

The relationship of rail transport infrastructure to residential property rental values in Kubwa, Abuja, Nigeria

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Abstract:

On a global scale, numerous research studies have been embarked upon to show the level of relationship between transport facilities and residential rental values. This study dwelt on the various aspects of rail infrastructure and how it impacts on residential rental values. To accomplish the aim, questionnaires were distributed to head of households and practicing Estate Surveyors and Valuers in Kubwa, Nigeria after deducing their number from the general population. Physical observation also aided the researcher in data gathering. Data were interpreted using tables and percentage while Karl Pearson product moment correlation with the aid of Statistical Package for Social Sciences was employed for data analysis. From the correlation analysis the result revealed that the value of r (Pearson correlation) is 0.751 which indicates strong relationship. The p -value (.001) was less than 0.05 significant level. It was confirmed that the Rail transport infrastructure has significant impact on Residential rental values in Kubwa, Abuja. This translates to growth in rental values. The study recommended Government initiatives on the rail system which directly increases the quantity of optimum rail lines of high-frequency metro lines resulting to a substantial increase in real estate values. This study has provided first-hand information and guide for property investors, estate surveyors, built environment professionals as well as Government agencies on the importance of rail infrastructure and the various ways it can positively or negatively affect rental values.

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1. Introduction

In recent times, so many factors have influenced the level of property values (Gwamna, 2016). Residential land use happens to be the most widely spread and largest land use as shown by many research studies (Litman, 2020). The influence of different characteristics on the price of housing is not consistent. The influence can be affected by the economy, policy, social, and environmental changes (Chen, *et al.*, 2019). Similarly, many studies have shown that residential property rental values are influenced by structural, locational and neighbourhood attributes (Usman, 2016). Of particular consideration is the impact that transportation facilities bring to bear on the rental value of residential properties (Eom, *et al.*, 2019). On a global scale, numerous research studies have been embarked upon to show the level of relationship between transport facilities and residential rental values (Ning, *et al.*, 2018). Interestingly, some of these studies have dwelt on rail transport infrastructure and its impact on residential rental values (Lee and Holme, 2015; Marshall, 2018; Wenner, *et al.*, 2020).

Rail transport infrastructure can be regarded as an attribute encompassing the three fundamental attributes influencing residential rental values, that is, the structural, locational and neighbourhood attributes (Nweke, 2019). The buildings attached to a rail terminal or train station fall

under structural attributes. The rail lines and rail terminals are strategically located and residential land uses may have proximity to them, falling under locational attributes. The presence of rail infrastructure may serve as an amenity or disamenity to a neighbourhood. Despite the numerous studies on the impact of rail infrastructure development on residential rental values, very few studies have been undertaken in Nigeria to highlight the interrelationship between this study's variables. Undertaking this study which focuses on the impact that rail infrastructure has on residential rental values in Kubwa of the Federal Capital Territory of Nigeria is very apt at this time due to the dearth of literature in this regard.

Areas with expanding transportation networks tend to witness increase in property values, while areas without such improvements experience less rapid increase (Rahman, *et al.*, 2021). It is expected that cities with transportation improvements and speedy economic and population growth foster rapid and continued rise in housing and land values (Nweke, 2019). The impact of Rail infrastructure on residential rental values may be positive (amenity) or negative (disamenity) (Pan, 2019; Januário, *et al.*, 2021). The driving forces (rail transit) for the growth of employment subcenters and accessibility which attracts more population creating more demand for housing leads to higher residential rental values (Sharma and Newman,

2018; Li, 2018). Rail transit system may have mixed effects regarding spatial locations or temporal phases because nearness to rail transport stations can impose nuisance effects like increase in crime rates, noise and pollution to adjoining communities leading to a decline in rental values (Wagner, *et al.*, 2017; Meha, 2017). The findings of this research study would reveal whether the impact of Rail infrastructure on residential rental values in Kubwa, Nigeria is an amenity (positive) or disamenity (negative).

