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MODELLING THE DYNAMIC EFFECT OF INTERACTION BETWEEN URBAN INFRASTRUCTURE CONDITIONS AND RESIDENTIAL PROPERTY INVESTMENT RETURNS IN ABUJA, NIGERIA

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ABSTRACT

Purpose: The study examines the relationship between infrastructure condition and residential property investment in Abuja, Nigeria. It was carried out with specific focus on the effect infrastructure conditions impacts on property investment returns in the selected residential submarkets of Abuja.

Design/methodology/approach: A survey approach was adopted with residential properties currently in the market generating income (rental or capital values) for investors as the study samples. Firms of Estate Surveying and Valuation and households were also used for data collection. Transactions of 718 were obtained from 1, 2, 3 and 4 bedrooms properties as well as availability and condition of infrastructure. Correlation coefficient and regression model were used to examine the relationship and effect of infrastructure condition on residential property investment returns between 2009-2018.

Findings: The results from analysis revealed a significant and positive relationship between infrastructure conditions and rate of returns. This has also shown that the functional condition of infrastructure in Abuja has a significant effect on the rate of returns on residential property investment hence a good market performance.

Research limitation/implications: In examining the level of infrastructure condition on rate of returns on residential properties, an assessment of some basic infrastructure type such; water supply, electricity, access roads, streetlights, drainage system, waste management, health, recreation, education, and security within the selected locations in Abuja were used. The rate of returns was measure from 2009 to 2018.

Originality/value: The conclusion from the result is that infrastructure condition contributes to about 71% of the rate of returns on residential property and hence, a positive determinant of market performance.

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Keywords: Infrastructure condition; property investment; returns; neighbourhood; rental trends.

1. INTRODUCTION

Infrastructure is the fundamental support system serving a country, city and other areas; it includes the services and facilities necessary for an economy to function effectively (Tomlinson, 2001; Mendez, 2007). Infrastructure stands out glaringly as one of the pointers to an ideal urban economic development and its worth cannot be restrained since it plays a vital role in the growth and development of a nation. They also serve as one of the major pull factor of investments to any location being it real estate or any form of investment. Ogbuefi (2002) and Ajakaiye (2008) asserted that property investments performance indicators such as value indices, yields and total returns promote improvement in the analysis of the property investment returns at every location where invested real estate especially residential property is located. The improvement in these indicators is mostly enhanced by availability and functionality of neighborhood facilities and services.

Overtime, evidences have emerged of the close link between urban infrastructure and real estate investment and how same has impacted either negatively or positively on investment returns. Though the availability and quality of these infrastructures may vary from place to place and/or based on needs, it is apparent that certain infrastructure has been practically found to have significant influence on property values at certain point and at certain locations. Among which include commercial environment, road conditions, security, and physical structure of building and serenity of environment (Famuyiwa & Otegbulu, 2012; Ajayi, Jimoh & Jimoh, 2014). In some areas or locations, certain infrastructures such as good road network, electricity supply; portable water; drainage system; waste management system; recreational facilities security have been identified to have significant influence on rental values (Oduwaye, 2002; Ajibola et al., 2013; Amenyah, 2013; Udoka, 2013). These are also known to have improved residential property investment performance.

Returns on property investment indicate the percentage of the invested money returned to a property investor after the deduction of associated costs thus, other property investment indices are, price base index, level and type of information index and market capitalization index. The returns on property investment on the other hand, is dependent upon many characteristics associated with that property such as physical characteristics of property; location of the site in relation to employment centers and other facilities, accessibility and economic characteristics of neighbourhood. Oftentimes the common understanding has been that performance of investment in residential property is related significantly to availability, condition and adequacy of urban infrastructure. Therefore, in measuring the return on investment of residential property, the indices, say for one, two, three and four bedroom properties, need to be developed and to encompass the availability and condition of the infrastructure within a particularly chosen location. However, this is mostly not the case as there are no developed infrastructure conditions indices (ICI) upon which valid performance of residential property investment return option can be measured or estimated.

