Residential Rental Market in Ghana – Empirical Examination of Submarket Existence

E. K. Gavu

Faculty of Spatial Planning, TU Dortmund University, Dortmund, Germany
emmanuelkofi.gavu@tu-dortmund.de / +49 (0)176 71203853

Abstract

Purpose – Rent (or rental value) can be defined as a periodic amount that is paid (by a tenant) or received (by a landlord or his assigns) for the occupation and or use of property. Residential rental values (RRVs) vary among rental markets; thus correctly identifying the drivers of these values underscores the need to understand how the market functions. The purpose of this research is to testfor submarket existence based on empirical examination of the residential rental housing market in Ghana.

Approach – Based on literature review and market observations, we provide key concepts and an overview of the residential rental market in Ghana.Although there is a general consensus that submarket exists, empirical identification of same has employed varied methods. Based on real estate experts and stakeholder consultations, a priori delineations of submarket constructs are made based on spatial, structural and a nested approach. The existence of submarkets are tested usingthe Kruskal-Wallis H test and Hedonic modelling techniques.

Findings – By using fieldwork data from Accra rental market**,** the analysis provides credence to the conceptualisation of submarkets and how to empirically test for same. It is argued that researchers should employ alternative methods to compare results in order to make far reaching conclusions.

Research implications – examining the hypothesis that differential rental values exists for submarkets has implications for policy decisions to target submarket constructs differently to improve market maturity.

Practical implications – the research provides stakeholder investors in the rental space an understanding of market dynamics for profit maximisation, and

end-users to maximise utility in deciding where to live – and as such households could benefit from making informed investment decisions on housing.
Originality / Value of work – This research is one of the first attempts to empirically identify submarkets in the residential rental market in Ghana.

Key Words – Housing**;** Residential; Rental value; Rental submarket; Ghana

Paper Type – Research paper

1. Introduction

Rental housing is an important component of housing supply provision. There are lots of constraints on the supply side (including high cost in building, high financing costs, high cost of building materials among others) and as such housing options range from those that lack basic facilities (in some cases are shared) to the other extreme. Household income plays a key role in determining options available to same. Osumanu(2010) found out that a significant proportion of urban households cannot afford ownership due to low incomes, hence rental housing becomes the most logical solution to consider. Households make critical decisions as to which accommodations they prefer to rent based on whether the property in question fits their lifestyle or not.

It can be appreciated that a well-functioning housing market provides for a variety of housing options to the population. In a well-functioning rental housing market (in developed markets), the value of rental housing is linked to the quality of the housing, access to jobs and other public services, and access to basic infrastructure; which are all location specific. Supply in the market is from new constructions as well as modifications (and renovation) of the existing stock. And these changes to the stock are through the determinants of supply and demand forces. Although the rental market is a viable option in terms of housing supply, the government of Ghana's policy focus has been on ownership. This seems contradictory because rental housing is on the ascendency.

There is the general agreement that housing sub-markets do exists (Anim-Odame et al. 2010a; Anim-Odame et al. 2010b; Jones & Watkins 2009:78) and there are standard acceptable statistical tests for the existence of such (Schnare & Struyk 1976). Submarket definition is an important aspect in housing market

analysis and this is very useful in appreciating market dynamics and making market predictions (Wheeler et al. 2014). Housing markets research continues to receive little attention from researchers and research in this area is characterised by data unavailability and asymmetries(Anim-Odame et al. 2010a; Anim-Odame et al. 2010b).
The critical questions to ask about submarket existence are: Are these submarket segmentations really different? Or are the differences found, merely a reflection of variations expected from random sampling from the same population? Are the differences genuine or do they only occur by chance.

We fill this knowledge gap by using fieldwork data (primary data) collected between March and October 2017. This rental data is collected for all neighbourhood classes in Accra. The analysis uses various theoretical definitions of submarket to empirically test for submarket existence based on spatial, structural and nested segmentation of the market. Submarket existence is examined using the Kruskal-Wallis H test and hedonic modelling techniques. The main aim of this research is to test submarket existence based on empirical examination of the residential rental housing market in Ghana.

The research proceeds in the following structure: section 2examinesthe residential rental market in Ghana and provides the striking features in same. Section 3 reviews relevant literature on submarket definitions and identification. Section 4 discusses the methodology and data used. Sections 5 and 6 presents and analyses of empirical results while section 7 provides conclusions on the study.

2. The residential rental market in Ghana

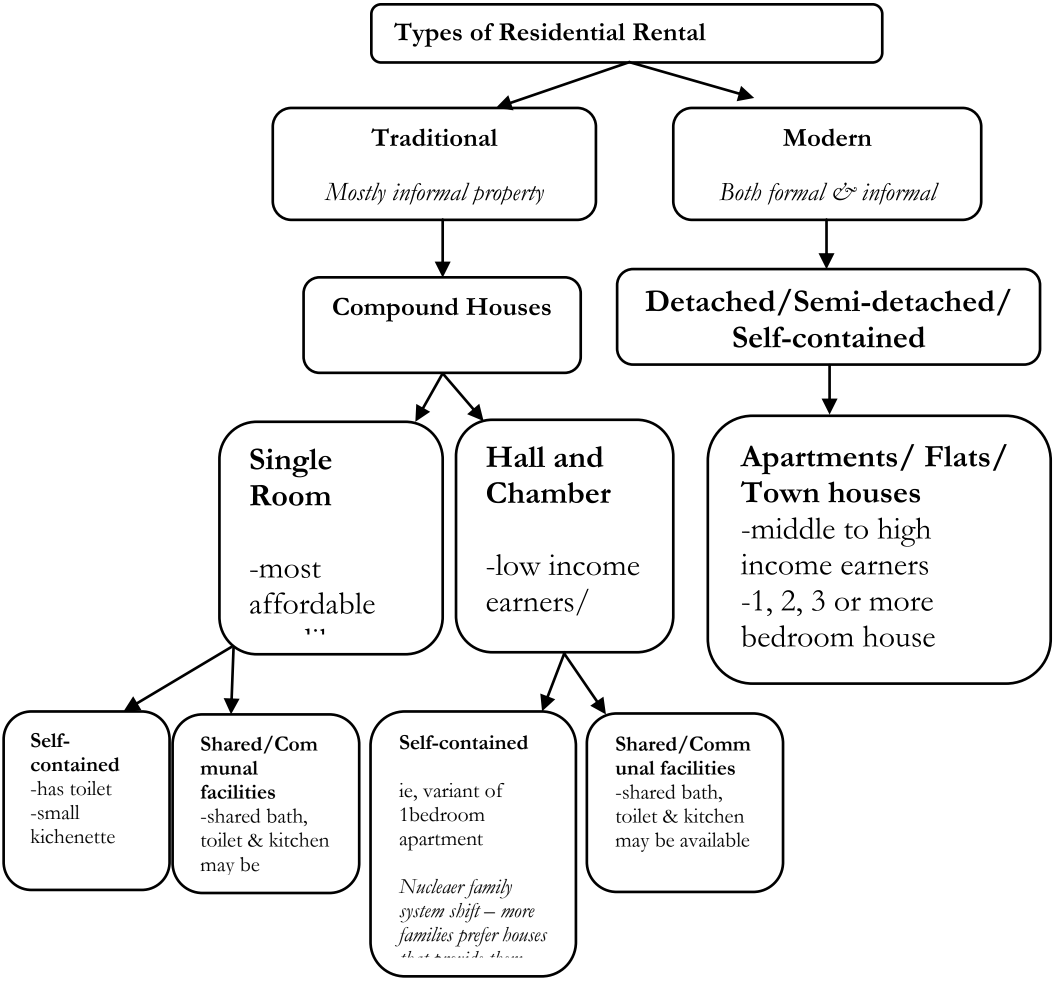
Ghana's housing market follows a free market economy model. The initial policy focus of government was direct state provision in the 1990s; however this role has shifted and been taken over by an active private sector comprising individual developers, private real estate firms and developers (Graham Tipple & Korboe 1998; Arku 2009b; Arku 2009a). The government's current role is a regulator and also to provide an enabling environment for developers to supply much needed housing. In some instances there are Public Private Partnership (PPPs) arrangements. In the recent past the attempts at improving housing supply has been to either sub-divide new land, extend infrastructure, make housing finance easier to access and also making it easier for private developers to develop new housing stock. All these attempts by the government were to encourage home ownership. In many countries however, home ownership has become the norm and the most desired option. However not everyone can afford to own property. There is the need for others to consider rental housing as a viable option especially in developing countries where incomes are generally low and demand for housing always exceeds available supply. This results in increasing prices for accommodation.

