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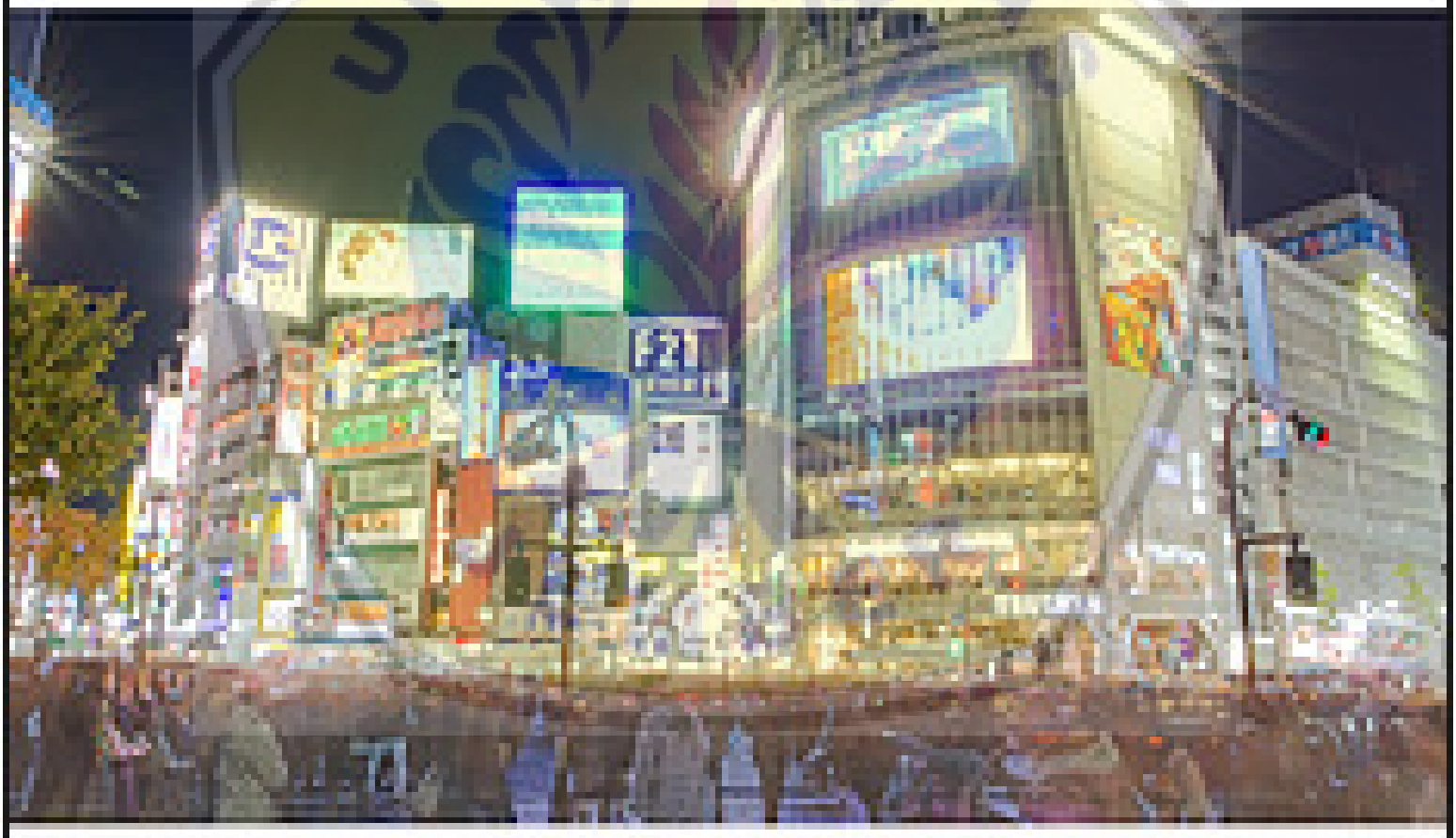

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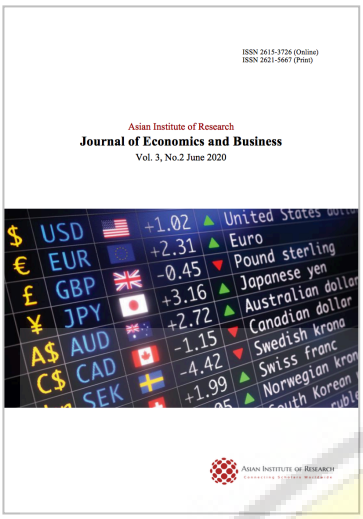

Journal of Economics and Business

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The Dynamic of 2011 – 2016 East Java's Regional Spatial Growth, An Exploratory Spatial Data Analysis

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Abstract
East Java is one of the Indonesian provinces with above national average of GDP growth. It experiences spatial growth disparity within the province. The implemented regional spatial plan assigns eight development regions, with their corresponding growth centers to reduce the disparities. The objective of this study is to explore the dynamic of the interregional spatial growth within this province, according to the designated spatial plan. The Exploratory Spatial Data Analysis (ESDA) is implemented on 2011 up to 2016 data of the region's economic growth. The result indicates the still existence of the spatial growth disparity. Most of the growth centers are in their second round of the backwash – effect stage.

Keywords: Growth Disparity, Spatial Growth, Spread – Backwash Effect, ESDA

1. Introduction

1.1. Background of the Study

Economic development is a necessary process to improve regional welfare and standard of living. Todaro and Smith (2009) define economic development as a process that involves various aspects, such as economic structure, social change, poverty, inequality, and unemployment in the context of economic growth. Among other measures, economic growth is a measure that is commonly used to indicate the nature of economic development.

Within a country however, regions have commonly experienced unequal rate of economic growth. In most countries, national economic growth has been dominantly supported by the growth of some designated growth centers. These growth centers have relatively higher economic growth compared to their surrounded regions. The persistent economic growth disparities have been a growing concern in many countries in the past decades, including Indonesia.

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The concept of spatial inequality has been evolved from the neoclassical trade and growth theory, the location theory, the external scale economies until the central place theory (Dawkins, 2003). The relation between geography and economic activities was the initial focus of many researches. The focus has been shifted to the mechanism of spatial imbalance of growth and its convergence process (Neary, 2001). The growing concerns on spatial disparities have been supported by the advance in theory (e.g. new economic geography) and in the development of spatial data analysis and GIS. For equity concerns, a more even distribution of economic growth across regions is desirable. Researches which describe the spatial pattern or analyze the mechanism of the spatial growth provide useful ground to prescribe policies promoting the desirable equal distribution of the growth.

Indonesia is one of the most spatially diverse nations in terms of natural resource endowments, population and economic activity distribution, ecology, and ethnicity. The country's regional development pattern has invited more interest for analytical as well as political purposes. While the country has shifted its centralistic government system to a highly decentralized one, the regional income per capita disparity is still the main issue. Any studies to address the reasons for this persistent disparity (Resosudarmo and Vidyattama, 2006; Hill, Resosudarmo and Vidyattama, 2009) have not achieved proper results.

This study particularly focuses about the economic growth in East Java, one of the provinces in Indonesia. It consists of 38 regencies/municipalities. Compare to other provinces, this province still relatively shows more evenly distributed development benefits (Dick, Fox and Mackie, 1993), but this condition does not guarantee the absence of economic growth disparity among the regencies/municipalities. During 2011 – 2016, East Java has experienced between 5.42% until 6.16% of GDP growth. Those numbers are always above the average of national growth (BPS, 2019). Within the province, in 2011, the 38 regencies/municipalities experienced economic growth on average 6.1%, with the highest growth of 10.39% and the lowest growth of 2.49% for Sampang and Bojonegoro respectively. The spatial distribution of the 2011 GDP growth for all Each Java's regencies/municipalities is depicted in Figure 1. The distribution indicates a non-stability variance of growth across the province. The regions in the northwest and southwest have the highest growth with small variation, while the rest of the regions have lower growth, with a big variation. In addition to the spatial non – stability of the growth variance, during 2011 – 2016 this province also experiences an increased disparity of the economic growth across the regencies/municipalities. It is shown in the Figure 2 which depicts an upward trend of coefficient variation of GDP growth (%) for all the 38 regencies/municipalities during those years.

