The Impact of Green Open Space on Housing Price in Urban Area: a Case Study from DKI Jakarta

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Dedication Page

For my beloved wife Annisa Anastasia,
for my *Boys* Gavin and Kylian,
You are my everything…
Dank U well…

Acknowledgement

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Abstract

Green open space is very important for the functioning of an urban area. Moreover, it specifically remains a major United Nations target conveyed through the sustainable development goals. It may give significant contribution for environmental sustainability, safety, health, as well as for sosial and economic development. When green open space adequately provided, it offers multi-dimensional benefits to the community and substitutes to positively impact the property values.

There are recent developments of green open space in Indonesia, including DKI Jakarta. This initiative aligns with an obligation as regulated by law no. 26/2007 on spatial planning to provide minimum 20% public green space of total urban area. The initiative of green open space continuously increased since 2015. It was recorded that 296 green open space has been built. This is a collaboration program between local government of DKI Jakarta and private sector to build a type of green space, with extra facilities specific for children.

This research try to estimate the land value which can explain the house prices in the area of study with the existencies of green open space using hedonic pricing model.

Relevance to Development Studies

The effects of the policy to develop more green open space in DKI Jakarta may give positive result, especially for local people. They use all parks that have been built as a social interaction with others, also as an interactive place for their children. This study found that green open space gave a significant impact for property value. This findings may give some contribution to the local government to consider the development of parks in DKI Jakarta to achieve the purpose of the policy and the well-being of community.

Keywords

Green open space, hedonic pricing model, spatial plan law, DKI Jakarta, house prices

Chapter 1
Introduction

1.1. Background

Public infrastructure is vital for the functioning of an urban area. Moreover, green open space specifically remains a major United Nations target conveyed through the sustainable development goals. It has significant contribution for environmental sustainability, health, safety, as well as for economic development. When public infrastructure adequately provided, it serves various benefits within its community and substitutes to positive impact of housing values.

The valuation of environmental goods on property price is a subject which has continued to gain recognition. The value of real estate, in this case its price are being translated as a consideration of environmental sound property. The analytical approached is utilize to assess the urban externalities (Des Rosiers, et al., 1999). In addition, real estate sector have tendency to be affected by external factors amongst other economic sectors, as it considered the mobility of its community (Darling, 1973). Determining the effects of externalities on property value provides a basis by which each attribute is inherently priced in the aggregated value of the building as they usually constitute part of the housing bundle, and represent significant aspects in fiscal and economic terms.

In modern society, these public services have simply become lubricants in the wheels of national development and are extremely essential for public welfare and fiscal growth. The development of infrastrucure such as green open space, roads development, transport line support the economies, hence it positively influence the value of real estate as they improve housing conditions and quality (Famuyiwa & Otegbulu, 2012).

The study will limit to the impact of public infrastructure level, and environment condition on house prices: particularly green open space. There are various means by which the measurements of the value of housing attributes can be made. However, the hedonic approach still considered as most potential tool for such purposes as it translates buyers' perception through their actual pricing behaviour. It is expected to describe value of property on the basis of house characteristics, physical and neighbourhood-related. This tool was introduced by Rosen (1974) and has remained extensively used in empirically evaluating housing characteristics.

More specifically, the study will focus in DKI Jakarta. The selection of DKI Jakarta was after considering that DKI Jakarta is one of the biggest metropolitan cities in the world, with a high density and availability of supported infrastructure. However, on the other hands, the air quality of DKI Jakarta is

very low. Referring to statistic figure, as published in the statistic portal of DKI Jakarta, the air pollution index (API) showed an increasing trend during 2019.

There are recent developments of green open space in Indonesia, including DKI Jakarta. This initiative aligns with an obligation as regulated by law no. 26/2007 on spatial planning to provide minimum 20% public green space of total urban area. As per year 2019, there is no city able to reach this minimum target. DKI Jakarta, for example, only provided 9.98% of green open space by 2018.

There are several studies have been conducted to analyze the relationship between value of property and green open. The green open space affect significantly air quality (Nowak et al. 2002; Nowak 1994: 63-81; McPherson et al. 1998: 215-223). According to Jens Kolbe and Henry Wustemann (2014), the availability of parks, forest, and water will result to an increase on price of apartment. Another study that shows similar result is an article by B. Bolitzer and N.R. Netusil (2000), which the study results a statistic significant effect on a home sale's price.

1.2. Research Question

Focusing on observing green open space developments in DKI Jakarta, this study will be looking at:

a) The influence of green open space on housing price within the study areas

This developments may give a monetary incentive for the local government by observing the developments of green open space. If the influence of this factor is significant to house prices, the potential revenue could be gained by local government can be estimated.

1.3. Research Contribution

Where there are several studies conducted about the impact of green space to land value, this paper will try to discuss the impact on green open space to house prices in DKI Jakarta, one of the world's biggest metropolitan area, with the population more than 11 millions people and population density around 16.880 people per km^2. In addition, the study will also incorporate Geographic Information System (GIS) to hedonic model established. This research also the first study that conducted for region of DKI Jakarta.

1.4 Descriptive

The study will try to provide explanation whether development of green open space has correlation with the house prices. With regards to fulfill the obligation of law no 26/2007 on spatial planning, there were numerous developments during the last few years, starting on 2014-2015 in which most of the projects planned to be finished in 2019 and still on going with a new form that which called *Taman Maju Bersama* (TMB). Moreover, when possible, the study may also categorize which type of green open space that effect the most. The initiative of green open space continuously increased since 2015. It was recorded that 296 green open space, in form of *Ruang Publik Terbuka Ramah Anak* (RPTRA) has been built. This is a collaboration program between local government of DKI Jakarta and private sector to build a type of green space, with extra facilities specific for children.

Based on topics above, the study will focus on development of green open space, in regards to Jakarta's spatial plan this research only consider city parks and local parks, and analyze if they give any impact to the house prices.

1.5 Method

1.5.1 Empirical Strategies

This research uses hedonic price model to estimate the land value which can explain the house prices in the area of study with the existencies of green open space. The first step is to identify determinant variables to the land value using hedonic price model, which indicate that the land price is affect by the implicit value the owner experienced.

The premature assumption of the variables include several explanatory variables which describe neighborhood attributes, such as accessibility to services (supermarket, school, hospital) and surrounding infrastructure (accessibility of public transportation, type of road, distance to public transportation hub) and also disamenities (garbage dump, riverbanks, cemetery). This estimated parameters will reflect elasticity of land price with respect to the independent variables.

