Int. Journal of Economics and Management 12 (S1): 259-272 (2018)

IJEM
International Journal of Economics and Management
Journal homepage: http://www.ijem.upm.edu.my

The Impacts of Population Distribution and Economic Activities towards Land Value in the Capital of Jakarta

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ABSTRACT

This study aims to investigate the impacts of increasing land value towards local government's policy regarding the supply of public vertical housing following the written rule of spatial planning. The premise used in this study is that factors such as population distribution and local characteristics affect in shaping land value of property tax (NJOP) in Jakarta. Data used in this study are population density during the period of 2010 to 2015, and village potencies in 2014 consisting of 261 sub districts in Jakarta. The study used two methods of analyses, which are statistical descriptive and spatial econometric. The results show high land-value areas tend to have close proximity with another high land value area, and vice versa for area with low land value. Second, there are some high land-value areas surrounded by low land-value areas such as Kelapa Gading which is surrounded by Koja and Cilincing. Third, land values' spatial dependence pattern are affected by their zones, where High-High (HH) areas are dominated with business area and Low-Low (LL) areas are dominated with residential area. Fourth, variations in estimating land values are explained in spatial lag model, in which population density and market with non-permanent buildings significantly affect negatively, and the number of stations significantly affect positively to the land value. Meanwhile, markets with permanent and non-permanent buildings are not significant. Fifth, a significant negative relationship could be defined as static land value, particularly on high density areas due to lack of land utilization – added with the influence of control variables (market and station). This could lead to land supply problems for public vertical housing. Sixth, an increase in population density added with control variables cause pressure in residential areas leading to negative externality in the form of slum areas.

JEL Classification: Q21, R14, R15, R58
Keywords: Population distribution; land value; public vertical housing; spatial pattern

Article history:
Received: 21 June 2018
Accepted: 19 November 2018

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INTRODUCTION

The value of land in Jakarta shows uneven dynamic over time, between areas. Rapid urbanization makes migration from outside Jakarta encourage population and economic activities in Jakarta. This is because the attractiveness of the urban economy that requires a lot of manpower along with rapid industrial development in urban areas. The interaction between people, land, and city policies creates spatial structure in Jakarta – which ultimately contributes to the value of land in Jakarta.

Based on data record of population census obtained from Central Bereau of Statistics Indonesia (BPS), the population keeps increasing except for Central Jakarta which most zoning area is occupied by government buildings and business sectors. The highest population growth was recorded in suburban areas such as East Jakarta and West Jakarta, which reached up to 300% since 1970.

In keeping pace with population growth, addressing limited landholdings and regulating urban areas at the same time, the local government imposed a policy of providing public vertical housing for low income citizens. From 141 blocks and 5 towers of publicly-rented vertical housing and 35 blocks of public-owned vertical housing, nearly 70% of which are located in North Jakarta and East Jakarta, where the population density is in low level.

In 1999, central bureau of statistics recorded as much as 66,592% land in Jakarta was used as residential areas, 1,2106% was used as green space and 6,5% was road surface area. A decade after in 2009, residential areas are still scattered within Jakarta region. Considering Jakarta as the capital city of Indonesia and a part of national strategic region, local government set out Spatial Plan Year 2030.

In order for land usage goes according to the spatial planning, incentive support is required in the form of land tax imposed through stipulation of Sales Value of Taxable Object (Nilai Jual Objek Pajak/NJOP) based on the Land Value Zone (Zona Nilai Tanah/ZNT). The handling of land taxes was transferred from central tax to local taxes in 2013, as a follow-up to regional autonomy and fiscal decentralization policies.

Based on data in Agency of Regional Tax and Distribution of Jakarta from 2013 up to 2016, Central Jakarta was recorded with highest median value of NJOP. Whereas, the lowest median value of NJOP was recorded in East Jakarta. The data show that the probability of population distribution to area with low NJOP value could occur.

Considering Jakarta Spatial Plan 2030 which regulates the land use rigidly, the urging needs of liveable housing, and the land value, these three factors directly affect the supply of vertical public housing which is targeted to low income citizens.

Table 1 Median Value of NJOP, 2013 – 2016 (in thousand Rupiahs)

Area	Median NJOP			
	2013	2014	2015	2016
South Jakarta	2,183	3,375	4,380	4,380
East Jakarta	1,345	2,183	2,327	2,327
Central Jakarta	3,057	6,620	7,535	7,535
West Jakarta	2,496	3,560	3,560	3,560
North Jakarta	2,321	4,235	4,785	4,785

Source: Agency of Regional Tax and Distribution (2016)

To overcome the shortage of public housing and organize the slum areas, local government builds public vertical housing based on the spatial plan regulation. One of the plans is to build vertical house integratedly with market by cooperating with Regional Owned Enterprise (BUMD).

Problems in urban areas are pollution, traffic congestion, the increasing number of population density, and lack of public housing availability; this encourages suburbanization and the emergence of slums. Mills and Mieszkowski (1993) in their suburbanization theory through the approach of fiscal and social issues, said that the decline in living standards could be a factor of citizen migration to suburbs. The uncontrolled suburbanization phenomenon could lead to urban sprawl with the residential areas scattered across the city; thus making the values of land and property were sky-rocketting.