It is on the above premise that, this study aimed to examine the relationship between infrastructure conditions and residential property investment returns in Abuja, Nigeria. It is the study objective to assess and determine residential property investment returns

for a period of 10 years (2009 - 2018); to assess and develop infrastructure condition indices (ICI) for some of the basic neighbourhood facilities and services in the study area; to measure the effect of infrastructure condition on residential property investment returns in Abuja, Nigeria.

It is the expectation that the outcome of this study will serve as yardstick for corporate investors to measure the performance of property investments in the light of available infrastructure. Professionals in the real estate industry will also found the outcome here beneficial in terms of information for their consultancy. It also a knowledge gap identified and addressed that contribute to existing body of literature.

2. LITERATURE REVIEW

Generally, there is a link between investment in residential property market, provision of infrastructure and the economy of any nation. The link could either have forward positive effects if there is sufficient provision of infrastructure and effective operation of property market or it could be backward negative if there is a disconnect or inadequacy in the provision of infrastructure and ineffectiveness in the property market operation. According to Samjay (2013) residential property markets supported by adequate infrastructure provision indicate important interface with economic activity and strength of the financial markets of the country. Around the world, majority of the financial institutions depend on residential property assets for up to 42% of their operations, therefore, crucial adjustment in the residential property markets can have great impact on residential property rental and sales pricing performance which can in turn have effect on the economy.

The study of Walter (2009), analysed the relationship between infrastructure and residential property investment which was framed on the fact that infrastructure is one of the fundamental factors that boosts values and returns on residential property investment. Hence, the study sought to examine the extent of this effect on residential property investment market in Kumasi, Ghana between 2001 and 2008. The result indicates a positive effect and by implication assisted the real estate entrepreneurs in preparation of proper cash inflow and also enhances consolidated cash outflow projections. Investors in residential property will be able to further make informed decisions that will profit their investments from such study outcome.

Oduwaye (2002) examined the level of adequacy of infrastructure availability on property investment return in Akure, Nigeria. Infrastructures used for the study were road, electricity supply, water, drainage system, waste management system and recreational facilities. A sample of 343 households was used and data subjected to descriptive analysis techniques using the relative important index (RII) to rank the level of infrastructure, the outcome indicates significant inadequacy. The implication of the findings is that the lack of adequate good road network, electricity supply; portable water; drainage system; waste management system; recreational facilities has contributed negatively on real property value and consequently its returns. Udoka (2013) adopted a similar methodology while examining the relationship between infrastructure provision and real estate investment returns in Akwa Ibom state, Nigeria. The use of descriptive analysis was made from the data collected from 250 residential properties. The results of the ranking using the RII indicates that infrastructure such as roads, hospitals, schools, water supply and sewage contributed positively towards the improvement in residential property investment performance.

Ajayi, et al (2014) in their study of Minna, Niger State, used similar infrastructure to those of Oduwaye (2002) and Udoka (2013) to measure the effect on property rental values within a timeline of 1998 – 2009. They employed a regression analysis technique to measure the probable impact of some of the infrastructure on property rental values. The study found that not much impact have been made so far by these infrastructure except for access to road which contributed to about 43.9% variation in rental values. Further, the study could not provide the effect of these infrastructures on investment returns; it did not also explore the level of condition of the infrastructure itself other than its availability. Famuyiwa and Otegbulu (2012) examined the influence of public infrastructure on property value in Lagos, Nigeria. The data on 118 residential properties were modeled into hedonic regression for the purpose of valuation. The results showed that out of fifteen (15) infrastructural facilities used, six were determined to have significant impact and these were; accessibility, commercial environment, road conditions, security, physical structure of building and serenity of environment. Their level of significance therefore explained about 66% variation in property price returns.

In Kenya, Gatauwa and Murungi (2015) used Meru County as a case study to assess the influence of infrastructural provision and real estate investment returns. The study examined transport and communication factors, social amenities, industrial development, educational institutions and commercial development. A total of 955 real estate properties were sampled, data obtained was subjected to regression analysis and the outcome revealed that these infrastructures accounted for 89.3% variation in the performance of property investment in Meru County. The conclusion therefore was that infrastructure development has a great impact on real estate investment return among other factors as it will lead to demand for real estate property and hence, positive returns.

