, H. M. R., Chan, P. P. K., & Cho, Y. S. (1995). A Hedonic price model for private properties in Hong Kong. *Journal of Real Estate finance and Economics,* 10, 37-48. http://dx.doi.org/10.1007/BF01099610

Muth, R. F. (1969). Cities and Housing: The Spatial Pattern of Urban Residential Land Use. *Chicago:* University of Chicago Press.

Nappi-Choulet, I., Maleyre, I. and Maury, T. (2007);A Hedonic Model of office Prices in Paris and its immediate Suburbs. *Journal of Property Research.* 24(3), 241-263

Omoogun, C. B. (2010).The Impact of Landfills on Residential Property Values in Metropolitan Lagos. *Ph.D. Thesis*, Department of Estate Management, Covenant University, Ota, Nigeria. Department of Estate Management,Covenant University, Ota, Ogun State, Nigeria.

Rosen, S. (1974). Hedonic Price and Implicit Markets: Product Differential in Pure Competition. Journal of Political Economy, 82(1), 35-55. http://dx.doi.org/10.1086/260169

Selim, H. (2009) Determinants of Housing Prices in Turkey: Hedonic Regression versus Neural Network; *Expert System Applications.*36: 2843-2852

Yusuf, L. G. (2012); Hedonic price modelling of the influence of violent ethno-religious conflict on Residential property value in Bauchi Metropolic, Nigeria. *Journal of Sustainable Development.* 5(9); 85-97