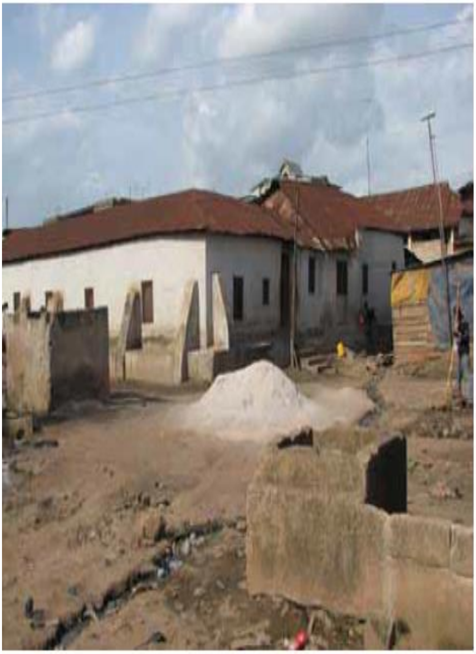
The national housing policy of Ghana aims at "*creating viable and sustainable communities through the provision of adequate, decent and affordable housing that is accessible and sustainable to satisfy the needs of Ghanaians"*(Government of Ghana 2015). To reduce the over 1.7 million housing deficit (Osumanu et al. 2018), government's main approach is to create an "enabling environment" for private sector investment and accelerate upgrading of the existing housing. The typology of accommodation in the rental housing market in Ghana consists of; the formal and informal sectors (see figure 1). The formal sector is much more organised and comprises of gated communities and estate buildings. It is well served with basic infrastructure and buildings conform to planning standards. Housing supply here is mostly by government and the private sector (real estate developers). About 90 *per cent* of the housing stock is exclusively for sale. The few available for rent are mostly affordable to the expat community and serves those in the middle and especially those in the high income brackets. Rental prices are mostly quoted in United States Dollars (USD).

In Ghana the informal rental market is generally of poor quality. It often lacks access to basic water and sanitation. Landlords operate outside the legal regime because of housing shortages, and evictions are rampant. They use this phenomenon as bases to (most often) exploit tenants who are at their mercy. However these private sector informal landlords have contributed in curbing the housing situation. Without them the situation could have been worse. This market is yet to receive the needed attention from policy makers. However it must be noted that most of the houses are overcrowded, poorly sited (for example very close to public toilets, dump sites) and do not have building permits. These buildings are more or less randomly sited and access for emergency services like fire and ambulance become an issue when disaster strikes.

The informal rental market is dominated by what is known as the traditional compound houses(Osumanu 2010) which is home to majority of the population (see figure 2). These are mostly communal single storey structures (with one or two rooms that serve a household) with a courtyard where multiple households share common bathroom and toilet facilities. They are normally occupied by low income earners. Basic infrastructural facilities around these houses are either non-existent or inadequate. About 50 *per cent* of households in Ghana live in one room dwellings and Accra is no exception(Ghana Statistical Service 2013).

Other housing options available in the rental market include semi-detached houses, detached houses, apartments and bungalows. Three main types of rooms are available for the low income tenants for renting in compound houses. These are *'single-rooms'*, '*hall-and-chamber units*' and the '*hall-and-chamber self-contain units'*. The *single-room* consists of one room that serves as both living and bedroom space for the tenant. The *hall-and-chamber unit* has 2 rooms; one used as living room (which can also be converted to a bed room space) and the other as a bedroom. In the first two scenarios all other facilities are shared by other households on the same compound. With the *hall-and-chamber self-contain* units the tenant may have a private space for kitchen, a toilet and bath. However because of crowding other spaces like kitchen and toilet facilities can be converted to rooms for rental purposes.


Types of Residential Rental
Traditional
Mostly informal property
Modern
Both formal & informal
Compound Houses
Detached/Semi-detached/ Self-contained
Single Room
-most affordable
Hall and Chamber
-low income earners/
Apartments/ Flats/ Town houses
-middle to high income earners
-1, 2, 3 or more bedroom house
Self-contained
-has toilet
-small kichenette
Shared/Communal facilities
-shared bath, toilet & kitchen may be
Self-contained
ie, variant of 1bedroom apartment
Nucleaer family system shift – more families prefer houses
Shared/Communal facilities
-shared bath, toilet & kitchen may be available



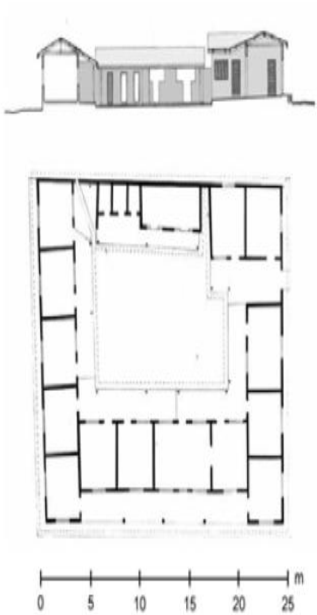


Figure 1: Residential Rental accommodation types in Ghana Source: Author's construct, 2018
Photo credit © G Tipple Photo credit © Royal Danish Academy of Fine Arts
Figure 2: Traditional compound house and plan Source: (UN-Habitat 2011)

3. Housing submarket: definition and identification

Maclennan and Tu (1996) posit that; *"In reality different [renters] have different housing preferences and have a variety of spatial as well as sectorally distributed dwelling alternatives which may not comprise a single market*". The taste and preference of people to various housing types are varied, so are corresponding rental values. This gives rise to a housing market that is diversified and can be further segmented. This segmentation is what is referred to as a housing submarket or localised segment within the housing market.

There is the general agreement that housing sub-markets do exists (Anim-Odame et al. 2010a; Anim-Odame et al. 2010b; Jones & Watkins 2009:78).Submarket definition is an important aspect in housing market analysis and this is very useful in making market predictions (Wheeler et al. 2014). A housing submarket can be defined as "*an area where there are statistically significant and enduring price differences for some commodity or housing characteristic in relation to the overall market or other similarly defined areas within it* (Maclennan & Tu 1996). Wheeler et al.(2014) further asserts that, "*the practice of defining submarkets for price assessment is based on the principles of landscape compartmentalization and substitutability that combine to produce relatively homogeneous assessment units*". This principle ensures that analysis of housing market produces results that actually throw more light on how the market really functions. Mutually exclusive areas are selected and analysed based on research objectives and the particular market specifications.

Just as there are many and varied definitions of housing submarket, there are likewise many ways to identify same (Hwang 2015). The principle of substitution is key in defining submarket boundaries. Can the property be substituted by another and perform same or similar functions? If the answer is yes then these substitutable properties could be within a similar submarket. Carruthers (1989) posits that if there is a high degree of substitutability between 2 or more market subgroups, say S_i and S_n, then these subgroups effectively belong to the same submarket and should not be segmented. Models are then estimated for each homogeneous area and the hypothesis tested, is whether these homogeneous areas (submarket) are indeed heterogeneous. The focus of several research have based submarket definitions based on spatial; structural; or nested spatial/ structural segmentation of the market (Watkins 2001).

3.1 Spatial segmentation

Spatial segmentation uses *a priori* methods to delineate so called submarket boundaries. The approach has been to use income groups and neighbourhoods that exhibit similar characteristics to segment the market. The housing submarket is typically defined as geographic areas where the price per unit cost [rent] of housing quality (identified by using some index of housing characteristics) is constant (Goodman & Thibodeau 1998; Jones et al. 2009). Housing market areas are composed of spatially defined housing sub-markets

(Goodman 1978; Jones et al. 2009). Few studies examine the spatial contiguity on housing sub-market classification (Wu & Sharma 2012). To avoid biases in classifications, some researchers resort to empirical analysis to define submarkets. Hedonic regressions may be used (Ugarte et al. 2004); use of a finite mixture model using demographic information (Belasco et al. 2012) and the use of hierarchical models (Goodman & Thibodeau 1998) are examples of methods adopted to spatially delineate the housing market. A geographically weighted regression model can also be used to detect housing sub-markets (McCluskey & Borst 2011; Borst et al. 2007). The assumption here is that if submarkets exist then the hedonic coefficients or price functions are distinguishably different from each other and also different from a single market in equilibrium.

3.2 Structural segmentation

Structural segmentation focuses on the housing structure and its inherent characteristics. So for example apartments may be segmented from single family homes. Allen et al. (1995) use the Tiao-Goldberger test and the Swamy Random Coefficient model techniques to examine the existence of submarkets based on property type. Using this approach, submarkets exists when coefficients from hedonic modelling are statistically tested and results suggest that these coefficients are not the same.

3.3 Nested spatial/ structural segmentation

By the nested spatial/ structural segmentation the approach is to focus on the joint importance of both the spatial and structural attributes in defining submarkets(Watkins 2001; Adair et al. 1996). Whereas Watkins (2001) mentions that submarkets have broadly been categorised based on 3 groupings, McClusky and Borst (2011) posit that in modelling location and submarket delineation, the existing literature can rather be organised into 6 broad categories. They further argue that models utilise one or a combination of these categories: (1) Market segmentation – *a priori* segmentation by structure or spatially; (2) Neighbourhood delineation variable – normally make use of predefined administrative boundaries; (3) Neighbourhood influence variables – amenity variables that affect value either positively or negatively; (4) Accessibility measures – distance to economic centres or transport opportunity; (5) Explicit and implicit use of location – techniques that utilise *x, y* locations; (6) Advanced model specification methods – *i.e.*, using geographically weighted regression techniques.

