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Geographical Pattern of Economic Activities: an Evidence from Large and Medium Manufacturing Industries in Indonesia

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Geographical Pattern of Economic Activities: an Evidence from Large and Medium Manufacturing Industries in Indonesia

E Santoso[1], M Ismail[2], I Noor[3] and M Ekawaty[4]

[1]   Doctoral Student in Economic Science, Brawijaya University, Indonesia
[2,3,4] Lecturer at Economic Department, Brawijaya University, Indonesia

*E-mail: santoso_edy@yahoo.com

Abstract. The aim of this paper is to analyze geographical pattern of economic activities from an evidence of large and medium manufacturing industry in Indonesia. By utilizing data for manufacturing industry for the 2010–2015, the exploratory spatial data analysis is applied to identify geographical distribution of economic activities. The result indicates that the spatial distributions of manufacturing industries are unevenly distributed indicating the clustered phenomenon pattern. A high concentration of manufacturing industries is depicted in several provinces, as well as in Java Island. The Moran's *I* tend to decrease along the period of study. From the LISA, is apparent that there was a statistically significant high clustering. Only some provinces indicate significant clustering, such as in west Java, Banten, DKI Jakarta, and Central Java. The result of LISA indicates a positive spatial autocorrelation in research area revealing the existent cluster of economic activities. This paper attempts to contribute theoretical thought as well as empirical notes on spatial concentration in Indonesia. The researchers utilize spatial approach by taking spatial dependence among region units explicitly into account in peeling phenomenon of geographical concentration of manufacturing industry in Indonesia.

Keywords: geographical pattern, manufacturing industries, spatial dependence, Indonesia

1. Introduction

The most characteristic of spatial distribution of manufacturing industry is focused on concentration and unevenness. The concentration of manufacturing industry indicates that industrialization is a selective process and occurs only in certain cases when viewed in geographical terms. The noticeable examples are viewed in manufacturing belt in the United States [1] and in similar industrial spatial concentrations which are also found in Axial Belt industrial estate in UK and Ruhr manufacturing belts in Germany [2]. Similar phenomena also can be found in Indonesia, for more than the last three decades which unevenly distributed. Indonesia's manufacturing industry has tended to be spatially concentrated in Java since the 1970s [3]. According to [4], the manufacturing industry was spatially concentrated in Java since the 1970s, although in the late 1980s it was shifted to Sumatra and Bali.

The spatial distribution of economic activity in Indonesia demonstrates the presence of inequality and concentration. The distribution of large and medium manufacturing industries is not evenly distributed and concentrated in a few regions. For 1990, the number of large and medium industries in Java reached 79.95 percents of the total industries in Indonesia. In 2010, the composition of the

companies number changed to 83.65 percents in Java and 16.35 percents for outer Java. Thus, for the last 25 years (1990-2014) the Indonesian manufacturing industries was still concentrated in Java.
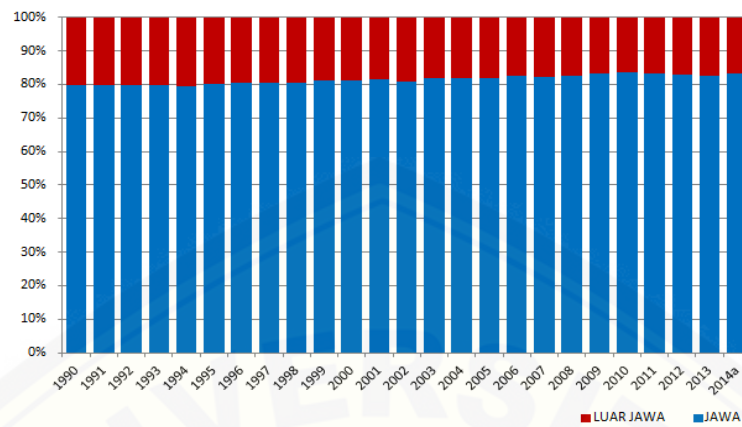
Source: Large and Medium Annual Industry Survey BPS, 2015