Hwa (2000), in his study takes a much broader case study approach to examine the challenges and prospects infrastructure has on residential real estate investment in the cities of Mumbai, Delhi and Gurgaon in India. A survey was made of 100 key players to obtain primary data while the secondary sources were the predominant data source and collection during the survey. The secondary sources were through newspapers, magazines, journals, internet and visits to the various real estate investments companies. The outcome from analysis revealed that infrastructure has contributed prominently towards the real estate investment returns.

Samjay (2013) studied income from residential properties between 2005 and 2012 in Atlanta Georgia, USA, from the investment point of view. With the use of return equations, estimations were conducted to analyse whether or not income level from property varied as a result of availability of neighbourhood infrastructure, holding their income-affecting variables (such as location, improvements) constant. It was discovered that return on residential property is highly influenced by infrastructure. The study involved comparison of yearly return increase in the effective rent charged for privately owned residential properties and the official yearly returns increase set through official negotiation for municipality-owned residential housing to see whether excessive price increases (indicating infrastructure drift) could be found. Evidence was found to support the existence of such drifts. This was as a result of effective and functional infrastructure provided and their good management.

Other studies identified transport infrastructure, energy infrastructure, information and communication infrastructure, social amenities, industrial development and educational infrastructure to have greater influenced on property returns. (Corgel et al., 1998; Gatauwa & Murungi, 2015). The results from other studies has also shown that burglary proof, paved premises, street light, gate house and fenced-wall were relatively

important facilities influencing property returns and tenants' satisfaction (Olujimi & Bello, 2009; Olujimi, 2010; Sodiya et al., 2016). The studies also found a significant difference in rent passing and sale of property across the housing estate.

Base on the findings from all previous empirical studies reviewed under this study, It was discovered that each and every neighbourhood have its peculiarities in terms of characteristics, infrastructure availability and condition. At same time they are subject to different returns on investment because of variation in fundamental property investment return determinants (Flatherty 2004, Olujimi & Bello 2009, Udoka 2013, Samjay 2013). In view of this, it is vital to pinpoint necessary property investment return growth variables which represent the Nigerian economy; availability and condition of available infrastructure and nature of residential property investment market in the country. Thus, this study is intended to identify these principal pointers and utilize them with the aim to examining their influence on residential property investment returns in Abuja.

Therefore, it has become clear in view of the foregoing studies the missing link between infrastructure and residential property investment returns. The missing areas are; the absence of the construction of infrastructure condition indice (ICI) and its influence on residential property investment returns. Most studies do use infrastructure availability only and others adequacy to measure its effect on residential property investment returns. the other area is the development of property return indices upon which the influence of ICI can be adequately capture in assessing the relationship of level of effect one exert on the other. This is the missing gap that forms the basis for this study.

3. RESEARCH METHODOLOGY

The study adopted a survey approach with residential properties currently in the market generating income (rental income) for the investors within Abuja Metropolis as the population. The total number of residential rental properties (RRPs) was generated through the households' population supported by the availability of records on the RRPs under the management portfolio of the practicing firms of estate surveying and valuation within the selected neighbourhood of Maitama, Wuse II, Lugbe and Kubwa. The use of Google earth pro and physical enumeration was also adopted to enhance accuracy and adequacy. The total sample frame generated summed up to 8,543 RRPs (Table 1). The sample size as determined for each of the neighbourhood was carried out with the use of Frankfort-Nachmias (1996) formula for sample size determination as follows:

$$n = \frac{Z^2 pqN}{e^2(N-1) + Z^2 pq}$$

Where N = population size;

n = sample size

p = 95% confidence level of the target population

q = 1- p

e = Acceptable error Z = 1.96 (the standard normal deviation at 95% confidence level)

Table 1: Sample size determined and questionnaire distribution

Location	Neighbourhood	Population	Sampled Size Administered	Number Returned
Abuja	Maitama	1,785	316	185
	Wuse II	1,856	318	193
	Lugbe	2,880	345	183
	Kubwa	2,022	323	157
	Total	**8,543**	**1302**	**718**

Hence a total of 1302 questionnaire were administered eliciting information on the availability and condition of infrastructure in the selected neighbourhoods (Table 1). The technique adopted for analysis of data are, descriptive statistics that were used in the construct of infrastructure condition index. Further, a multiple regression analysis technique was also used to develop a model for the prediction of residential investment return in the selected neighbourhoods of Abuja.

