Does Palembang City's Population Growth Affect Optimal City Size: Minimum Cost and Maximum Net Benefit Approach?

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***Abstract*—-This paper discusses the optimization of the size of Palembang City economically in accordance with the Alonso- Richardson Hypothesis, using a minimum cost and a maximum net benefit approach. The variables used to calculate optimal city measurements are the number of residents, the cost of the city management and the value of benefits for the citizens of the city. The research period is 2007-2017. The research uses descriptive and exploratory research methods by testing or proving theories to measure the optimization of city size. Hypothesis testing is done with economic modeling, namely the Multiple Linear Regression equation model with the least-squares method. The results showed that the variable population and population growth significantly affected the cost of city management and the benefits received for the residents of Palembang City, namely the creation of the Gross Regional Domestic Product (GRDP).**

Keywords: optimal city size, minimum cost, maximum net benefit, population, Palembang

I. INTRODUCTION

It cannot be denied that the size and density of the population and economic conditions of a city will affect the social conditions and welfare of all citizens of the city. If the population is too small then the economic growth of the city is slow due to the market being too small and the limited provision of social service facilities. Conversely, if the population of the city is already too large as is experienced by Jakarta, Bandung and Surabaya, it is estimated that there will be various negative impacts such as increased unemployment, poverty, traffic congestion and the number of slum areas in the city. Because it needs to be determined scientifically how much the population of a city that is in optimal conditions. Thus it is important to know the effect of population growth on the optimal condition of the city as seen from an analysis of management costs and benefits for the city.

In the last two decades, studies on optimal city measurement have begun to increase the attention of scientists, especially economists and regional scientists. This has seen a lot of discussion of theoretical concepts that developed in the 70s and 80s and empirical studies that have evolved to date. These empirical studies are not only developed countries, but also in developing countries such as [4], [12], [8], [10] and [7] and [11] Some of the reasons that cause such attention are to be used as a basis for formulating population growth policies, controlling urbanization, spatial planning and the direction of urban development in the long term.

According to [17] the city has an optimal size at a time when economic growth is adequate and community life is pleasant. Cities that pass the optimal size will have an impact on unemployment, poverty, crime. If many city residents are unemployed, there will be poverty, a declining community economy, slum areas, robberies, rampant robbery will occur, so criminality will increase which will ultimately lead to a less pleasant environment. If there is an unpleasant environment in a city, new problems arise in the form of obstruction of economic activities that can be explored and developed. The loss of the opportunity to increase urban economic activity, is a loss for city residents to increase their income, which results in low income per capita. From another angle it is clear that with the loss of opportunity both due to increased crime and an unfavorable economic situation, it is necessary to add costs to the city. The more the population of the city, the greater and the variety of facilities and infrastructure that must be provided by the city, especially in the form of *Public Service* Blair, 1981 in [6]

Based on the aspect of population, in general the city is defined as a surface area where there is concentration (concentration) of the population with various types of economic, socio-cultural and government administration activities [1] Therefore, the characteristics of cities or urban areas *(urban areas)* can be seen from the population, population density and economic structure [16] An area is referred to as an urban area, if the number of residents living in the area is at least as many as 50,000 people, whereas when viewed from the population density level of 100 people per square kilometer. When viewed from the structure of the economy that is not dominated by the agricultural sector, but the composition of industry, trade, and the service sector is greater than agriculture. In other words, the city is usually synonymous with a large population with a high population density and economic activity that takes place no longer in the agricultural sector but has shifted to the trade and service sectors and the lives of the people are more individual and modern.

The population of the city continues to increase every year while the size of the city remains. The continuing population growth raises the question of whether cities are reaching optimal city sizes?. Because as explained in various Urban Economic literature, including [13], [17] that the population can determine the size of a city. The increase in population causes the area to be built (urban area) to expand so that the city is growing. In fact, the development of the city may be wider than the administrative boundaries. As a result, the administrative boundaries of the city must be expanded so that negotiations and negotiations with neighboring districts are needed to surrender a portion of the administrative area. Ideally, cities should be able to accommodate rapid and dynamic city developments in the future. Therefore, it becomes important to be able to analyze the optimal size of a city. Economically, the optimal size is the size of the most efficient city, both in terms of the importance of urban finance and its impact on the socio-economic life of the citizens of the city concerned. Because, if the size of the city becomes inefficient, it causes the city to no longer be able to meet the needs of the citizens of the city so that the value of the benefits of the city for its citizens does not match the cost of managing the city.