Figure 1. Distribution of Large and Medium Industries by Region, 1990–2014

Several reasons are blamed for the unbalance distribution. For the manufacturing industry, the locations of industry are determined by any resources, such as: wage costs, transportation costs and market access, and the externalities of spatial concentration associated with saving localization and saving urbanization (so-called agglomeration economy). Uneven distribution of the resources leads to disparities in industrial concentrations among regions. Thus, it gives the explanation on the concentration of industry occurring in certain areas only. Hence, the spatial pattern of economic activity, especially manufacturing industry, has become an interesting phenomenon to be analyzed.

Spatial concentration is the grouping of industry and economic activity located in a particular region spatially [5]. Spatial dependence might arise due to the existence of technology spillovers, labor and non-labor migration, commodity flows, and other spatial interactions that benefit the common interest [6]. The spatial concentration of economic activity can be understood by regional economic theory especially from the location theory approach. The purpose of the location theory is to determine the reasons and explain why certain factors is important for one industry but not for other industries [7]. It also involves the principle of substitution, in which the industry selects a location from some alternative location, which in economic theory, is similar to the problem of how to replace labor production factors with capital or land and vice versa. Many factors are considered in relation to the determination of the appropriate location for the industry. These factors vary depending on the peculiarities of an industry [8].

The main objective of this paper is to analyze spatial distribution of manufacturing industries. The analyses would be focused on spatial exploratory analysis of Indonesia's manufacturing industries. Spatial exploratory analysis of industry location will aid in capturing important intangible aspects concerning spatial dependence. The majority of empirical work which relates to the concentration of the economic activities is still based on calculations of basic statistical measurements where the geographical properties of the data do not play any role. This paper considers spatial interaction among region units by taking spatial dependence explicitly into account. This spatial analysis will also aid in identifying phenomenon pattern for the distribution of manufacturing industries expressed which is clustered or randomly distributed. This objective is achieved by utilizing Global Moran's *I* Statistic and Local Indicators of Spatial Association (LISA) statistics.

The rest of this study is organized as follows: the second section discusses about the data and the applied methodologies. The third section analyzes the main expected result of the study. Finally, the last section provides conclusion of the study.

2. Methods

This study analyses the geographical pattern of economic activity especially for the spatial distribution of large and medium manufacturing industries by using the provincial data set from 2008 to 2015 for 33 provinces in Indonesia. In practice, there have been 34 provinces in Indonesia including several newly formed provinces being added to the former ones during decentralization era. In this case, data from newly formed provinces are combined with those of their original provinces.

For exploratory spatial data analysis, Moran's *I* was applied to determine the general level of spatial autocorrelation in the data. Theoretical models usually recognize the existence of spatial autocorrelation between regions; empirically, Moran's *I* becomes a popular tool for measuring spatial autocorrelation, which is an index of linear association between a set of spatial observations x_i x_j, and a weighted average w_{ij} of their neighbors [9]. For the number of establishments y, Moran's *I* is:

$$I = \left(\frac{n}{\sum_i \sum_j w_{ij}} \right) X \left(\frac{\sum_i \sum_j (y_i - \mu)(y_j - \mu)}{\sum_i (y_i - \mu)^2} \right) \tag{1}$$

