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MODELLING GROSS DOMESTIC REGIONAL BRUTO IN EAST JAVA PROVINCEUSING SPATIAL REGRESSION

Abdul Karim

Universitas Muhammadiyah Semarang , Semarang

***Corresponding author email: abdulkarim@unimus.ac.id**

Abstract

Central Java is considered potential to trigger an increase in national economic growth, the economic characteristics of Central Java is determined by agriculture, industry and trade, hotels and restaurants (PHR). Each region in Central Java has different characteristics, the western and southern regions are dominated by the agricultural sector, the northern region is dominated by PHR, while the east is dominated by the industrial sector. Based on these characteristics, it is necessary to do a spatial data-based analysis on GRDP data so that the above phenomena are modeled based on the economic characteristics of each region and know the relation of the region to each other in the context of the growth of Gross Regional Domestic Product (GRDP). Spatial regression is one of the solutions of the above problems, this method of development of regression analysis, spatial regression not only see the global effect also see the local effect. In this study using spatial regression with lag in independent variables, this model is called spatial lag X (SLX). Data used in this research is data obtained from Central Bureau of Statistics (BPS) in 2015, including data of GRDP price applies to 35 districts and cities in Central Java Province for the year 2015. Besides data of GRDP, data of factors influencing GRDP price Such as Road infrastructure data, Human Capital, and Manpower, are also used in this study. Based on the analysis result, it can be concluded that the human capital parameters give significant influence on OLS and SLX model. While in the SLX model only the weighted variable of labor has significant effect. Furthermore the best model is shown with the highest R2 value, the SLX model produces R2 of 0.64, so the best model obtained is the SLX model. Thus, it can be concluded that the GRDP value in a region in Central Java is influenced by the value of the human capital of the region as well as the labor of the nearest region.

Keywords: Spatial Regression, Moran's I, Gross Domestic Regional Bruto

1. Introduction

1.1 Economic Growth of Central Java

Central Java is a potentially potential province in the context of national economic growth, as economic growth trends are improving after the global crisis of 2008. In addition to being the third most populous province after West Java and East Java, Central Java's economy is relatively stable. Figure 1 shows the economic growth trend of Central Java with the national, from 2013 the economic growth of Central Java continues to increase. In 2013 Indonesia's economic growth is at 5.34 percent and 5.14 percent, while there is an upward trend in 2014 of 5.42 percent and 5.44 percent in 2015 (BPS, 2016). In contrast to Indonesia's economic growth that declined in the last 3 years, the economic growth of Central Java experienced an upward trend and was above the national economic growth level.

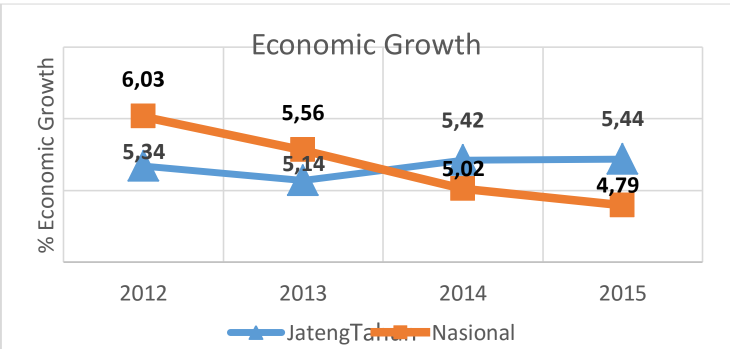

Fig.1.1 Comparison of Economic growth rate of Central Java and National

Central Java is considered potential to trigger an increase in national economic growth, the economic characteristics of Central Java is determined by agriculture, industry and trade, hotels and restaurants (PHR).

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The industrial sector, PHR (trade, hotels and restaurants) and agriculture, are each the leading sectors in Central Java Province. The sectoral real growth in 2012 has fluctuated from the previous year, the highest growth achieved by the financial sector, leasing and business services of 9.36 percent, but its role to GRDP is only about 3.89 percent. The agriculture sector experienced the lowest growth in 2012, at 3.71 percent. (BPS, 2013)

The industrial sector as one of the sectors that play a role in economic growth in Central Java, as well as acting as a provider of employment that accommodate the workforce. With a positive growth rate, the industrial sector plays a role in maintaining the national economic growth rate. Based on BPS data in 2013, the industry sector contributed the highest to GRDP in Central Java, namely 203,104,060.25 Million Rupiah.