Palembang is the second largest metropolitan city on the island of Sumatra after the city of Medan, which has an area of 363.68 km. The distance between Palembang and Singapore as one of the world's business centers is the same as the distance from Palembang to Jakarta, the country's capital [9] The city of Palembang is increasingly known after hosting national and international sports competition events, the National Sports Week XVI in 2004, the 2011 Sea Games and the 2018 Asian Games. Not to mention, with the increasing availability of various hotels, restaurants and entertainment facilities. and trade and services so Palembang is often chosen to host other events. Palembang's economic growth in 2017 reached 6.16 percent, this figure is higher than the national economic growth during 2017 which amounted to 5.07 percent. Thus, the economic growth of Palembang City is relatively good.

TABLE 1. General Conditions Of Population, Area, And Economic Of Palembang City In 2017

Condition	2005	2017
Total Population (Soul)	1338793	1623099
Population Density / Km^2	3342	4462.99
Area (Km^2)	363.68	363.68
Economic Growth (%)	8.66	6.16

Source: Palembang In Figures For 2005 And 2018, BPS

The above conditions will attract residents, especially residents around the city of Palembang to live in this city. The population growth of Palembang City was 21.23 percent in 2005 which was 1,338,793 people, increasing to 1,623,099 in 2017. Population density increased by 33.5 percent ie 3,342 people per square kilometer (2005) to 4,462.99 (2017). Palembang City as well as other big cities have a strong appeal for residents who live in areas outside the city. This happens because of the relatively large number of jobs in the city, higher wages offered, better standard of living, and provide opportunities to continue their studies, causing urbanization to flow stronger [1].

II. Literature Review

A. Optimal City Size Theory

According to [14] if the size of a city is too large in terms of its population or too small it will cause its own problems for the city. The size of the city is too big *(at the upper limit of the scale of city size),* then the problem faced is the problem of congestion, pollution, crime, robbery or increased crime, rising land prices, poverty, increasing unemployment, difficult employment, slum areas occur [16] Conversely, if a city size is too small the problems that arise are; scarcity of resources, difficulty in adapting to structural changes, lack of available economic and social opportunities, increased dependence on other regions and low ability to develop on their own, and increased costs of infrastructure development and per capita costs will be high [13].

Population per square meter population is not an optimal size of a city [3] because economically if income is greater than the cost of city expenditure, then it will not be a problem, but it will be problematic if the opposite happens. Therefore, the city should have a high income in order to cover the costs incurred by the city. To determine the optimal city size varies, according to [16] depending on the level of development and culture of the community. There are two optimal city size approaches, namely the Minimization Cost and Maximum Net Benefit Approach. Furthermore, according to determine the optimal city can be determined through public expenditure minimization and the agglomeration of Economies and External Cost approaches. To explain this optimal city size theory, there are three approaches, namely the Minimum Cost (ACmin) approach, the Average Cost and Average Product (AC, AP) approach and the Marginal Product and Marginal Cost (MP, MC) approaches.

B. Minimum Cost Approach

Minimum cost assessment based on analysis, namely optimal city development from an economic point of view is when the city can be managed with minimum average management costs. Such a view is based on the principle of economics that urban management should be carried out effectively and efficiently as reflected by minimum management costs. This view is consistent with the objectives and the government's main objectives in the management of the city (urban public management) which generally wants the city to be managed with a minimum cost. The costs of managing the city include: salaries and wages of the city apparatus, administrative costs, official travel costs, and the cost of maintaining city facilities and infrastructure. Investment costs for building physical facilities in this city are not included because they are development costs and not management costs. The economic principle that underlies this approach is large-scale economics which states that the size of a city will be enlarged to the point where a minimum average per capita management cost is reached. At this point, city management will run efficiently because it can organize city management using the lowest cost. When the size of the city can still be enlarged by allowing the population to continue to increase after passing the minimum point, the average management costs will increase. Thus, the minimum cost point can be used as the main basis for determining the optimal size of the city from an economic point of view at the lowest point.

C. Net Benefit Maximum Approach

However, when the amount of net benefits that can be enjoyed by the community is also taken into account in the analysis, the optimal city size criteria should be based on the amount of benefits and benefits that can be enjoyed by the citizens of the city. If this aspect is taken into account, the criteria for determining the optimal city should be based on the maximum difference between the Average Cost (AC) and the Average Benefit (AB). In this case AB (Average Benefit) represents the average value of benefits that can be enjoyed by all city residents. Determination of the optimal city size based on the maximum net benefit approach considers the interests of all city residents in addition to the city manager concerned. This approach is also widely used in practice because the net benefits of development for all city residents are indeed very important to consider in determining the optimum city size.