Table 1 Variables Measurement

Variables	Definition	Expected Sign	Source
Dependent			
Property Price	Desirable price for the house		online real esate marketplace
Independent			
Profile of the housing area (structural variable) • **Total built area** • **Number of bedrooms** • **Number of Bathrooms**	Profile of the housing area in block	(+)	online real esate marketplace
Proximity unit to each explanatory variables • **Neighborhood** • **Location**		(-)	Calculate using GIS

In hedonic pricing models (Bhattacharjee, et al., 2012) propose property unit prices are regressed on a bundle of characteristics of the unit that determine the value:

$$P=f(S, N, L, C, T) \quad (1)$$

where P denotes the price of the residential, and S, N, L, C and T denote, respectively, structural characteristics (total area, number of bathroom, tenure, etc.); neighbourhood characteristics (include local disaminites and amenities); locational attributes (distance to city center, transportation network, etc); other characteristics (such as clean water supply, electricity, central heating, etc.); and the time (date, month) when the value is observed.

For the purpose of this research, specify the hedonic house pricing model as:

$$P=f(S, N, L) \quad (2)$$

where *P* is the value of the house, *S* represent structural characteristics, *N* is a vector of neighborhood characteristics, and L represents location (access to market, city center, high school, public transport).

The empirical model used to assess the effect of green open space on house prices is log-log estimation model. This model is commonly used across the hedonic price method (Bolitzer and Netusil, 2010; Bhattacharjee et al., 2012; Ihlanfeldt and Mayock, 2010; Melichar et al., 2004; Adair et al., 2011; Wu et al., 2014) and suitable with the data. The estimation model in a log-log form is expressed as:

$$\ln P_i = \alpha_i + \Sigma(ln\mathrm{x}_i\beta) + \varepsilon_i \quad (3)$$

where Pi denotes the house prices of apartment in rupiah. Also, ε is an error term and α and β are parameters to be estimated. The X vector in Equation (3) is a set of observable house characteristics, that grouped into three categories: structural, neighborhood and location variable. The structural variables consist of total built areas, number of bedrooms and number of bathrooms. Meanwhile, distance to parks refers as neighborhood category. Lastly, location variable represents by MRT station, hospital, highschool, supermarket, busway shelter and city center to houses.

1.6 Data

In this study, it seems crucial to have datasets of the housing market and the location of green open space at approximately the time. Before conducting the analysis, I try to do web scraping from online property site in Indonesia. This paper will rely on DKI Jakarta's property data in year 2021. Each property data contains the sale price, construction materials, property type and features (floor area, land area, swimming pool and terrace), and some neighbourhood characteristics. Furthermore, the GIS is employed to geocode the address of each property data and is used to generate spatial variables measuring the straight-line distance in metres to the public amenities for all properties.

Regarding the location of the green open space, I propose to collect the data from Office of Human Settlements, Spatial and Land of DKI Jakarta Provincial Government (DCKTRP). DCKTRP will be asked to prepare the data, including the name, address, date of establishment, and total area. The addresses provided are also geocoded by GIS through which the distance between green open space and houses were determined.

1.7 Scope and Limitation

1.7.1 Scope

The area of study is limited to metropolitan area in inland, which covers all 42 districts that spread into 5 administrative cities (municipalities). However, this study does not consider the region of kepulauan seribu.

1.7.2 Limitation

As a limitation of this study, this research only focus on relationship between housing price and RTH in less than one year period, without taking into consideration the timeframe before and after the policy on minimum availability of 20% RTH is implemented. Moreover, interview to stakeholders that relevant to policy was not performed.

1.8 Organization of the Research Paper

This research paper consists of five chapters: chapter 1 is introduction, followed by chapter 2 for literatur review, then background situation of DKI Jakarta on chapter 3, continue with result and analysis on chapter 4, and last chapter is conclusion and recommendation.

Chapter 2
Literature Review

2.1 Conceptual Framework

Housing is a basic need for people, thus there are rapid developments in housing industries to cater people's needs due to the limitation of land while the population of people is increase. Land also unique as it is limited, fixed, cannot be moved, and transferred while people need it and number of people grows every year. They need land for live by building houses, plant crops for food, build for commercial and other developments. With the unique characteristic of land, the development however can be modified to provide sufficient facilities, including development in residential area.

As the development of land increase, so does the land value and price of property on its surrounding area. A study by Cho, Bowker and Park (2006) found that the green space in form of urban park in residential area have positive impacts on residential property values. According to Liu et al (2009), there are seven aspects of environmental variables that might contribute to the land value: degree of prosperity, transportation condition, public infrastructure level, facility supply, environment condition, population density and other factors. These factors and other several factor, such as interest rate, supplies, economic growth, mortgages then reflect into housing price.

From the previous literature, there is a chance that providing green open space might increase the land value. According to Qu (2005) there have a endogenous interrelationship between land value and house prices. Therefore, the study will consider land value in interpreting housing price. In Indonesia, tax object sales value (NJOP) is a common tool to represent the land value, as it is an estimated value of each land or property and become as a basis price for taxation. When there is an increase in NJOP value, it will contribute to a monetary value for local government.

2.2 Empirical Studies

The effect of urban environmental amenities, like green open space or parks, development, has been extensively studied for a very long time in regional planning, urban development, and even economics literature. Some of those studies have been exploring the impact of urban environmental amenities (green open space) on the dispersion of value of property and residential land use. With regards to this question, it is recognized that the application of hedonic pricing models is the most commonly used tools being used to analyse those correlation. This is a regression method that provides estimation

on economic value of properties as a function of the proximity to environmental and urban amenities. As a result, hedonic pricing models are being used in several studies to conclude the impact of green open space to housing price (e.g. Roebeling et al. 2007; Wu 2006; Wu and Plantinga 2003). In addition, although the models need massive amounts of primary data sales around certain environmental elements such as parks (Crompton 2005), it has been widely used in various regions: Japan (Hoshino and Kuriyama 2010), Austria (Amrusch and Feilmayr 2009 Denmark (Panduro and Veie 2013), the United States (Crompton 2005; Irwin, Jeanty, and Partridge 2014), to the United Kingdom (Gibbons, Mourato, and Resende 2014), Czech Republic (Melichar and Kaprova 2013) and China (Jiao and Liu 2010).

Referring to the available empirical relationships, the impact of environmental amenities that do not yet available to additional of property values can be estimated through hedonic pricing simulation models. Therefore, it is considered as a potential technique in supporting future development planning and rehabilitation of urban area.

2.3 House Characteristics and Attributes

Focusing on property prices, there are several variables that determined the property value in natural area. According to Sirmans et al., 2005, there are five categories of house characteristic or attributes:

1. building characteristics (number of bathrooms, number or bedrooms, size of building);
2. internal characteristics (heating mode, and air conditioning);
3. external characteristics (availability of parking lot, swimming pool, and garden);
4. environmental characteristics (park, mountain, lake, or river); and
5. location and neighborhood characteristics (distance to transportation link, city center, and quality of schools).