The increasing of land value becomes the catalyst of citizen migration to suburbs; since the land value in suburbs is cheaper than one in Central Business Districts (CBD). This can be seen from the increasing number of population density in East Jakarta which has low median NJOP value. On the contrary, Central Jakarta with high median NJOP value shows decreasing number of population density. The increasing number of population density encourages economic activities in the forms of markets and stations, causing residential extrusion and contributing to an increase in land value.

Based on the description above, this paper aims to identify spatial pattern of land value according to NJOP value and how factors of citizen distribution and Village Potencies (markets and stations) affect the land value. As the land value changes, how much it affects the public vertical housing supply for low income citizens.

REVIEW OF LITERATURE

Several theories uncovered factors affecting the land use and land value. Physical condition of land, location/distance to Central Business Districts (CBD), infrastructure and economic activities are among important determinants of land value (see for example, David Ricardo, 1817; Hoyt, 1939; Harris-Ullman, 1945; Christaller, 1933 among others). David Ricardo outlined land rent concept based on soil fertility, especially in agricultural sector, where the production would be high when the soil is more fertile. In recent theories with the structural transformation and development of modern transportation, Christaller, Hoyt and Harris-Ullman considered the impacts to urban spatial structure; then they transformed the city zoning where CBD is located on central area while the industrial areas lay along transportation routes or arterial roads, and residential areas are on the outskirts of the city. These theories also found out that markets and transportation services as proxies of economic activities are significant determinants of the land value.

Some other theories took population explicitly into account. Theories from Von Thünen (1826) and Bid Rents from William Alonso (1964) and Muth-Mills, showed that population plays a major part in affecting land value. Due to the development of monocentric city/city zoning and modern transportation, citizens started to live in residential areas; so that the population is distributed forming suburbs. Bid rents theory tells the further the distance from CBD, the cheaper the transportation cost, land value and properties. In this model, the orientation of both manufacturers and office firms are centered toward CBD. Alonso (1964) model in Figure 2 shows the allocation of land in monocentric city. The office district is the area in which the bid rent for office firms exceeds the bid rent of manufacturing firms, generating an office area with radius x_1 miles. Moving outward, manufacturing firms outbid other land users for land between x_1 and x_2, so the manufacturing district is a ring of width x_2-x_1. Residents have the maximum bid rent for the area between x_2 and x_3, so the residential district is a ring width of x_3-x_2. The activity with the steeper bid-rent curve shape occupies more central land. The slope of the bid-rent curve is determined by transport monetary value. The office sector has higher transport costs because the people in it have high opportunity of travel time cost to transmit outputs. In contrast, residential areas are located far from central city. The low land rent value in the area far from the central city is needed as a compensation of property values. Furthermore, economic activities determine land use where it encourages the distribution of population; thus it significantly affects the land value.

The current structure of Jakarta is more toward a multicentric city. However, the O’Sullivan (2011) bid-rent curve and monocentric land use are applied as an explanation on how the distance to CBD affects the transportation cost, the land value and properties.

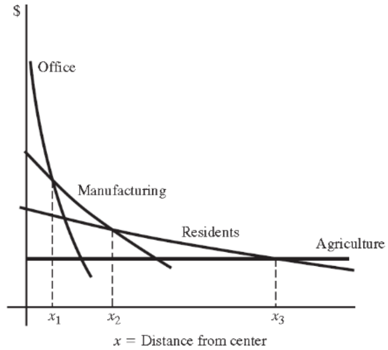


Figure 1 Bid Rents and Monocentric Land Use
Source: O’Sullivan (2011, p. 194)

The development of Jakarta started in Central Jakarta where the government offices and business offices are located, then pushed the central business districts outside the Central Jakarta. From government offices, or

Presidential Palace, to Thamrin, and Sudirman, the offices go all the way to Kuningan, Buncit, and Fatmawati to the south. This process pushed manufacturing and residential areas even further; in turn due to the limited land in Jakarta, large central offices were built in other areas like in TB. Simatupang Street and Kemayoran Complex. The office complexes are scattered in the some other areas in Jakarta. However, a significant amount of jobs are still centered in CBD, while smaller CBD built in other areas in Jakarta. While monocentric concept can be used as a starting point to analyse Jakarta, multicentric concept has to be employed to see the dynamic in Jakarta. This research applied both concepts to see the spatial dynamic of land value in Jakarta.

METHODOLOGY

Estimation Strategy

This study applied the Spatial Regression Model using GeoDa software, instead of the regressions by Ordinary Least Square (OLS). The OLS regression model is inaccurate to analyze spatial pattern of land value. Spatial analyzes requires error correlated (spatial autocorrelation). According to Tobler's (1970) rules of geography law, the land value in some area is affected by land value around its neighborhood (spatial dependence effect).

Spatial method is used to obtain observation affected by spatial or location effects. Spatial method uses dependence in covariance structure through autoregressive model, and the autoregressive process is showed through dependency relation between groups of observations and locations (LeSage and Pace, 1998).

Rook's Case weight matrix method is used to answer the first question on the spatial pattern of land value according to NJOP value. In rook's case weight matrix, direct neighbors subdistrics are given the value of 1, whereas indirect neighbors subdistricts are given the value 0. This method is considered more suitable in describing spatial dependence in Jakarta.