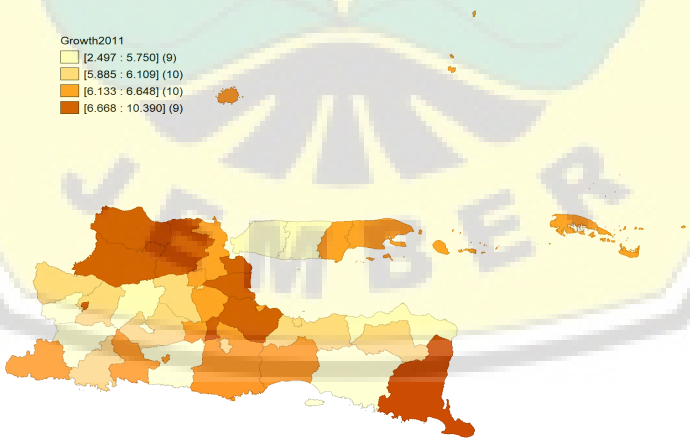

Figure 1 Spatial distribution of 2011 Growth Each Regency/Municipality in East Java

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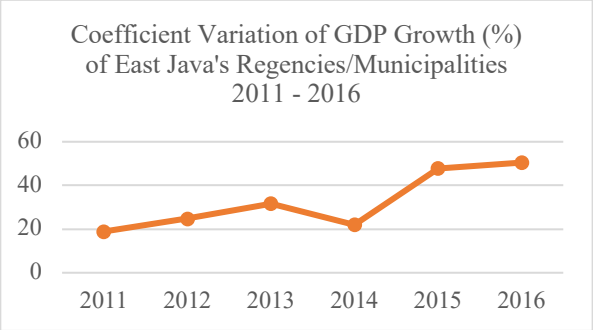

Figure 2 The trend of Coefficient Variation of GDP Growth (%) of the 38 East Java's regencies/municipalities during 2011 – 2016

In order to distribute the economic productivity more evenly across the region, the provincial government regularly updates the Regional Spatial Planning, in which the regions of the province are clustered into several development regions according to their similar geographical and the current socio-economic conditions. For each development region, one well developed central region (mostly municipality) is assigned to play its role as an engine of development for the rest of the regions in the same cluster. In this case, some growth centers are designated, and the backwash – spread mechanism is expected to reduce the economic growth disparities across regions. The most up to date spatial plan for East Java is presented in East Java's Local Regulation Number 5, 2012, about the Province Regional Spatial Planning 2011 – 2031. The spatial plan designates 8 units of the development region (*Satuan Wilayah Pengembangan*, SWP), which are shown in Figure 3. SWP 1 is the location of the capital of the province – Surabaya. The names of each SWP and their corresponding central location are depicted in Table 1. By comparing the map in Figure 1 and Figure 3, during 2011, it is obvious that there is still a discrepancy of growth among regencies/municipalities, even though they are located at the same SWP.

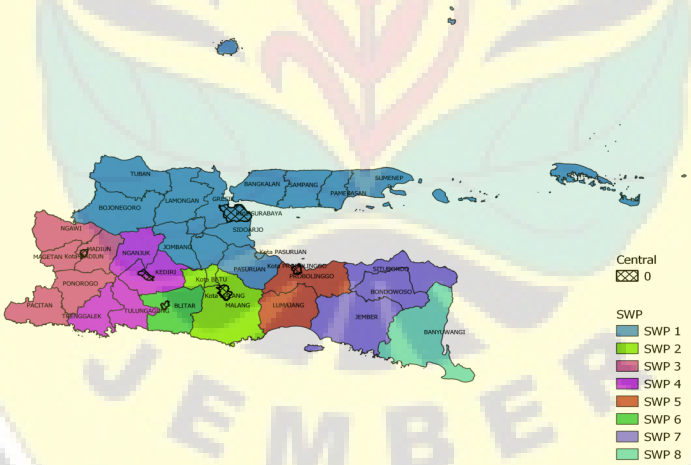

Figure 3 The division of Eight Development Region Units (SWP) for East Java's Regencies/Municipalities

Table 1 The Name of Each SWP and its central

Name of SWP	1	2	3	4	5	6	7	8
	Germakertosusila Plus	Malang Raya	Madiun	Kediri	Probolinggo - Lumajang	Blitar	Jember	Banyuwangi
Central	Surabaya Municipality	Malang Municipality	Madiun Municipality	Kediri Municipality	Probolinggo Municipality	Blitar Muncipality	central of Jember	central Banyuwangi

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The effectiveness of the implemented East Java's regional spatial plan in terms of the spatial growth disparities needs to be evaluated, which is the focus of this study. Based on the 2011 – 2016 GDP growth of the 38 regencies/municipalities of East Java, this study is aimed at identifying the phase of the growth in the province as the consequence of the designated growth pole/central for each SWP. Is it still in the initial stage in which the growth of the central is dominant, leading to the backwash effect? Or the regions have already in the later stage of the growth with more spread effect leading to a more equal growth across the region? Those questions are derived based on the following assumption:

- The growth in one regency/municipality is the product of the economic interaction with the nearby regencies/municipalities
- The interaction of the economic growth differs in nature and direction for each regency/municipality
- The interaction has a dynamic nature, it evolves over time.
- The role of growth centers to reduce the growth disparity also evolves over time.

To answer those questions, this study does not take an inferential approach (for the causal effect relationship). It takes the advantage of the geographical information of the available data and uses the tools in the Exploratory Spatial Data Analysis (ESDA). Analysis regarding the spatial interaction (spatial clusters) and the dominant effect in terms of location(s) with atypical growth (spatial outliers) and their dynamics, can be done within the context of exploratory spatial data analysis (ESDA) of the economic growth variable for the region under study over a period of time. ESDA is used as the second-best option to model the spillover effects without defining a specific causal effect relation. Moreover, for every tool in ESDA, it is possible to provide visualization of the result, in the form of graphic and map. The visualization the disparity and possible growth interaction is one aspect which has been fully explored by the available similar studies (Resosudarmo and Vidyattama, 2006; Hill, Resosudarmo and Vidyattama, 2009). Ying (2000) applies the technique to prove the existence of the trickle-down effect in the Chinese economy during the reform era (1978 – 1994). Celebioglu & Dall'erba (2010) apply ESDA to investigate the inequalities of the growth across 76 Turkish regions over 1995 – 2001. ESDA is also implemented in some studies (Ertur and Le Gallo, 2003; Dall'Erba, 2005) to explore the spatial distribution of the European region's per capita GDP.

1.2. Review on Economic Growth Theory

Economic growth is an increase in the production of economic goods and services, within a certain period. Theories about economic growth have evolved over the decades. The growth Solow model is the supporter of the neoclassical theory, in which the growth depends on capital and labor with diminishing returns. In the absence of technological progress, which is exogenous, the increase in capital and/or labor no longer increases the economic output. The Romer – Lucas endogenous growth theory "endogenizes" the exogenous factor from the growth model and considers that growth is an endogenous process. In this case, technological progress is assumed as an accumulation of human capital investment. This technological progress leads to more efficient utilization of capital and labor, such that the growth will be maintained.

Both theories have not considered the role of location or space in shaping economic growth. The importance of location is formally adapted by Fujita and Krugman (2004) in the New Economic Geography (NEG). In this theory, the formation of cities, the emergence of the industrial district, the existence of regional disparities or the emergence of core-periphery structure, are considered as the accumulation of the centripetal forces that pull economic activity in a certain location, and the centrifugal forces that push it apart (Fujita and Krugman, 2004). It theoretically explains how the geographical structure of an economy is shaped by the tug of war between those two forces. The concepts, tools and impacts of economic integration employed by NEG actually have been acknowledged before, such as growth pole theory by Perroux (1950) or the spread – polarization concept by Myrdal (1957) and Hirschmann (1966). They are both derived to capture the spatial uneven development process. The growth pole theory is introduced by Perroux (1950). It is proposed by observing the fact that not all business units can promote development. A unit that is capable of being the engine of development of its nearby units is designated as an economic pole of growth. The unit can serve its function well if it is in the most profitable location. According to Myrdal (1957) distance to market and basic input is one of the determinants of profit. Therefore, location defines profit and regional inequalities are the product of business location selection. Once the selected location is developed, it grows and interacts with its nearby location. The interaction is defined by Myrdal (1957)

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as a cumulative causation process. The process produces the "backwash effects" on the less developed location due to the mobility of its labor and capital to the growth pole. Therefore, the growth of the pole occurs at the loss of other locations. The pole serves as the polar of the economic agglomeration for the surrounding less developed locations. Hirschmann (1966) defines the resulting spatial pattern as a core-periphery pattern. He also asserts that even though initially the concentration of economic activities creates polarization effects and increases economic disparities between the core and periphery, the benefits will eventually spread to the peripheral locations with the growth of the economy. It is possible that in the long term the gap of the growth will be smaller.

2. Method

2.1. Data

This study uses regency/municipality – level of yearly GDP growth for all 38 regencies/municipalities in the province over 2011 – 2016, from BPS (*Badan Pusat Statistik*) (2017). All data are expressed in 2016 constant price.

2.2. Some Tools in Exploratory Spatial Data Analysis (ESDA)

This study utilizes some tools of ESDA, which are defined in Anselin (1999):

- to visualize the spatial distribution of the economic growth,
- to measure the magnitude of the growth interaction between regencies/municipalities,
- to visualize and measure the magnitude of the growth interaction between each growth center and its surrounding regencies/municipalities.

Each analysis is applied for every 2011 – 2016 data. The use of several years data enables this study to present the dynamic of the growth among the regions in this province. The results are combined to identify the phase of the growth, as the consequence of the designated growth center of each SWP.

Anselin (1999) broadly categorizes the ESDA techniques into a geostatistical perspective and a lattice perspective. The first one deals with the spatial observations as a sample of points from a continuous surface, whereas the latter deals with spatial locations as areal (lattice) units. Both are commonly applied in physical sciences and social sciences, respectively. This study mainly uses the latter perspective.

An essential mean to define the spatial arrangement of the lattice data is a spatial weight matrix $\boldsymbol{W}$. It is used in any statistical test of spatial association or in every spatial model. When there are n locations or spatial units, the dimension of $\boldsymbol{W}$ will be $n \times n$ with each element $w_{ij}, i, j = 1, \dots, n$ is defined as:

$$w_{ij}^{*} = \begin{cases} 1 \; if \; j \in N(i) \\ 0, otherwise \end{cases}, \text{ for } i \neq j \text{ and } w_{ij}^{*} = 0 \text{ for } i = j, \; w_{ij} = \frac{w_{ij}^{*}}{\sum_j w_{ij}^{*}} \qquad (1)$$

$N(i)$ is the set of neighbors of location i. By formulation in (1), the matrix is row – standardized. Arbia (2014) mentions that there are various concepts to define the neighborhood set. It can be one of the following:

- The adjacency between two administrative units (lattices). The spatial weight matrix defined from this concept is called the contiguity matrix.
- The maximum distance between location i and location j, d_{ij}. The two locations are neighbors if $d_{ij} < d_{max}$
- The k nearest neighbors' criterion.