2. Literature review

An important role is played by transport infrastructure in urban development where it links peoples' dwelling and work, as well as influences the form, density, and expansion of urban areas. Economically oriented persons make decisions that hinges on the trade-off between housing and the cost of transport to work. Some people mainly rely on rail transportation for such shuttling in big cities (Meha, 2017). Residential property is a multi- diverse product. The value of a residential property can be ascribed to a combination of factors, including its accessibility to Central Business Districts, facilities and services, its physical features, neighbourhood attributes, environmental situation, the virility of the surrounding economy, and demographics of the market area (Forouhar, 2016; Musa, 2016). Added to these factors, residential property value is influenced by accessibility to mass transit. This is owing to the fact that residential properties situated near transit hubs naturally enjoy improved provincial accessibility to employment places, educational institutions, recreation facilities, more movement possibilities as well as less transport costs (Forouhar, 2016).

As suggested by contemporary urban economic theory, utility-maximising households select a place in which to dwell so that qualities associated with housing (locational, neighbourhood, structural and environmental quality attributes) are acquired together as a bundle (Rosen, 1974). Regarding this, availability of mass transit services (such as light rail transit) should be expected to positively influence households' choices. Hence, it is anticipated that these inclinations would be mirrored in residential property values, especially for those situated near stations (Dziauddin, 2019).

Over the past five decades, the impact of urban rail transit systems on residential property values has been studied in many places. Even though the results are mixed including positive, negative and insignificant results, most of such empirical research has discovered significant positive relationships amid proximity to rail transport stations and values of residential property (Dziauddin, 2019). Pan (2019) studied the impacts of light rail on residential property values in a non-zoning city. His research results suggested that the METRO Rail line had significant positive effects on residential property values. Also, urban planners and policy makers considered light rail as an avenue to bring about urban land-use change and increase land values due to the advancement of rail accessibility. Similarly, Pagliara (2019) asserted that high

speed rail supports urbanisation leading to population increase and higher house prices.

As reported by Adolphson and Fröidh (2019), households and firms are drawn to locations in closeness to railway hubs in city areas generating additional demand for land use in the process. This was further corroborated by He (2020) who proved that system accessibility of rail lines had a statistically valid capitalisation effect on property values that cut across various submarkets. In several new town submarkets along the new lines, advancements in rail accessibility had a considerably larger effect on the variations in property values (He, 2020). Rail transport development is regarded by urban economics and transport researchers to be a vital policy tool for supporting growth, but when such development is related to property markets, substantial values are capitalised into property values across spaces (Wenjie, *et al.*, 2020).

Lieske, *et al.* (2021) conducted an empirical examination grounded on a series of Hedonic Price Models that predict changes in residential property value near transport infrastructure in Western Sydney, Australia. Results indicated that higher population density close to rail stations positively affected price. Also, there exists a non-linear association between distance to rail station and property price with a disamenity effect for residences within 400 metres of rail stations. There is a decline in sales prices within 400 metres of a station and rise in sales prices of 900 metres and 1,900 metres from rail stations. An extensive literature review of previous studies on the effect of rail transport on house prices and rents was undertaken by Suhaimi, *et al.* (2021). The study's outcome was that the effect of rail transport on housing is situation-dependent. Rail transport might impact housing in various ways, either positively, negatively or mixed, depending on the type of externalities exhibited by rail transport.

Using online housing platforms and proposing a conceptual framework to explain why and how Transit Oriented Development (TOD) impact house rental prices, Su, *et al.* (2021) sought to unravel the impact of TOD on house rental prices and implications on spatial planning. Their research confirmed that TOD housing properties depict significant higher rentals than non-TOD properties. Irrespective of the disparity among the 5 megacities, it was revealed that TOD features largely account for 10%-20% of the house rental prices.

Gupta, *et al.* (2022) analysed local real estate prices in relation to the Second Avenue Subway extension in New York City which is the most expensive rail transport infrastructure in the USA. Their study discovered 8% house price increase generating \$5.5 billion in new property values. Lin, *et al.* (2022) undertook a study to explore the relationship between metro stations and urban development with specific emphasis on the wide-ranging influences of metro development on economic and environmental development of cities. The literature review revealed that the positive capitalisation of metro stations is shown in property values in neighbouring areas to metro systems even though the effects may fluctuate spatially and geographically.

Based on a semi-logarithmic Hedonic Price Model in tandem with facility point-of-interest data and residential unit transaction statistics, Shi and Fu (2022) investigated how rail transits affect the spatial differentiation of urban residential prices. The researchers used Beijing Metro Line 10 and Line 13 as instances, and found out that neighbourhood characteristics definitely impacted residential prices along rail transit line in urban areas. They equally found out that the spatial impact of rail transit on residential prices in diverse places of the same city is not the same.