Several studies recognized the importance of housing characteristic to positive price of property, particularly: number of bathrooms (Ayan and Erkin, 2014; Jim and Chen, 2006; Li et al., 2016) and number of bedrooms (Conroy et al., 2013). In addition, availability of facility in the property also give positive impact to the price of property. In a case study of Metropolitan Izmit, Turkey, Ayan and Erkin (2014) found that swimming pool also make an increase of property. As a result, property with swimming pool tends to be sold at a higher price.

Neighborhood and location attributes such as quality of schools necessary to define price of property. Moreover, people are willing to pay more to get property that near high quality schools. (Ayan and Erkin, 2014).

However, house characteristic not always contribute positively to the price of property, for instance the age of building that resulted a negative impact (Ayan and Erkin, 2014; Conroy et al., 2013). This presentation means that the older of property, the lower the price as older properties may need more renovation (Conroy et al., 2013).

Another significant factor that also contribute negatively is location characteristic, which in this case define by distance to city center (Jim and Chen, 2006). Referring to the study, it was found that more distance between property to city center, causes significant drop in price of property. Moreover, the study conducted in Poznan Country, Poland recognized that not only distance to city center, but also to public facilities, such as the distance to railway stations and toll roads significantly affects the value of property (Łowicki and Piotrowska, 2015). Cervero and Kang (2009) found that, in Seoul, the distance between bus rapid transit stop and residential have a negative correlation, but gave a significant effect on property values.

Public transportation and main roads also found as important factors that determine the price of property, as these factors provide more comfort for people to commute, for example to office, shopping centres or other substantial places that visited frequently (Li et al., 2016).

From the previous studies, we can see that green open space are beneficial to land price. The study that conducted by Bolitzer and Netusil (2000) and Melichar et al. (2014), found that the public parks have a positive and statistically significant impact on the housing price.

2.4 Hedonic Pricing Model

The hedonic price model developed by Rosen (1974) is expected to obtain the impact of green open space on house prices. This model assumes that the function of goods' characteristics and any relevant attributed to the good will have impact on its value. A hedonic price model can be represented as P = P(z), where P, the selling price of a good, is determined by the embedded prices of relevant attributtes of the good z. The hedonic property price model, therefore, will result the marginal valuation of each property attributes (Lansford and Jones, 1995; Schläpfer et al., 2014). The changes of prices can be concluded by the combination of attributable factors. Not only supporting arguments are available, but there are also disagreements to the models due to its limitations: inability to assess off-site benefits, and difficulty to differentiate marginal changes. However, it is still considered as a supporting tool for determining value of particular attributes within environmental benefits (Halstead et al. 1997).

OLS is a well-known approach to estimate the hedonic housing price method (Gencay and Yang, 1996; Chau et al., 2004; Li et al. 2016; Behrer,

2010;Schläpfer et al., 2014). This model assumed that the relationship between residential price and attributes are linear. However, this assumption considered restrictive, as it is not always and necessary to be linear. Therefore, the model using nonparametric approach introduced to overcome the nonlinearity issue. (Koster et al., 2014). Moreover, this technique claimed that it can produce better results than OLS (McMillen and Redfearn, 2010; Bontemps et al., 2008; Anglin and Gencay, 1996).

From numerous previous studies that have been conducted, it is identified that the hedonic pricing models formed several forms: double-log (e.g. Bengochea-Morancho 2003), translog (e.g. Capozza et al. 1996), inverse semilog (McLeod 1984), semilog (e.g. Geoghegan 2002; Jim and Chen 2007), linear (e.g. Kong and Nakagoshi 2006; Bengochea-Morancho 2003), etc. In theory, there is no exact definition of a precise functional form for the hedonic pricing (Halvorsen and Pollakowski 1981; Palmquist 1991) and no evidence shows the best forms among others (Kang and Reichert 1987; Lansford and Jones 1995) as the empirical evidence (Palmquist 1991; Haab and McConnell 2002) or assessment goal (Laurice and Bhattacharya 2005) are usually considered to select the preferred form.

As recent studies developed, that factor environmental variables into residential prices. The HPM serves an appropriate approach to measure the contriution of external benefits to transaction prices. In addition, this method assumes that a heterogeneous commodity is determined by various attributes, and its value is based on a combination of attributes (Brasington and Hite 2008). Choosing a house means you are buying a god with certain package of "variables" In general, it can be presented as:

$$P = a + bX + \varepsilon \tag{4}$$

where P stands for the commodity price and X is a vector of explanatory variables. The value b is the estimated coefficient, while a and ε represent constant terms and error term respectively. This method has been commonly applied to measure the environmental factors on property value, including environmental externalities, such as air quality, city park, wetlands, and local park (Wu et al., 2014). Previous empirical research studies mainly have three types of HPM: double logarithmic forms, semilogarithmic , and linear (Wang and Qin 2009).

The log-log form of HPM has been widely applied in empirical studies (Melichar et al, 2014; Wu et al., 2014). The advantage of log-log model is more appropriate to elaborate the property price model which indicate that there is a strong linear relationship between the dependent and independent variables (Wu et al., 2014