Wheeler *et al*.(2014) also categorise methods of delineating housing submarkets as *a priori* methods, statistical approaches and subjective/ perceptual analysis as perceived by experts in the field. In subjective/ perceptual analysis the argument in support of utilising this approach is that submarket identification and description needs to be defined empirically based on how various experts and stakeholder groups define it.

3.4 Spatial disaggregation of housing sub-markets in hedonic predictions

In the land economics literature the mantra has been that location is a key determinant of price. There are empirical studies that suggest that location is more important than structural characteristics (Watkins 2001). However how the spatial and structural context translates to an implicit price is treated differently by researchers. Figure 3 depicts some characterizations that surround sub-market classification by considering spatial dimensions.

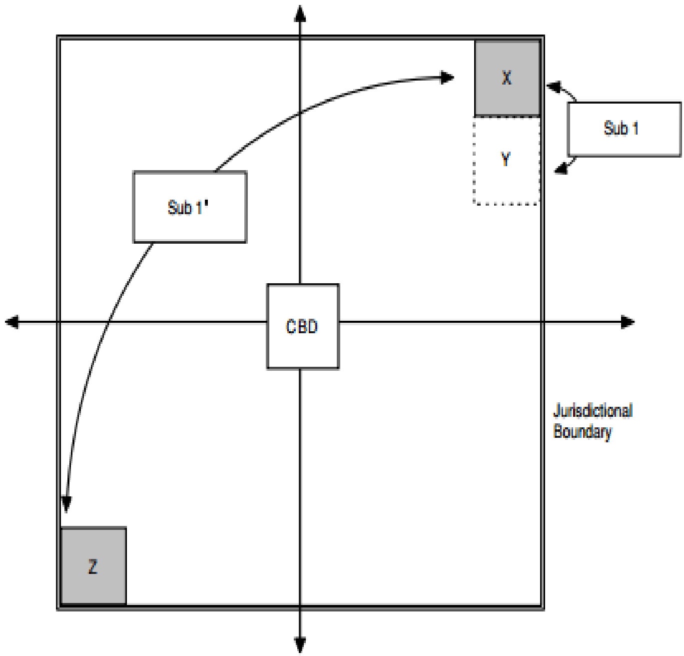


Figure3: Sub-market characterisations (Adapted from Goodman &Thibodeau 2007)

X, *Y* and *Z* in the figure above are dwelling units (housing) at arbitrary distances from the CBD. The assumption here is that every dwelling prefers to be close to the CBD because it offers greatest access. Now in the assignment of a property *X* to a submarket, should it be assigned to *Y* because they are close? What should determine whether *X* should be in the same sub-market with *Y* or *Z*?If the definition of sub-market is an area where per unit price of housing is constant, then the price should determine how sub-market groupings are done. If the price per unit is the same then housing *X* should belong to the same sub-market as housing *Z*, although the 2 are not in close proximity.

As has been evidenced above there is not a clear direction of how submarket classification should proceed. The term submarket connotes several meanings (Watkins 2001). There is little guidance on economic theory to appropriate definition and extent of submarket classification. Jones and Watkins (2009) ask the question *how can (sub) markets be modelled*? Theoretically submarkets exist because of multiple equilibria or disequilibrium as discussed earlier. Jones and Watkins further posit that "*following micro-economic theory, a submarket is deemed to exist if the 'law of one price' exists within the submarket; and if a hypothetical, standard housing unit trades at different prices in different submarkets*". These price differentials are as a result of segmented demand, characterised by consumer groups, and a segmented supply characterised by product group (Watkins 2001). Two assumptions stems from this definition. The first is that housing units within a submarket are relatively close substitutes within the same market. The second is that there exists price differentials then it presupposes that units are operating in different markets.

So in guiding the way forward in submarket identification and classification, a standard three stage test procedure as introduced by Schnare and Struyk (1976) to identify submarket boundary extent is proposed (Watkins 2001; Jones & Watkins 2009). The first stage involves house prices decomposed into component parts largely by relying on hedonic modelling techniques for each potential submarket. The assumption here is that renters know the rent of the property; can list the various attributes that have an effect on rent; and implicit prices from the hedonic model can be compared. The second stage requires a Chow test computed to compare regression equations for each (potential) submarket and analyse whether there is equality based on statistical significance. In the third stage when there appears to be statistically significant price differences, perform a Weighted Standard Error test to compare effect on the accuracy of house price models. It is generally accepted that when the error associated with the submarket level equations is more than 10 *per cent* less than the error generated by a single market-wide equation then submarkets exists (Dale-Johnson 1982). Hwang (2015) generalises the forgone analysis and argues that all these methods can be generalised into three steps namely; *"(a) a hedonic regression analysis to identify factors that explain variation in housing prices, (b) a cluster analysis to delineate homogeneous clusters, and (c) a statistical test to identify functional clusters*".

4. Dataand Methodology

In this section we discuss the data used for empirical analysis and discuss the method used.

4.1 Data

The data for the analysis consists of 536 rental transaction data collected during fieldwork in Accra between March and October 2017. Aside information on rental values for each of properties, author also collected data on structural, location and neighbourhood characteristics.Data for such studies is rarely available unless primary data collection is undertaken.

Sample design – In terms of local governance structure, the Greater Accra region has 2 Metropolitan, 9 Municipal and 5 District Assemblies (MMDAs).These 16 MMDAs form the administrative districts of the region. The target population was all residential rental housing units in the Greater Accra Region of Ghana. After discussions with real estate experts in the residential rental market in Accra, four district assemblies (administrative districts) were selected. Thesewere(1) La-Nkwantanang-Madina Municipal Assembly, (2) Adentan Municipal Assembly, (3) La-Dadekotopon Municipal Assembly and(4) Ayawaso West Submetropolitan District Assembly under the Accra. Author is of the view that such studies should encompass all residential classes to make the study thorough. These districts were chosen to cover a wide geographical area as possible where low, middle and high class residential neighbourhoods seamlessly converge. Each district is then sub-divided into their various neighbourhoods and zones. A number of clusters (neighbourhoods and zones) are selected based on population.

In this research, the UN recommended definition of a house as a "*structurally separate and independent place of abode such that a person or group of persons can isolate themselves from the hazards of climate such as storms and the sun*" is adopted(Bank of Ghana 2007). Houses included separate houses, semi-detached houses, flats/apartments and compound houses across the study areas. Temporary structures including huts, tents, containers and kiosks were omitted. Based on the sampling criteria, the study area showing locations of data collected and study area extent is provided in Figure 4.

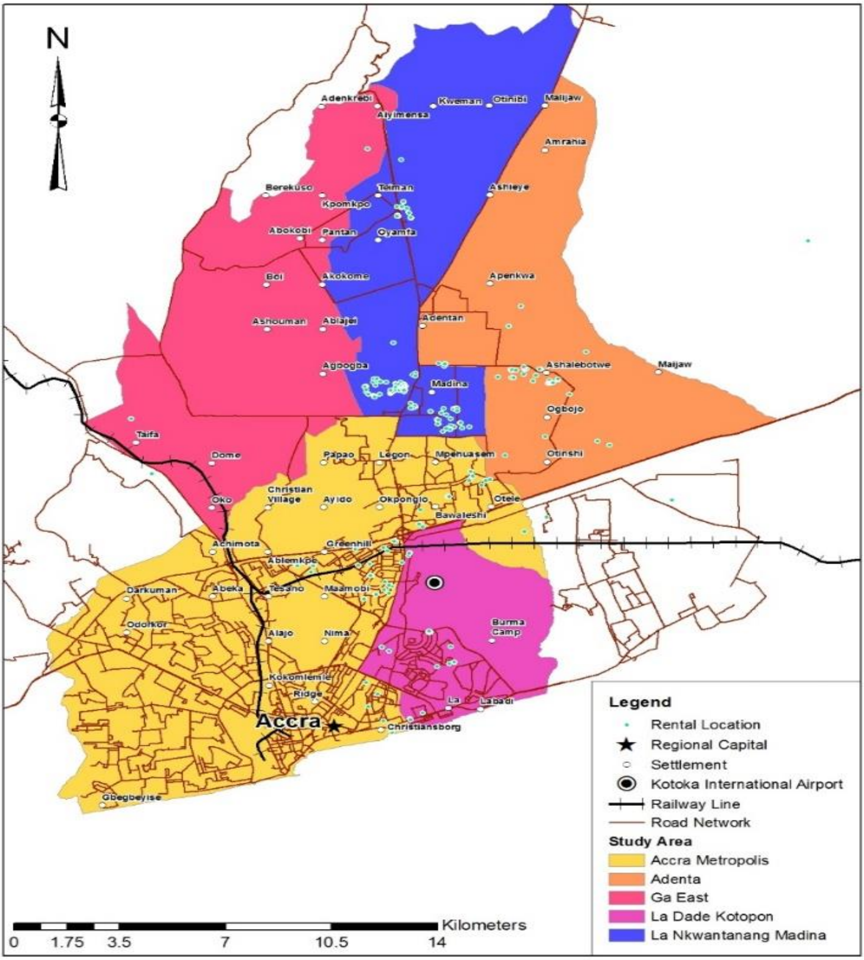


Figure 4: Map of study area

Sample realisation– The fieldwork comprised 536 rental units. There was no list of rental houses sample frame to draw sub-samples from. The purposive and snowball techniques served as the most practical means to sample houses within each neighbourhood within a district; as only rental housing are part of the sample. Using the '*Mergdata*' mobile platform (see www.mergdata.com) we first identify a rental unit (with the help of estate agents, landlords and tenants); record relevant details such as structural, location and neighbourhood characteristics and move to identify the next rental unit. Each observation is also geo-referenced to add a locational attribute to it. The sample was representative of rental housing in each of the selected districts and also for the region.