When the k nearest neighbors criterion is used, following the formulation in Ertur & Le Gallo (2003) the element of the matrix defined in (1) can be represented as:

$$w_{ij}^{*} = \begin{cases} 1 \; if \; d_{ij} \leq d_i(k) \\ 0, if \; d_{ij} > d_i(k) \end{cases}, \text{ for } i \neq j \text{ and } w_{ij}^{*} = 0 \text{ for } i = j, w_{ij} = \frac{w_{ij}^{*}(k)}{\sum_j w_{ij}^{*}(k)} \qquad (2)$$

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in which $d_i(k)$ is the k^{th} smallest distance between location i and location j such that each location i has k neighbors, $k = 1,2,3, \ldots$. This approach is preferable than the adjacency approach when one (or some) of the administrative units is isolated (e.g. separated island) such that it does not share borders with any other administrative units. It is preferred in this case to avoid having a spatial weight matrix with one (or some) row with all zero elements.

The spatial weight matrix $\boldsymbol{W}$ is used to construct a weighted average of the variable value understudy, observed at the neighbors of a location. Given $\boldsymbol{Y}$ as an $n \times 1$ vector of variable (growth of GDP in this case) of all locations $(Y_i, i = 1, \cdots, n)$, the weighted average is defined as $\boldsymbol{WY}$. It is known as the spatial lag of $\boldsymbol{Y}$. The appropriate concept to define $\boldsymbol{W}$ depends on the nature of the spatial interaction of the variable. For the case of East Java's economic growth, the distribution map in Figure 1 indicates that the strongest interaction occurs among the regions which share borders. But since East Java has some administrative units which belong to a separated island, the concept of k nearest neighbors is preferred than the adjacency/contiguity concept.

In ESDA, **distribution map** is used to visualize the spatial interaction of the growth and the possible spatial growth disparities. It is then complemented with the calculation of **Global Moran's I statistic**, to measure the magnitude, to test its significance and to identify the type of global spatial interaction of the economic growth for all regencies/municipalities. The statistic is proposed by Cliff & Ord, (1981), and formally defined as:

$$I = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(y_i-\bar{y})(y_j-\bar{y})}{\sum_{i=1}^{n}\sum_{j=1}^{n}(y_i-\bar{y})(y_j-\bar{y})} \qquad (3)$$

for Y_i the variable under study (e.g. the growth of regency/municipality i) $i = 1, \ldots, n$ for the whole study region. It measures the degree of linear association between the observed value in location i (Y_i) and its spatial lag $(\sum_{j \in N(i)} w_{ij} Y_j)$. Inference for Moran's I is based on a normal approximation, using a standardized z value of the statistic (by its mean and variance) (Anselin, 2001). A positive value of this statistic indicates that locations with similar values tend to be clustered. On the other hand, a negative value of Moran's I is an indicator that nearby locations have dissimilar values.

Local Moran statistic is used to identify the spatial interaction between each regency/municipality and its surrounding regions. The local statistic serves the same purposes as the global one, but it is more useful when the spatial interaction does not have structural stability over space, which is applied for the case of economic growth. This study focuses on the local spatial interaction of the economic growth on each of the designated growth centers. Following the global Moran's I in (2), a Local Moran's I is proposed as:

$$I_i = \frac{\sum_{j=1}^{n} w_{ij}(y_i-\bar{y})(y_j-\bar{y})}{\sum_{j=1}^{n}(y_i-\bar{y})(y_j-\bar{y})} \qquad (4)$$

It is defined as a class of local indicators of spatial association (LISA). The statistic is capable of showing the masked atypical local spatial association, which deviates from the global pattern (Ertur and Le Gallo, 2003). Anselin (1995) argues that LISA (i.e local Moran's I) must be a decomposition of the global statistic (i.e. global Moran's I). The decomposition is the contribution of each individual observation and LISA which is calculated in a location i indicates the degree of spatial association between Y_i and $Y_j, j \in N(i)$. The sum of LISAs for all locations $i = 1, \ldots, n$ is proportional to the corresponding global statistic of spatial association. The significance level of Local Moran's I in (4) is calculated based on a conditional permutation approach, using 1000 random permutations of each region's neighbors, following the definition in Anselin (1995). It is calculated for each region. A significant - positive local Moran's I is an indication of spatial clustering of similar values around the particular location (hot spots). It can be a location with high value surrounded by locations with also high values of Y (High – High, HH) or the other way around (Low – Low, LL). The local Moran's I can also detect spatial outliers that are characterized by a negative – significant value of the statistic. The negative value of I_i indicates that Y_i is much higher or lower than the average of $Y_j, j \in N(i)$. Anselin (1999) describes the situation as High – Low HL or Low – High LH respectively.

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The Moran scatterplot is used to visualize the type (positive or negative) of local spatial interaction for each regency/municipality. It is a scatterplot between one location standardized value of the variable under study (e.g. GDP growth) and the average value of the standardized variable of its neighbors. A combination of the magnitude/the significance of local Moran's I statistic and the type of interaction identified in the Moran scatterplot indicates the dominant growth effect created by the growth centers and the possible stage of the growth. Anselin (1999) proposes the use of a map of significant local Moran's I as a complement for the Moran scatterplot. The map assigns different pattern/color for each regency/municipality, which depends on the type of local association of the economic growth of each location and the significance of the local interaction. Mainly there will be four patterns/colors which correspond to each type of significant local association, namely HH, LL, LH, and HL. There will be no color/pattern assigned for a location with any type of insignificant local association. A combination of both graphs, the Moran scatterplot and the map of significant local Moran's, is a mean to interpret the possible spatial clusters (HH an LL) or spatial outliers (LH or HL).

3. Results

3.1. The Spatial Distribution of Yearly GDP Growth 2011 – 2016

Within the context of the spread – backwash effect of the growth pole theory, a tool to visualize the spatial distribution of regional GDP growth is a choropleth map. It is a preliminary analysis, to indicate possible spatial interaction of the growth among the nearby regions or possible spatial growth disparities across regions. The GDP growth of 38 East Java's regencies/municipalities are classified into 4 classes, using first, second and third quartiles as the class dividers. The classification is the basis for producing the map which represents the GDP through various shading pattern on the geographical areas. Each class has a different shade. The darkest shade corresponds to the class with higher GDP growth. The shade goes lighter for the classes with lower value GDP growth. The map displays the possible clusters of regencies/municipalities with similar GDP growth. The obvious clusters indicate a positive spatial interaction among nearby regencies/municipalities. The choropleth map of yearly GDP growth is made (2011 – 2016). The dynamic of the spatial distribution and spatial interaction can be captured by comparing each map. These yearly GDP growth maps are presented in Figure 1 (only for 2011 growth) and Figure 4 (for 2012 – 2016 growth).

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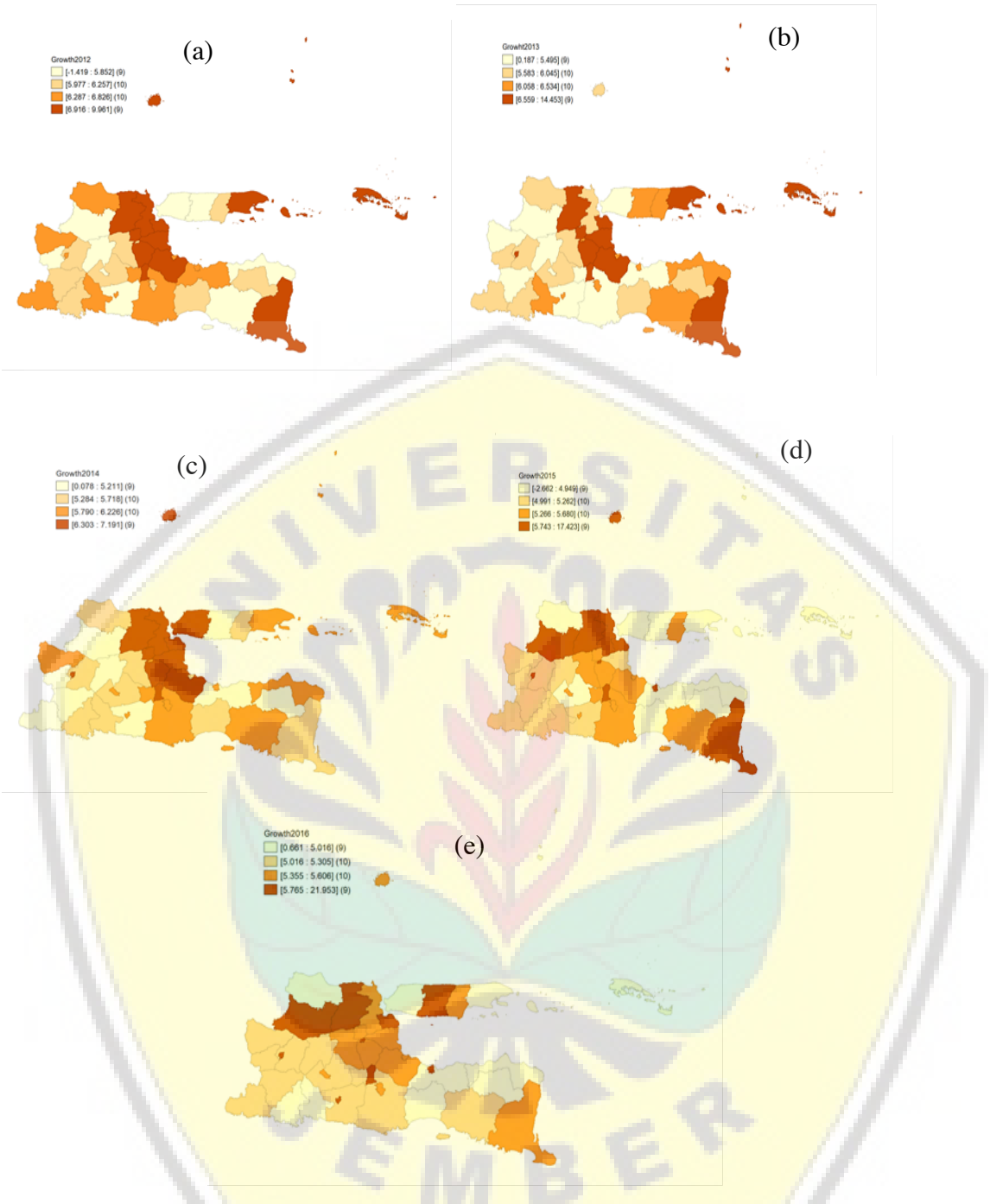

