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# Exploring the Mechanism of Residential Attractiveness in Compact Urban Areas – a Case Study of Hong Kong

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**Abstract.** Compact cities adopt high density, mixed land use and transit-oriented development (TOD). For sustainable development, compact development reduces the use of automobile and lessens the overdevelopment of land resources. For solving urban sprawl and housing shortage, more and more metropolises have adopted compact development. Academics, planners and policy makers mainly focused on evaluating the impacts of neighborhood attributes on housing prices and residential movements. Few have examined the relationships between residents' demand and residential attractiveness in compact cities. Therefore, this study develops Residential Attractiveness Evaluation (RAE) Model to evaluate the attractive degree of urban areas based on residents' demand in compact cities. Hong Kong is chosen as the study area which is a typical compact city. The results show that districts near the CBD and both sides of Victoria Harbor have highest residential attractiveness than other areas. Community planners and policy makers should consider residential attractiveness based on residents' demand in efforts to promote sustainable development. Residential attractiveness is the foundation of residential land use planning and policies. Planners in compact cities should adopt various planning strategies according to different residential attractiveness. Moreover, residential attractiveness is the benchmark of evaluating residents' satisfaction of new residential planning and policies.

## 1. Introduction

For rapid urbanization, more and more cities have faced many urban problems, like traffic congestion, environment pollution and urban sprawl [1]. The low-density urban development based on the automobile which has been widely adopted in European and North American countries is not appropriate in Asian cities. Thus compact development was presented and popular with urban planners and policy-makers [2]. The characteristics of compact development are high density, mixed land-use and transit-oriented development [3, 4]. Compact cities efficiently use land resource and decrease the waste of land. They can protect the habitat environment and wild landscapes. In addition, compact urbanization can promote public transit development and reduce the use of cars. It aims at protecting environment and developing sustainable communities. For the success of compact development, urban planners and policy makers should provide good living environment and increase the attractiveness of



residential areas for residents. They should understand the attractiveness of residential areas based on residents' demand in compact cities, and provide sustainable development strategies according to various conditions.

Architects, planners and economists focused on the influences of housing attributes on housing prices and residential mobility. Previous studies indicated that some attributes influenced residential movement and behavior, like household and neighborhood characteristics, accessibility factors, and economic attributes. Residents moved to a new place which can provide best combination of influential attributes [5]. Although extensive literature has indicated the relationships between housing attributes and residential mobility [6, 7], the spatial attractiveness of each area according to residents' demand has been rarely evaluated. In addition, Extensive literature paid more attention on residential mobility in low density and automobile commuting cities [8, 9]. They have limitations in capturing the residents' demand on high density and public transit-oriented cities, like Hong Kong. Therefore, this work attempts to develop a systematic framework to evaluate the spatial attractive degree of compact urban areas based on residents' demand. This work can help urban planners and policy makers to understand residential attractiveness of each district in planning process. They should provide various planning strategies according to different attractive degrees to promote sustainable development.

Section 2 introduces the characteristics of study areas in Hong Kong. Furthermore, section 3 describes the process of data collection and the development of systematic framework to measure attractiveness of residential urban areas based on residents' demand. Then section 4 shows how to apply the systematic framework for evaluating the residential attractiveness of urban areas in Hong Kong. Section 5 discusses the application for supporting sustainable land use planning and policies. Finally, section 6 presents the contributions, and points out the limitations and future research.

## **2. Study area**

Hong Kong is one of famous compact cities which is located in the south of China. In recent decades, urban planners and policy makers have adopted TOD and compact development in Hong Kong which can promote it more sustainable [2, 4]. Hong Kong has strict planning and policy restrictions on the development of new urban land. These policies can protect wild landscapes and our habitat, and promote sustainable development. Hong Kong government has used the mass transit railway (MTR) as the backbone of the public transport system. It can reduce the use of automobile and air pollution. Hong Kong has also developed densely populated buildings and mixed land use to reduce the waste of resources. Hong Kong is composed of three major areas: Hong Kong Island, Kowloon and New Territories. In addition, the CBD of Hong Kong is located in Hong Kong Island. From the perspective of town planning, the whole territory of Hong Kong is categorized by the Planning Department into three levels: Primary Planning Units (PPUs), Secondary Planning Units (SPUs) and Tertiary Planning Units (TPUs). TPU is the smallest district unit which has the available data from Population Census in Hong Kong. It is appropriate to be regarded as the unit of residential district in this work. Therefore, this study evaluates the attractiveness of TPUs for residents in Hong Kong.