3.1. Variables definition and model

A multiple regression model can be specified as:

$Y = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 \ldots\ldots\ldots\ldots + b_n X_n + e$ …….. . . . ; (1)

Where

Y = Dependent variable

X1, X2, X3…Xn = Independent variables

b0 = Constant

b1, b2, b3…. Bn = Coefficient or parameters which show the extent to which each of the independent variables affects variable Y.

e = Error term which represent other omitted variables.

The regression model for the study is described below based:

$$R = a + \beta WT + \beta ELEC + \beta DRN + \beta RD + \beta WDIS + \beta SECT + \beta REC + \beta STRLG + \beta EDU + \beta TELE + \beta HEL + e \quad \ldots\ldots (2)$$

R = Returns,

WT = Water Supply

ELEC = Electricity,

DRN = Drainage

RD = Road

WDIS = Waste disposal

SECT = Security,

REC = Recreational

STRLG = Streetlight

EDU = Education,

HELH = Health,

α = Intercept

ε = error term

Data measurement for the variables included in the model is as shown in Table 2.

Table 2: Data measurement for model development

Variables /Total Return Index (TRL)	Description/ Rate (%)	Scale
Water condition index	Quality index 1%-99%	Ratio
Electricity condition index	Relative supply Index 1%-99%	Ratio
Drainage condition index	Standard quality index 1%-99%	Ratio
Road condition index	Standard quality 1%-99%	Ratio
Waste disposal	Quality of physical environment	Ratio
Security condition index	Relative level of security (1%-99%)	Ratio
Recreation facilities condition	Relative availability index (1%-99%)	Ratio
Streetlight condition index	Relative availability index (1%-99%)	Ratio
Education facilities condition	Relative availability index (1%-99%)	Ratio
Health.	Relative availability index (1%-99%)	Ratio

4. RESULTS AND DISCUSSION OF FINDINGS

4.1. Rate of returns on property investment

The rate of returns for One Bedroom (1B/R) property in Abuja is presented in Table 3 and the average rate of returns trended on double digit rate over the period understudy. Kubwa had its highest rate of return (RoR) in 2010 while Lugbe peaked at 20.50 in 2012. However, Maitama performed better comparatively reaching 38.99 and 39.84 in 2013 and 2016 respectively, though Maitama also recorded the least among all the submarkets in 2018.

Table 3: Rate of returns on 1B/R property investment

Year	Kubwa	Lugbe	Wuse II	Maitama
2009	19.23	15.49	19.45	21.98
2010	23.19	18.13	14.17	27.63
2011	15.66	16.11	15.27	32.06
2012	20.85	20.50	15.19	23.98
2013	14.59	17.35	15.38	38.99
2014	15.23	18.73	28.34	35.09
2015	14.56	17.24	14.53	26.37
2016	16.53	17.84	19.54	39.84
2017	17.12	16.59	17.59	30.68
2018	17.09	18.65	10.32	7.88

For the Two Bedroom (2B/R), the annual RoR peaked higher in Kubwa in 2010 with Lugbe having the least RoR while Maitama average higher comparatively. (See Table 4). It has shown that the average RoR also trended in double digit indicating a good performance,

Table 4: Rate of returns on 2B/R property investment

Year	Kubwa	Lugbe	Wuse II	Maitama
2009	21.43	22.88	10.34	20.34
2010	38.95	26.94	16.42	29.19
2011	17.99	17.54	27.10	30.35
2012	13.70	17.25	36.76	39.36
2013	21.52	21.52	27.73	22.59
2014	21.28	21.24	17.77	11.41
2015	16.96	16.96	28.37	22.68
2016	11.96	11.97	17.81	32.93
2017	13.34	6.55	34.98	18.85
2018	14.05	11.26	37.84	30.98

The 3 bedroom properties also show a double digit annual RoR property investment indicating the property market for this accommodation type performed well within the period understudy (see Table 5). However, the performance for Maitama in 2010 showed a single digit indicating poor performance comparatively, though the RoR rose significantly to 38.49 and 31.49 in the subsequent years.

