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Modelling coastal externalities effects on residential housing values

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Abstract

Purpose – This paper aims to examine the impact of coastline on the rental value of residential property in proximity to the coastline, using the hedonic pricing model from two perspectives. First, Model 1A–C accounted for estimating the influence of coastal amenities while controlling for other housing attributes influencing rent. Second, Model 2A–C accounted for the interaction between coastal amenities/disamenities and other housing attributes influencing rent.

Design/methodology/approach – A survey approach was adopted for the data collection process. For both models, property values were measured in proximity to coastline using 0–250 m, 251–500 m and 0–500 m.

Findings – Findings revealed that property rental value increases as we move away from the coastline when disamenities are not controlled. The results suggested that for a mean-priced home (N2,941,029 or $8,170) at the mean distance from the coastline (301.83 m), a 1% increase in distance from the coastline would result in a 0.001% or N9.77 ($0.03) increase in rental value.

Practical implications – The implication to real estate valuers is that varying premiums should be considered when valuing a property depending on the distance to the coastline while considering other housing attributes.

Originality/value – This research introduces a novel approach to the hedonic model for determining property values in proximity to coastal environment by estimating the influence of coastal amenities while controlling for other housing attributes influencing rent, on the one hand, and accounting for the interaction between coastal amenities/disamenities and other housing attributes influencing rent, on the other.

Keywords Housing, Flood, Residential, Rent, Properties, Coastline

Paper type Research paper

Introduction

Globally, the coastal area is a place of choice for many people for its diverse tangible and intangible amenities (Parker and Oates, 2016). Consequently, studies have revealed that

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values of residential properties in coastal areas have been worthwhile to investors across the globe, with the proximate properties to coastline outperforming those at rows behind as distance to the coastline increases (Bin and Kruse, 2006; Bin *et al.*, 2009). However, in recent times, coastlines are vulnerable to disamenities such as the increased risk of flooding with various effects upon any development along its axis (Kalaugher, 2007; Urama and Ozor, 2010). Therefore, the trend of discourse in coastal hedonic price studies has been devoted to studying and evaluating the effect of coastal amenities and disamenities on property values. A tenable justification of the discourse trend is aptly rooted in Bin *et al.* (2008a) that biased inferences can result from not accounting for coastal amenities and disamenities.

Most coastal hedonic property studies were conducted in developed economies (Makinde and Tokunboh, 2013; Oladapo *et al.*, 2019). To reflect the peculiarities of the developing countries, a study in African countries such as Nigeria is necessary. Moreover, rental data are used in this study, which improves previous studies that rely on transaction-based or appraisal-based sale data. Rental data are more responsive to changes in the market while its analysis will allow for more sturdy models giving a better understanding of housing (Aliyu, 2010; Acheampong and Anokye, 2013; Famuyiwa, 2018). In addition, the rate of flood occurrence based on revealed preference techniques from tenants' percept was used to capture coastal disamenities, unlike previous studies that rely on historical floodplain maps. A dummy variable signalling the location of the floodplain in or outside of a floodplain could effectively underestimate the risk of flooding (Daniel *et al.*, 2009).

In developing countries, there is sparse literature focusing on coastal amenities/disamenities impact on property values (Udechukwu and Johnson, 2010). Most property appraisers are faced with the problem of how to incorporate associated coastal amenities and disamenities when determining property market value (Kruger, 2015). Therefore, this paper examines the effect of coastline on residential property values along the coastline corridor in Victoria Island, a coastal community in a Mega city of a developing country in Nigeria.

In Victoria Island, a previous investigation by Udechukwu and Johnson (2010) for Victoria Garden City (VGC), Lagos, Nigeria, found that a home with a view commands a premium of 8% or N2.59m naira more than homes without a view. In the same study area, Makinde and Tokunboh (2013) found that full view on average property increased the housing price by 47.9%. Each of these studies accounted for the effect of coastal amenity on residential property value while neglecting coastal disamenity. Unlike the generic definition of view used in the studies, this study used the Euclidean distance of the property to the nearest coastline, a recent measure of coastal amenity. The generic definition of view measure is associated with the spatial dependency of observations, while view scape can change over time as structures adjoining a residential building are altered (Bin *et al.*, 2008a; Walsh *et al.*, 2015).

The study by Ajibola *et al.* (2017) was limited to identifying the climate-related threats affecting property values and benefits derived along the Coastline in Victoria Island, Lagos State, Nigeria, while also collecting rental values of commercial and residential properties. The study did considers the non-monetary properties values by evaluating the challenges and benefits as effects of coastline on property values while also collecting rental values of commercial and residential properties. The study failed to model or determine the influence of the coastline on proximate properties. This is a drawback in coastal housing economics and property value modelling literature. The present study estimates in real (monetary) term the marginal effects of the amenities and disamenities on house rent by emphasizing distance to coastline and using two model specifications concentrated on selected residential properties in the study area.

Literature review

Numerous contributions from coastal hedonic property studies have considered the extent to which coastal amenities and disamenities influence residential property values. Most studies investigating the property value effect of coastal amenities without controlling for coastal disamenities have focused on the value-added through the view of water and proximity to water. Jim and Chen (2006) used a hedonic pricing model to examine the effect of environmental amenities on house prices in four residential precincts in Haizhu district, Guangzhou, China. The study found that environmental attributes such as green space view increase house prices by 7.1%, while proximity to water bodies could raise house prices by 13.2%. The authors found that traffic noise and proximity to woods were not significantly significant in the house transaction prices. The authors concluded that proximity to water bodies has a more positive impact on house prices than other environmental amenities.

