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EDITORIAL COMMENTS

Welcome to yet another volume of the Journal of Environmental Design. Volume 15 of the JED contains several thought-provoking well researched papers on the various dimensions of the built environment. It must be stated that environmental problems in general have become intricate phenomena requiring a wide range of interests and experts in their planning, management and design. The JED continues in its 15th volume to highlight the works of these experts and presents their informed views and cutting age research findings for the benefits of policy makers and students of environmental studies. The papers have been peer-reviewed and carefully selected to ensure intellectual balance and intelligent discourse.

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Professor Best Ochigbo

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HEDONIC PRICING OF HOUSING QUALITY ATTRIBUTES IN ILORIN

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Abstract

The overall assumption of the hedonic price model (HPM) with respect to real estate is that house prices are affected by various variables and the price of the real estate is determined by certain characteristics. The hedonic pricing model allows inferring on the value of environmental good by observing the actual behavior of individual on related market. The study of hedonic property pricing has not received the needed attention in Nigeria property market. This has led to the problem of prioritization the property attributes. This study therefore analysed the rental price of 800 properties in Ilorin metropolis with a view to identifying the property attributes with higher price. The study employed hedonic price modeling to decompose the properties' and determine their individual prices. The first generalized hedonic regression model employed showed a dual role of more than two attributes with poor variance inflation factor characterized in the multi-collinearity test and the second model termed stepwise hedonic regression provided a correct estimate with total absence of multi-collinearity and was used to determine the price of the variable attributes. The finding revealed that building size, age, garage, swimming pool, access road and in-house water have about 73.5% explanatory power in rental price variation. The implicit prices of the significant attributes such as building size, age, garage, swimming pool, access road and in-house water were N89,908, - N28,561, N19,097, N29,913, N71,318 and N61,178 respectively. The study therefore concludes that every stakeholder in property market in Ilorin metropolis should consider building size, age, garage, swimming pool, access road and water supply as indispensable attributes in the property markets as they command a significant price of the properties in the study area.

Keywords: housing attributes, rental pricing, hedonic modeling, Nigeria

Introduction

Housing price depends on a number of characteristics because residential housing are heterogeneous and multidimensional commodities characterized by durability, structural inflexibility and spatial fixity. The most commonly available information upon which determination of rental value could be based is broadly categorized into structural (physical characteristics), locational and neighborhood attributes (Chau *et al* 2001; So *et al* 1996). These attributes are referred to as intrinsic determinants; they are therefore endogenous to residential property and majorly influence property values. It is important to note that residential property market is localized market thereby affected by local property attributes. Chin and Chau (2003) showed that housing characteristics can be generally divided into three types: structure characteristics, neighbourhood characteristics and location characteristics. These characteristics influence the decision of choice in housing. In other words, household decision begins from choosing a place to live in, neighbourhood to live in within the geographical location, type of house to live in within the neighbourhood and especially the choice of his preferred characteristics and facilities. The decision of households concerning the choice of location, structural and neighborhood attributes of the residential property is limited by market rental value; because rental value is function of inherent property characteristics and which can be hedonically modeled out for valuation purposes (Wen, 2004). Determinants of residential property value requires indexing the individual hedonic attributes of the property, The hedonic housing approach regresses property rent against various housing characteristics to determine the importance of specific characteristics involving structural attributes such as number of rooms, bathrooms and etc. to explain property value (Bello, 2009).

Hedonic method is also used in estimating property values on the basis of its characteristics, and also to construct price indices. When this method is used in valuation purposes, the characteristics of a property are valued using the regression coefficients (the price of the unit of characteristics) and strength of relationship is determined and the rental price of a property can be estimated. One area in which the hedonic pricing model has been beneficial to researchers, practitioners and policy makers in the housing market is the area of assessing the value of properties, especially for rating purposes. Estimating or assessing the value of properties has traditionally focused on the use of conventional valuation methods like the comparable method, the income/investment method, the profit method, the residual/development method, and the contractor's/cost method. However, the use of the hedonic pricing model in assessing property values is now very common in most developed countries. The hedonic pricing model is indeed considered as one of the advanced valuation method in today's valuation practice (Pagourtzi *et al.*, 2003).