For the purpose of this study residential neighbourhoods selected are classified into low-class, middle-class and high-class residential neighbourhoods (see table 1). From this classification two neighbourhoods are selected from each of the districts. For an unbiased selection of neighbourhoods, the 2010 population and housing census district reports[1] are used to select the two largest populations in each of districts. The neighbourhoods included in the analysis are presented in table 1.

Submarkets examined and used for analysis are based on spatial (low; middle; and high income neighbourhoods), structural (single room; hall and chamber; and apartments, flats and town houses) and nested segmentation of the market.

[1] See http://www.statsghana.gov.gh/DistrictReport.html for district reports for Greater Accra region

Table 1: Selected residential neighbourhoods

District	Low-class residential area	Middle-class residential area	High-class residential area
La-Nkwantanang-Madina	Madina, Oyarifa,		
Adentan Municipality	Ashaley-Botwe	Adenta	
La Dadekotopon Municipality	*La		Airport, Cantonments
Ayawaso West Submetro		Agbelenkpe	Dzorwulu/ East Legon,

Source: Field survey 2017

4.2 Methodology

This section presents two methodologies in identifying submarkets; the Kruskal-Wallis H test and hedonic modelling techniques. Submarket definitions are explored to test empirical evidence of existence of same based on data available. By spatial segmentation we test whether rental values are significantly different for the three neighbourhood groups (i.e., low income, middle income and high income neighbourhoods). By structural segmentation we test whether rental values are significantly different based on real estate type as a submarket segment (i.e., single room; chamber and hall; and apartment, flat, house and town house). And lastly, by a nested segmentation of the rental market, we test whether submarket exists based on a combined definition of submarket based on spatial and structural characteristics (e.g. low income neighbourhood single rooms, middle income neighbourhood apartments, high income neighbourhood apartments among others).

Are these submarket segmentations really different? Or are the differences found, merely a reflection of variations expected from random sampling from the same population? Are the differences genuine or do they only occur by chance.

4.2.1 The Kruskal-Wallis One-Way Analysis-of-Variance-by-Ranks Test (or H test)

This test sometimes called the "one-way ANOVA on ranks" is a nonparametric test which is used to determine whether there is a statistically significant difference between two or more groups of an independent variable on a continuous or ordinal dependent variable. Chan and Walmsley (1997) explain that the *H* test is "*used to determine whether … independent groups are the same or different on some variable of interest when an ordinal level data or an interval or ratio level of data is available*". When given multiple samples (*C*), with n_i observations in the i^{th} sample, the *H* statistic tests the null hypothesis that the samples come from identical population distributions(see Breslow, 1970; Chan & Walmsley, 1997; Kruskal, 1952; Kruskal & Wallis, 1952; MacDonald, 2009 for further reading).

In the computation process, all scores from the *k* samples combined are ranked in a single series. The smallest score gets a rank of 1, the next smallest 2, and in this order until the largest gets a rank score of *N*. The sum of ranks in each sample or group is computed. The Kruskal-Wallis test then determines whether the sum of ranks in each group are disparate and are not likely to come from samples drawn from the same population (Siegel & Castellan, 1988 p.185).

To ensure that the data can be analysed using the Kruskal-Wallis H test, it must satisfy the four assumptions inherent in using the test(see Siegel & Castellan, 1988);

1. The dependent variable should be measured at the ordinal or continuous level.
2. The independent variable should consist of two or more categorical independent groups.
3. Independence of observations.
4. Determine whether data distribution for each of the groups are similar (ie, have the same shape) or not. This is done by running the homogeneity of variance test for nonparametric data. The results we hope to get is a significant value that is greater than 0.05 which indicates that the distribution for each of the groups is similar. If the distributions have the same shape then we use the Kruskal-Wallis H Test to compare the medians of the dependent variable (in this case rent) for the different groups within the independent variable of

interest. Further, if the distribution has a different shape, then we rather use the Kruskal-Wallis H Test to compare the mean ranks.

The H test statistic is given as;

$$H = \left[\frac{12}{n(n+1)}\sum_{j=1}^{c}\frac{T^2{}_j}{n_j}\right] - 3(n+1) \qquad (1)$$

Where:
n = sum of sample sizes for all samples,
c = number of samples,
T_j = sum of ranks in the j^{th} sample,
n_j = size of the j^{th} sample.

Where;
H_0: population medians/ mean ranks are equal
H_1: at least one of the population medians/ mean ranks are not equal

The computed value of the *H* statistic is used to determine whether to accept or reject the null hypothesis. If there are more than 5 samples in each group, the *H* statistic has been shown to be distributed approximately as a chi-square(X^2) distribution (with $df = C - 1$) at a previously set level of significance. The decision is made by comparing the *H* statistic value to the X^2 value. The decision criteria are as follows: If critical chi-square value is less than the *H*-statistic, reject the null hypothesis that medians/ mean ranks are equal and vice versa suggests thatthere is not enough evidence that the medians/ mean ranks are equal.

When the H statistic is statistically significant, it shows that at least one of the groups is different from the rest. The omnibus test does not indicate which groups are different; how many groups are different; or whether the differences are also statistically significant. To determine this, another procedure called "*multiple comparisons between groups*" is used. Pair-wise multiple comparisons are constructed to identify the source of these significant differences(Hettmansperger 1984). This procedure analyses the various subgroups within the population and tests the null hypothesis that some groups,*a* and*b*, are the same; as against the alternate hypothesis that some groups *a* and *b* are different(ieH_o: $\theta_a = \theta_b$; and H_1: $\theta_a \neq \theta_b$). The hypothesis is tested at an alpha level of significance of 0.05. The null hypothesis is rejected if the H statistic is greater than the X^2.

4.2.2 Hedonic pricing model

The use of the hedonic method has roots in multiple regression analysis; where independent variables are regressed over a dependent variable. In terms of real estate, rental value may be regressed over structural, location and neighbourhood characteristics to explain implicit contribution of each characteristic on value. The hedonic pricing model (HPM) tends to utilise all available evidence of transactions in order to model the market. The choice of a modelling approach may be described as not a purely technical problem, but rather one of finding the "best statisctical solution" that explains the particular market understudy. The selection of the appropriate method is dependent on the market structure, the availability and quality data, objectives of the study.

The data used for this analysis includes mainly private sector residential rental housing values across neighbourhoods in Accra. Although such studies are important in order to anlyse and explain rental housing dynamics in a developing economy like Ghana, research has rather been given little attention as already discussed.

The hedonic equation in simple terms regresses rent (or price) on housing characteristics. The assumption here is that the determinants of these rents are known;

$$R = f(S, N, L, C, T) \tag{1}$$

Where:
R – Rent
S – Structural characteristics
N – Neighbourhood characteristics
L – Location characteristics within market
C – Contract conditions
T – Time value

For convenience sake the *S, N, L, C, T* characteristics are reduced to a larger *X* factor. Therefore the equation then becomes:

$$R = e^{x\beta\varepsilon} \tag{2}$$

Equation (2) interprets as:

$$lnR = \mathbf{X\beta} + \boldsymbol{\varepsilon} \quad \mathbf{(3)}$$

Since β and ε are not known, we therefore estimate,

$$lnR = \mathbf{Xb} + \mathbf{e} \quad \mathbf{(4)}$$

Where *b* and *e* are actual estimates. Using properties of logarithms, the predicted rent of a given unit can be computed as $R = e^{xb}$. The value of an individual characteristic can be estimated X_1, at a given level of X_1 as:

$$R = e^{xb} \quad (5)$$

The price of X_1, or any other single attribute varies with the level of X_1, as well as with the level of other X_i. The rent of real estate assets therefore are non-linear. The rent model is represented by the equation:

$$lnR(x_j) = \beta_0 + \sum_{i=1}^{n} \beta_i \ln(x_{ij}) + \sum_{k=1}^{n} \beta_k D_{kj} + \varepsilon \quad \mathbf{(6)}$$

Where $lnR\ (x_j)$ is the natural logarithm of rent, β_i and β_k are coefficients, lnX_{ij} are the natural logarithms of continuous independent variables, D_{kj} are dummy variables and ε_j represent random errors.

The log linear model is the most widely used and tested for housing market analysis (Malpezzi 2002). In this work we adopt a modified form of the hedonic equation from Büchel and Hoesli (1995 p.1203). The functional form adopted is the multiplicative form because several variables are non-normal and also because of heteroscedasticity.