Figure 4 Distribution of Growth Each Regency/Municipality in East Java, (a) 2012 growth, (b) 2013 growth, (c) 2014 growth, (d) 2015 growth, (e) 2016 growth

3.2. The Measure of the Magnitude of the Growth Interaction between East Java's Regencies/Municipalities

Global Moran's I is the tool in ESDA which is useful for this purpose. It calculates the interaction, in terms of correlation, between the growth in a regency/municipality with the average growth of its neighboring regencies/municipalities. The calculation of Global Moran's I in (3) requires a definition of a spatial weight matrix ($\boldsymbol{W}$). Using the concept of k nearest neighbors for East Java's case, some spatial weight matrices $\boldsymbol{W_2}, \boldsymbol{W_3}, \boldsymbol{W_4}$, and $\boldsymbol{W_5}$ are defined respectively to define 2, 3, 4 and 5 nearest neighbors. The global Moran's I is calculated for each yearly GDP growth for 2 until 5 nearest neighbors such that for each year GDP growth there are 4 statistics. Their values and significances are depicted in Table 2. The result shows that the most significant interaction occurs for the 2011 GDP growth among 2 nearest regencies/municipalities. The strongest spatial interaction among 2

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nearest neighbors (the smallest p value) also occurs for 2013, 2015 and 2016 economic growth, even though the interaction is not as significant as the interaction of the 2011 growth. Therefore, this study conducts further analysis using the concept of 2 nearest neighbors. Using the 2 nearest neighbors' criterion, the dynamic of global spatial autocorrelation of the economic growth over 2011 – 2016 can be observed. The evolution of global Moran's I of GDP growth over those years is depicted in Figure 5. The graph in Figure 5 indicates that over the years there is no apparent global pattern in the interaction of the growth.

Table 2 The Moran's I of yearly Growth of GDP (2011 – 2016) for each k nearest neighbors ($k = 2,3,4,5$) and its significance

	Year	k nearest neighbors							
		2		3		4		5	
		Moran's I	p value	Moran's I	p value	Moran's I	p value	Moran's I	p value
Growth of GDP	2011	0.221	0.021*	0.099	0.098	0.079	0.103	0.061	0.126
	2012	-0.040	0.397	-0.066	0.277	-0.064	0.26	-0.042	0.36
	2013	-0.044	0.368	-0.0334	0.439	-0.022	0.491	-0.017	0.475
	2014	-0.028	0.471	-0.0129	0.398	-0.025	0.455	-0.003	0.342
	2015	0.068	0.117	0.0143	0.337	0.033	0.195	0.026	0.213
	2016	-0.048	0.204	-0.033	0.308	-0.025	0.389	-0.024	0.392

(*) for significant Moran's I, yellow highlight for the smallest p value of the statistics within the same year

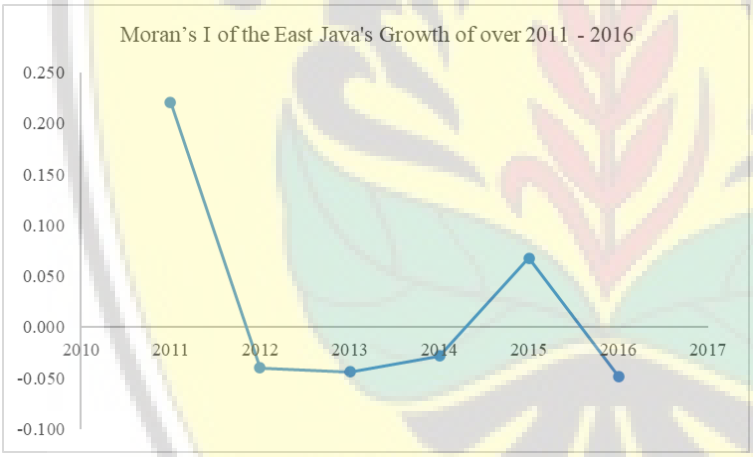

Figure 5 The dynamic of Global Moran's I of the East Java's Growth over 2011 – 2016

3.3. The Visualization of the Local Interaction

A map of the distribution of local GDP growth interaction (the local Moran's I), of each East Java's regency/municipality, can be made to visualize the pattern of the local interaction. To identify the sign, the type, and the significance of the statistic, especially for each growth center, the map is combined with the Moran scatterplot. Each dark blue dot in the presented Moran scatterplots represents a pair of standardized growth and its spatial lag of each growth center. The distribution maps of local Moran's I and the Moran scatterplot for the yearly GDP over 2011 – 2016 are respectively presented in Figure 6 until Figure 11.

3.4. The Measure of the Magnitude of the Growth Interaction between Each Growth Center and Its Surrounding Regencies/Municipalities in East Java

It corresponds to the local spatial autocorrelation of the GDP growth between each growth center and its surrounding regencies/municipalities. This study uses the local Moran's I as the measure of local spatial autocorrelation. The analysis is conducted for each yearly GDP growth (2011 – 2016). It is done by observing each map in Figure 6 until Figure 11 for each corresponding year, focusing on the sign, the type, and the

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significance of the local Moran's I of the GDP growth between each growth central and its surrounding. The result of the analysis is summarized in Table 3. They provide some information regarding the role of each growth pole in supporting the growth of its surroundings.

Table 3 The sign, the type and the significance of local Moran's I of East Java's GDP growth of each growth center over 2011 – 2016

SWP	GROWTH CENTER	Local Moran's I 2011		Local Moran's I 2012		Local Moran's I 2013		Local Moran's I 2014		Local Moran's I 2015		Local Moran's I 2016	
		SIGN	TYPE	SIGN	TYPE	SIGN	TYPE	SIGN	TYPE	SIGN	TYPE	SIGN	TYPE
1	Surabaya Municipality	-	HL	-	HL	-	HL	**+ (**)**	**HH**	**- (**)**	**HL**	**- (**)**	**HL**
2	Malang Municipality	-	LH	+	HH	+	HH	+	HH	+	HH	-	HL
3	Madiun Muncipality	-	HL	-	HL	-	HL	-	HL	-	HL	-	HL
4	Kediri Municipalitiy	+	LL	+	LL	+	LL	-	HL	-	HL	+	HH
5	Probolinggo Municipality	+	LL	+	HH	-	HL	-	HL	-	HL	-	HL
6	Blitar Municipality	-	HL	-	HL	-	HL	-	HL	-	HL	-	HL
7	Jember Regency	-	LH	-	LH	-	HL	-	HL	-	HL	+	LL
8	Banyuwangi Regency	-	HL	-	HL	-	HL	+	HH	-	HL	+	LL

(**) the local Moran's I is significant at $\alpha = 0.05$

4. Discussion

Before discussing more detail regarding the phase of the growth in East Java, there are some findings based on the yearly GDP growth maps in Figure 1 (for 2011 growth) and Figure 3 (for 2012 – 2016 growth) which reveal the general conditions of the growth in this province. The first finding is that Surabaya as the central of SWP 1 as well as the capital city of the province has always experienced high economic growth over the observed periods. The result is not surprising since it is designated to be the engine of development, not only for the regions within SWP 1 but also for other regencies/municipalities across the province. The second one is that during the observed years there always have been apparent clusters of regencies/municipalities according to their economic growth. It is an indication of economic interaction among the nearby regencies/municipalities. The last finding is about the dynamic nature of the growth. Initially, most regencies/municipalities from SWP 1 belong to the highest class of economic growth. Over the years the highest growth shifts to the other SWPs in the proximity of SWP 1.