Baranzini and Schaerer (2011) analysed 12,932 rental data to examine the value of view and land uses close to buildings in Geneva-Switzerland rental market. The authors found that rent premium for a dwelling located in a neighbourhood with an extended surface of water can be as high as 3% and a maximal view of water-covered area can raise rent up to 57%. They also found that dwellings with a view of the famous Geneva water fountain generate an average 3.6% higher rents. The authors noted that while the size and the view of the natural environment raise rents, the view of built environments declines them.

Zhang *et al.* (2015) analysed the price–volume relationships in Chinese coastal and inland housing markets. Using panel data obtained from 35 Chinese metropolitans, findings show that relationship exists in coastal cities where house prices are high with speculation. This shows that strict market intervention could bring significant change but cannot radically change the driving mechanism. The study concentrated on Granger relationship of price to volume ratio, which is not within the scope of this present study.

Dumm *et al.* (2016) examined price performance of the value of view across the boom, bust and post-bust phases of the most recent real estate cycle using sales data from the Tampa Bay, FL housing market for the 2000–2012 period. The authors found that the value of view for waterfront properties, as one category, commanded a price premium of 7.2% over non-waterfront properties for the period 2000 through 2012 while the average price premiums of view vary by type of waterfront across the 12-year time period and ranged from 3.1% for pond to 15% for lake, 61% for canal, 62% for river and 107% for bay, respectively. They concluded that the performance of specific waterfront property types across the economic cycle shows that the premiums were highest at the end of the boom stage (2006–2007) and at the end of the recovery stage (2011–2012).

Each of the studies that examined the property value effect of water view has shown that water views increase property values. In addition, there are variations in the estimated amounts of the increase across different geographical areas. Intrigued by associated shortcomings of the generic definition of a view, Conroy and Milosch (2011) analysed 9,755 single-family home sales in 106 neighbourhoods of San Diego County. The study found that a 1% increase in distance from the beach reduced house prices by 0.146%. The results of their study also revealed that coastal premium is approximately 101.9% for houses within 500 feet of the beach falling to 62.8% for homes between 500 and 1,000 feet, declining to about 3.3% for homes located between five and six miles of the beach, ultimately becoming insignificant beyond six miles from the beach.

Liu *et al.* (2019) analysed 14,789 apartment transactions to explore the interaction effects between landscape variables on house prices transacted between first quarter of 2015 and fourth quarter of 2017 in Chongquig, China. The authors found that people will pay 0.92% more money for a house 10% nearer to the urban river, while peninsula view and mountain view could increase the total prices of houses by 6.82% and 14.33%, respectively. They found an amenity premium of 5.67% on house price of the interaction of an urban river landscape and an urban mountain landscape but the coefficient of the interaction of river housing and peninsula landscape view on house price though positive was insignificant.

Later, studies began to account for more detailed estimates for the combined effect of coastal amenities and disamenities on property values. Bin and Kruse (2006) analysed differential flood risks associated with the location of homes within three significant flood categories zones in Outer Banks housing markets of Carteret County, North Carolina. The hedonic models revealed that moving away from the coastline at the mean distance of 220 m has 14.3% ($45,184) lower property values. The study found that location within the 500-year floodplains reduces a property value by 10.3% ($32,519) while areas within the 100-year floodplains and 100-year floodplains with wave exposure raise property values by 10.0% ($31,640) and 26.5% ($83,580), respectively. The study concluded that while property values are lower if located within a flood zone not subject to wave action, flood location vulnerable to wave action is associated with higher property value.

Bin *et al.* (2008a) analysed a data set of 1,075 homes sold in four beach communities in New Hanover County, North Carolina, between 1995 and 2002. The authors found that decreasing the distance to the nearest beach by ten yards (approximately 9 m) results in an $854 increase in property value. They also found that the mean willingness to pay (WTP) for sound frontage and pier are $141,022 and $51,944, respectively. They submitted that the location within a Special Flood Hazard Area (SFHA) zone lowers property values by approximately 11%, while the mean WTP to avoid site in SFHA is $36,082.

Bakkensen and Barrage (2021) examined flood risk belief heterogeneity and coastal home price dynamics in Rhode Island. This was achieved by estimating how climate risk beliefs affect coastal housing markets. The study implements a door-to-door survey and provides theoretical and empirical evidence by building a dynamic housing market model, which shows that belief heterogeneity can reconcile the mixed empirical evidence on flood risk capitalization. Findings revealed significant flood risk underestimation and sorting based on flood risk beliefs and amenity values. The study focuses on flood risk belief which is outside the scope of this research.

The studies of Bin and Kruse (2006) and Bin *et al.* (2008a) investigated how floodplain location alters residential property value. It is observed that there are somewhat mixed results with the use of floodplain types. The conjecture that properties in flood location associated with wave action commands higher property values than those in flood zone not subjected to wave action appears counter intuitive. A similar study by Yi and Choi (2020) has explained that such a result is new information to the housing market and can be interpreted as the market response to the updated flood risk. However, Daniel *et al.* (2009) argued that the existence of water is associated with both negative and positive spatial amenities, so a floodplain location indicating a dummy variable may underestimate the value of the risk of flooding.

Consequently, studies began to use actual flood events as a proxy for flooding to account for disamenities in coastal hedonic price studies. Daniel *et al.* (2009) investigated 9,505 residential properties to detect the presence of ex ante house price variations considering the perceived level of risk before the 1993 and 1995 river floods. It was observed that house prices before the 1993 flood were not different from those not subject to flood risk. However, between the two floods, the house value decreased by 4.6%. In contrast, the risk premium increased to about 9% after the second flood. In addition, within 500 m of the river, they found that dwellings experience a positive effect of 2.7%. At the same time, houses affected by the flooding are 4.7% cheaper than other houses. The study concluded that local housing markets in The Netherlands are significantly sensitive to flood risk.