Chapter 3

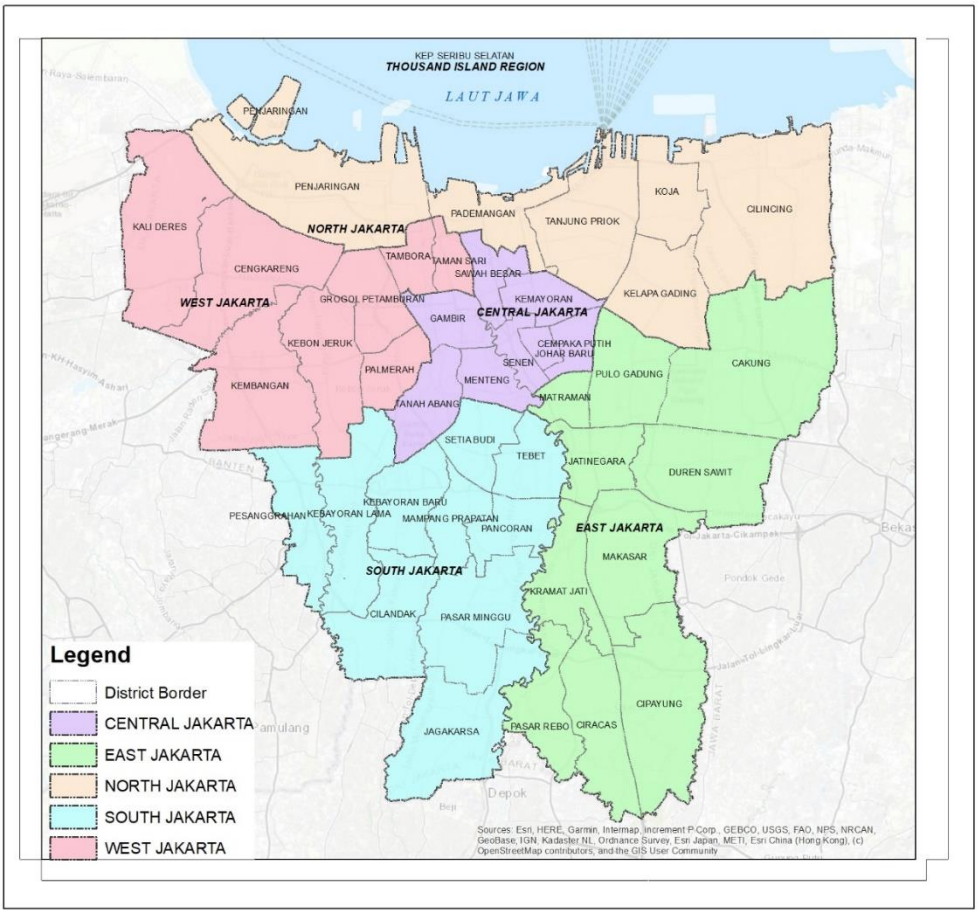
Background Situation in DKI Jakarta

3.1 Geography in DKI Jakarta

Jakarta is the capital city of Indonesia, one of the biggest metropolitan area in the world. This Province has more than 11 millions population with the density 16.884 per km^2 (Jakarta, 2020). As a special area, Jakarta divided by five districts and one municipal, which are: Central Jakarta (47,90 km2), North Jakarta (142,20 km2), West Jakarta (26,15 km2), South Jakarta (145,73 km2), and East Jakarta (187,73 km2), as well as Regency of Kepulauan Seribu (11,81 km2).

In the northern side, there is a 35 km beach that serves as disembogue of 13 rivers and 2 canals. In the South and East side border is city of Depok, Regency of Bogor, city of Bekasi and Regency of Bekasi. Meanwhile in the West border is city of Tangerang and Regency of Tangerang, and the north border is Sea of Java.

Figure 1. The Administrative of DKI Jakarta



Geologically, all lands consist of sediment of pleistocene underlies in ±50 m below the soil. The south side of Jakarta consist of alluvial, while lowland of beach overlay to the inland around 10 km that has darker sediment underneath and not visible on the ground as covered by alluvium. In the northern side, this layer will be found on 10-25 m, and in South will be found on around 8 – 15m. It is shallower to the south, and in certain part this will be found on 40 m depth.

Most of the time, Jakarta has a hot climate around 32,7°C - 34,°C at noon and around 23,8°C -25,4°C at evening. The average yearly rainfall is 237,96 mm. Between year 2002-2006, the lowest rainfall was 122,0 mm, which happened on year 2002 and the highest was 267,4 mm that occurred on 2005. The humidity level was 73,0 - 78,0% and average wind velocity was 2,2 m/s - 2,5 m/s.

3.2 Green Open Space Policy in Jakarta

Based on an act number 26 / year 2007 about spatial planning, the target on the availability of Green Open Space is at least 30% from administration size of the city. The 30% divided into two categories: 10% of private, and 20% for public.

The development, setting, and fulfillment of green open space for all components in urban environment are the responsibility of all stakeholders, including the central, provincial, or regional government, private sectors, and the community.

To establish an environmental suitability development, particularly the availability of RTH, monitoring during implementation phase is required in addition to a proper planning. Monitoring in provision of RTH become vital along with the rapid progress in technology development within metropolitan cities.

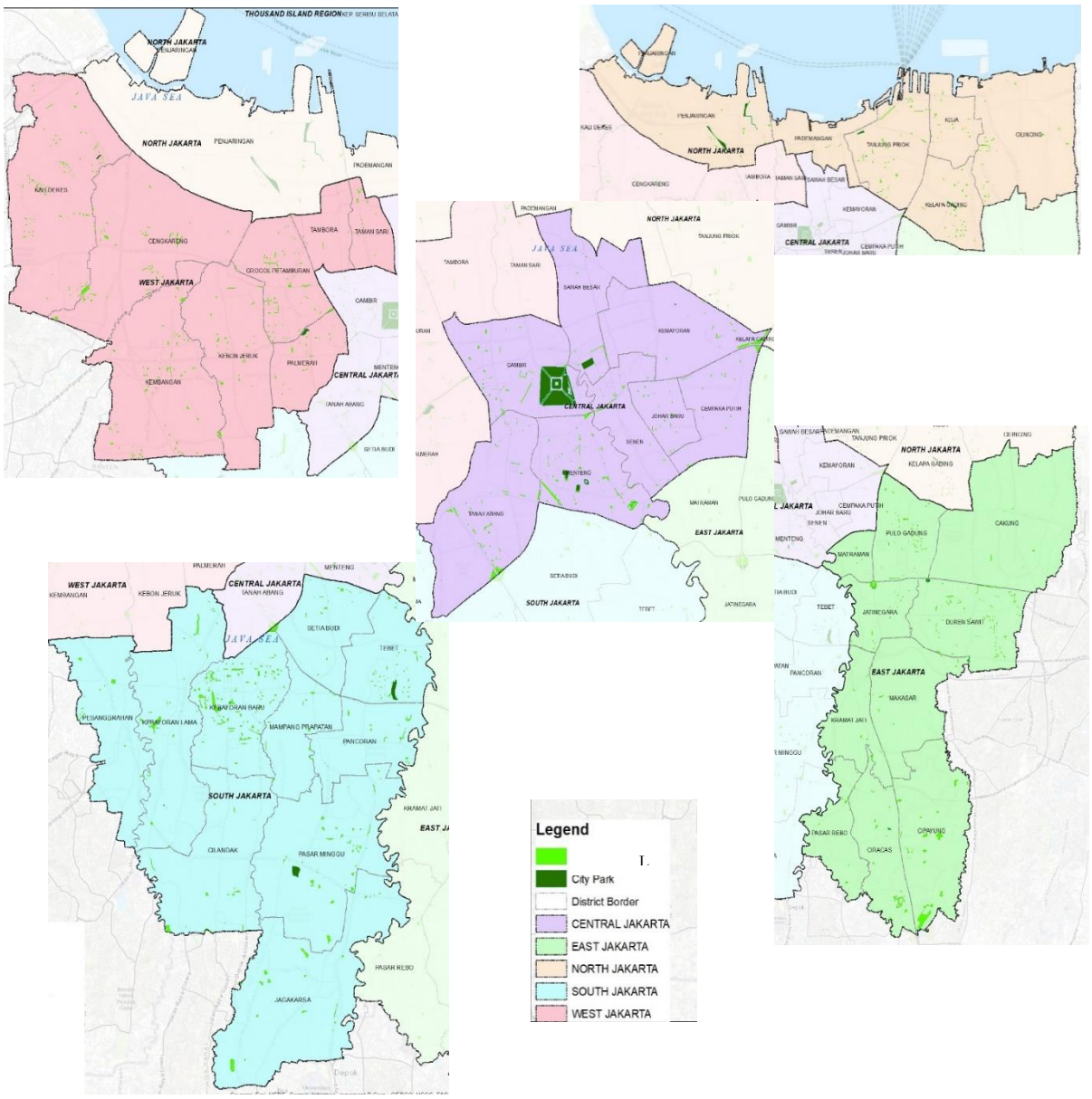
Moreover, 30% is a minimum space to support the balance of ecosystem in the city, for hydrology system and microclimate balance, as well as other ecology that can provide clean air, and increase the aesthetics of the city. The 30% target can be achieved gradually through typical urban land allocation.