## **3. Materials and methods**

### *3.1. Analytical framework*

This research develops a systematic framework to evaluate residential attractiveness of urban areas for residents in content of compact urbanization. Based on the review of theories about residential mobility, Residential Attractiveness Evaluation (RAE) Model which is derived by Multiplicative competitive interaction (MCI) model is developed to estimate residential attractiveness of urban areas according to residents' demand. Three attributes which significant influence residents' preferences in compact cities are identified as independent variables, including access to metro station, access to CBD and median household income. Two types of revealed-preference data consisting of geographical data and socio-demographical data are collected. In this research, residential attractiveness of each urban area in Hong Kong is measured to illustrate how to analyze the relationship between residents' demand and residential attractiveness in compact cities.

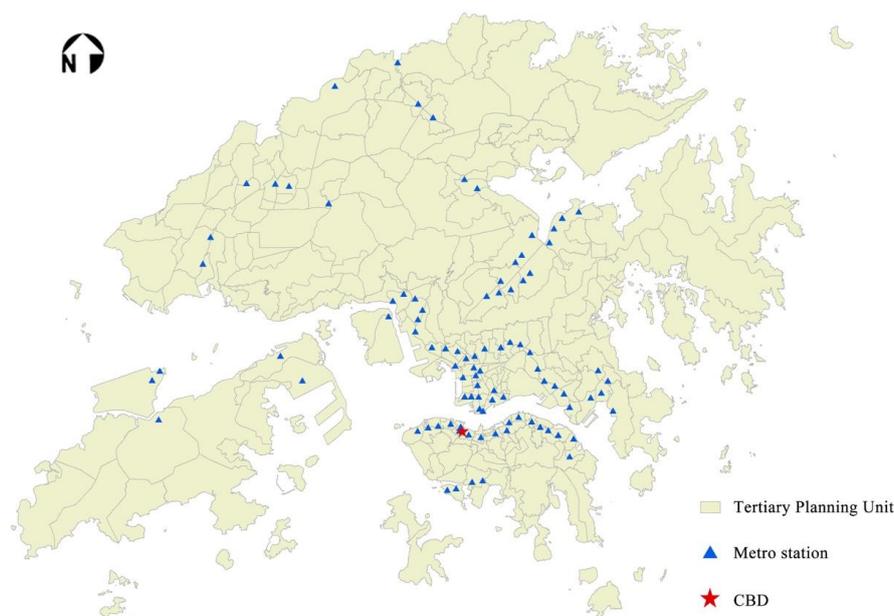
### 3.2. Variables

Residents consider some location attributes when they decide to live in a residential area, like accessibility, neighborhood and socio-economic characteristics [7, 10]. Compact urbanization is famous by public TOD, high-density and mixed land use [3]. In compact cities, there are three attributes which have significant impacts on residential mobility, access to the metro station (METRO), access to the CBD (CBD) and median household income (MHI) [11, 12].

In compact cities, the public chose metro as the initial travel mode, including going to work, study or shopping [11]. Thus, access to the nearest metro station plays a significant role in the residential movement and behavior in compact cities [12]. Accessibility of the CBD has also been proved as an important attribute for residents in compact cities [7, 12]. It has been aggregated with sufficient and abundant public facilities, and has a great attraction for the public. Moreover, median household income decides the affordable value of residential properties. It has been regarded as an important attribute which influenced the residents' willingness to move [5, 6, 12]. Therefore, access to metro station, access to CBD and median household income are regarded as significant attributes which are used in the RAE model.

### 3.3. Data collection

This research develops an evaluation method to measure the attractiveness of all available areas for residents in a compact city. The data of 289 TPUs in Hong Kong are collected to test the proposed model. Figure 1 presents the location of TPUs in Hong Kong. There are three variables in the proposed model: network distance to the nearest metro station, network distance to the CBD, and median monthly household income. The location of all TPUs are from Hong Kong Population Census Database. Meanwhile, the coordinate of CBD and metro stations are processed from Open Street Map to ArcGIS. The data of distance are easier to collect and more accurate than the data of traveling time in this research. So network distance from central point of TPUs to the nearest metro station and to the CBD are measured by Google Map. Moreover, the data of median household income are from HK Population Census Database. However, TPU 251, 434, 814, 834, 913, 933, 934, and 963 which do not have available data are removed. The descriptive statistics of variables are presented in table 1.