Those findings give preliminary insight regarding the role of the growth pole in spreading the economic growth to the surrounding regions. The distribution maps of the growth only confirm the spatial interaction of the economic growth and the role of Surabaya as the capital city of the province. The maps do not give adequate information regarding the role of the other growth centers in supporting the economic growth of their respective surrounding regions. This study uses a quantitative approach to obtain more detail regarding the role of other centers, and the stage of spread – backwash effect of East Java's economic growth. Which leads to the interpretation of the Global Moran's I and the local Moran's I of the GDP growth among the regencies/municipalities over the observed years.

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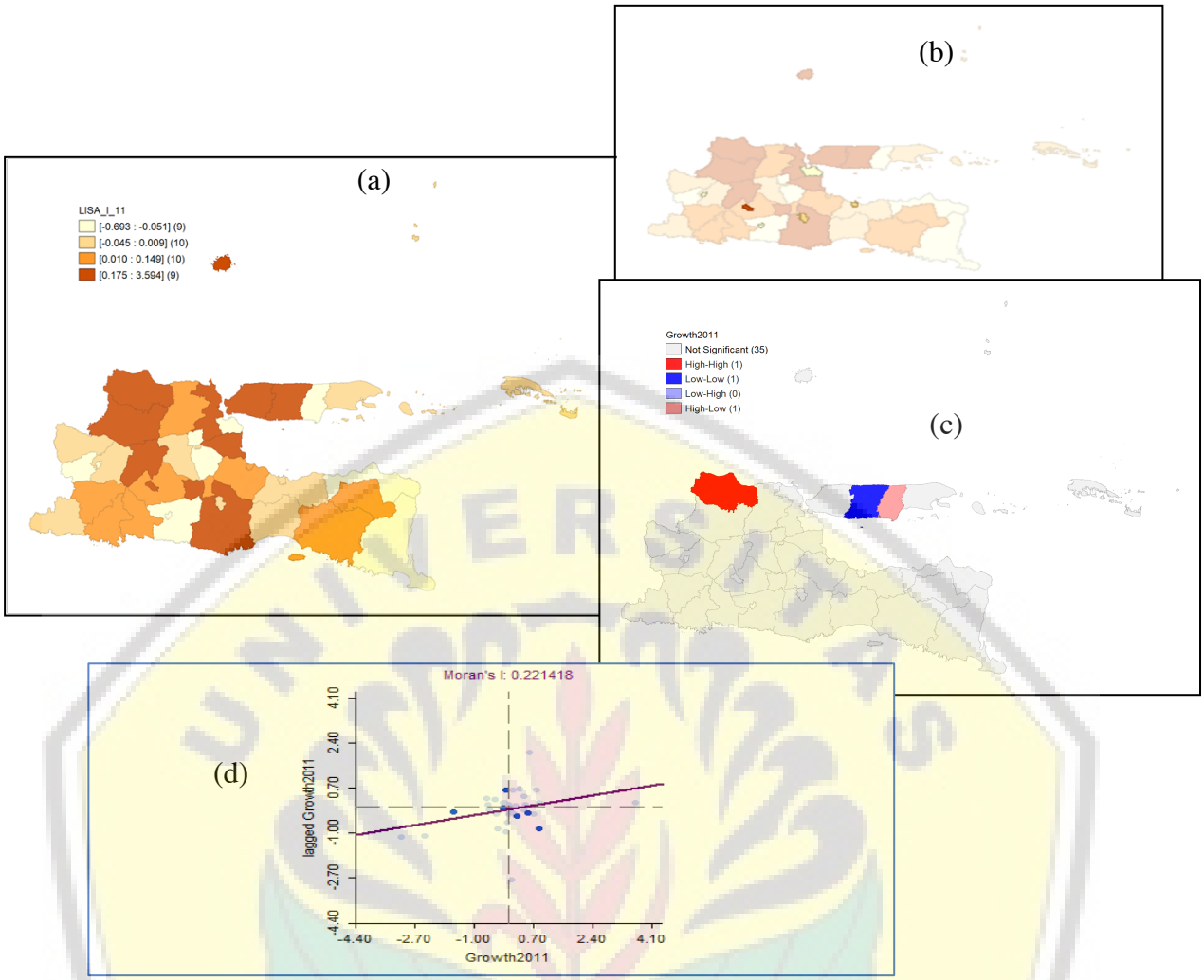

Figure 6 (a) The Distribution Map of Local Moran's I for East Java's 2011 Growth, (b) The value of Local Moran's I for all Growth Poles' 2011 Growth, (c) The map of significant local Moran's I ($\boldsymbol{\alpha = 0.05}$), (d) Moran Scatterplot, for East Java's 2011 Growth

By observing the plot of global Moran's I of the yearly growth (2011 – 2016) in Figure 4, there is no pattern of the global growth interaction. The most possible explanation for this situation is that the direction of the spatial interaction of the GDP growth varies from one regency/municipality to another. The GDP growth in one regency/municipality might positively trigger the growth in its surroundings, while the GDP growth in another one can slow down (negatively affect) the growth of its surroundings. It happens because each regency/municipality has a different role in East Java's development plan. In this case, the aggregate of positive and negative effects leads to a non-significant global effect. Therefore, spatial interaction of the economic growth at the local scale must be carried out. The character of the GDP growth will be discussed for each year based on the Local Moran's I. The local Moran's will be presented in the form of distribution map, and the corresponding Moran Scatterplot is used to visualize the type of local spatial interaction of the growth for each regency/municipality.

4.1. The 2011 Economic Growth

The distribution map of local Moran's I for 2011 economic growth is depicted in Figure 6(a). Clusters of regencies/municipalities with strong positive local spatial interaction emerged mostly in SWP 1. It is the SWP where Surabaya plays its role as the growth center as well as the capital of the province. Focusing the attention only on the growth centers, the map on Figure 6(b) shows that, there are two growth centers with positive local Moran's I. Combining with the map in Figure 6(c), it is revealed that all growth poles have insignificant local Moran's I. But the information regarding the type of interaction occurs in each growth centers will be useful to

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identify the phase of spread – backwash effect of the growth. The type of interaction can be revealed by observing the corresponding Moran scatterplot, which is depicted in Figure 6(d), focusing on the dark blue dots. It is mentioned earlier that the dark blue dots correspond to the nature of local spatial autocorrelation between the GDP growth in the growth centers and their corresponding neighboring regencies/municipalities. Table 3 provides a summary regarding the sign, the type and the significance of local spatial interaction of each growth center for 2011. All growth centers experience insignificant local spatial interaction of the growth. The two growth centers with positive local Moran's I are Kediri (SWP 4) and Probolinggo (SWP 5). The dark blue dots which correspond to those growth centers in the Moran scatterplot, fall in quadrant III. It is the quadrant for the LL type of interaction. During this year, even though the interactions are not significant, Kediri and Probolinggo which experienced low growth are surrounded by low growth regencies/municipalities. The remaining growth centers have negative local Moran's I which can fall in quadrant II (LH) or quadrant IV (HL). Malang (SWP 2) and Jember regency (SWP 7) are the growth centers with LH type of interaction. They experienced low economic growth but are surrounded by high growth regencies/municipalities. It can be inferred that during 2011, the growth centers with the insignificant LL and LH types of spatial interaction (Kediri, Probolinggo, Malang, and Jember) still have quite low economic growth such that they could not play their roles in creating the spread – backwash effect to their surrounding regencies/municipalities. The rest of growth centers have insignificant HL type of interaction, including Surabaya. It implies that the high economic growth in each of those growth poles during 2011 is still in the early stage, in which they start to create the backwash effect on its surroundings, even though the effect is not significant.

By observing Figure 6(c) there are some non-growth central regencies/municipalities with significant local Moran's I (the red, blue and pink shaded regencies/munipalities). They are Tuban (HH), Sampang (LL) and Pamekasan (HL). Both are in SWP 1, with Surabaya as their growth center. Both regencies are not the direct neighbors of Surabaya. Furthermore, the earlier analysis indicates that the Surabaya's growth is not strong enough to promote the growth of its neighbors, such that its high growth does not reach Tuban, Sampang and Pamekasan. During 2011 Tuban has experienced high GDP growth which is significantly in line with the high GDP growth of its neighbors. This high growth is mostly due to its local economic condition. Even though Tuban does not have a role as growth central, its economic growth is strong enough to promote the growth of its surroundings. The opposite holds for Sampang. It has low GDP growth, which is mostly due to its local economic condition. It significantly interacts with its neighbors, such that they also suffer from low GDP growth. A different situation is experienced by Pamekasan. It has high GDP growth, the behavior which is completely different from the low growth of its surrounding. A similar reason applies to Pamekasan. Its high growth is also due to its local economic condition.