The adopted model is:

$$R = \alpha_1 S^{\beta 1} L^{\beta 2} \quad (7)$$

Where R is a vector of rental values; S is a vector of structural characteristics and L is a vector of locational and neighbourhood characteristics.Some variables are dummy which do not transform because the natural logarithm of 0 is not defined. 1 is used to represent when a dummy characteristic is present and 0 when the characteristic is not. Therefore the model to be estimated is:

$$lnR = \beta_0 + \beta_1 lnS_1 + \beta_2 lnS_2 + \beta_3 lnL_1 + \beta_4 lnL_2 + \varepsilon \qquad (8)$$

Where S_1 is a vector of continuous structural variables; S_2 is a vector of structural dummy variables; L_1 is a vector of continuous locational and neighbourhood variables; L_2 is a vector of locational and neighbourhood dummy variables and ε is an error term.

Estimated vectors of coefficients of transformed continuous variables (ie β_1 and β_3) represent the relative variation of rent after a 1 *per cent* change in the quality of the characteristic, which represents elasticities. β_2 and β_4 are semi-elasiticities where $e^{coefficient}$ represents the percentage change in rent after the dummy changes its state (ie from 0 to 1 or vice versa). The intercept in this case could be defined as the mean effect of all excluded explanatory variables.

5. Empirical analysis and results

In this section the results areanalyse in two parts. Firstly, the results of the Kruskal-Wallis H test are examined and discussed. Secondly, results of the hedonic pricing model are analysed based on submarket constructs. Each submarket is modelled and pairwise comparisons used to determine whether there exists statistically significant results based on decision rules.The submarkets analysed in this research are described in Table 2.

Table 2: Spatial, structural and nested submarket definitions

Submarkets	**Definition**
Spatial	
LIN	Low income neighbourhoods
MIN	Middle income neighbourhoods
HIN	High income neighbourhoods
Structural	
SR	Single rooms
HC	Hall and chamber units
AFTH	Apartment, Flat and Town houses
Nested	
LIN.SR	Single rooms within low income neighbourhoods
LIN.HC	Hall and chamber units within low income neighbourhoods
LIN.AFTH	Apartment, Flat and Town houses within low income neighbourhoods
MIN.SR*	Single rooms within middle income neighbourhoods
MIN.HC*	Hall and chamber units within middle income neighbourhoods
MIN.AFTH	Apartment, Flat and Town houses within middle income neighbourhoods
HIN.SR*	Single rooms within high income neighbourhoods
HIN.HC*	Hall and chamber units within high income neighbourhoods
HIN.AFTH	Apartment, Flat and Town houses within high income neighbourhoods

Note: * sample data not available and hence omitted in further analysis

5.1 Kruskal-Wallis H test approach – empirical analysis of submarket existence

Based on the assumptions that characterize this technique, we conclude that the data can be analysed using the Kruskal-Wallis H Test. The dependent variable is a continuous level (ie, Rent per month in US Dollars – converted from Ghana cedis with an exchange rate of USD1.0000 = GHS4.4009 as of August 2017); the independent variable consists of distinct categories of spatial, structural and nested submarket constructs. The distribution in each of the submarket categories has different shapes and data does not assume a normal distribution as can be seen in the box plots (Figure 5).

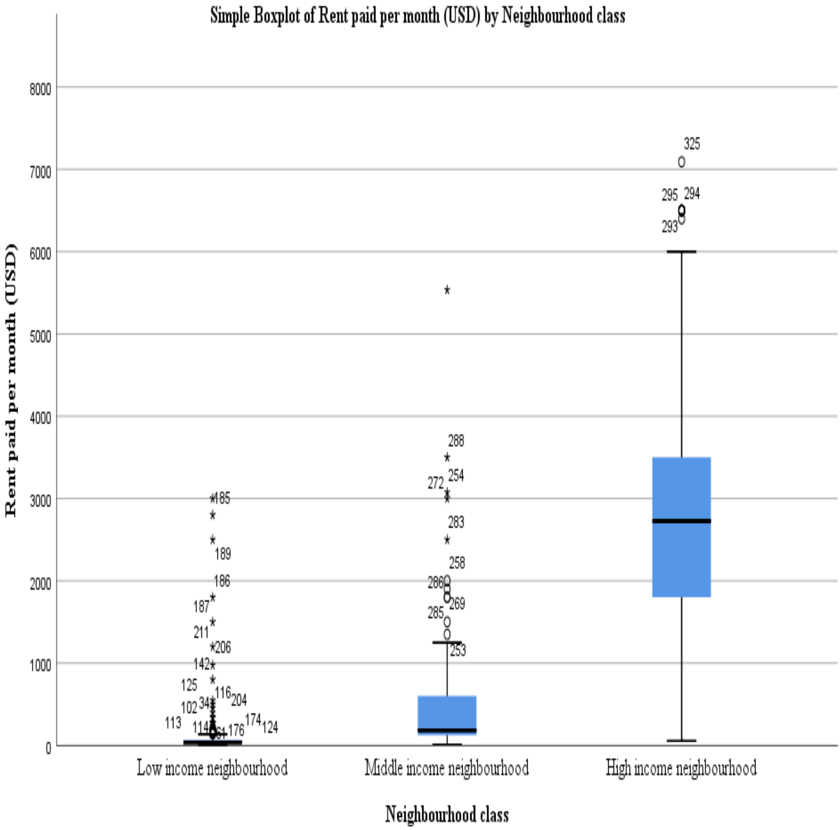


Figure 5(1) Box plots of rent differentiated by spatial segmentation of the market

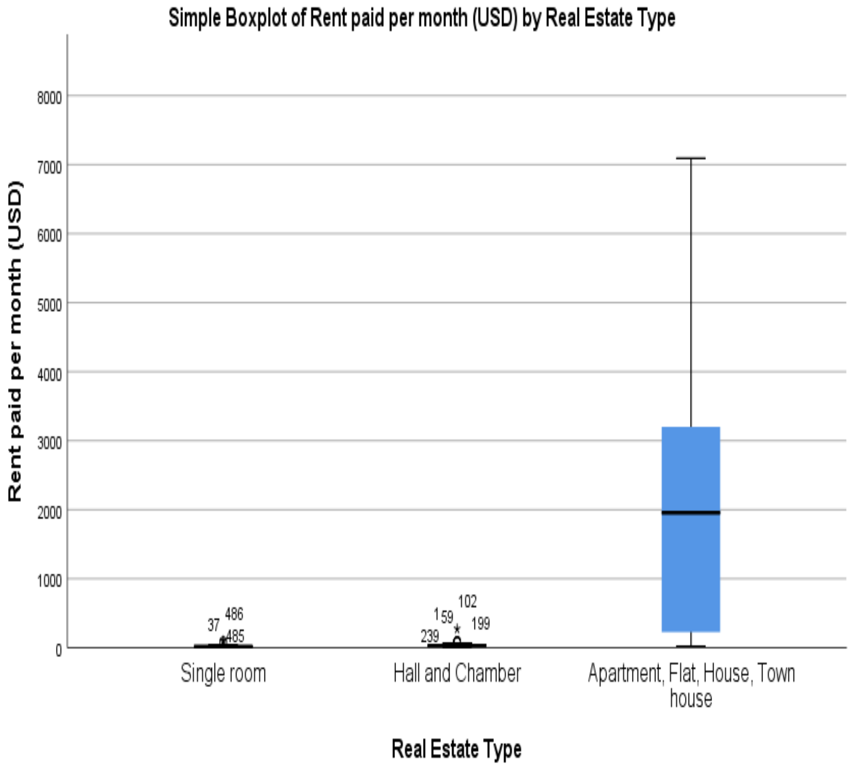


Figure 5(2): Box plots of rent differentiated by structural segmentation of the market

Three submarket definitions are explored to examine the existence of submarkets in the residential rental market using the Kruskal-Wallis One-Way Analysis-of-Variance-by-Ranks Test (or H test). The data comprised cross-sectional data of 536 residential rental values from Accra, Ghana's capital.

From Table 3, it is evident that the omnibus test run for all submarket constructs suggested that submarkets do exist based on the various definitions of submarkets, and that at least one of the groups is different from the others. However examining results of the post hoc analysis shows whether these differences are statistically significant, how many groups actually differ and where these submarkets occur. For example with the spatial submarkets identified there is a statistically significant difference between MIN rental properties and HIN rental properties. There is not enough evidence to suggest that submarkets exist between LIN with MIN and LIN with HIN.

It is however interesting to note that with regards to structural submarkets, the H_0 is rejected for all pairwise comparisons when post hoc analysis was conducted. This suggests that submarkets exists and are also statistically significant for SR, HC and AFTH submarkets. More so, results of 7 out of 10 pairwise comparisons for the nested submarkets also suggest the existence of submarkets.

It is realised from the empirical analyses that based on spatial segmentation of the rental market there exists statistically significant submarkets between MIN and HIN. The other pairwise comparisons of submarket existence between LIN with MIN and between LIN with HINsuggested that submarkets do not exist. This result suggests that based on spatial segmentation, the marked differences in rental value is found mostly among middle and high income neighbourhoods.