**Figure 1.** TPUs in Hong Kong.

**Table 1.** Descriptive statistics of major variables.

Variable	Minimum	Maximum	Mean	Std. Deviation
METRO	0.07	27.90	4.3855	5.26065
CBD	0.10	59.50	19.8700	13.32573
MHI	4778.00	208293.00	42122.1750	38149.37021

### 3.4. Residential attractiveness evaluation model

In this research, the Residential Attractiveness Evaluation Model is proposed to evaluate the attractiveness of areas for residents in Hong Kong. Discrete choice theory was always used to predict the optimal choice between two or more discrete alternatives for a rational consumer based on his/her preference [10]. MCI model is derived by discrete choice theories and used to measure the attractiveness of a product for consumers [13, 14]. Residential properties can be regarded as a product which are purchased by residents. Therefore, this study adopts MCI model to evaluate residential attractiveness (RA) of districts in compact cities. The RAE model is derived by MCI model which is presented as follow:

$$RA_i = \exp(\alpha_i) \cdot \prod_{k=1}^K X_{ki}^{\beta_k} \cdot \varepsilon_i \quad (1)$$

where  $i$  is the number of a district in a compact city.  $RA_i$  is the residential attractiveness of the  $i$ th district.  $\alpha_i$  is the intrinsic component.  $K$  is the number of set of attributes, while  $k$  is the number of an influenced attribute ( $k \in K$ ). Moreover,  $X_k$  is the  $k$ th attribute that significantly influences residential mobility.  $\beta_k$  is a parameter of  $k$ th attribute, and  $\varepsilon_i$  is an error term.

In Hong Kong, three attributes have most significant influences on residents' preferences when they want to move in a residential area. Independent variables are *Access to Metro Station (METRO)*, *Access to CBD (CBD)* and *Median Household Income (MHI)*. The proposed model is presented as follows:

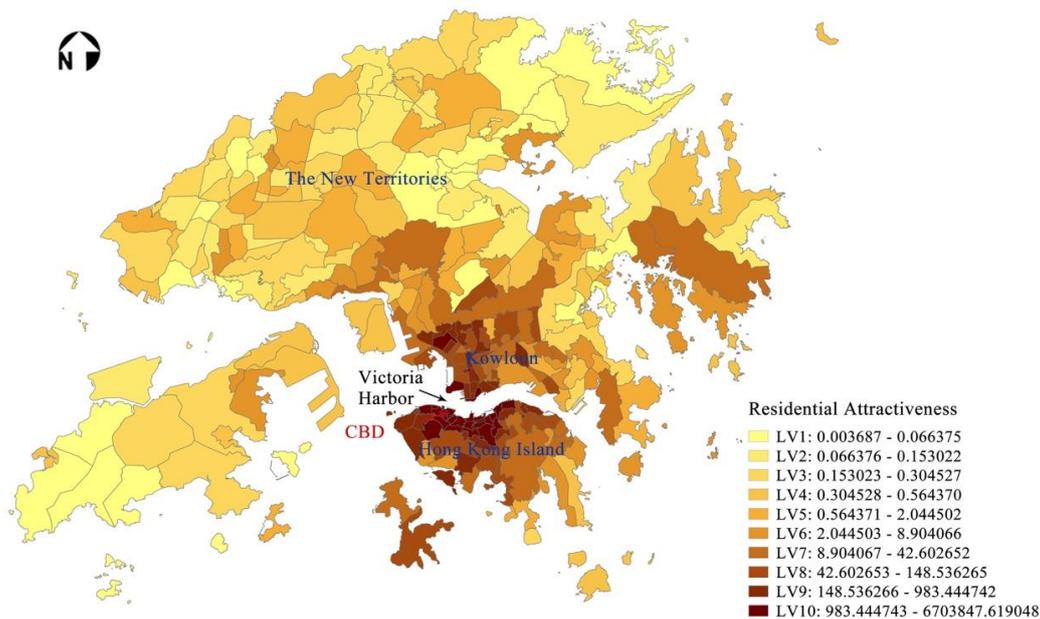
$$RA_i = \exp(\alpha_i) \cdot (METRO_i^\gamma \cdot CBD_i^\lambda \cdot MHI_i^\mu) \cdot \varepsilon_i \quad (2)$$

$\gamma$ ,  $\lambda$ , and  $\mu$  are the parameter of major attributes in the proposed model. In Hong Kong, an exponential parameter  $\gamma$  for network distance to the nearest metro station is 1. A distance decay parameter  $\lambda$  for network distance to CBD is 3, and an exponential parameter  $\mu$  for median household income is 1. RA can be used for urban planners and policy-makers to understand the attractive degree of each district for residents in compact cities, and to support sustainable residential land use planning and policies.