The hedonic pricing model is based on the premise that the price or value of a good is determined by the utility that the various attributes of the particular product bears. When the property values are regressed on the various housing attributes, the empirical magnitudes of the coefficients of the various attributes constitute the hedonic prices of the various characteristics (Fan et al., 2006; Wilhelmsson, 2009).

Literature Review

Tse and Love (2000) identified four categories of attributes, namely structural, physical, neighbourhood and environmental, to measure residential property values using a hedonic equation in Hong Kong. Their findings showed that estate-type dwelling units are valued by the homebuyers as attributes reflecting the preferred quality of a living environment. Rahman and Hadie (2004) analysed the importance of subdivision amenities on the residential value in Maryland, Washington. Using Box-Cox of hedonic price model to determine importance of each of the housing attributes on property value, various housing dummy variables were employed, and the result implied that the equilibrium price of housing increases with lot size and building area, and there is increase in housing price with open space and type of amenity depending whether there is walking paths and sitting area. The study concludes that measuring some specific subdivision amenities significantly affects residential property values, and omission of such variables produces biased coefficient estimates.

Uchenna (n.d) analysed the impact of housing attributes with respect to the cost of private rental housing in Lagos Nigeria. Box-cox hedonic model transformation was used for the study. The study employed both structural and environmental attributes of housing in Lagos. The result of hedonic analysis suggests that both structural and environmental attributes were influential attributes of rent of housing, however, structural attributes appeared to be more important than environmental attributes due to higher elasticity in price of the structural attributes such as room size, building size and parking lot. Therefore the outcome of this result contradicts the results in developed countries. Jim and Chen (2006) in their work noted that, the key neighbourhood quality factors that influenced house prices in China were presence of green spaces and proximity to water bodies. Coker et al., (2007) used penalty scoring to identify the quality of housing and neighbourhoods. Using descriptive statistics, the study revealed a significant gap in quality between the medium and low – income estates investigated. Aina and Somefun (2007) in their study of effect of urban facilities on rental value revealed that high rent is due to other factors such as accessibility, location and expanding commercial activities in Ikeja, and concluded with recommendations on policy statement for implementation by government to guide and monitor facilities provision standard in residential neighbourhood, provide as matter of urgency the platform for citizen accessibility to affordable housing with respect to the facilities provided in and outside the residence. Bello (2009) analysed the hedonic characteristics of residential property market in Helsinki housing market, Finland. The study examined the price elasticity of housing characteristics by employing hedonic modeling to show the relative impact or influence of these characteristic on house price. Nine important housing attributes were used in explaining the impact of each attributes or characteristic using the pool raw data collected from the Office of Statistic Finland, and the result revealed that among other interesting variables employed, building age, number of rooms, number of bathrooms and size of building have a strong elastic impact on property price and study therefore concluded that older building attributes in Helsinki is preferred by the older people and new housing attributes preferred by young citizens.

Ola (2011) analysed the existing physical housing condition in Mushin Lagos state as well as socio-economic impact of the residents. The result revealed that poverty impacts on the life of the people and housing condition. The research recommends for poverty alleviation programmes to include provision of effective housing loan scheme and improvement of standard of living condition. Aluko (2011) studied the locational effect of neighbourhood attributes on housing values in metropolitan Lagos. Using the analysis of variance and multiple regression model analysis method, the study concluded that location attributes and neighbourhood showed more important on house value when small geographical housing units are examined. Igbinosa (2011) analyzed the determinant of residential property value in Benin and Lagos. The study analysed 3,034 residential transactions with a view to identifying the most property characteristics that have significant influence. The study employed sensitivity analysis and the result of the analysis found that six property characteristics significantly determined the property value among which includes neighbourhood attractiveness, size of land, year of sold, number of room, month of sale
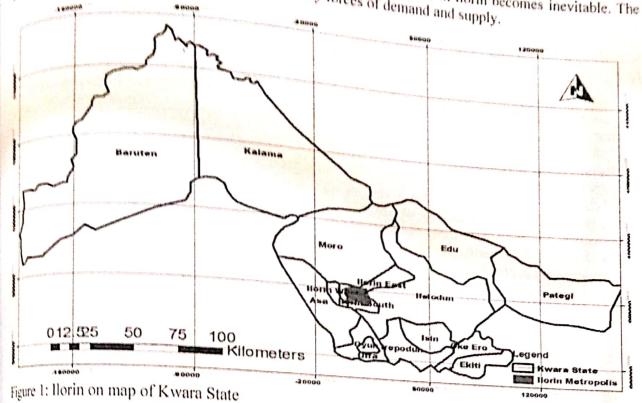
of property and type of property. The study identify the property characteristics that determine the sale price of property but could not examined the neighborhood attributes and the methodology employed for the study has not established extent of relationship and failed to fashion out degree of responsiveness of the property characteristics to property price.