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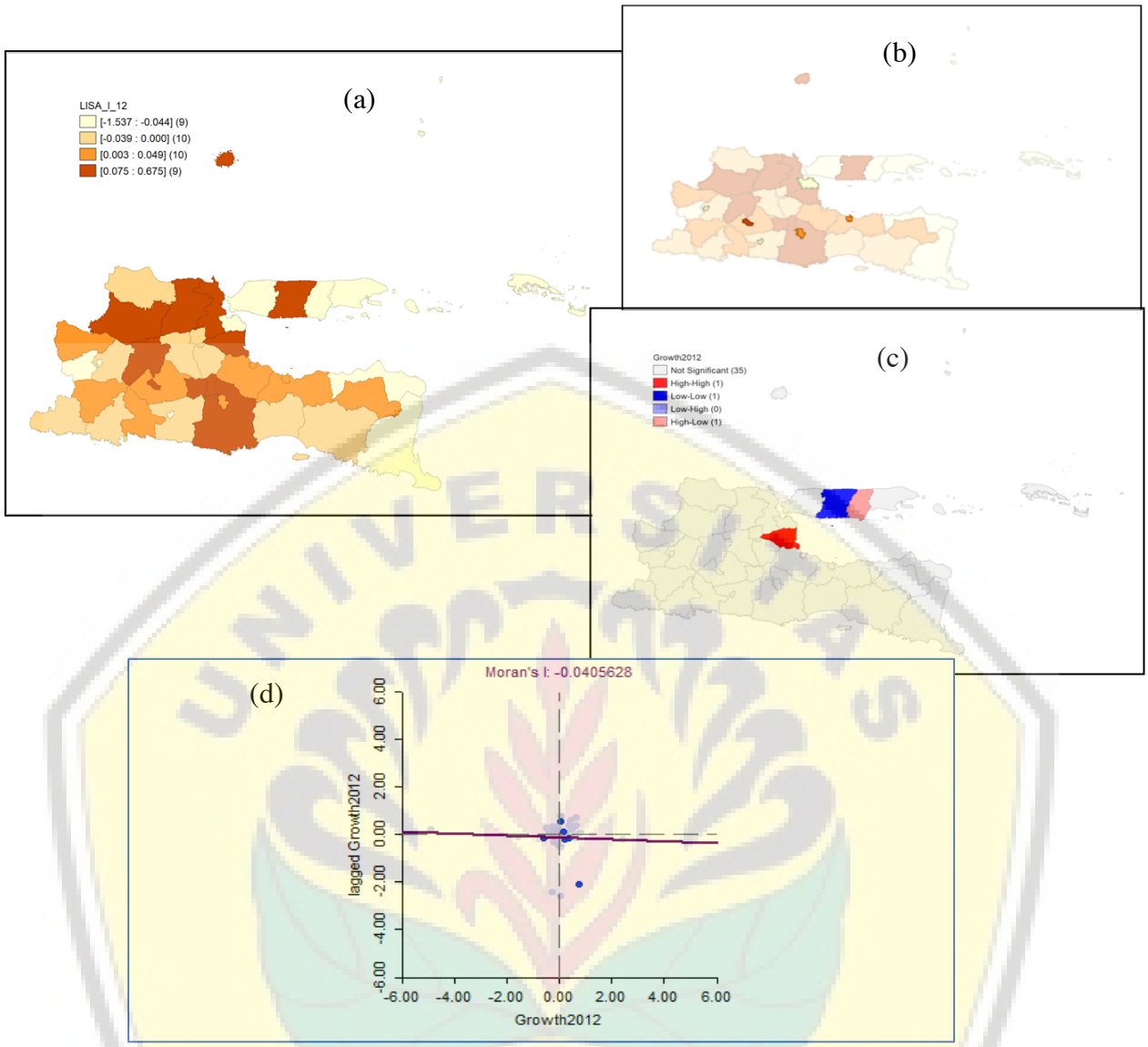

Figure 7 (a) The Distribution Map of Local Moran's I for East Java's 2012 Growth, (b) The value of Local Moran's I for all Growth Poles' 2012 Growth, (c) The map of significant local Moran's I ($\boldsymbol{\alpha = 0.05}$), (d) Moran Scatterplot, for East Java's 2012 Growth

4.2. The 2012 Economic Growth

A similar situation applies to the 2012 economic growth. The map in Figure 7(a) shows clusters of regencies/municipalities with strong positive local Moran's I emerge mostly in SWP 1 and SWP 2. The map in Figure 7(b) reveals that all growth centers still do not have significant local Moran's I. By comparing the result for 2011 and 2012 in Table 3, the dynamic of the local spatial interaction is shown by the change of the type of local spatial interaction of GDP growth in Malang and Probolinggo. Based on the nature of the dark blue dots in the Moran scatterplot in Figure 7(d) which correspond to Malang and Probolinggo, the 2012 GDP growth of those centers are considered high. The high growth in those regions are in line with the high growth of its surrounding regions (HH). For Malang, it is the opposite of what happens in 2011, in which the GDP growth of Malang is lower than the higher growth of its surroundings (LH). On the other hand, in 2011, Probolinggo and its surrounding regions have experienced low GDP growth (LL). Even though the interaction is still not significant, this dynamic indicates that during 2012 Malang's and Probolinggo's economic productivity is getting stronger. This situation is expected to support their role in promoting the economic growth of their neighbors. In a one-year time span, these two growth centers start to spread their effect. The remaining growth centers, however, are still in their 2011 type of local spatial interaction (see Table 3).

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The map in Figure 7(c) indicates that in 2012, there are some changes in the pattern of significant local Moran's I. There are still three regencies with significant local Moran's I. The first two are Sampang and Pamekasan. Both have the same type of local Moran's I as the type in 2011, LL and HL, respectively. The third regency, however, changes from Tuban into Sidoarjo. The situation in the first two non-growth centers is due to their local economic characteristic. Sidoarjo which shares borders with Surabaya, on the other hand, has experienced HH type of local spatial interaction. Its proximity to Surabaya indicates that its high GDP growth is mostly due to the spread effect of Surabaya's economic growth.

Generally, in 2012, each of the growth centers in East Java has experienced a different phase of growth. Some of them are still in the early stage, in which they start to create the backwash effect on its surroundings (i.e. Madiun, Blitar, and Banyuwangi). But there are some growth centers (i.e. Malang, Probolinggo, Surabaya) which are already in the later stage of the growth, in which they already have spread their growth to their surrounding regencies/municipalities.

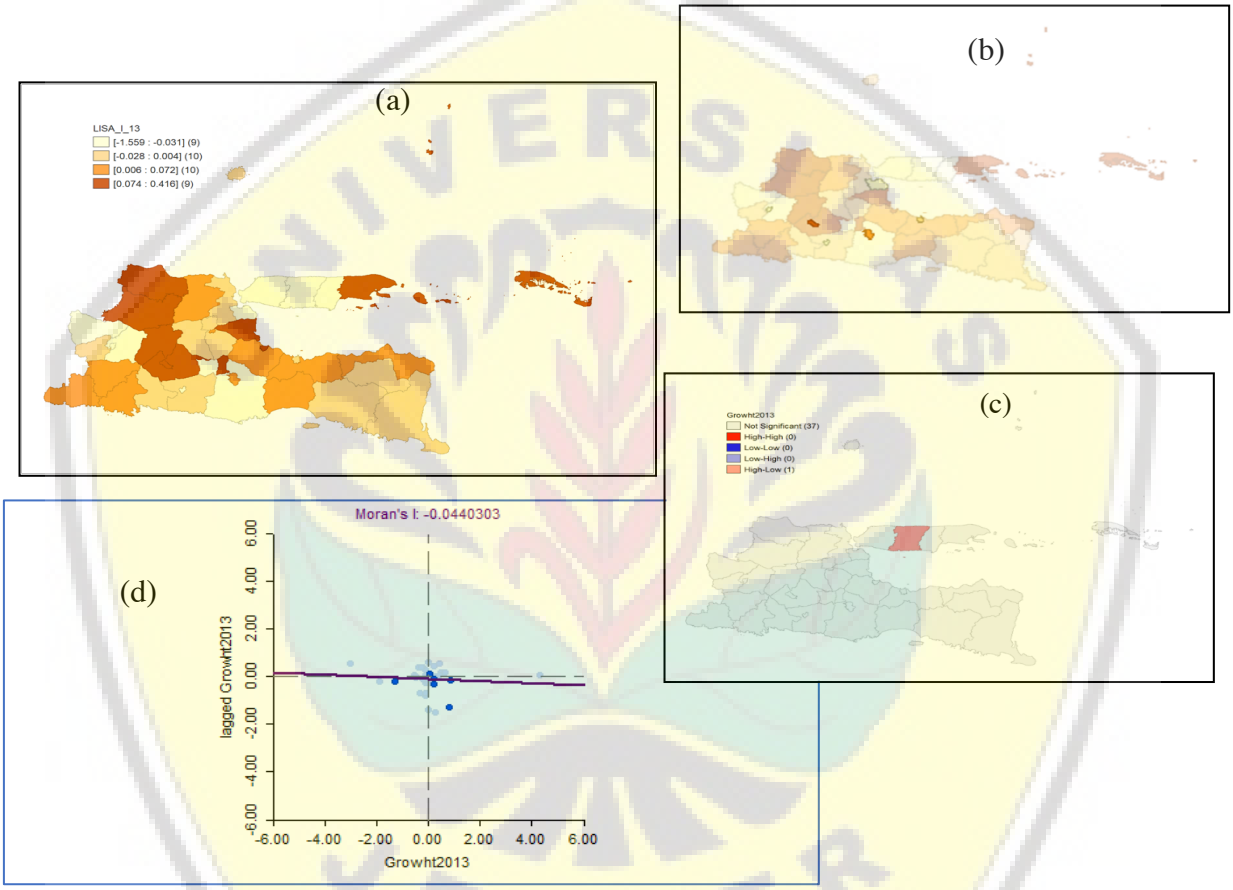

Figure 8 (a) The Distribution Map of Local Moran's I for East Java's 2013 Growth, (b) The value of Local Moran's I for all Growth Poles' 2013 Growth, (c) The map of significant local Moran's I ($\alpha = 0.05$) (d) Moran Scatterplot, for East Java's 2013 Growth

4.3. The 2013 Economic Growth

The general pattern of local spatial interaction of 2013 East Java's economic growth is depicted in Figure 8(a). There is slight change of pattern, but still, the strongest local spatial interaction emerges in SWP 1 and SWP 2. Combining with the map which focuses on the growth centers in Figure 8(b), the local Moran statistics of those centers stay insignificance. The Moran scatterplot in Figure 8(d) and the summary of the result in Table 3 indicate that during this year, Probolinggo and Jember experience some changes of their respective local spatial interaction. The local spatial interaction of the growth of Probolinggo changes from HH in 2012 into HL in 2013. In this case, Probolinggo can maintain its high economic growth within those years, and it starts to absorb the economic activity of its neighbors, even though the pull (backwash effect) is not significant enough. Therefore, the insignificant spread effect it produces in 2012 can easily turn into the backwash effect in 2013. A more drastic change happens

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in Jember. Its local spatial interaction of the growth has changed from LH to HL. Jember has experienced much stronger economic growth, such that it can divert the effect to its surrounding regions.