The first step of data analysis in spatial econometrics is done with Rook's Case weight matrix method.

$$\begin{bmatrix} 0 & 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix}$$

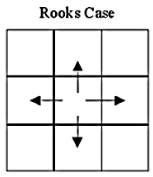


Figure 2 Contiguity Matrix and Weight Matrix Calculation
Source: LeSage (1998)

Further, Moran's scatterplot is made to see the relations between value and standardization obeservation. As mention by Lee and Wong (2001), Moran's scatterplot is used to interpret Global Moran's I statistical index.

Global Moran's I estimated correlation between variables, for example variable x are (xi dan xj), where $i \neq j$, i = 1, 2, …. n, j = 1, 2, ….. n, with data as n, therefore the equation of Moran's I as mention by Paradis (2016) takes the following form:

$$I = \frac{N \sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij}(x_i - x)(x_j - x)}{S_0 \sum_{i=1}^{n} (x_i - \bar{x})^2}$$

$\bar{x}$ in the equation above is the average of variable x, w_{ij}, where both are the elements of weight matrix. While S_0 is the summation of weight matrix elements, where $S_0 = \sum_i \sum_j w_{ij}$. The value of index I is between -1 and 1. In identifying pattern, it uses the criteria of index I value, if $I > I_0$ thus it has cluster or systematic pattern. Whereas, if $I = I_0$, thus the pattern is dispersed uneven (no autocorrelation). And if $I < I_0$, thus the pattern is not systematic or disperse. I_0 is expectant value from index I with following form if $E(I) = I_0 = -1/(n-1)$ (Lee and Wong, 2001).

Then the Global Moran's I statistical index is interpreted with Moran's scatterplot to see the relations between value and standardization observation. Moran's scatterplot is divided into four observation quadrants. Scatterplot in quadrant I (High-High) and quadrant III (Low-Low) tend to have positive spatial autocorrelation value. On the contrary, scatterplot in quadrant II (Low-High) and quadrant IV (High-Low) tend to have negative autocorrelation value.

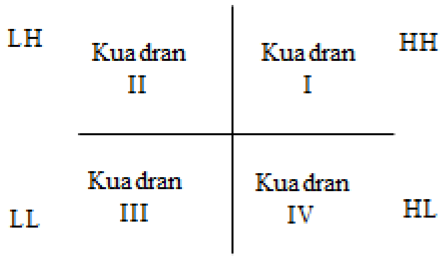


Figure 3 Moran's Scatterplot
Source: Lee and Wong (2001)

Hedonic Price Model

Regarding theoretical foundations, the hedonic model is based on Lancaster's (1966) theory of consumer's demand. Lancaster recognized composite goods, whose units are homogenous, in which the utilities are not based on the goods itself but the individual characteristics of goods (the composite attributes). Thus, the consumers make their purchasing decisions based on the number of goods characteristics as well as per unit cost of each characteristic.

Although Lancaster was the first to discuss about hedonic utility, he did not mention about pricing models. Rosen (1974) was the one who presented the theory of hedonic pricing. He argued that an item could be valued by its characteristics. In that case, the item's total price is considered as the sum of each homogenous attribute price; and each attribute has a unique implicit price in an equilibrium market. This implies that the item's price could be regressed on the characteristics to determine the way in which each of the characteristic uniquely contributes to the overall composite unit price.

Furthermore, O'Donoghue et al. (2015) argued that the hedonic price model relies on the assumption that a product's price is made up from the impacts of all its characteristics. The main idea is that the importance of a characteristic in the price could be derived from the observation of the market behavior. In any case, the idea is to use a hedonic price function which links land prices to the characteristics. Once this is established, the next step is to deduce the marginal value of a specific characteristic change.

The underlying goal when generating this model, as mentioned by Monson (2009), is to create an accurate predictive model. Unlike groceries, the value of individual features within a building or land cannot be directly observed[1]. Hedonic price model, however, could be used to measure the effects of these characteristics on the overall transaction price. This model is developed by using coefficients generated from regression analysis. Such relationship could be described as "land value is a function of each tangiable and intagiable building characteristics and other outside influencing factors".

In this study, the hedonic price model takes the following general form:

$$\ln(LANDPR_n) = f(D_i, SC_i, O_i)$$

where:
$\ln(LANDPR_n)$: the natural log of the land value in *n* year
D_i : a vector of population density within land *i*
SC_i : a vector of spatial control variables for land *i*
O_i : a vector of other factors associated with land *i*

This study used spatial regression since there is a spatial dependence effect in which land value in some areas is affected by land value around its neighborhood. If the dependence effect is ignored, then the parameters got will be biased, because the errors are correlated. Thus, it is more accurate to analyze the spatial pattern of land value.

There are two different models in spatial regression: spatial lag model and spatial error model. The lag model is used to identify spatial dependence within the observation; while the error model is used to identify the other factors outside spatial dependence impacting the land value.

[1] Sirmans, G., Macpherson, D., & Zietz, E. (2005). The Composition of Hedonic Pricing Models. Journal of Real Estate Literature, 13(1), 3-43.