Atreya *et al.* (2013) used a difference-in-differences spatial hedonic model to investigate the sale of 8,042 homes in Dougherty County, GA, from 1985 to 2004 to capture the time trend in the flood risk discount before and after the 1994 flood event. The authors found that before the 1994 flood, property prices in the 100-year floodplain declined by 9%, but the costs of properties in the 500-year floodplain did not change significantly. They found that immediately after the 1994 flood event, there was a 32% ($26,880) discount for the 100-year floodplain properties, discounted by $24,100 the first year after the flood, by $21,200 the second year, and flood risk discount becomes positive five years after the flood. Their findings also revealed that the prices of properties in the 500-year floodplain significantly weakly declined by 23% immediately after the surge, while the discount became insignificant after that. The authors also found that increasing the distance to Flint river (river associated with the 1994 flood event) by 1% results in an increase of the property values by 0.5%, whereas increasing the distance to other rivers by 1% results in the decline of the property values by 0.4%.

Bekes *et al.* (2016) investigated 28,542 real estate transactions in the Hungarian housing market from 2012 to 2013. They found that properties by major river ways without accounting for inundation risk are an 18% increase in house prices. Regarding the interaction term, they found that a 10% higher inundation risk is associated with 2.1% lower house prices along major rivers. The authors concluded that while riverside areas have an overall price premium, risky areas lose this advantage to flood risk.

Daniel *et al.* (2009), Atreya *et al.* (2013) and Bekes *et al.* (2016) used actual flood events as a proxy for flooding to account for coastal disamenities and amenities on property values and obtained a contradictory result. While Daniel *et al.* (2009) concluded that regional housing markets in The Netherlands are significantly susceptible to flood risk, Atreya *et al.* (2013) suggested that property prices in 100-year and 500-year floodplains after the 1994 flood event in Dougherty County, GA displayed a lower sensitivity to future flood risk. These conflicting opinions necessitate a study in developing countries such as Nigeria to reflect the region's peculiarities.

This paper, like several studies in a large theoretical body of hedonic literature on residential property market (Baranzini and Schaerer, 2011; Walsh *et al.*, 2015; Yamagata *et al.*, 2016; Kahveci and Sabaj, 2017; Bedell, 2018; Beltrán *et al.*, 2018; Du *et al.*, 2018), is deeply rooted in Rosen's (1974) work which provided a framework for hedonic analysis using a model of consumer bid and producer offer functions for determining the implicit price of the characteristics of a property for different consumers. The relationship between the price of housing units and housing attributes has been widely addressed in the coastal housing economics and property value modelling literature by the hedonic price models. From our extensive literature review, several empirical contributions from a large theoretical body of hedonic literature on residential property market suggest that house price is a function of packages of structural, location, neighbourhood and environmental attributes of the dwelling.

Methodology

Study area

Victoria Island is a Coastal Community of Eti-Osa Local Government Area (LGA) in Lagos State. Eti-Osa LGA borders Lagos Island and Ibeju-Lekki local government areas in the

West and East. In contrast, the Lagos Lagoon and the Atlantic Ocean define its northern and southern borders. The LGA covers land and water areas of 193,460 km^2 and 145 km^2, lying approximately between latitude 60°26'20"N to 60°27'50"N and longitudes 30°24'10"E to 30°40'10"E (National Population Commission [NPC], 2006; Lagos Bureau of Statistics [LBS], 2015; Agboola and Ayanlade, 2016). Figure 1 shows the map of the study area.

Victoria Island is an attractive, densely built and overpopulated area (Van-Bentum, 2012). It is an area desirable for people to reside in (Dada, 2009). Nevertheless, its axis has experienced consistent flooding because of sea-level rise over the years (Ajibola *et al.*, 2012). This coastal disamenity amidst the tangible and intangible benefits associated with the research area makes the study area suited for this study.

Previous studies used a threshold of 500 m to describe proximal environmental amenities to the apartments analysed (Jim and Chen, 2006; Daniel *et al.*, 2009). The study covers residential buildings within the width of 500 m from the Coastline inland, having a stretch of 1.2 km along the Atlantic Ocean extending from after the east mole/Atlantic city through to Oniru beach and Vantage beach. The tenanted residential property types considered are purposely built two- and three-bedroom blocks of flats and bungalow, respectively (see Figure 2).

Segmented linear spline of the distance of 250 m from coastline to the extent of 500 m was constructed to capture the non-linear effect of coastline on house rent (Kriesel and Friedman, 2002; Conroy and Milosch, 2011; Atreya and Czajkowski, 2014; Bedell, 2018). Figure 3 shows the map of the surveyed areas with residential properties at an incremental distance of 250 m to coastline.

Sampling procedure

Taking a cue from Gopalakrishnan *et al.* (2009), the residential properties within 500 m of the coastline was counted and the figures stand at 1,273. After ground-truthing, the physically identified single tenancy rented residential properties within 500 m of the coastline in the study area amounted to 484, which constituted the sample for the study.

Out of the residential properties sampled, 37.19% are within 250 m of the coastline, while the remaining 62.81% are located between 251 and 500 m of the coastline. The most equally distributed residential properties within 250 m to the coastline and those between 251 and 500 m of the coastline are associated with the three-bedroom bungalow with a proportion of 11.27% for the former and 10.30% for the latter (Table 1).