Owoeye and Omole(2012) carried out a survey on housing and neighbourhood quality of residential core of Akure, using multiple linear regression model for the analysis of data collected. The study revealed that poor housing system and lack of neighbourhood facilities contributed a significant impact to poor quality of environment in the centre of the city. In Kenya, Kariuki (2012) opined that, development of property is the associating factors that increase the value of property in a neighbourhood, and further emphasized that, these factors increase credit facilities from financial institution, improvement of developments and new roads construction. Famuyiwa and Otegbulu (2012) examined the neighborhood infrastructure on rental value in Lagos. The study analysed the influence of fifteen neighborhood infrastructural characteristics on property value using hedonic regression model, the study found out that six variables out fifteen among which include accessibility, proximity to CBD, road condition security physical structure of building and serenity of the environment maintained statistical significant influence on rental value. This study concludes that neighborhood infrastructure characteristics generally have positive effects on housing values, as they constitute positive externalities to surrounding properties.

In the study by Anthony (2012) who examined the determinants of residential property value in Kumasi, Ghana for rating purpose, and the hedonic model was employed to model the implicit prices of housing attributes, the result showed that property age; location of the property; availability of garage, fence wall and swimming pool; and land registration; all influence residential property values in urban Ghana and the result of Chow Test, suggest that the implicit prices of the housing characteristics are constant over time, therefore the variables can pooled together for such analysis. Yusof and Ismail (2012) studied the performance of property determinants of property in Malaysia, the research demonstrated how statistical model can be used to analysed property investment. The study employed hedonic regression analysis to determine the relative contribution of the property determinants to price, and the result of the study identified location, number of room and building area as major determinants or influential factors that determined the performance of residential property investment in Malayia market. The study therefore used only structural attributes to establish the characteristics that determine the property value but did not incorporate locational influence and effect of neighborhood.

Many studies have shown that improvement in neighborhood quality has impact on rental value of properties. Availability of infrastructures such as good drainage, electricity, good road network, waste management/disposal, sewage, and water supply have great influence on the quality of the neighborhood (Chun and Li, 2013). Another similar study in Taiwan by Chun and Li (2013) noted that in-house environment, security, neighborhood quality, sports and leisure have more impact on residential satisfaction within the area. In this regard, household will be ready to pay more for the property they will enjoy maximum satisfaction. From the shore of Nigeria, Olayinka et al., (2013) in their research noted that proximity to the major transport route, number and sizes of bedrooms, conveniences, access road, drainage and security are the main factors affecting property value in Magodo neighbourhood of Lagos State. Anushree (2013) examined the determinant of residential property value in Jaipur city, using correlation analysis and stepwise regression to determine the strength of relationship and the most statistical significant determinants that influence the rental value. The result identified distance to main road, land use, hospital, recreation, parks and shopping determinants to have significant relationship with rental value and distance to main road, recreation and temple to have significant influence of rental value. Therefore the study considers only locational determinants with no consideration of neighborhood and structural determinants. Lyndall and Chris (2014) investigated the impact of housing infrastructure charges on housing price in Australia, the research discovered through hedonic model that infrastructure actually impact on housing price. The housing infrastructure charges paid by developer are passed on to home buyer and significant contributor to increase in housing prices and reduced housing affordability.