Table 5: Rate of returns on 3B/R property investment

Year	Kubwa	Lugbe	Wuse II	Maitama
2009	11.24	13.44	12.45	22.44
2010	19.39	19.60	18.01	9.79
2011	24.96	22.28	26.72	38.49
2012	17.60	19.06	27.20	31.49
2013	12.09	15.26	37.87	20.02
2014	26.12	24.12	38.28	19.08
2015	29.97	13.97	18.62	21.63
2016	23.87	20.87	28.42	30.99
2017	18.27	21.50	27.24	37.82
2018	19.42	24.44	39.31	26.37

The RoR as shown in Table 6 revealed that Lugbe performed better comparatively maintaining an average above 20 throughout the study period. The result also indicates a general performance in property market, with the exception of Wuse II and Maitama in 2017 and 2016 showed a single digit rate of return which is the signal of a poor performance.

Table 6: Rate of Returns on 4B/R Property Investment

Year	Kubwa	Lugbe	Wuse II	Maitama
2009	18.86	22.19	16.34	27.21
2010	20.32	20.32	10.79	21.89
2011	21.27	21.09	10.80	19.65
2012	20.06	20.45	10.88	15.93
2013	26.44	26.22	11.03	33.92
2014	24.69	24.69	11.53	22.80
2015	23.34	22.79	12.08	13.30
2016	18.10	20.98	11.27	6.63
2017	23.54	21.46	3.75	36.42
2018	21.67	21.45	9.08	41.18

4.2. Construction of infrastructure condition index (ICI)

In analyzing data for the infrastructure condition, data were collected and measured on a 5-point Likert scale and a reliability test was conducted to ascertain the degree of consistency of the data among items using the Crombach alpha (α) technique. The result indicated a minimum acceptable coefficient of 0.75 (75%) for all the items in the study area. On a neighbourhood basis, the degree of reliability was computed at 77%, 79%, 86% and 89% for Kubwa, Lugbe, Wuse II and Maitama respectively. To determine the benchmark towards the development of ICI, a hypothesised mean was calculated as $((5 + 4 + 3 + 2 + 1)/5\ ) = 3.00$. (Ikediashi, Ogunlana & Boateng, 2014). This mean (3.000) was further converted to percentage for easy of interpretation of the ICI. by dividing by the highest number on the scale as thus; 3/5 = 0.6 (60%) therefore, any ICI above 60% indicates a better infrastructure condition while those below the benchmark indicates poor condition.

Table 7: Infrastructure condition index (ICI) in Abuja

Infrastructure	Kubwa (α = 0.77)				Lugbe (α = 0.79)				Wuse II (α = 0.86)				Maitama (α = 0.89)			
	N	Sum	Mean	ICI	N	Sum	Mean	ICI	N	Sum	Mean	ICI	N	Sum	Mean	ICI
Water supply	157	507	3.23	65	183	615	3.36	67	193	886	4.59	92	185	854	4.62	92
Electricity	157	567	3.61	72	183	651	3.56	71	193	793	4.11	82	185	871	4.71	94
Access Road	157	515	3.28	66	183	581	3.17	63	193	795	4.12	82	185	864	4.67	93
Security	157	471	3.00	60	183	515	2.81	56	193	800	4.15	83	185	793	4.01	80
Drainage System	157	460	2.93	59	183	560	3.06	61	193	790	4.10	82	185	850	4.59	92
Waste Disposal	157	482	3.07	61	183	585	3.20	64	193	801	4.15	83	185	759	4.10	82
Recreation Facilities	157	504	3.21	64	183	621	3.39	68	193	794	4.11	82	185	745	4.03	81
Education	157	463	2.95	59	183	512	2.80	56	193	809	4.19	84	185	746	4.03	81
Health	157	495	3.15	63	183	590	3.22	64	193	799	4.14	83	185	784	4.24	85
Street Light	157	512	3.26	65	183	610	3.33	67	193	820	4.25	85	185	796	4.30	86
Valid N (list-wise)	157				183				193				185			