In order to estimate the impacts of population density and economic activities on land value, the basic regression models are formed as follows:

Model *spatial lag:*

$$LogP_n = \rho WLogTax_n + \beta_1 LogDens_i + \beta_2 LogPsrPerm_i + \beta_3 LogPsrSemiPe_i + \beta_4 LogPsrNonPer_i + \beta_5 LogStasiun_i + \varepsilon_i \quad \text{(Model 1)}$$

Model *spatial error*

$$LogP_n = \beta_1 LogDens_i + \beta_2 LogPsrPerm_i + \beta_3 LogPsrSemiPe_i + \beta_4 LogPsrNonPer_i + \beta_5 LogStasiun_i + \varepsilon_i \quad ;$$

where $\varepsilon_i = \lambda W \varepsilon_i + \xi$; $\varepsilon_i = (I - \gamma W)^{-1} \xi$ (Model 2)

where:

$LogTax_n$	: Land value according to NJOP, in logarithm
ρ	: Spatial autoregressive coefficient
$WLogP_n$	: Spatial lag of land value according to NJOP
β_1 s.d. β_5	: Coefficient of regression
$LogDens_i$	: Population density, in logarithm
$LogPsrPerm_i$	: Number of market in permanent building, in sub-district *i*, in logarithm
$LogPsrSemiPe_i$	: Number of market in semi-permanent building, in sub-district *i*, in logarithm
$LogPsrNonPer_i$	: Number of market in non-permanent building, in sub-district *i*, in logarithm
$LogStasiun_i$	: Number of train station, in sub-district *i*, in logarithm
ε_i	: The error terms
λ	: Spatial autoregressive coefficient
W_ε	: Spatial error of land value according to NJOP
ξ	: Normal distribution with mean value 0 and variant $\sigma 21$

This study used secondary data to analyze, which are: (1) digital administrative and spatial map of Jakarta; (2) Sales Value of Taxable Object (Nilai Jual Objek Pajak/NJOP) per line of streets in Jakarta from 2013 up to 2016; (3) population density from 2013 up to 2016; and (4) the number of markets and stations within 261 sub-districts in Jakarta. The collected datasets are obtained from Central Statistics Bureau Indonesia (BPS) and Agency of Regional Tax and Distribution of Jakarta.

Variables of market (in permanent, semi-permanent and non-permanent building) and train station are the factors influencing people to decide to live in the area, unless the area is a business or government district. Therefore, the population density on the area would be shifting. Thus, the relationship of such variables is influenced by the locational characteristics of the impacted area.

Dependent Variable

The dependent variable in this study is the land value according to NJOP. Since the unit in each variable is different, a logarithm functional form is applied where the dependent variable is in LogP such that in $LogP_n = \beta_1 Log(X_1) + \beta_2 Log(X_2)$. Using this form, the estimated coefficient can be interpreted as follows: for each, an increase in $X_1$by a percent, leads to an increase in P_n by β_1 %.

Although the use of market price of land is a common approach to study the land value, this study does not provide the dataset of this assessment. Given the paucity of land market-price in Jakarta, the data must be obtained from public notary or public appraisers according to their workspace territories. There are relatively few data points. In addition, it does not guarantee that a public notary or public appraiser has a dataset of land market-price per line of road in their workspace territories.

NJOP land value datasets are available per line of road within all areas in Jakarta. The lines of road are aggregated in subdistrict level and the average value for each subdistrict is calculated to have the dependent variable. In determining NJOP land value per square meter, Agency of Regional Tax and Distribution of Jakarta as the authorities processed the comparative analysis between (for example) market price of land i and other factors associated with land *i*.

Independent Variable

There are three potential independent variables in the dataset; those are population density, number of market and number of station. Village Potencies data of 2014 are extracted to obtain the dataset of number of market and number of station.

Population density. Population density is estimated by dividing the population by total area. This variable is obtained from Statistics Central Bureau Indonesia.

Number of market. These data are obtained by extracting the Village Potencies data that were done by Statistics Central Bureau Indonesia in 2014. The definition of market in village potencies data is divided to three: market with permanent, semi-permanent and non-permanent buildings. In this studyused all three of them.

Number of station. This variable is also obtained by extracting village potencies data. The station in this variable is referred to train stations located within 261 sub-districts in Jakarta. The train stations that are passed by commuter lines connecting the areas in Jabodetabek.

RESULTS AND DISCUSSION

Statistical Descriptive Analysis

In this analysis, the data of 2016 median of NJOP, population density of 2015, and village potencies data (the number of market and station) of 2014 are used. Graphic 1 shows median distribution of NJOP from 2013 up to 2016 on 261 sub-districts in Jakarta.

Table 2 Statistical Descriptive Research Data

Variabel	Satuan	Obs	Mean	Max	Min	Std Dev
MedNJOP	Rp .000 / m²	261	5705,391	44875,000	1147,000	5996,585
Density	jiwa / km²	261	23695,455	315992,857	1441,699	25343,703
Psr_Perm	unit	261	0,720	8,000	0,000	0,913
Psr_Semi	unit	261	0,406	5,000	0,000	0,767
Psr_Non	unit	261	0,889	9,000	0,000	1,224
Station	unit	261	0,172	3,000	0,000	0,461

Source: Authors using data from Agency of Regional Tax and Distribution of Jakarta (2016) for NJOP value 2016; Statistics Central Bureau Indonesia (2016) for population density 2014 and village potencies 2014.

Based on the compiled data above, average of population density is 23.695 person/ km^2. From 261 sub-districts, Jelambar Baru (Grogol Petamburan) has the highest population density with 315.993 person/ km^2. Whereas, Gelora (Tanah Abang) has the lowest population density with 1.442 person/ km^2.