## 4. Results

Residents have different attitudes to residential properties in different districts according to their location and neighborhood characteristics. So, each area has different attractiveness for residents in a compact city. This study develops the RAE model to evaluate attractive degree of each district for the public in Hong Kong. Quantiles are used to divide the dataset into contiguous intervals according to the range of a probability distribution. This work selects decile categorization which is appropriate to present the residential attractiveness of each TPU in Hong Kong.

Figure 2 shows a visual map to directly present residential attractiveness of each TPU in Hong Kong. Results are divided into 10 parts. Each level has different attractiveness of these districts. Level 1 represents that a few residents are willing to move into this district, while Level 10 means the opposite. More residents want to move in the district in a higher level. The residential attractiveness degree map of TPUs in Hong Kong indicates that citizens in Hong Kong prefer to live in areas near the CBD and both sides of Victoria Harbor. In general, residential properties in Hong Kong Island attract more consumers to purchase than ones in Kowloon which are more attractive than those in New Territories.



**Figure 2.** Residential attractiveness degree map of TPUs in Hong Kong.

## 5. Discussion

Compact cities are famous by TOD, mixed land use and high-density development. Compact development not only provides convenient and good services for citizens' residence and travel, but also protects our habitat and supports sustainable development. For sustainable development, residential land use planning and policies should meet current demand of residents in compact cities [15, 16]. Therefore, the evaluation of residential attractiveness can help urban planners and government workers to understand living level of each district in their cities. They should adopt different planning strategies according to different attractive degree of districts for sustainable development.

By using the RAE model, this study evaluates the residential attractiveness of urban areas based on residents' demand in compact cities. Residential attractiveness can be used in land use planning and policies for supporting sustainable development. First, residential attractiveness can be a benchmark of residential level of districts based on residents' preferences in compact cities. Urban planners should adopt different planning strategies for urban areas with different attractive degree. The districts with high attractiveness can generate a large number of people. Planning department should consider walkable and transit-oriented development in these areas to develop sustainable neighborhoods. Furthermore, planners and policy makers should provide sufficient infrastructure and facilities for districts with lower residential attractiveness. They should also promote public transit-oriented development in these districts. Rapid transit investments can attract citizens to move in these districts and reduce the pressure on the population of city center. It also decreases travel costs and pollution emissions to improve sustainable development [3].

Second, Residential attractiveness can also help urban planners to decide whether the dominant land use is residential in land use planning. It can be used by policy makers to evaluate residents' satisfaction with new land use policies and residential developments. Government officers can measure the residential attractiveness of a specified area before and after the implementation of new policy and planning. The change of RAs reflects whether the new policies meet the needs of residents for living environment. Third, the RAE model would be a better method to gauge endogenous linkage between residents' demand and residential attractiveness in other compact cities, like Tokyo, Seoul, and Shanghai. It can also be developed to further evaluate citizens' satisfaction for other types of land use, like shopping centers, working places, public facilities, etc. New land use planning and policies with

the help of these methods can provide attractive and comfortable neighborhood for residents to support sustainable development in compact cities.

## 6. Conclusions

Recent literature has mainly focused on investigating the influences of housing attributes on residential location choice and housing prices. However, whether the urban areas meet the demand of residents in compact cities has rarely been evaluated. Therefore, this study develops the systematic framework to evaluate the attractiveness of urban areas for residents in compact cities for supporting sustainable residential land use planning and policies. The RAE model which is derived by the MCI model is developed to evaluate attractive degree of areas for residents in compact cities. Furthermore, this research shows how to apply the RAE model for estimating residential attractiveness of available TPUs based on residents' demand in Hong Kong. The findings indicate that residential properties in CBD and both sides of Victoria Harbor can attract more residents to live in. Citizens prefer to live in Hong Kong Island to Kowloon and New Territories. Urban planners and policy makers should take residential attractiveness into account when they undertake public infrastructure and transit investments. It is also the foundation of sustainable residential land use planning and policies. This study can help the government to evaluate attractive level of areas for residents in compact cities. Planners should present appropriate planning strategies for various areas with different residential attractiveness. It can also be adopted to estimate the residents' satisfaction of new land use planning and policies.

There are some limitations of this study. This study collects the data of Hong Kong to illustrate how to evaluate the residential attractiveness of urban areas based on residents' demand. However, major variables and parameters may be different in other compact cities. More empirical data from other regions should be collected to test in further work. Moreover, this research collects the geographic data by measuring the network distance from the central point of each TPU to other locations. But, large TPUs should be divided into some parts which have different location attributes and different attractiveness for residents. The residential attractiveness of more location in TPUs will be measured in future research and the results will be more accurate.

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