The map in Figure 8(b) reveals that only Sampang (in SWP 1), the non-growth center which has significant local spatial interaction of its economic growth. The type of interaction has changed from LL in 2012 into HL in 2013. Since Sampang is not the direct neighbors of Surabaya, therefore the change of its GDP from low to high is mostly due to its own local condition. Generally in 2013, most of the growth centers are still in the stage of creating a backwash effect on their neighbors.

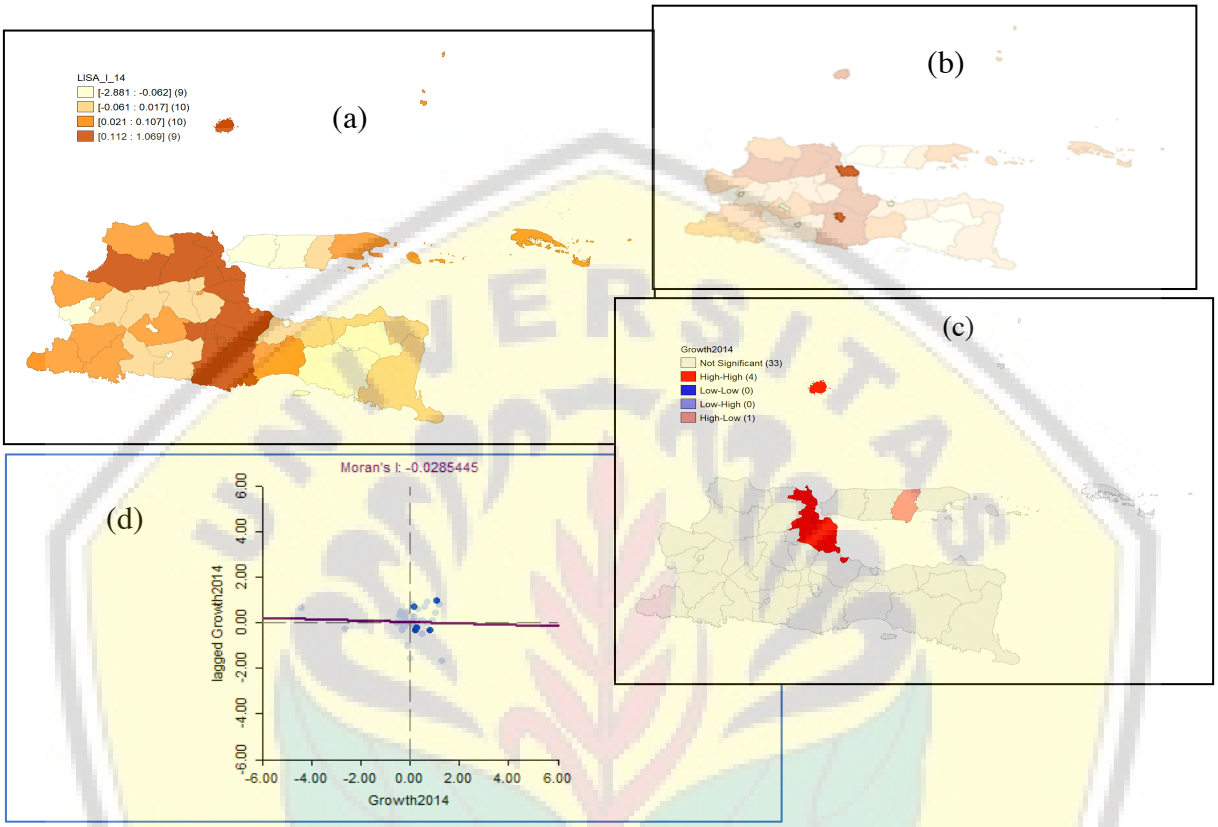

Figure 9 (a) The Distribution Map of Local Moran's I for East Java's 2014 Growth, (b) The value of Local Moran's I for all Growth Poles' 2014 Growth, (c) The map of significant local Moran's I ($\boldsymbol{\alpha = 0.05}$), (d) Moran Scatterplot, for East Java's 2014 Growth

4.4. The 2014 Economic Growth

The pattern of local spatial interaction of 2014 East Java's economic growth is depicted in Figure 9(a). Most of the regencies/municipalities in SWP 1 and 2 have the strongest positive local spatial interaction. Focusing on the growth centers, the map in Figure 9(b) indicates that the local Moran's I of those centers stay insignificance. The dark blue dots in the Moran scatterplot in Figure 9(d) and the summary of the result in Table 3 show that compares to the situation in 2013, during 2014 there are three growth centers that change their type of local spatial interaction. Surabaya and Banyuwangi change from HL type of local spatial interaction into HH type of local spatial interaction. Banyuwangi stays to have insignificant local spatial interaction, but Surabaya changes its status from insignificant into significant local spatial interaction. The third growth center which changes the status is Kediri. It shifts from LL to HL, even though it stays insignificant. Those changes indicate that some of the growth centers start to shift the stage from creating the backwash effect into the spread effect. Especially Surabaya as the capital city of the province, its high GDP growth significantly supports the high GDP growth of its surroundings. With the change of Kediri's status, all growth centers in 2014 experience high GDP growth, which is relatively high than their respective surrounding regencies/municipalities. The higher GDP growth of Surabaya leads to higher growth of its direct neighbors, Sidoarjo and Gresik, such that both locations (Surabaya, Sidoarjo and Gresik) have significant HH type of interaction (see Figure 9(c)). Pamekasan also has a significant HL type of interaction. Since it is in SWP 1 and Surabaya creates a significant spreading effect, even though it is not Surabaya's direct neighbor, its high GDP growth in 2014 partly due to Surabaya's strong economic growth.

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In general, all growth centers in 2014 have high economic growth. Most of them are still creating the backwash effect, except for Surabaya, Malang and Banyuwangi which start to spread their growth to their respective neighbors. The most significant spread effect is produced by Surabaya.

4.5. The 2015 Economic Growth

The distribution map in Figure 10(a) indicates that in 2015 there is a decrease on the number of growth centers with positive local spatial Moran LISA of GDP growth. Only Malang stays at positive HH local spatial interaction. The rest of the growth centers experience negative HL local spatial interaction. Most of them have the same condition as the condition in 2014, except for Surabaya and Banyuwangi (see Table 3 for complete comparison). The local spatial interaction of their GDP growth returns to the condition in 2013. After experiencing the HH type of interaction in 2014, in 2015 they return to the HL type of interaction. Therefore within 1-year time duration, East Java's economic growth phase changes from spread to backwash stage (again).

Figure 10(c) shows that during 2015 there are 4 regencies/municipalities which have significant local Moran's I. They are Surabaya (HL), Tuban (LH), Sampang (LL), and Pamekasan (HL). Among them, Surabaya is the only growth center. Both are in SWP 1. Even though they are not the direct neighbors of Surabaya, their current situation is partly due to the backwash effect created by Surabaya.