Average land value according to median value of NJOP 2016 is Rp 5.705.000 /m^2, the highest price is on Guntur (Setiabudi) with Rp 44.875.000 /m^2. Kamal (Kalideres) and Marunda (Cilincing) are recorded to have the lowest price with Rp 1.147.000 /m^2.

Guntur sub-districts has the highest median value of NJOP because the area is close to the city central with orderly road network. Meanwhile, Kamal and Marunda have the lowest median values of NJOP because both areas are densely populated and have high crime intensity.

Spatial Pattern of Land Value Analysis

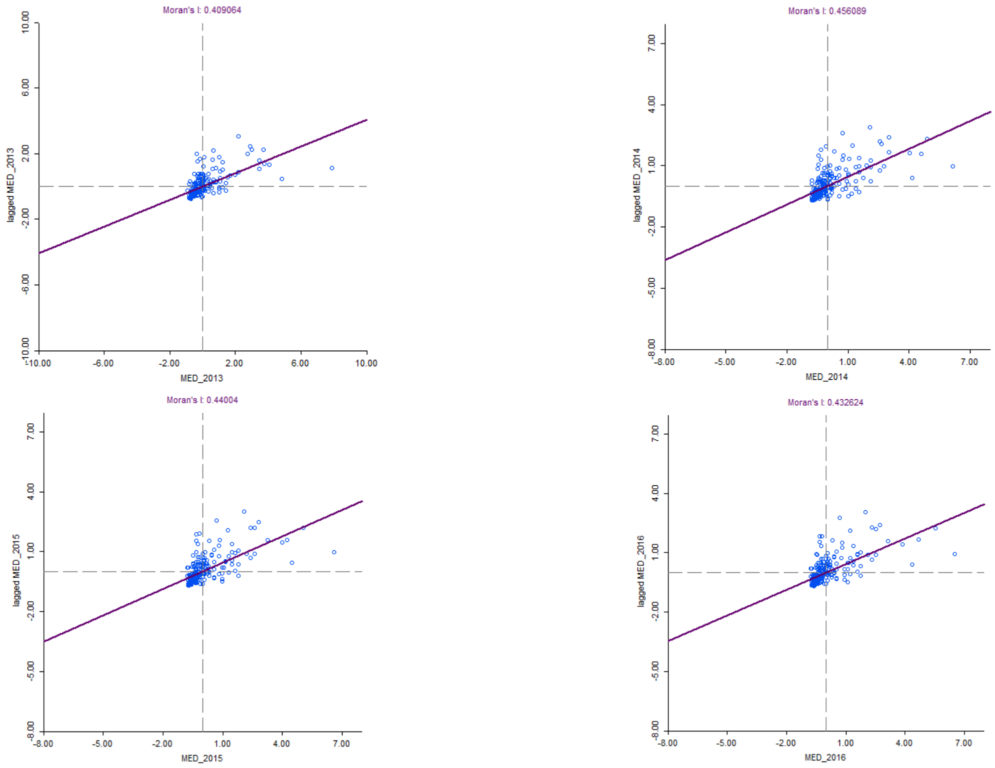


Figure 5 Moran's I Scatterplot of NJOP Value, in 2013 – 2016

This paper used rook contiguity spatial weight matrix where direct neighbours of sub-districts is given 1 and undirect neighbours is given 0. Based on the results of Moran's I scatterplot above, the spatial pattern is seen clustered. This indicates that land value in Jakarta is affected by closest neighbours' land value. It means that supply and demand factors shaping land value could affect the spatial pattern of land value.

The spatial pattern map of land value that is explained in figure 5 shows that South Jakarta is the area that mostly on quadrant I (High-High/HH), next to South Jakarta are Central Jakarta and one sub-district of West Jakarta. While East Jakarta, North Jakarta, and several areas of West Jakarta are on quadrant III (Low-Low/LL).

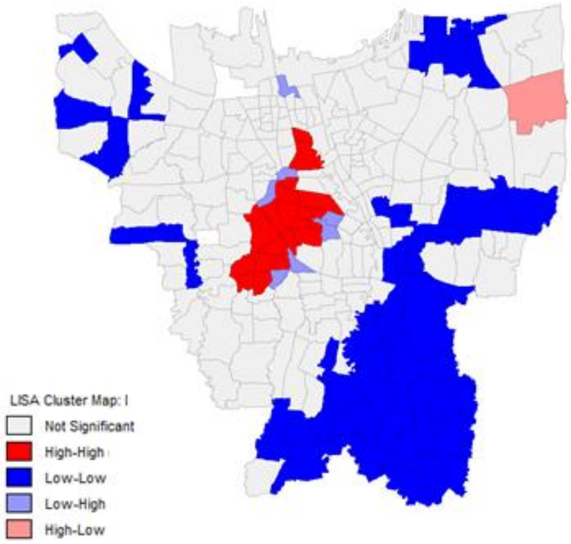
The high-value areas are dominated for government, offices and manufacturing sector. While low value areas are dominated for residential.

There are several areas situated in quadrant II (Low-High/LH); it means that the areas with low land value are surrounded by areas with high land value. Those areas are Kebayoran Lama, Petogogan, Pasar Manggis, Penjaringan, Papanggo, Tambora and Menteng Atas.