In view of the above, ICI for Kubwa as determined, ranges between 0.59 - 0.72 (59% - 72%), Lugbe, ICI ranges 0.56 - 0.71 (56% -71%), Wuse II ICI ranges between 0.82 - 0.92

(82% - 92%) and Maitama ICI ranges between 0.81 – 0.94 (81%-94%). This outcome suggests that Kubwa and Lugbe has some infrastructure that are in good and functional condition while others are not whereas infrastructure condition in Wuse II and Maitama are better than those of Kubwa and Lugbe comparatively. See table 7 for detail ICI for all infrastructure available in the selected neighbourhoods.

4.3. The relationship between ICI and PRI

The result of the strength of relationship between ICI and Property Returns Index (PRI) indicates a significant strong and positive relationship. (See Table 8 below). Water, electricity, access road and neighbourhood security relates positively with PRI. Drainage system correlates strongly with PRI in Wuse II and Maitama while the relationship is insignificant at Kubwa and Lugbe. The results also show that the condition of waste disposal relates better with PRI compare with Kubwa, Wuse II and Maitama whereas, health relates significantly in Kubwa and highly insignificant in Wuse II. Further, recreational facilities strongly correlate with PRI in Wuse II, the condition of health facilities maintained strong correction with PRI in Kubwa while the availability and condition of street lights maintained strong correlation with PRI in both Wuse II and Maitama. The implication of these outcomes is that, all the aforementioned infrastructure are likely to cause positive significant change in return on residential properties invested across the neighbourhoods.

Table 8: Correlation between ICI and PRI in Abuja

Infrastructure	Kubwa ®	N	Lugbe ®	N	Wuse II ®	N	Maitama ®	N
Water supply	.89*(.000)	189	.79*(.001)	183	.65*(.025)	193	.69* (.021)	185
Electricity	.59*(.017)	189	.78*(.001)	183	.75* (.12)	193	.61* (.031)	185
Access Road	.69*(.007)	189	.83*(.000)	183	.69*(.031)	193	.57* (.045)	185
Security	.88*(.000)	189	.56*(.032)	183	.82*(.001)	193	.85* (.000)	185
Drainage System	.46(.262)	189	.16 (.421)	183	.62*(.035)	193	.68* (.029)	185
Waste Disposal	.17(.477)	189	.79*(.012)	183	.45(.124)	193	.34(.654)	185
Recreation Facilities	.12(.434)	189	.26(.327)	183	.59*(.048)	193	.23(.701)	185
Education	.33(.321)	189	.15(.421)	183	.42(.145)	193	.41(.312)	185
Health	.63*(.013)	189	.45(.122)	183	.39(.451)	193	.48(.073)	185
Street Light	.11(.661)	189	.05(.512)	183	.72*(.002)	193	.50* (.045)	185

4.4. The effect of infrastructure condition on property investment returns (PIR)

The results of analysis for Kubwa, Lugbe, Wuse II and Maitama shows that the regression model is fit for the purpose of prediction of the effect of infrastructure condition on residential property investment returns in Abuja. The result presented in Table 9 below is the result 157 property transactions in Kubwa residential property submarket. The study employed multiple sales and letting approaches for analysis the result for Kubwa revealed 65% variation in PIR which can significantly explained by the conditions of water supply, electricity, access road, neighbourhood security and health facilities. This therefore implied that, these infrastructure conditions are can exert a statistically significant effect on PIR in Kubwa residential submarket. It also shows that a 1% improvement in the conditions of the

infrastructure will cause positive significant change in PIR by 37%, 36.9%, 76.1%, 58.5% and 60.9% respectively. With the F-statistics of 9.24 which is significant at p-value of 0.000 less than 0.05 precision level, the model is considered fit for the purpose of prediction as adopted for Kubwa.