Table 3: Kruskal H test results for spatial, structural and nested submarkets

Submarket	N	H test	*Chi square (X^2)*	Submarket existence	Comment
Spatial Submarkets					
Omnibus test – all 3 spatial submarkets	536	376.82*	367.99	Yes	H_0 rejected
LIN with MIN	288	92.59*	100.76	No	Not enough evidence
LIN with HIN	459	316.77*	346.36	No	Not enough evidence
MIN with HIN	325	115.91*	75.86	Yes	H_0 rejected
Structural submarkets					
Omnibus test – all 3 structural submarkets	536	323.24*	220.72	Yes	H_0 rejected
SR with HC	158	25.91*	14.90	Yes	H_0 rejected
SR with AFTH	451	179.59*	86.71	Yes	H_0 rejected
HC with AFTH	463	196.07*	103.67	Yes	H_0 rejected
Nested Submarkets					
Omnibus test – all 5 nested submarkets	530	415.44*	379.11	Yes	H_0 rejected
LIN.SR with LIN.HC	152	29.48*	15.66	Yes	H_0 rejected
LIN.SR with LIN.AFTH	130	88.84*	96.57	No	Not enough evidence
LIN.SR with MIN.AFTH	144	106.66*	128.54	No	Not enough evidence
LIN.SR with HIN.AFTH	317	164.82*	90.92	Yes	H_0 rejected
LIN.HC with LIN.AFTH	140	77.96*	64.71	Yes	H_0 rejected
LIN.HC with MIN.AFTH	154	108.22*	127.24	No	Not enough evidence
LIN.HC with HIN.AFTH	327	181.16*	107.01	Yes	H_0 rejected
LIN.AFTH with MIN.AFTH	132	6.12*	1.60	Yes	H_0 rejected
LIN.AFTH with HIN.AFTH	305	111.76*	54.78	Yes	H_0 rejected
MIN.AFTH with HIN.AFTH	319	112.07*	69.99	Yes	H_0 rejected

Note: * indicates significance level at 5%

Further based on a structural segmentation of the rental market, there exists statistically significant differences between rental values based on all 3 submarket constructs as analysed (i.e., for SR, HC and AFTH). The null hypothesis was rejected for all multiple pair-wise comparisons examined. This further suggests that submarkets exist based for structural submarket constructs analysed.

More so, based on a nested segmentation of the market, 7 out of 10 pairwise comparisons tested positive for submarket existence. For the other 3, we conclude that there is not enough evidence to suggest that submarket exists for those segments.

Previous studies suggested submarket existence based on several market segmentations (Schnare & Struyk 1976; Goodman 1978; Allen et al. 1995; Fletcher et al. 2000; Goodman & Thibodeau 2007; Anim-Odame et al. 2010a; Anim-Odame et al. 2010b; Wu & Sharma 2012; Wheeler et al. 2014). The results suggest that submarkets exist for a structural segmentation of the market than for a full span of spatial segmentation. The results can be further tested by examining hedonic models for market segments to further deepen the understanding on the contribution of neighbourhood and location attributes on rental value determination. Further research is needed with probably an expanded data set covering the whole region to further examine this phenomenon to make far reaching recommendations.

Knowing whether differential rental values exists for different submarket constructs is important for a number reasons; (a) policy decisions to target differently as factors that determine rental values in the market may vary, (b) stakeholder investors in the rental space would understand the market dynamics better for profit maximisation, (c) end users would also be able to maximise utility in deciding where to live – and as such households could benefit from making informed investment decisions on housing, and (d) the research community would be able to provide timely information on (sub)market dynamics for various stakeholders in the market.

In the next subsection, we analyse the phenomenon of incorporating hedonic modelling techniques for the aggregate residential rental market and also at submarket level. This is done (a) to further examine the existence of submarkets based on Schnare and Struykt's(1976) recommendation on submarket construction (where coefficients of hedonic models based on submarket constructs are analysed); and (b) examine the determinants of rental value and the contribution of various factors both at the aggregate market level and also at submarket level. In testing for submarket existence, hedonic price functions are estimated for each potential submarket construct; then a chow test computed to examine whether significant differences exists between submarkets; and lastly a weighted standard error is computed.

5.2 Hedonic pricing model approach – empirical analyis of submarket existence

In this analysis the objective is to examine and identify which variables as per empirical data explains the variations in residential rental value. The hedonic equation is modelled for the (a) aggregate rental market(city-wide rental housing market); (b) spatial submarket construct comprising of the threeneighbourhood classes, (c) structural submarket construct comprising three distinct real estate types and (d) nested approach in which both spatial and structural submarkets coexist. Variable names and definitions are presented in table A1 in the appendix.

a. The aggregate rental market model

Table 4 provides descriptive statistics of the significant variables as used in the final set of variables for the aggregate model.It summarises rent and attribute data that are statistically significant. The mean size of rental property is 13sqm, mean number floors is about 1.5 and mean number of bathrooms per house is 2. Monthly rental values range from USD8 to USD7091, with a mean montly rent of USD1450, which reflects the different qualities of property examined in this study.

For variable inclusion into the aggregate rental market model, we first run a stepwise regression to determine which of the variables are statistically significant at a predetermined α level of 0.05. Out of a total 49 different independent (predictor) variables, 16 of them better explains the data (see table A2 in appendix). The strongest effect is when rental property is located in a high income area (LOC_3). This is followed by the total floor area of the property (lnAREA).

Table 4: Descriptive statistics for residential rental data for Accra (aggregate rental market)

Variables	**Minimum**	**Maximum**	**Mean**	**Std. deviation**
RENT (usd)	8	7091	1450,25	1692,6210
lnRENT	2,07	8,87	5,8724	2,0975
LOC_3	0	1	0,46	0,4990
AREA (sqm)	9	652	13.32	108,1700
lnAREA	2,25	6,84	4,5108	0,9525
LQual	0	1	0,57	0,4950
MKT	0	1	0,83	0,3790
FEN	0	1	0,75	0,4360
STO	0	1	0,48	0,5000
FLO_4	0	1	0,69	0,4610
NoFl	1	19	1,46	1,2050
lnNoFl	0	2,94	0,239	0,4464
REC	0	1	0,41	0,4920
LOC_2	0	1	0,14	0,3510
CBD	0	1	0,12	0,3200
BUS	0	1	0,96	0,1850
BATH	0	10	2,24	1,2810
lnBATH	0	2,3	0,6562	0,5568
RET_1	0	1	0,14	0,3430
TBATH_2	0	1	0,81	0,3930
CQual	0	1	0,98	0,1420
			N = 536	

Source: Fieldwork 2017

The author estimated a market-wide residential rental market model based on equation 8 above. The rental value of a house is explained by structural, locational and neighbourhood characteristics. The aggregate model is presented in Table 5 and this is fairly consistent with similar results presented in the literature (see Anim-Odame et al., 2010a, 2010b).The empirical results suggested that *number of bedrooms* may not be a determinant of rental value, as it was not significant even at the 10% level. The author is however of the opinion that the *total floor area* (AREA) replaces *number of bedrooms*in this context. The explanatory power of the model is 0.919 (ajdusted R^2) which compares well with other models of the Ghanaian market (*ibid*). Variables maintained and utilised for analysis are those where coefficient estimates are significant at the 1% and 5% levels. Apart from *floor type tiled* (FLO_4), all variables are significant at 1% level. More so,apart from*Single Room*(RET_1) all variable coefficients have expected signs. There is also evidence to suggest that *quality of landscaping* (LQual) and *construction quality* (CQual) do play a significant role in influencing rental values.

Rental values are explained by structural, locational and neighbourhood characteristics. Continuous variables are transformed and enter the model equation as natural logarithms and the other variables are entered as dichotomous dummies that indicate whether a particular variable is present or not. For instance, *FEN* takes a value of 1 if fence wall is available and 0 if otherwise. The variable, *lnAREA*, represents the natural logarithm of the total floor area of the rental accommodation.

From Table 5, estimated vectors of coefficients of transformed continuous variables represent the relative variation of rent after a 1 *per cent* change in the quality of the characteristic. Dichotomous variablesrepresent the percentage change in rent after the dummy changes its state (ie from 0 to 1 or vice versa). The intercept in this case could be defined as the mean effect of all excluded explanatory variables.

Table 5 Hedonic price estimate for Accra (aggregate rental market)

Variables	Coefficients	t-values	
Constant	0,272	0,786	
LOC_3	1,53	15,428*	
lnAREA	0,401	6,002*	
LQual	0,677	7,41*	
MKT	0,364	4,952*	
FEN	0,274	3,362*	
STO	0,229	3,029*	
FLO_4	0,195	1,888**	
lnNoFl	0,277	4,424*	
REC	0,261	3,751*	
LOC_2	0,34	3,349*	
CBD	0,332	3,723*	
BUS	0,53	3,504*	
lnBATH	0,385	4,871*	
RET_1	-0,367	-3,484*	
TBATH_2	0,382	3,601*	
CQual	0,674	2,997*	
Standard error	0,5817		
R^2	0,9220	Adjusted R^2	0,9190
F-value	364,2400	Sample size	532
Note: * denotes coefficients are significant at 1% and ** 5% level of significance. Variable definitions are given in table A1 (includes all variables collected during fieldwork).			