Study Area and Methodology

Ilorin is the study area and it is located in the north central Nigeria. It lies at an average elevation of about 290 metres above sea level (Fig 1). Ilorin climatic condition is of two distinct seasons; the rainy and dry

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...ons which are experienced every year. The major ethnic groups in Ilorin are the Yoruba and Fulani ...ters. In term of socio-economic characteristics, the area comprised of majorly civil servants who ...god in government activities, private services such banks, small and medium scale industries, ...isans. In term of property market analysis, Ilorin comprised majorly of residential, institutional and ...mercial housing investments. The property market is steady and non-cyclical and non-volatile; ...efore the pricing of the housing attributes may reflect real market fundamentals, and the need for ...nic pricing to determine the individual price of the each attribute in Ilorin becomes inevitable. The ...ket appears not to be artificial but determined by forces of demand and supply.

Figure 1: Ilorin on map of Kwara State

The study utilized multiple sales approach whereby the various sale prices of properties and their corresponding attributes were ascertained through a registered estate firms in Ilorin. The study simple-randomly utilized data on 800 properties rental transactions and attributes of the properties collected from registered estate surveying and valuation firms across Ilorin. The attribute data were measure as shown in table 1.

Table 1: Variables utilized for data collection

Variables		Definitions
i.	Property rental price ®	Annual price of property (Amount in Naira)
ii.	Building area (BA)	Building area in square meter
iii.	Age	No of year(s) the property has been built
iv.	Garage(G)	1 if there is garage, 0 otherwise
v.	Roof quality (RQ)	1 if there is aluminum with POP, 0 otherwise
vi.	Parking lot (PL)	1 if there is parking lot, 0 otherwise
vii.	Ext. Wall condition (WQ)	1 if the wall is painted, 0 otherwise
viii.	Landscape(L)	1 if there is interlock, 0 otherwise
ix.	Swimming Pool(SP)	1 if there is pool, 0 otherwise
x.	Security post(S)	1 if there is security post, 0 otherwise
xi.	Floor condition	1 if there is terrazzo, 0 otherwise
xii.	Access Road (RD)	1 if there is tarred access road, 0 otherwise
xiii.	Drainage (DR)	1 if there is covered drainage, 0 otherwise
xiv.	Water supply(WS)	1 if there is constant water supply, 0 otherwise
xv.	Electricity (ELET)	1 if there is regular supply, 0 otherwise

To determine accurate and consistent econometric model, selection of functional form that most suitably explains the connections between the explanatory variables and the property prices is very important. By

choosing the most appropriate functional form, the problem of heteroskedasticity can be reduced drastically. However, 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. There are three models that have been widely used in similar studies - the linear, semi-log, and the log-linear. The semi-log functional form reputed for its easy interpretation and estimated parameters as possessing a direct economic meaningfulness according to (Babawale and Johnson, 2012) was adopted for this study. The hedonic pricing model is adopted for the study on the premise that the value of a property is determined by the utility that the various attributes of the particular product bears. The hedonic pricing technique is used as a tool to reveal the implicit prices or rent of these attributes. When the property values are regressed on the various housing attributes, the empirical magnitudes of the coefficients of the various attributes constitute the hedonic prices of the various characteristics (Rosen, 1974)

$$\text{Log}Y = a + \log b_1 x_1 + \log b_2 x_2 + \ldots\ldots\ldots + \log b_n x_n + e$$

$$\text{Ln(Annual rental price)} = a + \text{ln Building area } x_1 + \text{ln Age } x_2 + \text{ln Garage } x_3 + \text{ln Roof quality}\ldots\ldots + \log b_n x_n + e$$

Results and Interpretation

Table 2 showed the descriptive analysis of the variables employed for the study. The average rental price of the properties is N169,000, and having an approximate building size of 264sqm and the mean age of the properties is approximately at 13years. About 70% of the properties had garage, 80% of the properties had good roof quality materials such as aluminum and POP, 30% of the properties had parking lot, 40% of the properties had a good external wall condition, 60% had a good landscape , 40% had swimming pool, 40% had security post, 80% had a good floor condition, 40% of the properties had good access road, 40% had a good and covered drainage, 60% had water supply and 40% had a constant power supply (electricity).