Whereas, quadrant IV (High-Low/HL) is high value areas that are surrounded by low value areas. The areas in quadrant IV are Kalibata, Kelapa Gading Barat, Kedoya Selatan, Pluit, and Kembangan Selatan.

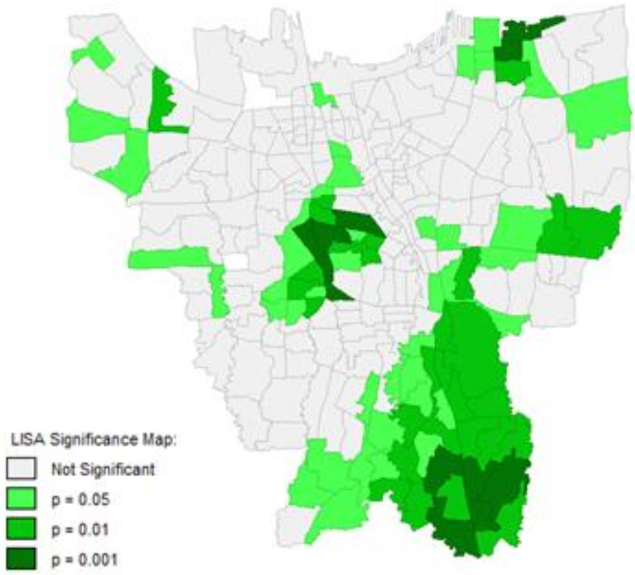
On significance map in Figure 6, it is seen that East Jakarta and South Jakarta have the most significance areas. It is because both regions have a high citizen population and density compared to other regions. Moreover, the land use is dominated by residential, thus they are most affected in shaping the land value.

Figure 6 Spatial Pattern of Land Value in Jakarta



Furthermore, the spatial patterns seen in figure 5 and 6show that there is spatial dependence effect, which fit in Von Thünen and bid rent theories. These areas of (High-High/HH) and (Low-Low/LL) are shown clustered, where (High-High/HH) areas are closer to CBD. It explaines that the further an area from CBD, the cheaper the land value. Nevertheless, there is a tendency of (High-Low/HL) and (Low-High/LH) in some areas.

Figure 7 Significance Map of Land Value in Jakarta



Lagrange Multiplier Test

Five different tests of Lagrange Multiplier test statistics are reported in the diagnostic output. The first two tests (LM-Lag and Robust LM-Lag) pertain to the spatial lag model as the alternative. The next two (LM-Error and Robust LM-Error) refer to spatial error model as the alternative. The last test, LM-SARMA, relates to the higher order alternative model with both spatial lag and spatial error terms (Luc Anselin, 2005, p. 197).

The important issue is to consider the Robust versions of the statistics when standard versions (LM-Lag or LM-Error) are significant. Conversely, when LM-Lag or LM-Error are not significant, the properties of the robust versions may no longer hold.

Based on GeoDa's data processing, from 261 research samples, Lagrange Multiplier test from 2013 up to 2016 showed more significant results of LM-Lag and Robust LM-Lag. It is seen that variations of land value could be explained by spatial lag model.

This confirmes that land value in Jakarta has spatial correlation effect and spatial dependence, which means that land value in Jakarta is highly affected by its neighbour's land value.

Table 3 Lagrange Multiplier Test

Test	NJOP 2013		NJOP 2014		NJOP 2015		NJOP 2016	
	lag Coefficient	error Coefficient	lag Coefficient	error Coefficient	lag Coefficient	error Coefficient	lag Coefficient	error Coefficient
LM Test	104.2951	100.9457	129.1626	123.3575	119.1317	113.0571	115.2623	109.4692
(p-value)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Robust LM	3.45	0.1007	5.82	0.0149	6.0817	0.0071	5.8009	0.0077
(p-value)	(0,06325)	(0,75104)	(0,01584)	(0,90287)	(0,01366)	(0,93266)	(0,01602)	(0,92988)

Spatial Lag Test

Based on Lagrange Multiplier test, the variation of land value could be explained by spatial lag model; therefore, a comparation between OLS model and spatial lag model is done.

The estimation result of spatial lag model for land value in 2013 up to 2016 shows that variables of population density and number of markets with non-permanent buildings significantly affect negatively the land value; while, the number of stations is significantly positive. The variables of number of markets with permanent and semi-permanent buildings spatially do not significantly affect the land value.

R-squared value in spatial lag of 2013 is 0.378 which means that variation of independent variable value could explain the variation of land value with 37.8%, while the rest is affected by model. Against the Log Likelihood, Akaike Info Criterion (AIC) and Schwarz Criterion (SC) in spatial lag model, there are slightly changes of value. There is an increase in Log Likelihood from -2430.22 (OLS) to -2388.75 (spatial lag). This confirms the spatial correlation effect on dependent variable. But, the AIC decreases (from 4872.43 to 4791.5), so does the SC (from 4893.82 to 4816.45).

Spatial autoregressive coefficient of land value in 2013 up to 2016 influences for 63.8% up to 67.1% and significantly shows spatial dependency. Such spatial dependence effect confirms the Moran's I index that high value areas tend to have close proximity with another high value area, vice versa for low value areas.

Coefficient of population density in 2013 up to 2016 is ≈ -0.011 to -0.0225. It means that every increase of 1% in population density, the land value decreases for 1.1% up to 2.25%.