The author adopted the most common procedure for testing submarket existence at a single point in time (Schnare & Struyk 1976; Dale-Johnson 1982; Watkins 2001). To determine the existence of submarkets involves these processes. Estimate the hedonic price function for each of the potential submarket constructs, so that standardised comparisons can be undertaken. Next, compute a chow test to determine whether by pairwise comparisons, significant differences exist between hedonic estimates of potential submarkets. Then lastly, a weighted standard error is computed to test the significance of price differentials for standardised rental housing in these potential submarkets. This procedure has the potential to test the accuracy of computed models when different submarket definitions are utilised. This procedure is repeated for spatial, structural and nested submarkets. The basis for this procedure is grounded in the assumptions that (1) *" ... all dwellings within a submarket are relatively close substitutes and are within the same market*, and (2) *"... if differential prices exists then there is good reason to believe that ... these operate in different submarkets"*(Watkins 2001).

b. The Spatial submarket models

This section discusses and examines spatial submarket constructs based on *a priori* classification of the rental market. We differentiate between*LIN*, *MIN* and *HIN*.For example, all low income areas within the study area are presumed to be in the same submarket, although these areas may not fall within one spatial location. Real estate agents in Ghana, are predominantly of the opinion that depending on which neighbourhood class a property is located, it commands a particular rental value within the market.

A summary of regression results for *a priori* spatial submarkets is presented in Table 6. Coefficients are relatively not important when explaining and testing for submarket existence (Watkins 2001; Dale-Johnson 1982). We therefore highlight significant variables variables for each of the submarkets. Explanatory power of variables for the 3 models have an adjusted R^2 values ranging from 0,50 to 0,82. With the exception of *MIN*;*LIN* and *HIN* produce high explanatory power of the model, this could reflect the high number of transactions for this market in dataset used. The results of the chow test in Table 7 suggests that submarkets exists and are statistically different from each other at a 1% level of significance.

Table 6: Regression results for a priori spatial submarkets

A priori submarkets	N	Adjusted R^2	F-statistic	Significant variables	Number of variables
LIN	209	0,823	70,013	lnAREA*, MKT*, STO*, FLO_4* lnNoFl*, REC*, CBD*, lnBATH*, RET_1*, TBATH_2*, CQual*	11
MIN	75	0,496	7,072	LQual**, lnNoFl**, REC**, lnBATH***, BUS*	5
HIN	248	0,781	74,378	CONSTANT*, lnAREA***, LQual*, MKT*, FEN*, STO*, lnNoFl***, REC*, CBD**, lnBATH*, RET_1*	11

Note: variables included where coefficient estimates are significant at 1% (*), 5% (**) and 10% (***) levels of significance.

Table 7: F-test results for a priori spatial submarkets

Pooled segments	Chow
LIN with MIN	3,93*
LIN with HIN	35,17*
MIN with HIN	17,38*

Note: * indicates significance level at 1%

The chow test results show that price differs significantly among the submarkets analysed. This suggests and gives empirical credence to the theoretical assumptions of the existence of spatial submarkets, and that implicit rental prices are not constant across the rental market in Accra. Based on these conclusions we state that the appropriate number of spatial submarkets may be 3.

c. The Structural submarket models

Submarkets are defined based on the structural characteristics of the rental accommodation. In the analysis that follow we differentiate between SR, HC and AFTH. The significant variables in each of the market segments are summarised in Table 8.

The explanatory power of structural equations is high for the AFTH submarket with and adjusted R^2 of 0.84; whereas the SR and HC submarkets have adjusted R^2 of 0.47 and 0.39 respectively. The results suggests that there could be no distinct differences between SR and HC segments but only a unique segment for AFTH. The results of the chow test (see Table 9) confirms this assertion by showing that there is no statistically significant difference between SR and HC segments (at even an α of 10% level). The chow test further shows that differences only exist with pairwise comparisons of SR with AFTH and HC with AFTH.

Table 8: Regression results for dwelling-type (structural) submarket models

A priori submarkets	**N**	**Adjusted R^2**	**F-statistic**	**Significant variables**	**Number of variables**
SR	72	0,474	6,810	CONSTANT*, lnAREA*, FEN**, TBATH_2*, CQual***, LOC_3***	6
HC	85	0,393	5,936	lnAREA*, MKT**, FLO_4***, lnNoFl**, lnBATH***, TBATH_2***, CQual*, LOC_2***	8
AFTH	375	0,836	127,967	lnAREA*, LQual*, MKT*, FEN*, STO**, FLO_4***, lnNoFL*, REC*, CBD*, BUS*, lnBATH*, CQual***, LOC_2*, LOC_3*	14

Note: variables included where coefficient estimates are significant at 1% (*), 5% (**) and 10% (***) levels of significance.

Table 9: F-test results for dwelling-type (structural) submarkets

Pooled segments	**Chow**
SR with HC	1,64
SR with AFTH	4,31*
HC with AFTH	3,12*

Note: * indicates significance level at 1%

d. The Nested submarket models

In this section we test the possibility that submarket constructs may have both spatial and structural dimensions. Here we test whether within each spatial dimension of submarket construct; a differentiation based on structural dimension was plausible. We distinguish between "*Single Room*" (SR); "*Chamber and Hall*" (HC) and "*Apartment, Flat, House and Town House*" (AFTH) for "*low income neighbourhoods*" (LIN); "*middle income neighbourhoods*" (MIN) and "*high income neighbourhoods*" (HIN). It should be noted that due to data availability MIN and HIN are only differentiated by AFTH because the data for MIN**.**SR, HIN**.**SR, MIN**.**HC and HIN**.**HC is either too small or not available. Based on the rental market outlook of Accra, the sample is consistent with actual happenings in the market, because MIN and HIN are mostly dominated by AFTH, while there is a good mix of structural differentiation of properties within LIN.

Based on this nested definition of submarket classification, we treat SR, HC and AFTH within each income class as a separate submarket, giving us a total of 5 submarkets. For example LIN**.**SR represents all single room accommodation in low income areas. The results for the regressions are presented in table 10. In terms of the explanatory power, the nested submarket equations range from 0.35 for LIN**.**SR to 0.81 LIN**.**AFTH equations.

The chow test results in Table 11 suggests that submarket do exist for nested submarkets at various significant levels. In other words we reject the null hypothesis of similarity between coefficients of the regressions at the α of 1% and 5% levels (for most of the submarket constructs), and that meaningful market segments or multiple equillibria exists. The results also suggests there is evidence of non-substitutability between dwelling types based location.

Table 10: Regression results for nested submarket models

A priori submarkets	N	Adjusted R^2	F-statistic	Significant variables	Number of variables
LIN.SR	70	0,349	4,695	CONSTANT*, lnAREA*, TBATH_2*, CQual***	4
LIN.HC	81	0,507	9,235	lnAREA*, MKT**, FLO_4**, lnNoFl**, lnBATH**, TBATH_2***, CQual*	7
LIN.AFTH	58	0,809	19,592	FLO_4***, lnNoFl*, REC**, CBD*, lnBATH*, TBATH_2*	6
MIN.AFTH	71	0,520	7,316	CONSTANT***, LQual**, FEN**, lnNoFl**, REC**, CBD***, BUS***	7
HIN.AFTH	246	0,753	68,760	CONSTANT*, lnAREA***, LQual*, MKT*, FEN*, STO*, lnNoFl***, REC*, CBD**, lnBATH*	10

Note: variables included where coefficient estimates are significant at 1% (*), 5% (**) and 10% (***) levels of significance.

Table 11: F-test results for nested submarkets

Pooled segments	Chow
LIN.SR with LIN.HC	2,14**
LIN.SR with LIN.AFTH	7,12*
LIN.SR with MIN.AFTH	2,46**
LIN.SR with HIN.AFTH	24,60*
LIN.HC with LIN.AFTH	1,77***
LIN.HC with MIN.AFTH	2,25**
LIN.HC with HIN.AFTH	11,37*
LIN.AFTH with MIN.AFTH	3,56*
LIN.AFTH with HIN.AFTH	32,44*
MIN.AFTH with HIN.AFTH	18,29*

Note: *, ** and *** indicates significance at 1%, 5% and 10% respectively

e. Standard Error of Estimate (SEE) analysis

The last stage in the hedonic model procedure requires that when there appears to be statistically significant price differences, perform a Weighted Standard Error test to compare effect on the accuracy of house price models. It is generally accepted that when the error associated with the submarket level equations is more than 10 *per cent* less than the error generated by a single market-wide equation then submarkets exists (Schnare & Struyk 1976; Dale-Johnson 1982). Based on this hypothesis we calculate the percentage change in SEE for all submarkets and provide results in Table 12.

Table 12: SEE and percentage change in SEE for submarkets

Submarkets	**SEE**	**% ∆ in SEE**
Aggregate model	0.5817	-
LIN	0.4875	16.1997
MIN	0.8666	**-48.9703**
HIN	0.4040	30.5515
SR	0.3870	33.4737
HC	0.4230	27.2837
AFTH	0.5890	**-1.2635**
LIN.SR	0.3901	32.9408
LIN.HC	0.3715	36.1416
LIN.AFTH	0.4995	14.1421
MIN.AFTH	0.8037	**-38.1579**
HIN.AFTH	0.4048	30.4122

From Table 12, 8 submarkets (LIN, HIN, SR, HC, LIN.SR, LIN.HC, LIN.AFTH and HIN.AFTH) showed large differentials in percentage change in SEE, which suggests significant effects on rental prices. The empirical results generally suggest that the residential rental market is segmented based on spatial, structural and nested categorisations. However, 1 submarket each from the 3 submarket groupings had percentage changes below 0, suggesting that these differences may have negligible effects on rental prices.