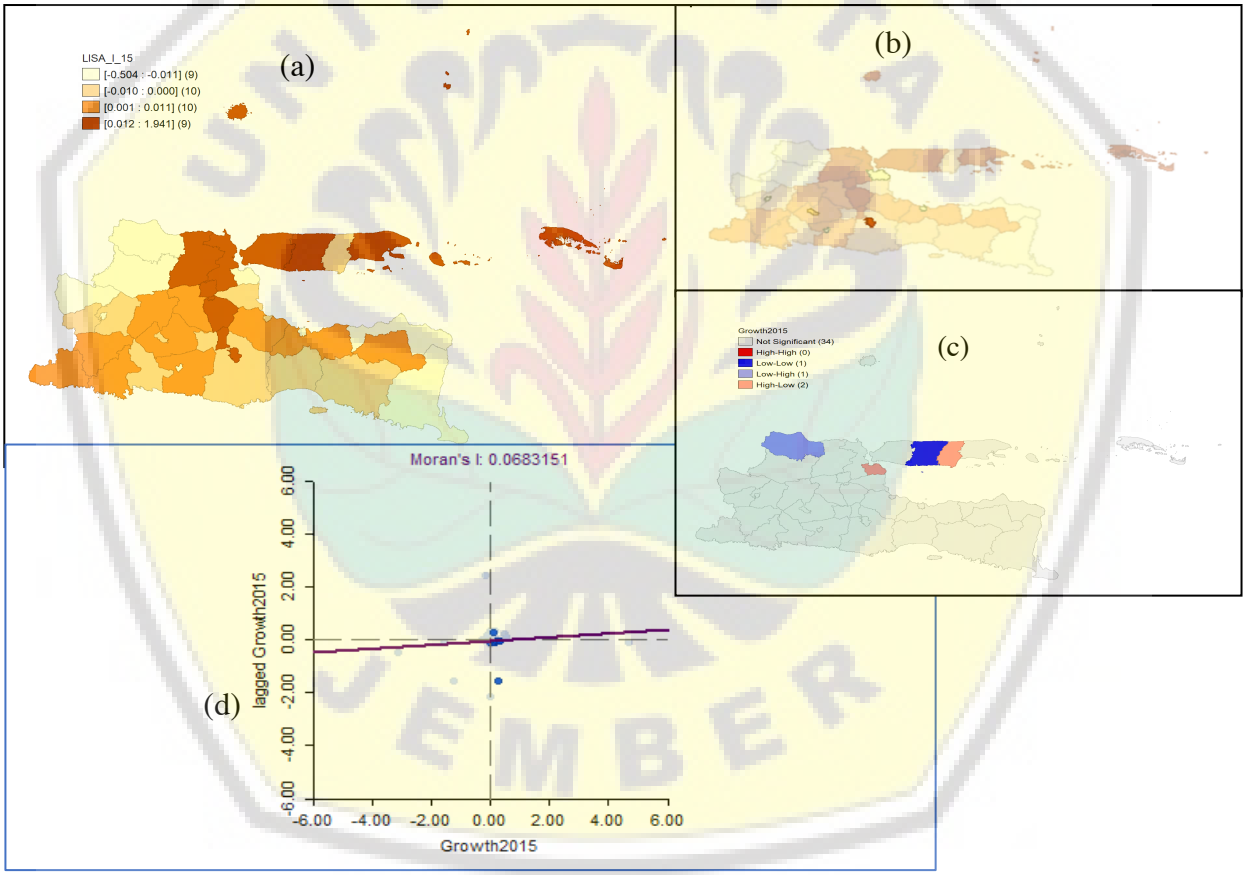

Figure 10 (a) The Distribution Map of Local Moran's I for East Java's 2015 Growth, (b) The value of Local Moran's I for all Growth Poles' 2015 Growth, (c) The map of significant local Moran's I ($\boldsymbol{\alpha = 0.05}$), (d) Moran Scatterplot, for East Java's 2015 Growth

4.6. The 2016 Economic Growth

Based on the distribution map in Figure 11(a), in 2016, the clusters regencies/cities with positive local spatial interaction of GDP growth are shifted from SWP 1 to SWP 5, 6, 7 and 8. However, since the positive local Moran's I might correspond to either HH or LL, an additional tool of ESDA is needed to decide the type. The focus is limited to only the growth centers (see Figure 11(b)). Combining the map in Figure 11(b) and the Moran scatterplot in Figure 11(d), from HL type of interaction in 2015 (negative interaction), Kediri, Banyuwangi and Jember change

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their type of interaction into HH, LL and LL, respectively. The rest of the growth centers still have an HL type of negative local spatial interaction (see the summary in Table 3). Among those growth centers, Surabaya is the only growth center that has significant HL type of negative local spatial interaction. Tuban and Sampang are the non-growth central with significant local spatial interaction occurs. Each has an LH and HL type of interaction, respectively. Since Surabaya creates a significant effect, the low growth in Tuban is partly due to the indirect backwash effect of Surabaya's growth, in addition to its local economic condition. On the other hand, the local economic condition of Sampang might dominate the indirect backwash effect of Surabaya, such that its GDP growth is still considered significantly high than its neighbors.

Generally in 2016, even though the local spatial interaction in each of the growth centers is not significant, the mostly HL type of interaction indicates that the economic growth in this province is in the phase of creating the backwash effect from the growth center to its surrounding. Kediri is the only growth center that tends to stimulate the high growth of its neighbors. This year, Banyuwangi and Jember do not perform high enough GDP growth, such that they fail to stimulate the growth of their respective neighbors.

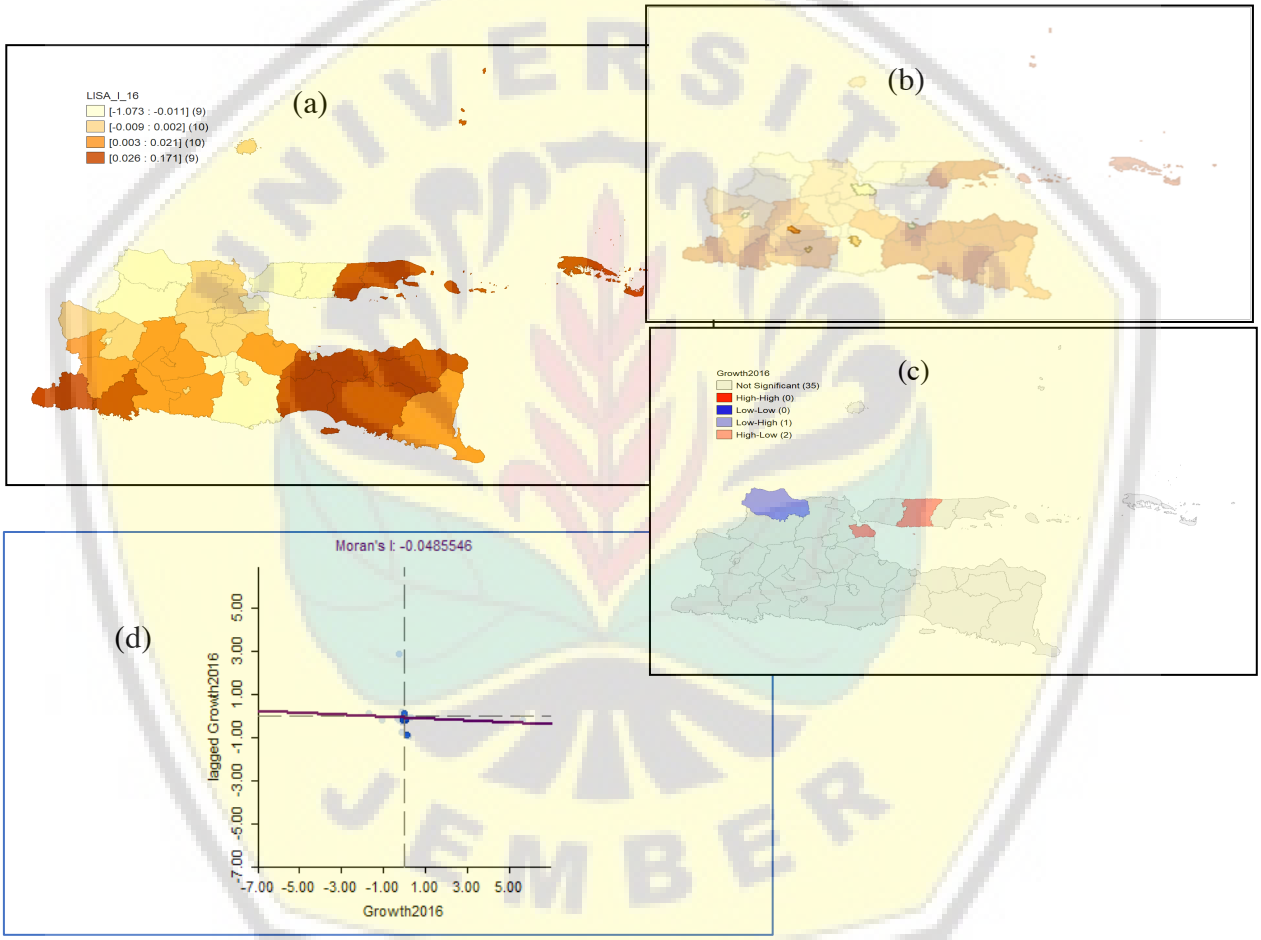

Figure 11 (a) The Distribution Map of Local Moran's I for East Java's 2016 Growth, (b) The value of Local Moran's I for all Growth Poles' 2016 Growth, (c) The map of significant local Moran's I ($\boldsymbol{\alpha = 0.05}$), (d) Moran Scatterplot, for East Java's 2016 Growth

5. Conclusions

After completing the ESDA for East Java's GDP growth over 2011 – 2016, some conclusions regarding the nature and the phase of economic growth within the province can be drawn, which are related to the implemented spatial plan. The strength of the spatial interaction of the growth decreases over the year. It is an indication of the dynamic of spatial interaction, which is more apparent locally over the years. Until 2016, the regional economic growth is

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still not evenly distributed. Some regencies/municipalities (mostly the growth centers) have considerably high economic growth compared to their respective neighbors. The growth of each growth centers does not significantly affect the growth of each of their neighbors, except for Surabaya. The significant effect of Surabaya is expected because it is the capital city of the province. The phase of the growth has dynamically changed. The growth centers start from mostly low GDP growth in 2011, then change slightly into higher GDP growth which partly creates backwash effect, until the growth is high enough to spread its effect in their neighbors. However, the stage of spreading the growth applies only two years after the spatial plan is implemented (in 2012). The stage of the growth, unfortunately, returns into the backwash effect – stage, and some growth centers act dominantly as the polar for their surroundings.

The results suggest that the implemented spatial plan needs to be evaluated. The growth centers, especially which are too distant from Surabaya must be provided with better infrastructure. With the improvement of better road infrastructure from the growth centers to their respective neighbors hopefully, strengthen the role of the growth centers in promoting the growth of their neighbors.

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