Table 9: Regression estimates of ICI and property investment returns in Kubwa

Model	Unstandardised Coefficients		T	Sig.	R2	F	p-value
	B	Std. Error					
(Constant)	10.648	3.069	3.469	.001	.65	9.24	.000
Water supply	.370	.198	1.867	.044			
Electricity	.369	.208	1.775	.048			
Access Road	.761	.208	3.659	.000			
Security	.585	.266	2.198	.029			
Drainage System	.017	.197	.086	.932			
Waste Disposal	.322	.205	1.571	.118			
Recreation Facilities	.006	.218	.029	.977			
Education	.268	.192	1.397	.164			
Health	.609	.208	2.933	.004			
Street Light	.205	.218	.939	.349			

$$R = 10.64 + .370WT + .369ELEC + .017DRN + .761RD + .322W + .585SECT + .006REC + .205STRLG + .268EDU + .609HELH + e$$

The outcome for Lugbe residential property submarket with 183 transactions indicates a 69% variation in the PIR that can be explained by the influence of the conditions of access roads, security, drainage system, waste management, education, and health facilities. This shows a slight variance from Kubwa. (See Table 10). The infrastructure has maintained a significant effect on the PIR to a level that any change or improvement in their conditions by 1% will cause a significant positive change in the PIR by 19.2%, 22.2%, 52.0%, 18.6%, 28.9% and 23.1% respectively. With p-value of 0.000 less than α = 0.05, the model has a good predictive ability and fit for analysis for Lugbe residential property submarket.

Table 10: Regression estimates of ICI and PRI in Lugbe

Model	Unstandardised Coefficients		T	Sig.	R2	F	P-value
	B	Std. Error					
(Constant)	6.791	1.003	6.772	.000	.69	15.4	0.000
Water supply	.013	.066	.196	.845			
Electricity	.058	.057	1.002	.318			
Access Road	.192	.091	2.096	.038			
Security	.222	.070	3.175	.002			
Drainage System	.520	.061	8.500	.000			
Recreation facilities	.073	.046	1.590	.114			
Waste Disposal	.186	.070	2.673	.008			
Education	.289	.070	4.153	.000			
Health	.231	.072	3.214	.002			
Street Light	.079	.070	1.140	.256			

$$R = 6.79 + .013WT + .058ELEC + .520DRN + .192RD + .186WD + .222SECT + .073REC + .079STRLG + .289EDU + .231HELH + e$$

The result for Wuse II revealed a total of 193 transactions in the property submarket and the outcome from the analysis indicates 70% variations in the use II residential property market. Through multiple sales and letting approaches the result revealed that 70% variation in the PIR that can be explained by six infrastructure types. These are; water supply, electricity, access roads, neighbourhood security, drainage system and recreational facilities. They have been determined to significantly influence the residential property market performance. (See table 11). Therefore, with the p-value of 0.000 less than $\alpha = 0.05$ level, the model is also deemed to have a good predictive power. This has shown that a 1% improvement in the conditions of water supply, electricity, access roads, security, drainage system and recreational facilities can impact positively on the return on investment by 4.9%, 13.6%, 16.1%, 27.9%, 35.3% and 8.4% appropriately.