Economically based on the analysis that some of the benefits that arise in the form of profit agglomeration *(economic agglomeration)* that can provide benefits to encourage business development in urban areas. Reason n yes is because cities larger can form a greater concentration of demand anyway so it would be beneficial for the development of the business world. In addition, larger cities will also be able to provide benefits in the form of savings in transportation costs because many related economic activities are on a larger scale city. Even in larger cities, the use of urban facilities simultaneously will be more possible so that the costs required will be relatively smaller.

D. Prior Research

[7] concluded various possibilities in identifying a specific "balance" of city size. The term error, that is, the difference between the actual urban population and the "Balance" predicted by the model can be explained, beyond the unknown city size. It was further concluded that the magnitude of the agglomeration economy created in general can be measured in terms of city population density. This relates to efficient city size planning. [10] in their research on optimal urban population size: national versus local economic efficiency discusses whether the population size of the Seoul Metropolitan Area in Korea is efficient in terms of the national economy. The results of the counter-factual analysis show that the decentralization of the national population far from the Seoul Metropolitan Area is desirable for Korea's economic growth. Korea's GDP is expected to be maximized when the Seoul Metropolitan Area's share of the national high school area is 39 percent in the short run and 35 percent in the long run. However, the Seoul Metropolitan Area government may have an incentive to maintain its population around 40 percent of the national population, where per capita income at the regional, not national level, is maximized.

[8] in his research on the optimal size of German cities and efficiency analysis perspective aims to see the relationship between production efficiency and population size of the German city. The results obtained are optimal city size in Germany, which is around 220,000 inhabitants, which is almost the average size of all cities in Germany. Despite regional differences, the optimal city size remains stable as an average size.

In the study [16] conducted in cities in West Sumatra, the results obtained using these three approaches differ. The calculation using the minimum cost per capita (*Minimum Cost*) approach is 2,448 people for each square kilometer, which is relatively smaller than the other two optimal city sizes. This means that if the orientation of the development of the city concerned is to minimize the operational costs required for the management of the city concerned, the size of the city needed is relatively smaller. If the optimal city size is done with the net benefit per capita (*Net Benefit*) approach, the required size is higher, that is 2,507 people for each square kilometer. This is done to free up work and meet the needs of all residents of the city concerned for the provision of employment and social service facilities, so the size of the city must be greater than the size of the city based on the minimum cost approach.

III. METHODS

This study analyzes the effect of population growth on the optimal size of Palembang City during 2007-2017. The analytical method uses the Alonso-Richardson Hypothesis which is the minimum cost maximum net benefit approach. Variables used to calculate optimal city measurements are ie the number of residents, the cost of the city management and the value of benefits for the cityzens of the city.

The research design in this study uses descriptive research and exploration by testing or proving theories to measure the optimization of city size. Hypothesis testing is done by economic modeling, namely the Multiple Linear Regression equation models with the least-squares method. The analytical method used in this study refers to the research of [16], [7], [12], [5], which is the development of models from [2].

A. Optimal City Measurement Method

The Alonso-Richardson Hypothesis states three three possible sizes of cities [17] First, the viewpoint of the city government that emphasizes the cost of minimum city management *(Cost Minimization), which is* the minimum point of average management cost *(Minimum Average Cost)* obtained from the positive second derivative. Second, the viewpoint of city residents who emphasize the maximum net benefit *(Maximum Net Benefit),* namely the maximum point of net benefits is determined based on the similarity between the angle of the average benefit curve *(Average Benefit)* with the average management cost curve *(Average*

Cost). Third, the entrepreneur's point of view emphasizes the maximum profit gained from the city's economic activities *(Profit Maximization)*. The maximum point for long-term profit is determined according to the cutoff of the average benefit curve *(Average Benefit)* with the average cost curve.

Based on the theoretical and methodological basis, the optimal amount of population can be determined. Thus, the optimal population can be compared with the actual population so it can be concluded whether the size of Palembang City has or has not yet reached its optimal level.

a. Per capita Minimum Cost Approach

$$AC_t = \alpha_0 + \alpha_1(PD) + \alpha_2\,(PD_t^2) + \mu_t \qquad (1)$$

PD_t = city dwellers in year t ; α_0= constant, α_1 and α_2 = regression coefficient, while μ_t = error (error).