Method of data analysis

The choice of variables used in this study was driven by a holistic review of the coastal property hedonic literature and the selection of relevant variables to the study area. The data extracted from the field survey of the properties pertain to house rent, frequently

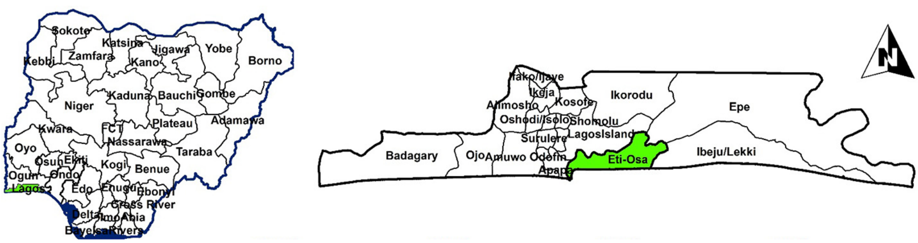

Figure 1.
Map of the Nigeria showing the study area

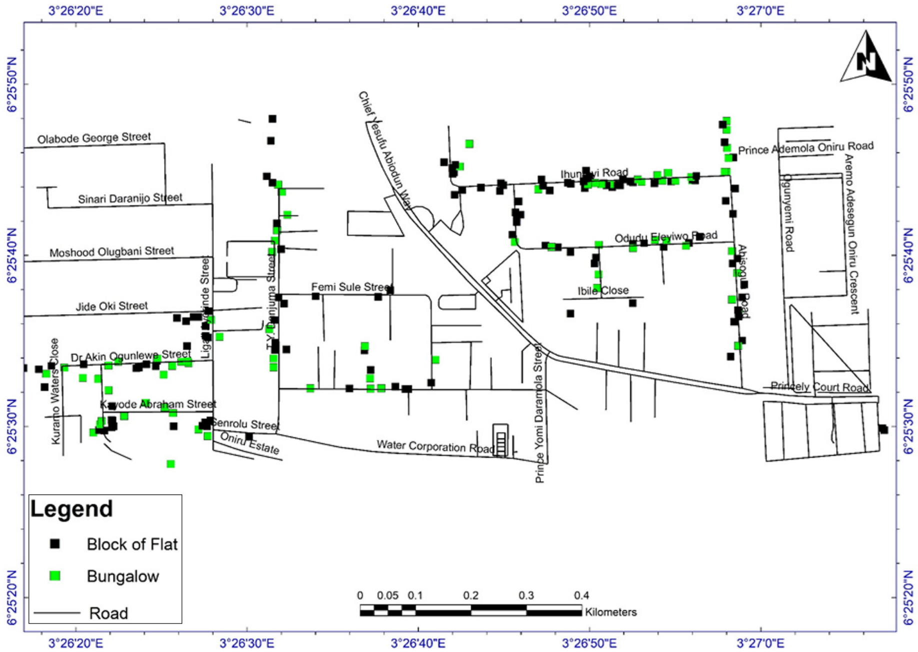

Figure 2.
Surveyed property types

appearing structural attributes in the literature, namely, building floor area, age of house, number of bathrooms, number of bedrooms, building condition, multistory or number of floors and presence of garage (Baranzini and Schaerer, 2011; Conroy and Milosch, 2011; Gordon *et al.*, 2013; Hansen and Benson, 2013; Makinde and Tokunboh, 2013; Atreya and Czajkowski, 2014; Wyman *et al.*, 2014; Below *et al.*, 2015; Walsh *et al.*, 2015; Dumm *et al.*, 2016), and locational characteristics, including distance to workplace, distance to the nearest public transport stop and distance to the nearest school (Blackwell *et al.*, 2010; Baranzini, and Schaerer, 2011; Conroy and Milosch, 2011; Makinde and Tokunboh, 2013; Atreya and Czajkowski, 2014; Dumm *et al.*, 2016; Liu *et al.*, 2019). Other frequently appearing attributes in the literature related to neighbourhood is quality of neighbourhood landscaping (Bourassa *et al.*, 2004; Bourassa *et al.*, 2005; Des Rosiers *et al.*, 2007; Jim and Chen, 2009; Du *et al.*, 2018; Liu *et al.*, 2019; Oyedeji, 2019) and the environmental variables of interest which are majorly distance to the nearest coastline and flood occurrence rate (Conroy and Milosch, 2011; Atreya and Czajkowski, 2014). Figure 4 depicts the rented properties from which the information used were extracted.

As argued by Kriesel *et al.* (2000), hedonic regressions estimations ensure a more robust comparison as they allow the averages to be computed on a constant-quality basis. Data on the level of flood occurrence indicate that the preponderance of respondents' responses on the rate of flood occurrence oscillates between low and medium perceptual ratings in the study area in the past two years. The hedonic regression model was used to examine the influence of coastline while controlling for other housing attributes on the rental value of residential properties. Models were estimated with the log–log functional form in which all the variables, except dichotomous variables, are measured in logarithmic form. The natural