3.2.1 Carbon Emission Issue

Pollution in metropolitan city like Jakarta is considered as one of critical issue, particularly air pollution. The air pollution mainly generated from the fuel oil used in transportation, therefore this problem is avoidable for high density city like Jakarta. However, green and open space is expected to provide solution in reducing such pollution. Therefore, a sufficient open space as well as an efficient energy policy should be the main development agenda for centre and local government.

Indonesia is considered as the third worst country in terms of air pollution, after Mexico and Thailand (Marayoga, 2010). Moreover, it is proven that the increase of greenhouse gas and pollution in urban areas is mostly contributed from transportation sector (Edyanto, 2013). The more populated and more complex of activities within the community, will consequently possess higher air pollution, such as Jakarta.

Figure. 2 Green Open Space in Each Municipalities in DKI Jakarta



The Kyoto Protocol 1997 that has been ratified by 141 countries, including Indonesia stated the urgency of reducing emission of 1990 by 2021 for 5.2%. Estimation of Carbon dioxide (CO_2) emission on 1989 period that generated from human activity is 5,8 – 8,7 million tonnes, in which around 71% - 89% is from fuel fossil (Edyanto, 2013).

With regards to overcoming the environmental issues, including carbon emission, flood, increasing sea level , and land sinking, the Government of DKI Jakarta implemented location regulation number 1 year 2012 on DKI Jakarta Spatial Plan. This regulation aligns with law no 26 year 2007 about spatial planning that gives direction regarding development on green open space that needs to be provided until 30%from total land size of DKI Jakarta within 20 years period.

3.3 Green Open Space Function

The provision of Green Open Space (RTH) based on size of land is as follows:

a) Green open space consists of public RTH and private RTH;

b) The minimal proportion of RTH in the city is 30% that consists of 20% of public RTH and 10% of private RTH;

c) If the city already has RTH that larger from what stated in the regulation, thus it should be maintained at the same size.

3.3.1 Role and Function of RTH in shaping the character of urban space

Based on its definition and function, RTH has an essential role to build a "healthy city". The existence of RTH as a free open space with green elements such as tree that can improve people's mental and physical health.

The provision of RTH is not only from government, such as city park and green lane but its existence can also be improved by increasing awareness of people about the importance of RTH. There are various of RTH that can be built in public and private land. Therefore, it is important to build awareness of people and it can be promoted through socialization about the importance on presence and utilization of RTH. Moreover, development and preservation of green community also important to create a healthy lifestyle. A support that Government can provide is establish a social activity and local regulation, which amongst them is incentive for public / private that provide RTH in their own land. Support from government can be done

3.3.2 Main function, and Ecological function

The ecological function is to ensure the physical sustainability of city, a form of RTH that located within the city such as a RTH for resource and wildlife conservatory.

Several ecological functions of RTH are: water infiltration, produce oxygen, covering noise, filter from solid particles that can pollute the city, absorbs gases of glasshouses or acid rain, windbreak, avoid sea water intrusion, climate amelioration and groundwater conservation.

3.3.3 Secondary Function: Architectural, Social and Economy

Additional functions of RTH (social, economy, and architectural) are supporters and an added value of environment and culture of the city. Therefore, it can be located and shaped as needed, such as recreation, and support of city architecture. In a city, these four functions can be combined based on need, purpose, and sustainability of the city.

(1). Social function

RTH can reduce the stress level of people, conservation of heritage site, reduce social conflict, increase security of the city, and improve productivity.

(2). Economy function

Economy function of RTH can be obtained directly and indirectly. Directly, the benefit of RTH can be collected from sales or utilization of RTH such as firewood or wood. Cultivation of type of plant that can produces seeds, fruit or flower can be used for various needs: improve nutrition, health, and income of the people. Besides for consumption, walnut can also be used for handcraft. Moreover, the flower of cape tree is also benefited. Nutmeg, tangerine, and other plants can be used to increase health level of the people.

Meanwhile, indirect function is a protection of wind, shade, and add the convenience of people as well as esthetic of the city (Fandeli, 2004).

RTH can improve the level of economic stability through touristic and other business opportunity, as people will enjoy the life and have longer shopping within green area, offices, apartment on the green area will be occupied with higher value, and green area is potentially contribute to the increase the productivity of worker (Forest Service Publications, 2003. *Trees Increase Economic Stability*, 2003).

(3). Architectural function

Variation of composition of vegetation will increase the beauty of the city. The head of tree can give delicate impression to the city. There is a study about existence of RTH to esthetic of the city is people willing to pay for RTH as it provides beauty and convenience to the city (Tyrväinen, 1998)

3.4 Needs of RTH based on certain function

The function of RTH includes in this category is to give protection or security and infrastructure such as preservation of natural resource, protection for pedestrian or maintaining the use of developed land. Type of RTH in this category such as:

(1) Green area

(2) Border of rail,

(3) Green area of high voltage electricity,

(4) Green open space of local protected area, such as:

(a) RTH on border of river,

(b) RTH on border of beach, and

(c) RTH on border of raw water source

Chapter 4

The Effect of Green Open Space on Housing Price

4.1 Data and Statistical Descriptive

This study covers a two-stage approach to obtain the data that will be analyse further. Firstly, the data collection that taken from Indonesia real estate marketplaces (website of rumah123.com and rumah.com) from June to October 2021. Later on, data filtering to develop the final dataset. However, please note that the data listing in online marketplace is the advertised price, which may different from the real price when transaction occur (Horowitz 1992). In practice, the price listed in the marketplace is based on legal contract between seller and buyer, instead of survey to the targeted properties or the sale value of the tax object (NJOP) issued by the government. The value of NJOP has been used to determine property prices in developed countries. However, in Indonesia, it is most likely that the property price can be three times of NJOP due to several considerations, such as location, condition of the property, and neighboor price (Berawi et al, 2020). Despite all of these limitations, valuable data sources for research development in the property and housing sectors is provided by real estate marketplaces.