Where w_{ij} indicates elements of the spatial weight matrix *W* (distance/contiguity weight matrix) between two points (*i* and *j*), *μ* the mean of all *y* observations, and *i, j* = 1… n. This tool measures spatial autocorrelation (feature similarity) based not only on feature locations or attribute values alone but on both feature locations and feature values simultaneously. A set of features and an associated attribute, evaluates whether the pattern expressed is clustered, dispersed, or random. The tool calculates the Moran's *I* value and a Z score evaluates the significance of the index value. In general, a Moran's *I* value near +1.0 indicates clustering while an index value near -1.0 indicates dispersion. In the case of the Spatial Autocorrelation tool, the null hypothesis states that "there is no spatial clustering of the values". If the Z score is large (or small) enough to such that it falls outside of the desired significance, then the null hypothesis can be rejected. If the null hypothesis is rejected, the next step is to inspect the value of the Moran's *I*. If the value is greater than 0, the set of features exhibits a clustered pattern. If the value is less than 0, the set of features exhibits a dispersed pattern. To execute the data, GeoDa software is applied and designed to be a software tool that facilitates the exploration and analysis of geospatial data [10].

3. Results and Discussions

The main objective of this paper is to analyze the distribution of Indonesian manufacturing industries geographically. There are two expected results to be achieved in this paper, which are: to uncover the existence of spatial dependence related to the distribution of manufacturing industries in Indonesia and to contribute significantly to industrial cluster in Indonesia. The expected results are discussed as follows:

3.1. Spatial dependence of the distribution of manufacturing industries

The spatial distribution of manufacturing industries for the year 2015 is presented in figure 2. The figure illustrates that the distribution of Indonesia's manufacturing industries is unevenly distributed for all 33 provinces. Mostly, the manufacturing industries are concentrated in Provinces which are located in Java Island. In addition, this spatial concentrated was also caused by the infrastructure and labor accumulated in Java [11]. It implies that the Indonesia's manufacturing industries shows a spatial pattern and it is not independently distributed over space. Economic activity tends to be geographically clustered. Moran Model allows recognizing the existence of spatial dependence between regions. To prove that the Indonesia's manufacturing industries are not independently distributed over space, Global Moran's *I* is applied. This index analyzes the spatial dependence (autocorrelation) among region related to the distribution of manufacturing industries. The high value of the Moran's *I* indicates the presence of spatial interactions resulting in spatial dependencies among

regions. Spatial dependence is measured as the existence of statistical dependence in a collection of random variables, each of which is associated with a different geographical location.
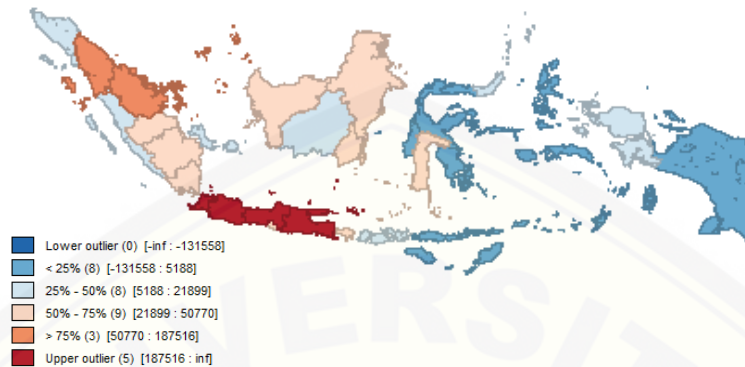