Table 11: Regression estimates of ICI and PRI in Wuse II

Model	Unstandardized Coefficients		T	Sig.	R2	F	P-value
	B	Std. Error					
(Constant)	1.376	2.527	.545	.007	.70	10.02	0.000
Water supply	.049	.214	.229	.019			
Electricity	.136	.259	.522	.002			
Access Road	.161	.265	.606	.045			
Security	.279	.233	1.196	.033			
Drainage System	.353	.219	1.610	.009			
Recreation	.083	.166	.499	.018			
Waste Disposal	.624	.222	2.804	.206			
Education	.678	.230	2.943	.104			
Health	.467	.248	1.886	.361			
Street Light	.194	.240	.809	.419			

$$R = 1.37 + .049WT + .136ELEC + .353DRN + .161RD + .624WD + .279SECT + .083REC + .194STRLG + .678EDU + .467HELH + e$$

The analysis of the effect of infrastructure condition on investment performance of residential properties in Maitama is presented in Table 12 in line with the result, 185 property transactions in Maitama residential property submarket were recorded. The result revealed that 80% variation in PIR can be significantly explained by five infrastructure types. These are; water supply, access road, security, drainage system, recreational facilities, waste disposal and health facilities and combine maintained a significant influence on performance of residential property investment submarket in Maitama. This is such that any significant change in these infrastructure conditions by 1% improvement, will cause positive significant change in property return by 13.5 34.2%, 17.8%, 15.2%, 11.8%, 20.3%, and 20.3% respectively. In view of this, the model is fit for the purpose of prediction since f-statistics (10.02) is statistically significant at p-value (0.000) less than 0.05 level of correctness; therefore, the model can be used for the prediction in Maitama residential property investment submarket.

Table 12: Regression estimates of ICI and property investment returns in Maitama

Model	Unstandardized Coefficients		T	Sig.	R2	F	P- value
	B	Std. Error					
(Constant)	3.265	.852	3.830	.000	.80	9.08	.000
Water Supply	.135	.052	2.568	.001			
Electricity	.031	.073	.423	.673			
Access Road	.342	.078	4.365	.000			
Security	.178	.083	.141	.008			
Drainage System	.152	.067	2.272	.024			
Recreation facilities	.118	.053	2.233	.027			
Waste Disposal	.203	.067	3.030	.003			
Education	.146	.084	1.737	.084			
Health	.203	.077	2.636	.009			
Street Light	.021	.079	.269	.788			

$$R = 3.26 + .135WT + .031ELEC + .152DRN + .342RD + .203WD + .178SECT + .118REC + .021STRLG + .146EDU + .203HELH + e$$

Infrastructure are a very critical subset of our built environment system. The basic types like water supply, electricity, access roads, streetlights, drainage system, waste disposal, health, recreation and security are very important towards enhancing a good quality of and functional living environment and for investment. A streak of studies has established a clear and positive link between infrastructure and property values/returns while others found otherwise at certain locations. In the Abuja property market, infrastructure availability and conditions has accounted for a viable investment returns in residential properties, the performance of these property types has trended in mostly double digits' rate of return in the last 10 years (2009-2018). On location basis, Wuse II and Maitama submarkets presents a better infrastructure condition indices and contributed to about 70% and 80% in the rate of return compare with Kubwa and Lugbe with 65% and 69%. On aggregate for Abuja property market, infrastructure conditions have accounted for 71% of the rate of return and positive residential property market performance.

5. CONCLUSION

The study has assessed the effect of infrastructure conditions on residential property investment returns in Abuja. This was achieved by developing infrastructure condition indices from water supply, electricity, access roads, streetlights, drainage system, waste disposal, health, recreation and security and residential property return indices to be able to determine the effect appropriately. It was found that infrastructure conditions in Wuse II and Maitama are way above average indicating indices of 82% - 92% and 81% -91% above the average international standard benchmark of 60%. While Kubwa and Lugbe maintains a little above average as comparatively. (AAPPA- Australian Association of Higher Education Facilities, 2000). Therefore, the infrastructure conditions in Abuja are in a good condition and has affected positively the market performance in terms of rate of returns on residential property investment.

The implication of this outcome is that the real estate sector contributes to the national GDP though it may not be as expected, the contribution can be enhanced by property market

efficiency and its products. Therefore, as one of the determinant of market viability and performance, infrastructure is expected to be maintained in a functional condition that will in turn improve the values of residential properties. This will provide the government better rates and taxes after assessments and adequate revenue will be generated and thus available funds for the maintenance and expansion of infrastructure in Abuja.

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