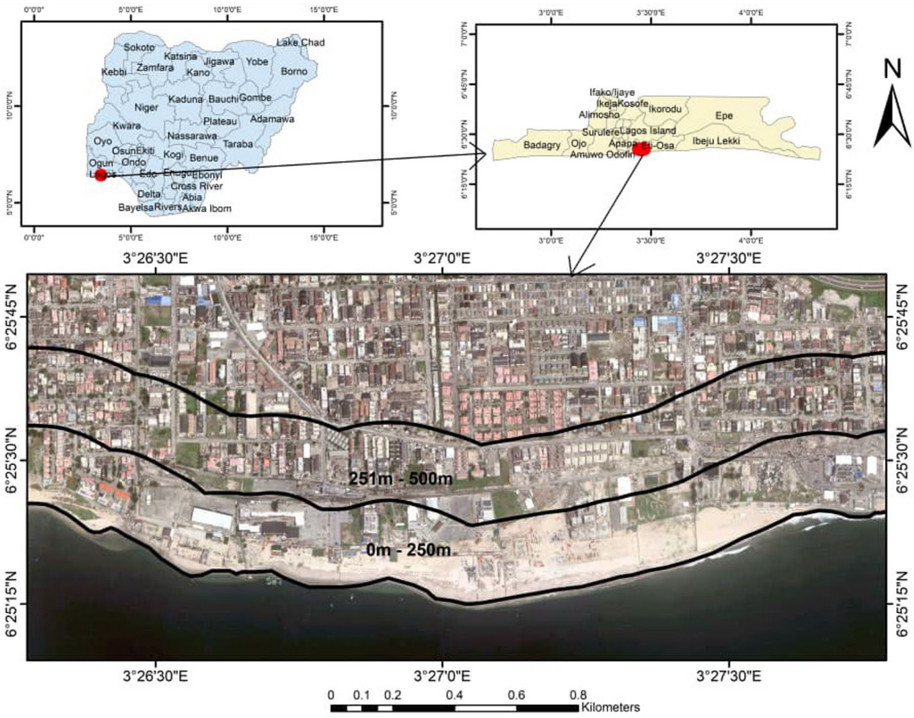

Figure 3.
Surveyed area at an incremental distance of 250 m to the coastline

Table 1.
Questionnaire administration

Distance to coastline	Coastline stretch	Questionnaire Administered	Questionnaire Retrieved	Questionnaire Valid
Within 250 m	Residential buildings behind Oniru Beach	180	147	118
Between 251 and 500 m	Resort to Vantage Beach Resort/Lekki	304	239	200
Total	Leisure Lake	*484*	*386*	*318*

log of distance to the coastline log(DISCOAST) was included to capture coastal amenities associated with the homes within 500 m of the coastline. Model 1 is given as follows:

$$\begin{aligned} LogRENT = {} & \beta_0 + \beta_1 logBLDAGE + \beta_2 logBFLOAREA + \beta_3 logDISTWORK \\ & + \beta_4 logDISBSTOP + \beta_5 logDISTSCH + \beta_6 logDISCOAST \\ & + \beta_7 NBEDROOM + \beta_8 NBATROOM + \beta_9 NFLOORS \\ & + \beta_{10} GARAGE\_Yes + \beta_{11} BLDCOND\_Excellent \\ & + \beta_{12} LSCAPQUA\_Excellent + \varepsilon \end{aligned} \quad (1)$$

where rent is expressed in its natural logarithm, β_0 is a constant term, the coefficients β_1–β_6 is the percentage change in rent resulting from a unit change in age, building floor area,

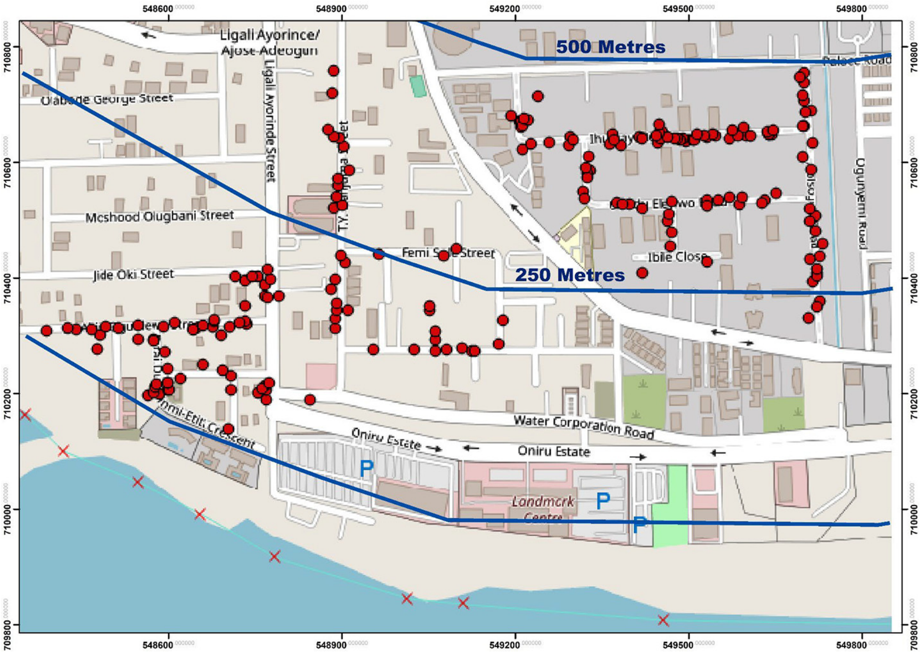

Figure 4.
Rented residential property at incremental distance (250 m) to the coastline

house–workplace distance, house–bus stop distance, house–school distance and house–nearest coastline distance (or interaction of distance to the coastline and flood occurrence), respectively. The coefficients β_7–β_{13} reveal the percentage change in renting an additional bedroom, bathroom, floor, garage, excellent building condition and excellent landscape quality. The uncorrelated residual term is ε.