Table 2: Descriptive Statistics of the Variables Used

Variables	Mean	Standard Deviation	Minimum	Maximum
Property rental price	169000	85962.35	50000	350000
Building area (BA)	264	155.40	110	630
Age	13.4	6.07	2	22
Garage (G)	0.7	0.46	0	1
Roof quality (RQ)	0.8	0.40	0	1
Parking lot (PL)	0.3	0.459	0	1
Ext. Wall condition (WQ)	0.4	0.490	0	1
Landscape (L)	0.6	0.490	0	1
Swimming Pool (SP)	0.4	0.490	0	1
Security post (S)	0.4	0.491	0	1
Floor condition	0.8	0.400	0	1
Access Road (RD)	0.4	0.49	0	1
Drainage (DR)	0.4	0.491	0	1
Water supply (WS)	0.6	0.492	0	1
Electricity (ELET)	0.4	0.501	0	1

Table 3 showed the summary of the model employed for the study. About 24.4% variation in rental prices can be explained by six attributes. This indicates that six variables significantly influences rental price of the properties in Ilorin.

Table 3 Summary of Descriptive Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.494[a]	.244	.213	.21898

Table 4 showed the result of f-statistics of the model. The result showed that f-statistic (7.944) is statistically significant as *p-value* at 0.000 is less than 0.05 level of precision. This result indicates that difference in rental prices of different properties due to different attributes is statistically significant. Therefore the model is found significant in other word, the model is fit for the purpose of rental price modeling.

Table 4: Significance of the Model

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	5.333	14	.381	7.944	.000[b]
	Residual	16.544	345	.048		
	Total	21.877	359			

Table 5 showed the result of regression analysis. The coefficients of the regression results indicate magnitude of change or elasticity of the variables. The result revealed only six variable maintained significant influences on house price (building size, age, garage, swimming pool, access road and water supply). This result showed that there is a lot insignificant variables in the model which have contributed to high level of multi-collinearity in the variance inflation factor(VIF), therefore to carry out stepwise analysis to eliminate insignificant variables and make correction to the problem of multi-collinearity in the data set, and the result is presented in table 7, 8 and 9.

Table 5: Regression Results

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1 (Constant)	4.276	.146		29.310	.000		
Building Size	.551	.055	.537	10.011	.000	.761	1.314
Age	-.193	.033	-.379	-5.855	.000	.522	1.915
Garage(G)	.048	.024	.195	2.019	.044	.234	4.272
Roof quality (RQ)	.022	.033	-.085	.643	.520	.125	7.989
Parking lot (PL)	.015	.031	.056	.498	.619	.174	5.762
Ext.Wall condition (WQ)	.003	.017	.013	.189	.851	.475	2.104
Landscape(L)	.026	.024	-.110	1.059	.290	.204	4.902
Swimming Pool(SP)	.061	.024	-.249	2.491	.013	.220	4.547
Security post(S)	.020	.020	.073	.992	.322	.405	2.468
Floor condition	.003	.027	-.013	.122	.903	.185	5.419
Access Road (RD)	.095	.031	-.384	3.043	.003	.138	7.260
Drainage (DR)	.025	.016	.112	1.555	.121	.421	2.373
Water supply(WS)	.019	.009	.170	2.111	.036	.340	2.945
Electricity (ELET)	.010	.017	-.044	.614	.539	.427	2.341

Table 6 showed the summary of the stepwise regression. The result identified the variables that contributed significantly to house price variation. The result further identified that 75.4% variation in rental price is majorly contributed by six variables.