Based on this approach, the decrease of land value is affected by population density with control variables (market and station). The decrease means that the land value according to NJOP is stagnant (tends to be higher) every year. It happens due to lack of land transaction, and minimal land utilization in high density area.

Furthermore, there are many markets and stations found in areas of quadrant 1 (High-High), where the land is dominated by Nation Owned Enterprise (BUMN) and Regional Owned Enterprise (BUMD). For instance, Lenteng Agung, Tebet Timur, Mangga Dua Selatan, Pasar Manggis, Kembangan Utara, Gunung Sahari Selatan and Jembatan Beci.

The estimation of spatial lag model of land value in 2016 is:

$$LogTax2016 = 0{,}645WLogTax2016 + -0{,}022LogDens2015 + -224{,}065LogPsrPerm + -182{,}2LogPsrSemiPe + -426{,}806LogPsrNonPer + 1064{,}38LogStasiun$$

Spatial Regression Model Test

Two regression models are used; first is Breusch-Pagan test to know the homogeneity's assumption in the model. Second is Likelihood Ratio test to know the impacts between independent variables towards dependent variable. Moreover, Likelihood Ratio test is done to confirm Langrange Multiplier test's result, to see the spatial dependence effect from independent variables towards land value. With GeoDa, Table 5 shows Breusch-Pagan test and Likelihood Ratio test.

Table 4 Spatial Regression Model

Test Model	2013 value (prob-sig)	2014 value (prob-sig)	2015 value (prob-sig)	2016 value (prob-sig)
Breusch-Pagan Test	12.4441	8.232	9.3982	8.6494
	(0,02918)	(0,14390)	(0,09420)	(0,12389)
Likelihood Ratio Test	82.9306	100.6138	92.637	89.1835
	(0.00000)	(0.00000)	(0.00000)	(0.00000)

Based on the output above, Breusch-Pagan test for spatial lag model shows significant results in 2013 and 2015 meaning that the model rejects H_0 and accepts H_1. While the results in 2014 and 2016 are not significant meaning that the model accepts H_0 and rejects H_1.

From Likelihood Ratio test in 2013 up to 2016, the results are significant. Therefore, it could be concluded that there is spatial dependence effect towards land value which used rook weight matrix contiguity. This test confirms Moran's I index's result.

CONCLUSION AND RECOMMENDATION

The purpose of this study is to investigate the impacts of increasing land value affected by population distribution and economic activities towards local government's policy on the supply of public vertical housing following written rules of spatial planning.

The result of applying spatial regression models shows that population density and spatial control variables, in terms the numbers of markets and stations, affect spatial patterns of land where area with a high land value situated in their own cluster - closer to CBD. It fits to the theories of Von Thünen and bid rent telling that the closer distance from CBD, the higher the land value; on the contrary, the further distance from CBD, the lower the land value.

The findings in this study can be concluded as follow. First, Moran's I scatterplot diagrams from 2013 up to 2016 found that the spatial pattern is clustered. Such systematically spatial patterns describe the dynamics between areas/regions due to the neighbour effect. Areas with high land value (High-High/HH) tend to have close proximity with another high land value area. Among others are South Jakarta's border (Kebayoran Baru and Setiabudi) with Central Jakarta (Tanah Abang and Menteng). Vice versa for area with low land value (Low-Low/LL), mostly around East Jakarta's border with Bekasi. However, there are also areas with high land value which are surrounded by low land value areas; such as Kelapa Gading that is surrounded by Cilincing and Koja, or Setiabudi's border with Tebet. Second, such spatial pattern of land value is affected by the area's zoning, where High-High areas are dominated by government, offices, and manufacturing sector; while Low-Low areas are dominated by residential. Based on that spatial pattern, local government could be more specific in implementing policy intervention regarding vertical public housing supply. Third, the variations of land value estimation could be explained by spatial lag model, in which variables of population density and market with non-permanent buildings significantly affect negatively the land value, while the number of stations shows significant positive effect. The variables of market with permanent and semi-permanent buildings are not significant in affecting the land value. The negative impact of population density and market with non-permanent buildings towards land value means that there is a decrease in land value about 1.03% up to 2.25%. This stagnant land value is caused by the lack of land utilization in high density area along with control variables (market and station) in the area; this makes landlords hesitant to sell their land. A case in point is Cikini (Menteng, Central Jakarta), where initially it is a residential area which transforms into a home industry area due to its close proximity to the city centre. Fourth, the high level of land value implicates to land supply problems for public vertical housing provided for citizen with low income level. Fifth, an increase in population density added with control variables (market and station) could pressure the residential area and led to negative externalities in the form of slum areas.

Policy Recommendation

Local government's effort on supplying public vertical housing for citizens with low income level by relocating them to the established vertical housing in low density area should be appreciated.