6. Conclusion

This research has analysed Accra's residential rental market (RRM) by testing the empirical existence of submarkets using the Kruskal-Wallis H test and Hedonic modelling techniques. Due to data paucity and asymmetries, research of this nature is given less attention by researchers. Anecdotal and theoretical evidence suggests that submarkets may exist for Accra's RRM. This research fills the literature gap by providing empirical evidence to test submarket existence at different scales of aggregation.

Potential residential rental submarkets were selected based on literature review, discussions with rental market stakeholders and market observations. To test for submarket existence, separate models are run for each submarket construct, which samples are drawn from the aggregate rental market. The total number of observations for each potential submarket is provided in each analysis.Using spatial segmentation definition three submarkets are identified; by structural three and also by the nested definition, nine submarkets are identified. However, only five nested submarket constructs are analysed because sample sizes were too small for regression analysis.

Based on the Kruskal-Wallis H test, empirical evidence suggested that submarkets existed especially for structural and nested segmentations of the market, and these were also statistically significant based on evidence from pairwise comparisons.

Based on the hedonic models analysed, the aggregate market model fits very well with the data, with an adjusted R^2 of 0.92. The aggregate model had 16 independent variables which were highly significant, whereas submarket constructs had fewer independent variables significant. Potential submarkets tested, did show statistically significant attributes (based on the F-statistic and p-values). All F-estimates for the hedonic models are significant at a 1% level. This suggests that the joint effort of the variables is significant. The F test results suggest that the H_0, that rental values are equal, is rejected between the submarkets analysed.

Comparison of the standard error of the estimate (SEE) provides the effects on the model improvement. Difference in SEE is more than 10% for 8 out of 11 submarkets examined. We can therefore conclude that these differences have a significant effect on rental prices. It should be noted that MIN, AFTH and MIN.AFTH submarkets have percentage change in SEE below 0, which suggests that these differences are negligible in terms of overall variation in rental prices.

The results suggested that, residential rental submarkets do exists and can be defined by spatial, structural and nested segmentation of the market. Based on empirical evidence of submarket existence, structural and nested submarket constructs tend to better explain submarket existence better than spatial constructs. Both the Kruskal-Wallis H test and the Hedonic modelling techniques provided useful insights to the residential rental market dynamics of Accra-Ghana.

Further research can consider stratifying submarkets based on other submarket definitions and test the existence of submarkets. This will determine whether the segmentation defined in this research is robust to be used for generalisations in the rental market in Ghana. The results discussed here however have important implications to support the understanding of the rental housing market dynamics in a developing country context. Based on empirical results analysed and discussed, we can conclude that submarkets exists in Accra's RRM.

Note:
The exchange rate used is USD1.0000 = GHS4.4009 as of August 2017.

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Appendix

Table A1: Variable names and definitions

Category	**Variable**	**Definition**
Structural	lnRENT	Natural log of Rental value per month in US Dollars
	lnAREA	Natural log of total floor area of property (compound excluded)
	lnNoFl	Natural log of number of floors or storeys of property
	lnBRM	Natural log of number of bedrooms
	lnWC	Natrual log of number of WC or toilet available
	lnBATH	Natural log of number of bathrooms
	TBATH	Type of bathroom - ie, shared or separate
	KIT	Dummy equal to 1 if kitchen available, 0 if otherwise
	TKIT	Type of kitchen - ie, shared or separate
	STO	Dummy equal to 1 if storeroom available, 0 if otherwise
	FLO	Floor finish (dominant) - ie, cement sand screed, terazzo, tiled

	FEN	Dummy equal to 1 if fence wall available, 0 if otherwise
	PAR	Dummy equal to 1 if parking space (garage or outhouse) available, 0 if otherwise
	CQual	Dummy equal to 1 if construction quality is good, 0 if bad
	LQual	Dummy equal to 1 if landscaping is available, 0 if otherwise
	DET	Dummy equal to 1 if physical condition of property is good, 0 if otherwise
	RET_1	Dummy equal to 1 if property is Single Room
	RET_2	Dummy equal to 1 if property is Hall and Chamber
	RET_3	Dummy equal to 1 if property is Apartment, Flat or Town house
Locational	ACC	Dummy equal to 1 if property has suitable vehicular access available, 0 if otherwise
	TRFC	Dummy equal to 1 if property is close to traffic congestion area, 0 if otherwise
	GAB	Dummy equal to 1 if waste disposal or garbage collection is available, 0 if otherwise
	MKT	Dummy equal to 1 if property is close to market or shopping centre (within 1km), 0 if otherwise
	CBD	Dummy equal to 1 if property is near to the CBD (within 1km), 0 if otherwise
	JOB	Dummy equal to 1 if property is near job opportunities, 0 if otherwise
	EDU	Dummy equal to 1 if property is near educational facilities, 0 if otherwise
	HLTH	Dummy equal to 1 if property is near to health facilities, 0 if otherwise
	REC	Dummy equal to 1 if property is near recreational facilities, 0 if otherwise
	INF	Dummy equal to 1 if property is near squatter or informal settlements, 0 if otherwise
	SEC	Dummy equal to 1 if property is near police

		station or police post, 0 if otherwise
	WOR	Dummy equal to 1 if property is near place of worship, 0 if otherwise
	BUS	Dummy equal to 1 if property is near bus stop, 0 if otherwise
	VQual	Dummy equal to 1 if quality of property view is good, 0 if otherwise
Neighbourhood	ELEC	Dummy equal to 1 if property has electricity available, 0 if otherwise
	WAT	Dummy equal to 1 if property has pipe or well available, 0 if otherwise
	SLT	Dummy equal to 1 if streetlighting available, 0 if otherwise
	DRN	Dummy equal to 1 if suitable surface drainange available, 0 if otherwise
	LOC_1	Dummy equal to 1 if property is in low income neighbourhood
	LOC_2	Dummy equal to 1 if property is in middle income neighbourhood
	LOC_3	Dummy equal to 1 if property is in high income neighbourhood

Table A2: Summary results of stepwise regression – aggregate model

Model	**R**	**R^2**	**Adjusted R^2**	**Std. Error of the Estimate**
a. (Constant), LOC_3	0,821	0,674	0,673	1,17159
b. (Constant), LOC_3, LnAREA	0,924	0,854	0,854	0,78434
c. (Constant), LOC_3, LnAREA, LQual	0,940	0,883	0,882	0,70277
d. (Constant), LOC_3, LnAREA, LQual, MKT	0,945	0,893	0,892	0,67455

e. (Constant), LOC_3, LnAREA, LQual, MKT, FEN	0,948	0,899	0,897	0,656 34
f. (Constant), LOC_3, LnAREA, LQual, MKT, FEN, STO	0,950	0,902	0,901	0,644 30
g. (Constant), LOC_3, LnAREA, LQual, MKT, FEN, STO, FLO_4	0,952	0,906	0,905	0,633 10
h. (Constant), LOC_3, LnAREA, LQual, MKT, FEN, STO, FLO_4, LnNoFl	0,954	0,909	0,908	0,622 60
i. (Constant), LOC_3, LnAREA, LQual, MKT, FEN, STO, FLO_4, LnNoFl, REC	0,954	0,911	0,909	0,617 06
j. (Constant), LOC_3, LnAREA, LQual, MKT, FEN, STO, FLO_4, LnNoFl, REC, LOC_2	0,955	0,913	0,911	0,611 44
k. (Constant), LOC_3, LnAREA, LQual, MKT, FEN, STO, FLO_4, LnNoFl, REC, LOC_2, CBD	0,956	0,914	0,912	0,606 83
l. (Constant), LOC_3, LnAREA, LQual, MKT, FEN, STO, FLO_4, LnNoFl, REC, LOC_2, CBD, BUS	0,957	0,916	0,914	0,601 78
m. (Constant), LOC_3, LnAREA, LQual, MKT, FEN, STO, FLO_4, LnNoFl, REC, LOC_2, CBD, BUS, LnBATH	0,958	0,918	0,915	0,596 41

n. (Constant), LOC_3, LnAREA, LQual, MKT, FEN, STO, FLO_4, LnNoFl, REC, LOC_2, CBD, BUS, LnBATH, RET_1	0,959	0,919	0,917	0,591 63
o. (Constant), LOC_3, LnAREA, LQual, MKT, FEN, STO, FLO_4, LnNoFl, REC, LOC_2, CBD, BUS, LnBATH, RET_1, TBATH_2	0,959	0,921	0,918	0,586 42
p. (Constant), LOC_3, LnAREA, LQual, MKT, FEN, STO, FLO_4, LnNoFl, REC, LOC_2, CBD, BUS, LnBATH, RET_1, TBATH_2 , CQual	0,960	0,922	0,919	0,581 74