Finally, after preprocessing, this study acquired data on selling price of 2,296 sample housing units as final data set. This study ignored the time influence on house prices because of the short of the time span, which only less than a year. In addition, this study also excludes apartments and villas. It is important to note that the housing sample were distributed in 42 districts accross 5 municipalities in mainland DKI Jakarta Province.

4.1.1.Data Collection

Web scraping is one of a common technique to overcome the issues in large number of data collection in various sectors including housing. Several tools are also available for data collection from web pages and offers a customized solution for novice user. Besides data collection, this tool also used in this study to excerpt information, transform to databases, as well as structure the data from web pages automatically.

Non-technical user also able to access it, provides flexibility to face challenges of complex websites, and straightforward interface for data collection. Furthermore, it is also possible to modify the search based on preferred criteria, in this study for example the price of property, number of bathrooms and bedrooms, and size of house. Specific location can also be chosen through this tool, by select desired latitude and longitude points, and this option is

available on the website page by activating coordinate inspection. Therefore, after selections have been made, the following information are collected for purpose of this study: housing price, total area, building size, number of bedrooms and bathrooms, geolocation.

The table 2 below shows the variables collected, such as range of property to the neighborhood attributes (for example: city park, central business district/CBD, hospital, supermarket, shelter/ station, and highschool). This is the result after taking geo location into consideration during earlier data collection phase. Subsequently, all of these data keyed in into the GIS which allows user to get, manage, analyze, and offer supports in making the descision based on geographical data.

This research utilized a software, called arcGIS to analyze information of location and translate variables in determining move of housing prices.

Table 2 Dependent and Independent Variables Measurement

Variables Types	Variables	Variable Quantification	Source
Dependent	Property Price	IDR	Online real esate marketplace
Independent			
Structural Attributes	Total built area	total built area of property ($m^{2)}$	Online real esate marketplace
	Number of bedrooms	total number of bedroom of the property (unit)	Online real esate marketplace
	Number of bathrooms	total number of bathroom of the property (unit)	Online real esate marketplace
Neighborhood Attributes	Green open space	Distance between property and city park and local park(m)	Calculate using GIS
Locational Attributes	High School	Distance between property and high school(m)	Calculate using GIS
	MRT Station	Distance between property and MRT station(m)	

	City Center/ CBD	Distance between property and city center/ CBD(m)	Calculate using GIS
	Hospital	Distance between property and hospital(m)	Calculate using GIS
	Shelter bus	Distance between property and busway shelter(m)	Calculate using GIS
	Supermarket	Distance between property and supermarket(m)	Calculate using GIS

4.1.2 Data Filtering

After collection of required data set is performed, it is very important to ensure the data generated is ready for further process: input for modelling, and analysis. Although as mentioned earlier that the tool generates data automatically from the website and allows user to modify the text entry and create listing including the format, but the typo, duplication of data, missing number, irrational data, or any other flaws is highly possible. These flaws can be generated from the tool itself or due to incorrect data from the website. Therefore, it is necessary to perform data filtering before data analysis, so the original dataset being used is standardized and rational.

Listing of one property more than one time by same ID is allowed in marketplace, therefore some IDs (which refers to seller) does this so their listing can be on the top of research page. However, it results duplication of data, thus eliminate duplicate data is the first thing conducted in this process. Besides multiple listing from same seller, there is also possibility that same property listed by several sellers with different or similar price. Therefore, it is also critical to identify which properties are categorized into this group and eliminate so it will appear only for one time for data analysis.

4.1.3 Data and modelling

Two data sources being used to produce values for each selected variable in the HPM models: marketplace data as well as data from google maps and GIS. The marketplace data was collected online through real-estate marketplaces operated in Indonesia, which provides infromation on price of housing (IDR), size of housing (square meter), the number of rooms (unit), etc. The second data which taken from google maps and GIS covers distance and neighborhood location of the property.

This research utilizes the HPM method to assess the impactss of selected variables to the housing price. This is a widely known method by academics and researchers in various sectors including property, as this method able to quantify the impact of relevant attributes to the overall transaction price.

Moreover, multiple regression analysis enables housing price to be determined based on neighborhood characteristics, structural characteristics, accessibility, and types of land-use.

The assumption in linear form is the distance to rail station (or any other attribute) is constant term to the price of property (Zhang and Xu 2017). Meanwhile semi-log, which only transformed dependent variables, and log–log form changes all variables into the logarithmic model. Log–log form estimates a constant elasticity of property price to the independent variables. The selection of functinal form of HPM is not indicated. Several researches have tested to figure out the benefits and limitations of each form (Malaitham et al 2020), however, there is no conclusion stated that one form is dominant over the others (Hussain et al 2019).

Generally, the correlation between independent and dependent variables formed the specification of the model. To produces an optimum result, it is important to follow the nature of analysis, data availability, and case studies in determining functional form.

The log-log model, which was used in this research is common across the hedonic price model (Jim and Chen, 2006; Chau et al., 2004; Behrer, 2010; Ayan and Erkin, 2014) and results an appropriate fit with the data in our study. The estimation model in a log-log form is expressed as:

$$\ln P_i = \alpha_i + \Sigma(ln \mathrm{x}_i \beta) + \varepsilon_i \quad (5)$$

where *P*i represents the advertised selling price of house i in rupiah. X vector in Equation (5) is a set of observable house characteristics, which include green open space that represents the simulated variable in this study by city park and local park. Furthermore, the other variables in X vector in Equation consist a comprehensive list of additional characteristic variables: structural, neighborhood and locational variables. Structural characteristics can be represent by number of bedrooms, bathrooms and total built area. While locational characteristics provide data about the distance of the house to several public facilities, such as hospital, shelter bus, and high school. Park and coast can consider as a part of neighborhood characteristics.

This research utilized the hedonic price model to determine the relationship between house prices and green open space, as well as other characteristic variables. The model applies cross-sectional data and utilizes OLS regression techniques to develop estimation of logarithm parametric, in which it is the most common technique in providing the proximity of hedonic price function (Preez et al., 2013). In addition, several studies recognized that the log-log model is suitable to elaborate the property price model which indicate that there is a significant linear relationship between the independent and dependent variables (Wu et al., 2014).

This study regard the house prices as the dependent variable in HPM. Eleven explanatory variables were selected in three different categories: structural, neighborhood and locational attributes. This study selected three structural attributes, including total built area, number of bathrooms, number of bedrooms. The locational attributes were distance to supermarket, distance to hospital, distance to highschool, distance to MRT station, distance to city center, and distance to busway shelter respectively. While, distance to park was selected as neighborhood attribute. All variables, both dependent and independent, are transformed into natural logarithm.