However, the study found such effort has difficulties. Therefore, the following policy directions could be considered: first, instead of building the vertical house on low density areas, it is better to build it on high density areas which are closed to economic activities; thus it will not alienate the citizens from their usual economic activities. But this preposition is not without problems. High density areas which are closed to economic activities tend to have a high value. In solving these land supply problems, local government could cooperate with Nation Owned Enterprise (BUMN) and Regional Owned Enterprise (BUMD) that own space/land in high density areas. In the meantime, the local government have already developed vertical house integrated with markets (case in Pasar Rumput). But the government should consider its development integrated with stations, for example in Pasar Minggu Baru and Kalideres stations where the stations are surrounded by residential areas. Third, potential slum areas should be a point of attention, whether for the future policy on vertical housing supply or building rehabilitation, so that all citizens could have liveable houses. Fourth, the citizens that live in an area with high land value and high density (Kelapa Gading), which is surrounded by low land value area (Cilincing and Koja), could be scattered to live in the neighbour areas of Cilincing or Koja along with the development of economic infrastructure. The consideration is that because the three areas are mostly used as residential areas where the inhabitants commute to work in Central Business District (CBD), thus it would not be a problem. Moreover, the low value of land gives advantage to the citizens, because they could increase their land consume.

Limitation of Study

To date, studies on the spatial pattern of land value are limited. For instance, Yowaldi (2012) only focused on the urban structure in Bekasi, West Java using building permit (IMB) database, while Purnomo (2013) examined spatial pattern analysis of land price in Depok city using market price of land and distance to CBD dataset. Both studies however did not use population distribution or the presence of markets and train stations as factors. Using the market price of land is a common approach to study the land value; however, this study cannot further investigate the market price of land per line within Jakarta areas to this rule, since public notary and appraisal database do not provide such information due to their workspace territories. Therefore, it is left for further studies to explore the roles of land market price in affecting spatial patterns.

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APPENDICES

Figure 1 Moran's I Scatterplot and Spatial Map of Quadrant II and IV

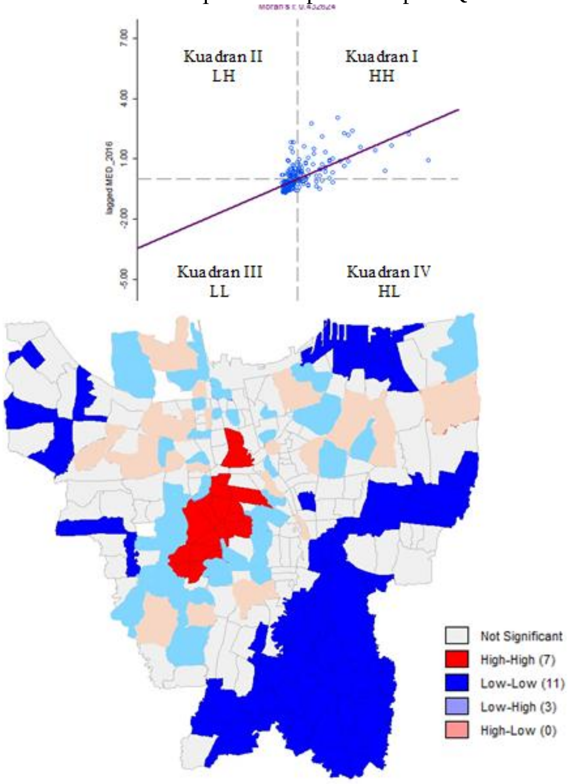

Table 1 The Comparison of The OLS Model and Spatial Lag Regression

Coefficients	2013		2014		2015		2016	
	OLS	lag	OLS	lag	OLS	lag	OLS	lag
W_MED		0,638165		0,671851		0,65474		0,645671
(p-value)	-	(0.00000)	-	(0.00000)	-	(0.00000)	-	(0.00000)
CONSTANT	3410,7	1488,73	6166,56	2448,02	6906,31	2861,99	6994,09	2957,16
(p-value)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
DENS	-0,0124765	-0,0103779	-0,0248263	-0,0191511	-0,0301852	-0,0224497	-0,0299908	-0,0225372
(p-value)	(0,0601)	(0,05046)	(0,04909)	(0,04795)	(0,03333)	(0,0429)	(0,03981)	(0,05007)
PSR_PERM	-74,1528	-109,616	-102,344	-183,187	-145,691	-225,311	-137,39	-224,065
(p-value)	(0,69141)	(0,46436)	(0,76993)	(0,49661)	(0,71169)	(0,46632)	(0,7348)	(0,485)
PSR_SEMIPE	-189,223	-137,807	-243,828	-212,18	-193,659	-150,811	-220,866	-182,2
(p-value)	(0,4003)	(0,44492)	(0,56277)	(0,51319)	(0,68319)	(0,68541)	(0,65099)	(0,63716)
PSR_NONPER	-303,371	-197,888	-616,169	-360,833	-687,636	-414,312	-702,481	-426,806
(p-value)	(0,0339)	(0,08405)	(0,02175)	(0,0804)	(0,02273)	(0,07957)	(0,02369)	(0,08171)
STASIUN	628,85	489,827	1323,93	1028,61	1301,85	995,202	1363,23	1064,38
(p-value)	(0,08914)	(0,09747)	(0,05625)	(0,05303)	(0,09533)	(0,10291)	(0,08961)	(0,09273)
R-squared	0,055223	0,378005	0,061211	0,430182	0,058561	0,406685	0,057556	0,395979
Log likelihood	-2430,22	-2388,75	-2594,03	-2543,73	-2625,11	-2578,79	-2632,53	-2587,94
AIC	4872,43	4791,5	5200,07	5101,45	5262,22	5171,59	5277,06	5189,88
SC	4893,82	4816,45	5221,45	5126,41	5283,61	5196,54	5298,45	5214,83