Then by drawing derivatives from equation (1) to PD by equating zero, an optimal city size can be obtained with the minimum cost approach (P_{mc}), which is P_{mc} = $-\alpha_1/2\alpha_2$ (2)

The minimum point in equation 2 is true if the second derivative of the equation is positive.

b. Per capita Minimum Cost Approach

$$AB = \beta_0 + \beta_1\,(PD_t) + \beta_2\,(PD_t)^2 + \mu_t \qquad (3)$$

The first derivative of equation (3) of PD and then equating it with the first derivative of equation (1), the maximum net benefit condition can be obtained as follows:

$$\beta_1 + 2\beta_2(PD)t = \alpha_1 + 2\alpha_2(PD)t \qquad (4)$$

Furthermore, by solving equation (4) of PD the optimal size is obtained based on the principle of maximum net benefit as follows:

$$PD_{mb} = (\beta_1 - \alpha_1)/\,(2\alpha_2 + 2\beta_2) \qquad (5)$$

The maximum point in equation (5) is true if the second derivative of the equation is negative.

B. Definition of Variable Operations

1. The population (PD) in this study was obtained from census data and annual prediction data as well as the area of urban areas available at BPS Kota Palembang.
2. Cost data (Total Cost) in this study was obtained from the total costs incurred to finance the management of a city obtained from indirect costs (apparatus salaries) and public expenditure that can be obtained from the amount of the Regional Budget Revenue and Expenditure (APBD) of the City of Palembang. This data can then be used to calculate the Average Cost (AC) by way of dividing by the number of people (P).
3. The data used for the variable benefits for city residents is the value of the production of goods and services produced by a city that is proxy using the Gross Regional Domestic Product (GRDP) data which is calculated on the basis of constant prices. Furthermore, this data will be used as a proxy for the benefits obtained by the citizens of Palembang City. This data will then be used to calculate Total Benefit (TB) and Average Benefit (AB) by dividing the population of Palembang City.

IV. RESULTS

Table 2 shows that the significance value of the Palembang population (PDPLM) variable and the increase in Palembang population (PD^2 PLM) is below 0.05, which means that the two variables statistically have a significant effect on the optimal city size variable with a minimum costs approach (AC). The coefficient of determination (R^2) = 0.945826 which means 94.58 percent. This shows that the variable population can explain the variance of the cost of managing the city of Palembang per capita, the remaining 5.42 percent is caused by factors other than population. The coefficient of the population is 0.0000415, the intention is that if the population increases 1 person, the AC value will increase by 0.0000415 million. The population increase (PD^2) coefficient has a negative sign, which is equal to 0.00000000001.21, meaning that if the population increase increases by 1 person, then the AC value decreases by 0.00000000001.21 million assuming the variable population remains.

TABLE 2 . RESULTS OF ESTIMATED EFFECTS OF POPULATION ON MINIMUM COSTS OF PALEMBANG CITY

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-26.89180	12.24983	-2.195278	0.0558
PD	4.15E-05	1.61E-05	2.572587	0.0301
PD^2	-1.21E-11	5.30E-12	-2.285804	0.0481
R-squared	0.945826	Mean dependent var		8.135000
Adjusted R-squared	0.933788	S.D. dependent var		0.405900
S.E. of regression	0.104445	Akaike info criterion		-1.467991
Sum squared resid	0.098179	Schwarz criterion		-1.346765
Log likelihood	11.80795	Hannan-Quinn criter.		-1.512874
F-statistic	78.56604	Durbin-Watson stat		1.077903
Prob(F-statistic)	0.000002			

Source: Data Processed, 2019

Likewise, Table 3 also shows that both the Palembang population (PD) variable and Palembang's population increase (PD^2) statistically have a significant effect on benefits for Palembang residents, with a significance value below 0.05. The coefficient of determination (R^2) = 0.966712 which means 96.67 percent. This shows that the variable population can explain the variance of the benefits Received for the citizens of Palembang City, the remaining 3.33 percent is caused by factors other than the population. The coefficient of the population is 0.0000939, the intention is that if the population increases 1 person, the AB value will increase by 0.0000939 million. Assuming the variable PD^2 is fixed. PD^2 coefficient number has a negative sign, which is equal to 0.000000000086686, meaning that if the number of population increases 1 person, then the AC value decreases by 0.000000000086686 million assuming the variable population remains.