As it is logical that the effect of distance to the coastline will be non-linear, a segmented set of models (Model 2) was estimated to incorporate flooding. To account for coastal disamenity as the distance to the coastline increases, the natural log of distance to coastline and rate of flood occurrence log(DISCOAST*FLODRATE) were interacted to account for the effect of coastal disamenity. Model 2 is given as follows:

$$
\begin{aligned}
LogRENT = {} & \beta_0 + \beta_1 logBLDAGE + \beta_2 logBFLOAREA + \beta_3 logDISTWORK \\
& + \beta_4 logDISBSTOP + \beta_5 logDISTSCH + \beta_6 log(DISCOAST*FLODRATE) \\
& + \beta_7 NBEDROOM + \beta_8 NBATROOM + \beta_9 NFLOORS \\
& + \beta_{10} GARAGE\_Yes + \beta_{11} BLDCOND\_Excellent \\
& + \beta_{12} LSCAPQUA\_Excellent + \varepsilon \qquad (2)
\end{aligned}
$$

The multicollinearity and spatial autocorrelation tests were applied to the hedonic models to establish if some regression analysis assumptions were met. Following Rosiers *et al.* (1996), Menard (2002), Gujarati (2004), Glen (2015), McCormack (2015), Xiao (2017) and Senaviratna, and Cooray (2019), the tolerances for all the explanatory variables for the models which are close to 1 and all the VIF values which are less than 4 suggest that multicollinearity is not a concern (see Appendix). Also, relying on Field (2009) and Glen (2016), the Durbin–Watson statistic values ranging from 1.647 to 2.226 (Tables 2 and 3) for all the regression models signify that there are no spatial correlations in the residuals of the estimated hedonic models. The empirical results are presented in the next section.

Results and discussion

The results of the hedonic price models are presented in Tables 2 and 3. The models have a good predictive power for the explanatory variables, with *R*-squared statistics ranging from 0.55 to 0.64. The *F*-statistics in the range of 6.491–21.115 show that at 0.1% level, the models are statistically significant and explain between 55% and 64% of the variance of rents in the study area. The entire sample models reveal that variables such as building age (LogBLDAGE), floor area (LogBFLOAREA), number of floors (NFLOORS) and Garage (GARAGE_YES) are significant determinants of rent of residential properties in the study area.

Across all the models, the coefficients on building age imply that a 1% increase in the property's age decreases rent in a range from 0.1% to 0.2%, or N26,581 ($74) to N49,017 ($136) at the mean [1] [2]. The coefficient on a floor area is significant at 0.1% across the models and imply that a 1% increase in a square metre of floor area increases house rent in a range from 1.86% to 2.71% or N31,485 ($88) to N46,573 ($129) [1] [2]. The estimated marginal effect for the number of floors variable in Models 1A and 2A implies that for the whole houses within 500 m of the coastline, properties with a higher number of floors increase the rent by approximately 3% or N95,600 ($266) [3] [4]. Moving to the segmented

Table 2. Log–log hedonic price models of coastline and housing characteristics for Victoria Island (non-flood effect)

	Model 1					
	A (0–500 m)		B (0–250 m)		C (251–500 m)	
Variables	Coeff	*t*-Stat	Coeff	*t*-Stat	Coeff	*t*-Stat
Constant	2.408	1.828	−1.091	−0.282	1.043	0.500
LogBLDAGE	−0.163**	−3.454	−0.098	−1.300	−0.235***	−3.775
LogBFLOAREA	2.381***	10.627	1.856***	6.040	2.672***	8.368
NBEDROOM	0.025	0.576	0.071	1.083	0.029	0.489
NBATROOM	−0.114	−0.953	0.105	0.624	−0.252	−1.471
NFLOORS	0.031***	3.966	0.010	0.803	0.055***	4.682
GARAGE_YES	0.152**	3.468	0.059	0.851	0.183**	3.124
BLDCOND_Excellent	0.028	0.892	−0.007	−0.162	0.020	0.460
LSCAPQUA_Excellent	0.028	0.817	0.039	0.743	−0.031	−0.679
LogDISCOAST	0.001	0.009	0.077	0.359	0.233	0.763
LogDISTWORK	−0.029	−0.932	−0.048	−0.852	−0.065	−1.510
LogDISBSTOP	−0.437	−1.220	1.074	0.952	−0.345	−0.718
LogDISTSCH	−0.002	−0.040	−0.073	−0.653	0.023	0.301
R^2	0.571		0.553		0.637	
Adjusted R^2	0.544		0.468		0.599	
Standard error (SE)	0.17254401		0.150936371		0.17801468	
Durbin–Watson	2.116		1.649		2.226	
F-statistic	21.104		6.491		16.657	
p-Value	0.000		0.000		0.000	
Observations	318		118		200	

Notes: Dependent variable: LogRENT; ***indicates significance @ 0.1% ($p < 0.001$) level, **indicates significance @ 1% ($p < 0.01$) level and *indicates significance @ 5% ($p < 0.05$) level