Table 6: Summary of Stepwise Analysis of Regression Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.784[a]	.754	.441	.41781

Table 7 showed the test of significance of the stepwise analysis of regression model. The f-statistic (17.960) at *p-value* at 0.000 is less than 0.05 level of precision is statistically significant. In other word the mean difference between rental prices of properties with difference attributes is statistically significant. Also the model is found fit for the analysis of stepwise regression. The f-ratio in this model is higher than the previous model in table 4 indicating large degree of freedom associated with the model thereby showing a preferred model.

Table 7: Test of Significant of Stepwise Regression Model

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	5.117	6	.853	17.960	.000[b]
	Residual	16.760	353	.047		
	Total	21.877	359			

Table 8 showed the result of stepwise coefficient of the regression analysis. The result of collinearity through both tolerance and variance inflation factor (VIF) has been found appropriate. Therefore there is no problem of multicollinearity in this model as compared with previous model in table 5. Also a higher T-statistics are observed in this model than previous model thereby indicating strong correlation between the dependent and independent variables.

Table 8: Stepwise Regression coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1 (Constant)	4.318	.126		34.327	.000		
Building size	.532	.053	.519	10.071	.000	.818	1.222
Age	-.169	.029	-.332	-5.776	.000	.659	1.518
Garage(G)	.113	.013	.115	8.148	.032	.762	1.312
Swimming Pool(SP)	.177	.018	-.289	9.878	.000	.390	2.562
Access Road (RD)	.422	.038	-.301	11.135	.000	.409	2.446
Water supply(WS)	.362	.026	.109	10.052	.041	.773	1.294

a. Dependent Variable: Price

The coefficients of the variables generated in this hedonic model represent an implicit price of buying that attribute which is not included in the constant term. In this study the constant term represents the amount of "fixed costs", on average. Those costs correspond to those expenses, such as stamp duty and registration fees and other legal fees. An examination of the regression coefficients in the table 9 emphasizes that building area, age of building; garage, swimming pool, access road and water supply have an explanatory power in determining the rental price variation of the property. This finding is consistent with previous studies by Yusof & Ismail (2012), Anthony (2012), and Chun & Li (2013). The technique enables one to quantify the variation. Therefore the average price of building size having a coefficient of 0.532 equivalent to 53.2% positive change in rental price is N 89,908 while other attributes are been held constant. The age of the properties were found negative to the price in the sense that the older the building the lower the value therefore additional one year to a property has negative coefficient at -0.169 equivalent to -16.9% costs about N28,561 reduction in property price. The average price of garage (at coefficient of 0.113) if present in the building is N19,097 while other attributes remain constant. The implicit average price of swimming pool at coefficient of 0.177 equivalents to 17.7% if present in the property is N29, 913. The implicit price of access road at coefficient of 0.422 which is equivalent to 42.2%, to the property if present is N71,318 and while other attributes remain constant. The average price of water (at coefficient of 0.362 equivalent to 36.2%) if present in the building is N61,178, while other attributes remain constant.

Implication of findings

The implicit price modeling in housing market is highly essential to property market stakeholders in order to understand the importance of the building attributes that must not be compromised. In this study, two forms of regression model were analysed, one is termed a generalized model that featured all the building attributes, but because of the dual role that some attributes displayed which led to second regression model called stepwise analysis that finally provide a correct estimates used to determine the implicit prices of properties' attributes. The study understood that identified six attributes have an explanatory power in rental price of the properties. Therefore the implicit price of building size explained major variation in rental price in other word, the size of property determined the rental price, this finding is consistent with that of Yusof and Ismail (2012). Age of the property explained negative variation in property price such that as property gets holder the price reduces by certain amount, in this case, it is assumed that there is constant renovation. Presence of garage and swimming pool, in the building also has explanatory power in rental price; thereby provision of garage and swimming pool have a contributory power on rental price, this finding is consistent with Anthony (2012); and provision of access road also has also explained variation in rental price in positive manner such that good access to the property contribute a better price of the property. Provision of in-house water supply also commands a significant price to the property; this finding is consistent with that of Chun and Li, (2013). Conclusively, stakeholders in property market should consider building size, age, garage, swimming pool, access road and water supply as indispensable attributes in the property markets as they contributed a significant price of the properties in the study area.

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