TABLE III. ESTIMATED RESULTS OF THE EFFECTS OF TOTAL POPULATION ON BENEFITS FOR PALEMBANG RESIDENTS

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-72.69937	14.50588	-5.011717	0.0007
PD	9.39E-05	1.91E-05	4.913594	0.0008
PD2	-2.86E-11	6.27E-12	-4.553101	0.0014
R-squared	0.966712	Mean dependent var		3.792500
Adjusted R-squared	0.959315	S.D. dependent var		0.613175
S.E. of regression	0.123681	Akaike info criterion		-1.129908
Sum squared resid	0.137672	Schwarz criterion		-1.008681
Log likelihood	9.779446	Hannan-Quinn criter.		-1.174790
F-statistic	130.6847	Durbin-Watson stat		1.600529
Prob(F-statistic)	0.000000			

Source: Data Processed, 2019

A. Optimal City Measurement Results

1. Minimum Cost Approach

The formulation of the cost per capita equation is:

$$AC_i = \alpha_0 + \alpha_1(PD)_i + \alpha_2(PD)_i^2 + e_i$$

$$AC_{plm} = -26.891796 + 0{,}000041497\,(PD)_i + -0{,}0000000000121\,(PD)_i^2 + e_i$$

Then, by pulling the derivative from the equation against PD and equating it to zero, we can get the optimal city size with the minimum cost approach, P_{mc} = 1,714,752.06

2. The Maximum Net Benefit Per Capita Approach

The average equation formulation (AB) is as follows:

$$AB_{it} = \beta_0 + \beta_1(PD)_{it} + \beta_2(PD)_{it}^2 + e_{it}$$

$$AB_i = -72.699373 + 0{,}000093855\,(PD)_i + -0{,}000000000286\,(PD)_i^2 + e_i$$

The minimum point in this equation is true because the second derivative of the equation is negative, that is 6,432,186.73.

V. CONCLUSION

This paper concludes that population and population growth affect the optimal size of Palembang City both with a minimum cost approach of 1,714,752 people, as well as a maximum net benefit approach of 6,432,186.73 residents in the city.

REFERENCES

[1] Adisasmita, H. Rahardjo, Urban Economic Development, Yogyakarta: Graha Science Publisher, 2005.
[2] Alonso, William, *The Economics of Urban Size, Regional Paper Association Science*, Vol. 26, 1971.
[3] Ananta, A., Human Resource Economics, Jakarta: Demographic Institute FEUI, 1996.
[4] Arnott, Richard, J., "Does the Henry George Theorem Provide a Practical Guide to Optimal City Size?", The American Journal of Economics and Sociology, Vol. 63: 1057-1090, 2004.
[5] Azhar, Zul, "Optimal City Size Analysis" (A Strategy in Planning the Development of the Municipality of Bukittinggi), Thesis, Unpad, 1997
[6] Branch, M., Urban Planning (Comprehensive; Introduction and Explanation, Yogyakarta: Gajah Mada University Press, 1996.
[7] Camagni, R, R. Capello, and A. Caragliu. One or Infinite Optimal City Size?: In Search of An Equilibrium Size for Cities. Annual of Regional Science, 2013.
[8] Hitzschke, Stephan. The Optimal Size of German Cities: An Efficient Analysis Perspective, 2011.
[9] Imelda,.2013.Identification of growth Center and Hinterland area of Palembang, research Report on economic Development Department lecturer, Palembang: Fakultas Ekonomi Universitas Sriwijaya.
[10] Kim, E., G. Hewings and K. Nam, Optimal Urban Population Size: National vs Local Economic Efficiency. Urban Studies, Vol. 51: 428-445, 2004.
[11] Marques, RC., A. Kort, M., and Dollery, B, Determining the Optimal Size of Local Government: The Case of Tasmanian Councils. Australian Journal of Public Administration, 74, 212-226, 2015.
[12] Nazara, S. and Nurkholis. Optimal Measures of Local Government in Indonesia: Case Study of Regional and District Expansion in the Era of Decentralization, Indonesian Journal of Economics and Development, Vol. VII, No. 02: 129-157, 2007.
[13] Richardson, W., Harry, *The Economics Of Urban Size*. Saxon: House Lexington Books, 1973.
[14] Richardson, W., Harry, *Urban Economics*, Hinsdale, Illinois, USA; The Drydes Press, 1978.
[15] Richardson, W., Harry, *Regional and Urban Economic*. Harmondsworth, Middlese, England: Penguin Book Ltd., 1978.
[16] Syafrizal, Regional and Urban Economy. Depok: Rajawali Press, 2017.
[17] Syafrizal, Regional Economic Analysis and Its Application in Indonesia. Depok: Rajawali Press, 2018.