4.1.4 Data Description

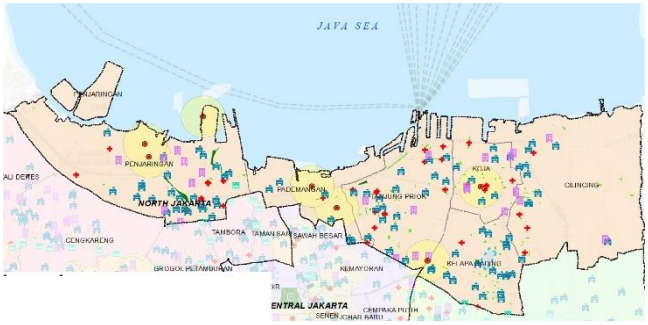
Table below explains the average, minimum, and maximum values from dependent and explanatory variables of total 2,296 sample houses observed. Amongst all attributes, distance to park is considered as the key attributes concluded from this research. The distance was measured by using GIS, and the closest distance is 0,05 km while the maximum distance is 6,6 km with average distance of observed house to park is 0,46 km and 0,99 km of standard deviation.

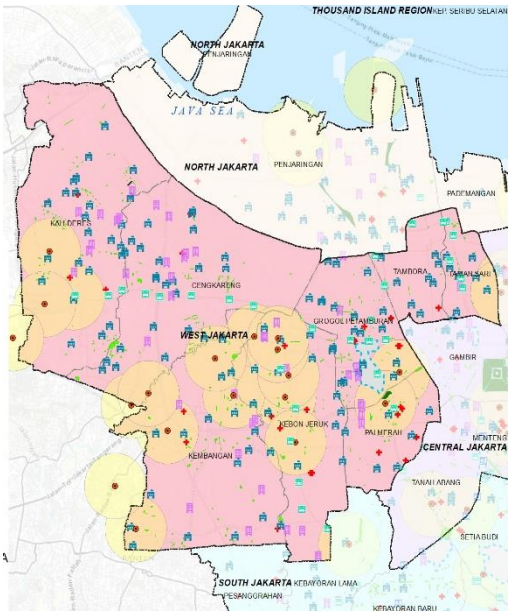
Table 3. Descriptive statistics

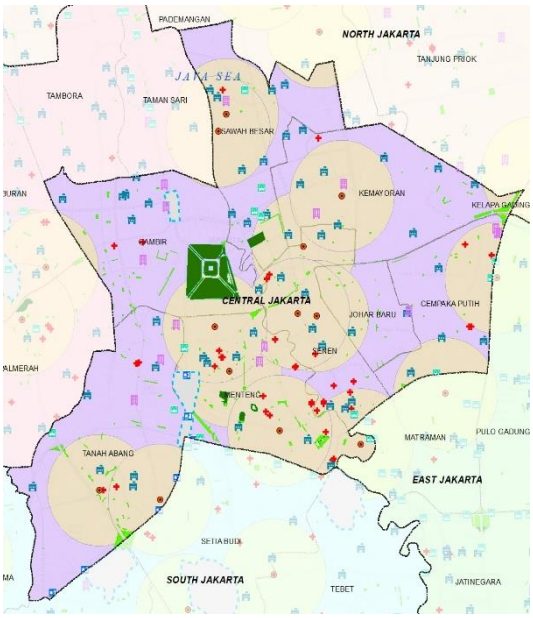
Variable	Obs	Mean	Std. Dev.	Min	Max
price	2,296	9.41e+09	1.96e+10	2.30e+08	3.50e+11
size	2,296	321.9046	554.3752	20	22000
bathrooms	2,296	3.472561	1.718066	1	10
bedrooms	2,296	4.192073	1.725409	1	10
dist_park	2,296	462.3233	994.2129	5.518302	6645.666
dist_market	2,296	1460.976	1391.335	21.10596	8846.451
dist_hosp	2,296	2434.005	1614.154	117.4438	10248.53
dist_school	2,296	734.3148	1005.13	20.06182	6685.589
dist_MRT	2,296	6319.841	4023.734	36.77669	17422.46
dist_busway	2,296	2115.472	2121.095	45.8848	11107.85
dist_city	2,296	5482.774	3471.22	50.12675	18015.66

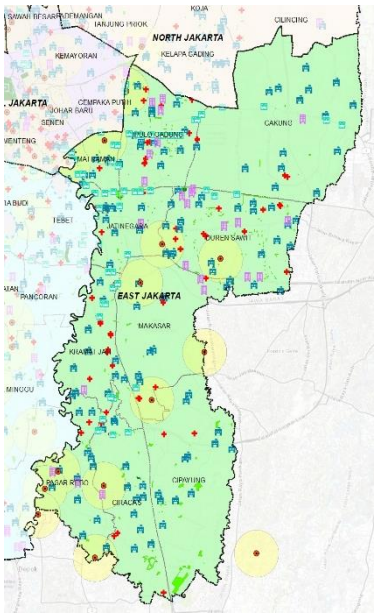
Moreover, the average type of house has total built area of around 322m^2 with 3 bathrooms, 4 bedrooms and price of IDR 9 billion. Meanwhile, average distance between house to several places that visited frequently by community such as supermarket, hospital, high school and city centre is 1,5 km, 2,5 km , 0,7 km, and 5,5 km respectively. Moreover, the observed houses have shorter distance to busway shelter, compare to MRT station with the average distance is 2 km and 6 km.

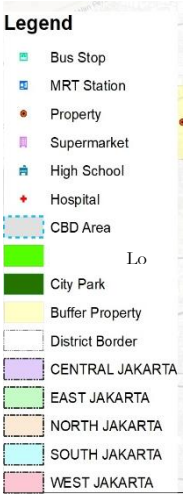
Figure. 3 Geographical position for all variables

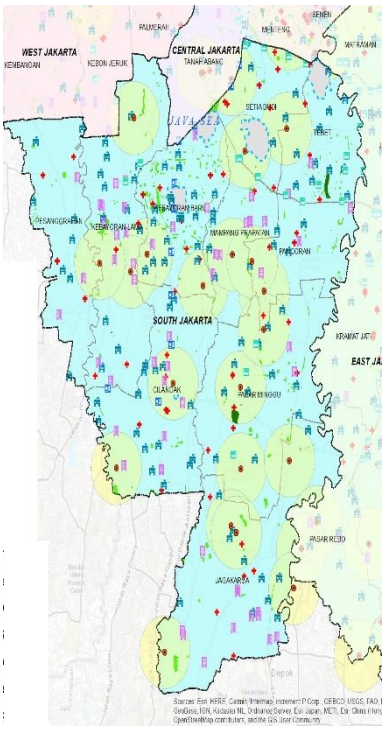












4.2 Correlation Test

This study tries to provide a correlation test to detect multicollinearity. According to Gujarati (2003) , Ragnar Frisch was the one who is using the term multicollinearity, which describes the availability of a perfect linear relationship among some or all explanatory attributes of a regression model. The existence of this phenomena may cause several problems, such as difficulty in making a precise estimation or even the goodness of fit (R2) of the model is very high, but the coefficients of independent variables tend to be statistically insignificant (Gujarati 2003). In other study, it is argued that when there is strong correlations within all selected independent variables, the multicollinearity forms (Kutner et. Al, 2005). Moreover, it is challenging to differentiate the contributions of each independent variables to dependent variables when these independent variables try to show their own strength. (Zainodin and Yap 2013). The result of correlation test is as follow:

Table 4. Collinearity statistics

Variable	VIF	1/VIF
logno~hrooms	3.18	0.314388
logno~drooms	2.86	0.349512
logtotal_b~a	2.37	0.422464
logdist_ci~r	2.13	0.468862
logdist_MR~n	2.11	0.474547
logdist_bu~y	1.75	0.572219
logdist_high	1.57	0.634939
logdist_su~t	1.54	0.649640
logdist_park	1.39	0.721839
logdist_hosp	1.25	0.798084

Referring to the result of collinearity statistics as presented on table.4 , the VIF values of all variables is less than 10 and 1/VIF id more than 0,01. Therefore, it indicates that collinearity is not recognized amongst the variables.

4.3 Results

Table 5. Regression Variables

logprice	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
logdist_park	-.0237248	.0111156	-2.13	0.033	-.0455226	-.001927
logtotal_built_area	.9747048	.021637	45.05	0.000	.9322746	1.017135
logno_of_bathrooms	.1243967	.0438065	2.84	0.005	.0384921	.2103013
logno_of_bedrooms	.0760044	.0501499	1.52	0.130	-.0223397	.1743485
logdist_supermarket	.0528845	.0172572	3.06	0.002	.019043	.0867259
logdist_hosp	-.0097474	.0174701	-0.56	0.577	-.0440064	.0245116
logdist_high	.047298	.0151271	3.13	0.002	.0176337	.0769622
logdist_MRTstation	-.2280413	.0190895	-11.95	0.000	-.2654759	-.1906067
logdist_citycenter	-.0552276	.0197271	-2.80	0.005	-.0939124	-.0165428
logdist_busway	-.0026618	.0140824	-0.19	0.850	-.0302775	.0249539
_cons	18.6469	.203592	91.59	0.000	18.24766	19.04615

Number of obs	=	2,296
F(10, 2285)	=	696.53
Prob > F	=	0.0000
R-squared	=	0.7530
Adj R-squared	=	0.7519
Root MSE	=	.57455

The result of HPM regression on this subsection is divided into three categories: structural, neighbourhood and location attributes. Through this model, it is recognized that 75 percent of variance of independent variables able to determine the variance of dependent variable (price of housing). In addition, it shows that the Prob>F value is less than 0,05, therefore it considered as significant. Therefore, dependent variable can significantly impacted by all independent variables.

Out of 10 independent variables considered, 7 variables found have significancy with regards to change in dependent variable. The remaining three independent variables, which are: bedrooms, distance to busway stop, and distance to hospital considered insignificant to the marginal of housing price. Thus, it may indicate that these three independent variables are less considered by people when it comes the decision of housing price.

Moreover, this paper finds that distance to park, which is the interest variable, has a quite significant negative relationship with house prices. It shows that the 1% decrease in distance from house to park will contribute to the increase of housing price for 0,0237%. This result support the preliminary assumptions, as it means that the closer house to the park, the higher the price of house.

Meanwhile, on structural attributes, the total built area of housing is recognized as the most relevant variable to the housing price: 0,974% on residential property impact for every 1% larger of the built houses. The remaining structural attributes, such as number of bathrooms and bedrooms also gives positive effect on house prices, which result 0,124% and 0,076% extra value to the house prices subsequently.

Furthermore, distance to MRT, which considered as one of location attributes showed significant effect in terms of housing price. A 1% decrease on distance from house to MRT station will contribute to 0,228% extra value to the property prices. Besides MRT station, distance to city centre also statistically proven has impact to housing prices: 0,055% of higher value for every 1% closer to the property location.

Other location attributes that also considered are busway shelter and hospital. Although the statistic result of distance to busway shelter and hospital also shows negative sign as expected, they did not give significant effect to the housing price. This results are different with Cervero and Kang (2009) found in Seoul, that the distance between bus rapid transit stop and residential gave a significant effect on property values.

On the other hand, other location attributes such as distance to supermarket and highschool, shows a quite significant effect to the property prices. However, the value is positive, which means that the house prices will increase when the distance between house and supermarket as well as highschool further away. While Ayan and Erkin (2014) found the other way around, they said that people are willing to pay more to get property that near high quality schools.

Lastly, based on the analysis conducted, it can be summarized that following main variables that has effect to housing price in DKI Jakarta are distance between house to park, distance between house to MRT station as well as the size of building. Therefore, these variables, implementation policy of development on RTH, as well as development of public transportation will have social impact to the community. Moreover, these also give impact to economic value, in this case is housing price in DKI Jakarta.

Chapter 5
Conclusion and Recommendation

5.1. Conclusion

As supported by previous hedonic pricing studies, parks (city park and local park) have recognized to have a significant effect to the housing price. Therefore, by utilizing a hedonic price model and ordinary least squares regression, similar conclusion has been derived: the saleof housing price in DKI Jakarta has relation with the distance of parks in DKI Jakarta.

Not only distance to park, but this research also shown the result of other several variables, such size of building area, number of bathrooms and bedrooms, distance to the city centre and proximity to the closest MRT station and busway shelter, distance to the hospital, high school and supermarket as location variables of explanatory variables.

This research have performed two regression models. Compared to log-linear, the log-log model considered for more than 75% of the price variance, thus provides the finest model amongst all models. Based on regression analysis, the building size as the component with the highest explanatory value. Other statistically significant variables are the distance to the nearest MRT station and to the city center. The total built area of housing affects the price of housing positively, however, the distance to the city center and to the nearest MRT station decrease the house prices. As the preliminary expectation, the interest variable, which is the distance to the closest park resulted significant effect to the house prices with the negative sign.

Based on the log-log model estimation result, a drop of 0,0273% in housing price will consequently result in decreasing of housing price for every 1% further away from park. This result is considered as modest, amongst all studies that have been conducted. However, the result from this research shows that the distance between property and park is quite significant as consideration for people in choosing their property location. Therefore, maintain and develop more green areas, especially in urban area can be considered as one of policy implication for urban planning.

5.2. Recommendation

This research has provided the most significant variable that impact the housing price in DKI Jakarta. However, there are few recommendations that could be considered for further studies:

1. Expand the time frame of data. This study used less than one year of data period, thus by using longer time frame, the trend of housing price is expected to have better reflection.

2. Besides expanding the time frame of data, considering taking the data of before and after implementation policy would be beneficial for further study. The comparison between these periods may capture the impact of policy implementation.
3. Perform quantitative analysis as a supporting evidence to analyze the statistical result.

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