**Figure 2.** The Spatial Distribution of Indonesian Manufacturing Industries, 2015

For Moran's *I* indicate positive spatial correlation, showing that province with a high or low numbers of manufacturing industries are similar to their neighboring province. Conversely, a negative and significant value for Moran's *I* indicate negative spatial correlation, showing that province with a high or low number of manufacturing industries are unlike their neighboring province [12]. The Moran's *I* statistic is equal to 0.623179 for the year of 2015, indicating a strong positive spatial relationship (autocorrelation) and the phenomenon pattern expressed which is clustered. To prove its significance, pseudo p-value in the randomization is utilized for reporting p-value, which is $\rho = 0.001$ (proving that it is definitely significant). The size of the Moran's *I* also indicates that the Indonesian manufacturing industry is distributed in a clustered pattern.
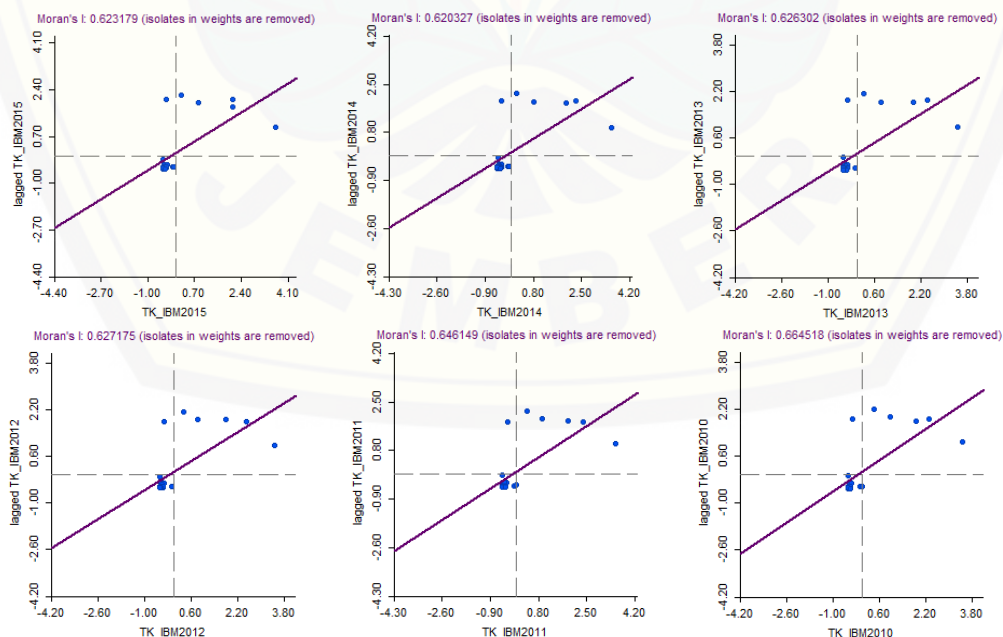
Source: calculated by author

Figure 3. Global Moran's *I* Scatter Plots for Manufacturing Industries, 2010-2015

By comparing the value of Moran's *I* in a series, we could know the trend of spatial dependence is presented among region. Whether the spatial dependence among province getting strengthened or weakened for along study period. For example, the Moran's *I* in 2008 was 0,6728, in 2010 was 0,6645, reached its maximum value in 2007 was 0,6898 and in 2015 amounted to 0,6232 (authors calculation). That the spatial distribution of manufacturing industry for along periode of study has a tendency to weakening. Figure 4 shows the global Moran's *I* statistic for spatial distribution of manufacturing industries in Indonesia for the year 2007 to 2015 using the spatial weight matrix. The values of global Moran's *I* statistic show a downward trend from 2007 to 2015 and significant positive spatial autocorrelation. The results suggest that the locations of province with high or low the number of manufacturing industries are clustered, and the spatial pattern has a developing trend of decrease spatial autocorrelation. Its mean, the spatial distribution of manufacturing industries are still clustered but the degree of spatial dependence among region are going down. This was due to a series of deregulation by government corcerned with industrial development [4]. So, the spatial distribution of manufacturing industry more evenly distributed.
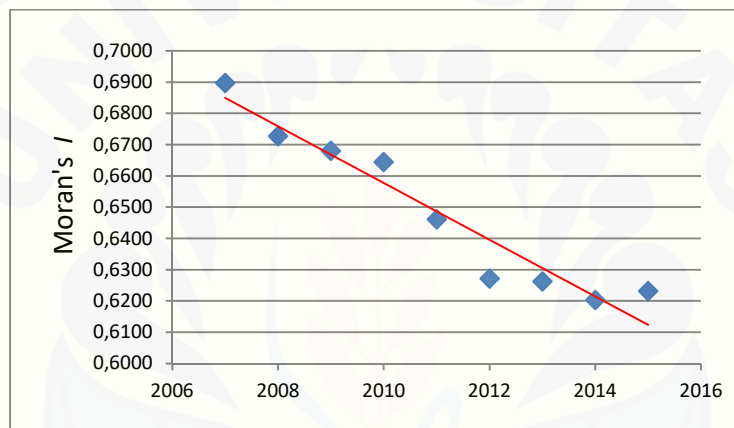
Source: calculated by author