Similarly, Forouhar's (2022) study endeavored to appraise the neighbourhood changes around rail transport stations in addition to offer a likely explanation of how neighbourhoods can be distinctly affected by the existence of rail stations. Using longitudinal dataset and employing a mixed-method approach, a comparative assessment of 6 stations of the Tehran Metro Rail system was carried out between the high-income neighbourhoods and low-income neighbourhoods of the metropolis. The difference-in-difference analysis pointed out that the low-income areas witnessed growth in the number of households and growth in population density, leading to higher residential property rental values

The effects of rail transit and bus accessibility on house prices in the vicinity of Metro lines 6, 7, 9 and 14 in Beijing under the polycentric setting were examined by Zhou, *et al.* (2022). Ordinary Least Squares (OLS) and Geographically Weighted Regression (GWR) were utilised to set up the global and local Hedonic Price Models correspondingly. The results specified that residential properties adjoining metro lines and stations and bus stops experienced an increase in house price, and rail stations exerted more impact.

Zhang (2023) investigated the result exceptions of value increase when approximating the impact of a light rail system on various types of value, namely property and land values. In estimating how property sales price and assessed price of land change within catchment locations of Gold Coast light rail transit in Australia, two difference-in-difference models were used. Results revealed there are substantial differences between the influences of rail ventures on property value (positive) and land value (negative). This implies that property value should be clearly distinguished from land value. In a related study using a difference-in-difference approach, de Oliveira (2023) researched on the effects of subway station on house prices in São Paulo, Brazil. The study's results showed that total effects range from -2.30% for sale units closer than 200 metres to a subway station in the more affluent locations in town, to an 11.80% price addition for sale units closer than 350 metres to monorail stations in the less affluent neighbourhoods. Evidence suggests that the rental market mostly relates in a stronger manner to these improvements.

Cárdenas, *et al.* (2023) assessed the impact that the announcement of the first metro line has on house prices in the city of Bogotá. The study combined advanced databases, web scraping and Google maps including administrative records to analyse the ways in which the announcement of the rail construction affects the rentals or

sale market prices for the dwellings in the localities of the infrastructure developments. Findings disclosed that the impacts were significant in the housing sales market but not the rental market. The residences for sale situated within 1.5 kilometres from the forthcoming rail station portrayed a hike of 6.5% in prices.

Despite the various studies on the impact of rail infrastructure development on residential rental values, very few studies on these variables have been done in Nigeria. This prompted the undertaking of this research study which focused on the relationship between rail infrastructure and residential rental values in Kubwa of Abuja, Nigeria.

3. Methodology

3.1 Research design and questionnaire

This study adopted the Survey research design. The survey procedure was applied because it is the appropriate method for a researcher that intends to administer questionnaire to respondents, interview them and also undertake physical observation of the study area. Two sets of questionnaires were designed. One set for the head of households in neighbourhoods of Kubwa selected by simple random sampling method. The second set of questionnaires was directed at practicing Estate Surveyors and Valuers in the vicinity of Kubwa who were selected by purposive sampling method. Physical observation was undertaken to take note of components of rail transport infrastructure in the study area.

3.2 Research population

The population of Kubwa as at 2006 was 12,183 (NPC, 2006). The World Population Review (2020) put the population growth rate in Kubwa at 6.03%. To arrive at the projected population of Kubwa, a formula in equation 1 for calculating population projection was used:

$$Nt = (Pe)^{rt} \quad (1)$$

Where P is present population, e is a constant at 2.71828, r is the rate of increase divided by 100, and t is the time period. Therefore,

$$\begin{aligned} Nt &= (12,183 \times 2.71828)^{0.0603 \times 15} \\ &= (33,116.8)^{0.9648} = 22,958.5 \text{ (additional population)} \\ &= 22,958.5 + 12,183 = 35,142 \text{ (projected population)} \end{aligned}$$

In determining the sample size for the study, Yamane's (1967) sample size formula in equation 2 was used:

$$n = \frac{N}{1 + N(e)^2} \quad (2)$$

Where; n is sample size for the study, N (target population size) = 35,142, e (precision level) = 5% and 1 = constant at a confidence level (assumed) = 95%