Variables	A (0–500 m) Coeff	A t-Stat	B (0–250 m) Coeff	B t-Stat	C (251–500 m) Coeff	C t-Stat
	Model 2					
Constant	2.619	2.285	−0.806	−0.254	2.796	1.518
LogBLDAGE	−0.162**	−3.44	−0.101	−1.318	−0.237***	−3.78
LogBFLOAREA	2.385***	10.622	1.863***	6.147	2.712***	8.395
NBEDROOM	0.025	0.569	0.073	1.116	0.017	0.294
NBATROOM	−0.117	−0.986	0.103	0.612	−0.293	−1.696
NFLOORS	0.032***	3.975	0.009	0.75	0.053***	4.602
GARAGE_YES	0.152**	3.484	0.058	0.833	0.198**	3.478
BLDCOND_Excellent	0.028	0.891	−0.006	−0.14	0.022	0.517
LSCAPQUA_Excellent	0.028	0.841	0.044	0.859	−0.028	−0.597
Log(DISCOAST*FLODRATE)	−0.020	−0.239	0.047	0.387	−0.085	−0.319
LogDISTWORK	−0.028	−0.898	−0.051	−0.91	−0.052	−1.241
LogDISBSTOP	−0.494	−1.545	1.004	1.049	−0.687	−1.525
LogDISTSCH	−0.004	−0.062	−0.079	−0.751	0.015	0.195
R^2	0.571		0.553		0.635	
Adjusted R^2	0.544		0.468		0.597	
Standard error (SE)	0.17251806		0.150912125		0.17838925	
Durbin–Watson	2.119		1.647		2.225	
F-statistic	21.115		6.494		16.547	
p-Value	0.000		0.000		0.000	
Observations	318		118		200	

Notes: Dependent variable: LogRENT; ***indicates significance @ 0.1% ($p < 0.001$) level, **indicates significance @ 1% ($p < 0.01$) level and *indicates significance @ 5% ($p < 0.05$) level

Table 3. Log–log hedonic price models of coastline and housing characteristics for Victoria Island (flood effect)

models, a unit increase in the number of floors leads to a rise in house rent by as much as 5.7% or N167,095 ($464) in Model 1C and 5.4% or N160,857 ($447) in Model 2C for residential properties between 251 and 500 m from the coastline, or as low as approximately 1% or N29,500 ($82) in Models 1B and 2B for homes within 250 m of the coastline [3] [4].

As displayed in Models 1A and 2A, the significantly positive coefficient for the dummy variable, which captures the garage effect, increases rents for the whole houses within 500 m of the coastline by approximately 16% or N483,000 ($1,342) [3] [4]. The impact is most significant in Models 1C and 2C, where the rent of a home having garage could increase by around 20% or N593,469 ($1,649) and 22% or N647,102 ($1,798), respectively. The results suggest that tenants attach importance to this attribute in the study area, but more weight is attached to the attribute in homes between 251 and 500 m of the coastline. The insignificantly positive coefficient for the dummy variable that captures the garage effect implies that the garage increases house rents by approximately 6% or N178,000 ($494) within 250 m of the coastline (Models 1B and 2B) [3] [4].

Moving on to the variables of interest, the signs (positive or negative) of the effects of the coastal amenity (LogDISCOAST) and disamenity {Log(DISCOAST*FLODRATE)} variables across the models are somewhat not consistent with expectation. The variable *LogDISCOAST* is positive but statistically insignificant in Model 1A. As the results show, a 1% increase in distance from the coastline leads to a rise in property values by 0.001%, which is equivalent to N9.77 ($0.03) when evaluated at the average house rent among homes up to 500 m of the coastline [1] [2]. The result implies that distance to the coastline has a weak effect on the rent of the properties with increasing returns. The coefficient on *Log (DISCOAST*FLODRATE)* in Model 2A indicates that when flooding becomes an issue, increasing the distance to the coastline by 1%, there is an insignificant discount of about 0.02% associated with properties up to 500 m of the coastline, equivalent to N194.88 ($0.54) when evaluated at the average house price [1] [2]. The result implies that when flooding is accounted for, increasing distance from the coastline has a weak negative impact on house rents.

Turning to the segmented models, without controlling for flood occurrence, in Model 1B, the variable *LogDISCOAST* is positive but insignificant. The results imply that proximity to the coastline is somewhat undesirable and increasing distance from the coastline has a weak positive effect on the house rent. A 1% increase in distance from the coastline is associated with approximately 0.08% or N1,318 ($3.66) increase in property rent within 250 m of the coastline (Model 2) [1] [2]. The insignificant coefficient on *LogDISCOAST* in Model 1C suggests that a 1% increase in distance from the coastline increases rents by 0.23% or N1,757.09 ($4.88) [1] [2]. When flood occurrence is accounted for within 250 m of the coastline (Model 2B), the result reveals that proximity to the coastline further dampens house rent though insignificant. The insignificant coefficient on *Log (DISCOAST*FLODRATE*) is 0.047, indicating that a 1% increase in distance from the coastline increases rent by approximately 0.05% or N805 ($2.24) [1] [2]. Contrarily, in Model 2C, a 1% increase in distance from the coastline decreases rent by approximately 0.09% or N641 ($1.78) between 251 and 500 m of the coastline [1] [2].

The results reveal that proximity to Coastline (LogDISCOAST) has not enhanced residential property rental values in the study area. Without controlling for disamenities, proximity to coastline has a weak negative effect on rent for Models 1A–C. The weak negative effect of coastline on rent means that the coastline is insignificantly undesirable for households in the research area. The previous ocean surges and flooding experience in Victoria Island could be the possible reason why families are not willing to pay a reasonable premium to have access to the coastline that lies within 500 m of their homes (Awosika *et al.*, 2002; Olaniyan and Afiesimama, 2003; Oyinloye, 2016). This finding differs from other coastal studies that found that proximity to the coastline has a robust positive effect on residential property prices (Bin and Kruse, 2006; Bin *et al.*, 2008a, b; Samarasinghe and Sharp, 2008; Bin *et al.*, 2009; Conroy and Milosch, 2011; Atreya and Czajkowski, 2014; Fu *et al.*, 2016). While studies that found that proximity to the coastline has a robust positive effect on house prices are common, there is some evidence for similar findings that proximity to coastline negatively affects house prices (Bourassa *et al.*, 2004; Atreya *et al.*, 2013).