Figure 4. Trend of Moran's *I* statistics for Manufacturing Industries (2007-2015)

When looking on formation of spatial clusters in detail local spatial autocorrelation methods such as LISA [13] – the local equivalent of Moran's *I* – can be used. The mapped results of this analysis answer not only the question of whether any spatial pattern across studied area exists but also where the clusters are, what they look like, etc [14].

3.2. Local Indicator of Spatial Accociation (LISA)

An important component of geographical analysis is a focus on the local, refrected in new methods to deal with local spatial autocorrelation [15]. Specifically, considerable interest has been devoted to local indicators of spatial association (LISA) since the original LISA framework was outline in Anselin [13, 16]. The Moran's *I* is a global statistic. So, we know there is clustering going on in the research area, but we do not know exactly where clustering exist. To investigate further, we would do a LISA. This test not only tests for regional clustering, it can also show the presence of significant spatial clusters or outlier. LISA statistics was developed by [13], which measures the contribution of individual region to the global Moran's *I* statistic. Local Moran's *I* useful for showing places where significant spatial autocorrelation exists.

Figure 5. LISA Cluster Map for Indonesian Manufacturing Industries, 2015

LISA cluster map indicates locations with a significant Local Moran statistic. The LISA cluster map shows that how the attribute of industries clusters. The red color show the tracts where the province with a high rate cluster surrounded by province with a high rates cluster too (High-High), and blue shows the province with a low rate cluster surrounded by province with a low rates cluster too (Low-Low). There is even mix of high-low, for example the pink color. So, there is a cluster of high industries surrounded by cluster of lower industries. The HH and LL locations suggests clustering of similar values (positive spatial correlation), whereas the HL and LH locations indicate spatial outliers (negative spatial correlation) [13]. A positive and high autocorrelation is found in some provinces really show significant clustering. For the year of 2015, A high cluster (HH) industries occurs in four provinces, these provinces are West Java, Banten, DKI Jakarta, and Central Java. These provinces are have significant contribution to the global Moran's I statistic. For East Java, indicates not significant high clustering due to the spatial distribution of manufacturing industries spread from the northern region of the southern region (called the north-south corridor).

4. Conclusion

This study analyzes the geographical changes in spatial pattern of economic activities in Indonesia. The paper deals with the spatial distribution of large and medium manufacturing industries which examines whether a phenomenon pattern expressed is clustered, dispersed, or random using data set from 2010 to 2015 across 33 provinces in Indonesia. In this paper we contribute to the empirical literature on the spatial distribution of manufacturing sector by taking spatial dependence among region units explicitly into account. The Moran's I was employed to characterize the spatial distribution of manufacturing industries. The result shows a strong positive spatial relationship (autocorrelation) in research area and shows that the phenomenon pattern for the distribution of manufacturing industries expressed is clustered, and a high concentration of manufacturing industries is seen in Java Island. For along the period of study the Moran's I are tending to decrease. Its mean, the domination of Java Island as the centre of economic activities in Indonesia is no longer. From the LISA, we can ascertain that there was statistically significant high clustering in Indonesia. Only some provinces really show significant industrial.

The findings are not only strengthened the regional economic theory especially the economic geography theory, but also important to develop a policy recommendation due to industrial development planning. As a policy implication, the result showed that spatial dependence across regions was matter and in other side will be beneficial for the economic growth of the regions. It implied that all regions need to cooperate due to economic integration.

For further research, it would be interesting to develop model take into account some variables which determinant to spatial distribution of manufacturing industries. Hence, the model can be able to explain factors influencing industrial location.

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