From the formula therefore:

$$n = \frac{35,142}{1 + 35,142(0.05)^2} = \frac{35,142}{88.85} = 392$$

3.3 Analysis method

The Statistical Package for Social Sciences (SPSS) was used for data entry. The Pearson product moment correlation tool was then employed to analyse the entered data. The Pearson correlation tool is a bivariate statistical tool for analysing relationship between two variables. The Pearson product-moment correlation coefficient (Pearson correlation coefficient) is a measure of the degree of a direct association between two variables and is symbolized by *r*. Essentially, this correlation tool works to specify a line of best fit through the data of two variables. The Pearson correlation coefficient (*r*) shows how far away all these data markings are to this line of best fit (Newman, 2014).

4. Results and discussion

4.1 Questionnaire administration and retrieval

The total number of questionnaires administered was 380 for the head of households. Twelve (12) questionnaires were administered to practicing Estate Surveyors and Valuers. Tables 1 and 2 show the number of questionnaires administered and retrieved from the head of households and practicing Estate Surveyors and Valuers respectively. A total number of 380 questionnaires were administered for head of households while 296 were retrieved representing 78%.

Table 1: Number of questionnaires administered and retrieved for head of households

Number of questionnaires distributed	No. retrieved	Percentage retrieved
380	296	78%

Table 2: Number of questionnaires administered and retrieved for Estate Surveyors and Valuers

Number of questionnaires distributed	No. retrieved	Percentage retrieved
12	10	83%

A total number of 12 questionnaires were administered for Estate Surveyors and Valuers while 10 were retrieved representing 83%.

4.2 Distribution of respondents by occupation

Table 3 shows the distribution civil service by occupation. Civil service constituted the highest percentage of respondents' occupation at 59.2% (181), followed by the Self-employed at 18.6% (57). Most of the respondents were Government workers.

Table 3: Distribution of respondents by Occupation

Occupation	Frequency	Percentage
Civil Servant	181	59.2%
Trader	26	8.5%
Contractor	11	3.6%
Self-employed	57	18.6%
Estate Surveyor	10	3.3%
Others	21	6.8%
Total	306	100%

4.3 Type of property occupancy

Table 4 shows the types of property occupancy. On property occupancy, tenants had the highest percentage at 84.3% (258). Majority of the property occupants were tenants.

Table 4: Type of property occupancy

Property occupancy	Frequency	Percentage
Owner-occupied	20	6.5%
Hire-purchase	28	9.2%
Tenant	258	84.3%
Total	306	100%

4.4 Classification of property occupied by respondents

Table 5 shows the classification of property occupied by respondents. Various classification of property was seen in the study area. 2-bedroom flats recorded the highest percentage at 32.7% (100), closely followed by 1-bedroom flats at 28.8% (88).

Table 5: Classification of property occupied by respondents

Property classification	Frequency	Percentage
1 bedroom flat	88	28.8%
2 bedroom flat	100	32.7%
3 bedroom flat	29	9.4%
2 bedroom terraced duplex	37	12.1%
3 bedroom duplex	31	10.1%
4 bedroom duplex	21	6.9%
Total	306	100%

4.5 Duration of occupation of Property

Table 6 shows the duration of occupation of property. 52.6% (161) of respondents occupied their property for a period between 3-4 years, while 21% (64) were in occupation between 1-2 years.

Table 6: Duration of occupation of Property

Duration of occupation	Frequency	Percentage
Less than 1 year	35	11.4%
1 – 2 years	64	21%
3 – 4 years	161	52.6%
5 years and above	46	15%
Total	306	100%

4.6 Components of rail transport infrastructure in Kubwa

Based on the field survey carried out in the study area, physical observation was undertaken to take note of components of rail transport infrastructure in the study area. The following are the components discovered in the study area:

- Railway station and terminal consisting of the administrative offices, maintenance workshop, and stores.
- Electrical power facilities consisting of high voltage transformers which ensure steady power supply.
- Water supply facilities
- Commercial buildings and shops within the perimeter of the railway station
- Mixed land uses (mostly residential and light commercial) that are well planned.

- f. Accessibility enhanced by the presence of the rail station and terminal.