Moreover, when disamenities are controlled for, it is only in Model 2B that flooding lowers the rent with proximity to the coastline. The reverse is demonstrated in Models 2A and 2C. This discrepancy can be explained by the fact that no substantial cost of flood occurs when the entire sample is considered (Model 4) and in the location between 251 and 500 m of the coastline (Model 2C). In other words, the level of flood occurrences in the areas was relatively lower compared to locations within 250 m of the coastline. The finding that flooding lowers residential property value with proximity to the coastline reaffirms the studies of Bin *et al.* (2008b), Daniel *et al.* (2009) and Bekes *et al.* (2016). On the other hand, the finding that signifies that in the phase of flooding, rent increases with proximity to the coastline (Models 2A and 2C) somewhat agree with the study of Bin and Kruse (2006) and Atreya and Czajkowski (2014), which concluded that the associated positive amenity values of living in high-risk areas outweigh the flood risk.

Conclusion

This study estimated the price of proximity to the coastline, among other housing attributes. Without controlling for coastal disamenities, the results suggested that proximity to the coastline has an insignificant negative effect on property value in the research area. This finding indicates that values of proximate residential properties to the research area's coastline are somewhat associated with the risk of flooding. Moreover, controlling for disamenities, property values tend to increase with proximity to the shoreline in locations within 500 m of the coastline and between 251 and 500 m of the coastline, indicating that flood occurrence in the areas is low in the years between 2017 and 2018. Contrariwise, flooding further decreases rent with decreasing distance to the coastline within 250 m of the coastline. Considerably, the findings are within the confine of results in the literature.

This research provides valuable insight to coastal managers, government and real estate professionals. The findings suggest a reflection of flood risk in values of proximate residential properties to the coastline. The study recommends that government and coastal managers adopt proper protection measures of the coastline and ensure an integrated approach to flooding control to lessen the consequence of flooding in the research area. The implication to real estate valuers is that varying premiums should be considered when valuing a property depending on the distance to the coastline while considering other housing attributes in the study area. The future research agenda could use the concept of the submarket, which could involve the use of data for only a particular property type other than the amalgamation of the attributes of different residential property types used in this study. The approach will further enhance understanding the complex residents–environment behaviour within the various categories of residential properties with associated housing attributes.

Notes

1. The coefficient of the predictor variable, when both response variable and predictor variable are log-transformed, is interpreted as the per cent increase in the dependent variable for every 1% increase in the independent variable (Ford, 2018).
2. The equivalent actual term estimation of the marginal effect of the log-transformed continuous or distance-related explanatory variable on rent is calculated by ($\gamma * \beta \div \bar{y}$), where γ is the mean house rent, β is the coefficient of the continuous or distance-related variable and $\bar{y}$ is the mean value of the continuous or distance-related variable (Bin *et al.*, 2008b).
3. The percentage increase or decrease in rent resulting from a change in dummy or discrete explanatory variable is derived from the exponent of the coefficient of the variable, then one subtracted from this number and multiplied by 100: $[\exp(\beta) - 1]*100$ (Halvorsen and Palmquist, 1980; Giles, 1982; Baranzini and Schaerer, 2011; Ford, 2018).
4. The equivalent actual term estimation of the marginal effect of dummy or discrete explanatory variable on rent is calculated by $\gamma * \{\exp(\beta) - 1\}$, where γ is the mean house rent and β is the coefficient of a dummy or discrete variable (Bin *et al.*, 2008b).

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Appendix

Table A1.
TOL and VIF statistics of the explanatory variables in Victoria Island

			Non-flood effect						Flood Effect			
	Model 1A		Model 1B		Model 1C		Model 2A		Model 2B		Model 2C	
Variables	TOL	VIF	TOL	VIF	TOL	VIF	TOL	VIF	TOL	VIF	TOL	VIF
LogBLDAGE	0.748	1.337	0.697	1.435	0.710	1.409	0.753	1.328	0.681	1.468	0.708	1.413
NBEDROOM	0.698	1.432	0.636	1.571	0.563	1.777	0.710	1.408	0.648	1.544	0.612	1.633
NFLOORS	0.951	1.051	0.786	1.272	0.821	1.218	0.946	1.057	0.776	1.288	0.846	1.182
GARAGE_YES	0.680	1.471	0.769	1.300	0.587	1.704	0.681	1.468	0.779	1.283	0.616	1.624
BLDCOND_Excellent	0.720	1.389	0.786	1.272	0.656	1.524	0.720	1.389	0.786	1.272	0.652	1.535
LSCAPQUA_Excellent	0.653	1.532	0.630	1.588	0.589	1.697	0.671	1.490	0.659	1.519	0.610	1.639
LogDISCOAST	0.270	3.709	0.348	2.871	0.409	2.448						
Log(DISCOAST*FLODRATE)							0.369	2.711	0.517	1.936	0.496	2.015
LogDISTWORK	0.662	1.512	0.540	1.852	0.576	1.735	0.674	1.484	0.536	1.866	0.606	1.651
LogDISBSTOP	0.269	3.716	0.373	2.684	0.395	2.529	0.337	2.964	0.510	1.959	0.453	2.210
LogDISTSCH	0.639	1.565	0.710	1.408	0.681	1.467	0.647	1.545	0.814	1.228	0.691	1.447
Distance bands about the coastline	0–500 m		0–250 m		251–500 m		0–500 m		0-250m		251-500m	