4.7 Residential property and residential land use available in Kubwa

As already mentioned mixed land use was observed in the study area allowing the coexistence of residential and light commercial land use. Neighbourhood shops were seen selling provisions and consumables to the commuters and residents of the area. The residential property types noticed include 1 bedroom flats, 2 bedroom flats, 3 bedroom flats, 2 bedroom terraced duplex, 3 bedroom duplex and 4 bedroom duplex. Some housing estates were also seen in the course of the field survey. They include Dantata Housing Estate and Brick City Estate.

4.8 Data analysis

Correlation coefficient is a single figure that describes the strength of relationship between two variables. Statistical correlation is measured by what is

called coefficient of correlation (r). The arithmetical value range from +1 to -1 which gives an indication of the degree of relationship. Correlation coefficient is statistically defined as shown in equation 3:

$$r = \frac{n \sum XY - \sum X \sum Y}{\sqrt{[n \sum X^2 - (\sum X)^2][n \sum Y^2 - (\sum Y)^2]}} \quad (3)$$

Where r is the Pearson's correlation coefficient, n is the number of paired scores, X is the score of the first variable, Y is the score of the second variable and XY is the product of the two paired scores.

The main analysis was performed with *rail-infrastructure* as the predictor variable and *rental-values* as the outcome variable (Table 7). There exists a positive correlation between Rail transport infrastructure and Residential rental values, $r = .751$. The p -value (0.001) is less than significant level (0.05). The relationship is statistically significant; therefore, there is a correlation between Rail transport infrastructure and Residential rental values.

Table 7: Correlation Analysis

		Rail infrastructure	Rental value
Rail infrastructure	Pearson Correlation	1	.751**
	Sig. (2-tailed)		.001
	N	306	306
Rental value	Pearson Correlation	.751**	1
	Sig. (2-tailed)	.001	
	N	306	306

**Correlation is significant at the 0.01 level (2-tailed).

The strength of the correlation is determined by the absolute value of the Pearson coefficient. Adopting Cohen's (1988) procedures for interpreting strength of relationship (.1 < $|r|$ < .3 a small correlation, .3 < $|r|$ < .5, a moderate correlation, $|r|$ > .5 a strong correlation), the outcome of this analysis portray a strong positive correlation between the exogenous and endogenous variables

Rail transport infrastructure influenced 56% of the variability in Residential rental values given as: $r^2 = 0.751 \times 0.751 = 0.564 = .564(100) = 56.4\%$. The variability translates to a growth in rental values.

5. Conclusion

This study has attempted to fill a research gap regarding how rail transport infrastructure influences Residential rental values in the Federal Capital city of Nigeria. Most of the literature earlier reviewed showed that rail infrastructure significantly impacts on the rental values of residential properties. The development and advancement of mass transit facilities, especially large-scale rail transport systems, have been confirmed to promote urban and regional socio-economic growth.

The objectives of this study have been achieved. The findings of the study are in consonance with most of the reviewed literature. Rail transport infrastructure significantly and positively impacts upon Residential rental values in Kubwa, Abuja. The findings have contributed to knowledge

and can be a reference point for future research on impact of Rail infrastructure on Residential property rental values.

This study also provided first-hand information and guide for property investors, Estate Surveyors, built environment professionals as well as Government agencies on the importance of rail infrastructure and the various ways it can positively or negatively affect rental values.

Recommendations

High residential property rental values are desirable for property managers and investors as well as the Government who benefits from property rating and taxation as a revenue source. The following recommendations were proffered based on the findings in the study.

- The rail transport infrastructure should be modernized with modern and more efficient ones as well as engaging professional Facility managers for effective management of the facilities.
- Property developers in Kubwa should maximize their land holdings by constructing high-rise properties which would give them more rental income.
- More meaningful urban planning to situate rail stations in the derelict segments of Abuja, which are largely prone to value decline and physical dilapidation, can enhance the development prospects in such places via a land-value capture process.

- d. An appreciable increase in real estate values may be produced by Government initiatives on the rail system which directly increases the quantity of optimum rail lines.
- e. Much consideration ought to be given to the legal framework and policies guiding financial establishments that bring forth resources for urban and regional development in order to foster an effective and sustainable city cum regional development based on rail transport.

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