Based on the above phenomenon, it is necessary to do a spatial data-based analysis on GRDP data so that the above phenomena are modeled based on the economic characteristics of each region and know the relation of the region to each other in the context of the growth of Gross Regional Domestic Product (GRDP). Spatial regression is one of the solutions of the above problems, this method of development of regression analysis, spatial regression not only see the global effect also see the local effect. In this study using spatial regression with lag in independent variables, this model is called spatial lag X (SLX) by Lesage and Pace (2009).

Application of SLX methods that are part of Spatial Analysis can be used, as well as the addition of spatial effects as an influential component in the model. In the field of regional science, spatial effects are common between one region (for region) and another region of spatial autocorrelation (Karim, 2016). Examining the existence of regional effects is very important because ignoring it will lead to inaccurate conclusions. According to Anselin (2005), spatial autocorrelation is used to analyze spatial effects, which is actually a phenomenon occurring in spatial data. The analysis associated with the spatial aspect plays an important role in the formation of regional development.

1.2 Spatial Autocorrelation

According to Anselin (2013) Spatial Autocorrelation is the correlation between variables by itself based on space or can also be defined as a measure of the similarity of objects within a space (distance, time and region). If there is a systematic pattern in the dispersion of a variable, then there is spatial autocorrelation. In other words, spatial autocorellation suggests that observations at a location depend on observations in other locations that share similar characteristics. Spatial autocorellation measurements can use Moran's I. The hypothesis used is:

$H_o: I_M = 0$ (no autocorrelation)
$H_1: I_M \neq 0$ (There is autocorrelation)

According to Elhorst (2009) the test statistic used is in the following equation

$$Z_{hitung} = \frac{I_M - I_{Mo}}{\sqrt{var(I_M)}}$$

where,

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

$$E(I_M) = I_o = -\frac{1}{n-1}$$

$$var(I_M) = \frac{n^2(n-1)S_1 - n(n-1)S_2 - 2S_o^2}{(n+1)(n-1)S_o^2}$$

$$S_1 = \frac{1}{2}\sum_{i \neq j}^{n}(w_{ij} + w_{ij})^2 \qquad S_2 = \sum_{i=1}^{n}(w_{io} + w_{oi})^2 \qquad S_o = \sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}$$

$$w_{io} = \sum_{j=1}^{n} w_{ij} \qquad w_{oi} = \sum_{j=1}^{n} w_{ji}$$

where :
x_i = unit-i (i = 1, 2, ..., n)
x_j =unit-j (j = 1, 2, ..., n)
$\bar{x}$ = mean
var (I) = varians Moran's I
E(I) = *expected value* Moran's I

1.3 Spatial Lag X (SLX)

Regression analysis is one of the statistical methods that study the pattern of relationship mathematically between one dependent variable with one or more independent variables. The goal is to find out how much the value of the dependent variable on the basis of the influence of independent variables. Spatial regression with lag in independent variables is called spatial lag X (SLX) by Lesage and Pace (2009). The SLX model is a local linear regression model that produces the alleged parameters of the local regression model. The SLX model can be formulated as follows.

$$\mathbf{y} = \mathbf{X\beta} + \mathbf{WX\gamma} + \boldsymbol{\varepsilon}$$

where y is the N x 1 vector of the endogenous variable, X is the N xp matrix of the exogenous variable, ß is the px 1 vector in the regression coefficient, W is the N x N weighting matrix which expresses the N economic relationship, is the spatial parameter of the dependency, and e is Vectors are independent and identical distributed (iid).

2. Methods

2.1 Data

The data used in this study is data obtained from the Central Bureau of Statistics (BPS) in 2015. Defined observation unit In this study were 35 districts and cities in Central Java Province. Used GRDP data rates apply to 35 districts and cities in Central Java Province for 2015. In addition to GRDP data, data on factors affecting price GRDP apply as Road infrastructure data, Human Capital, and Manpower, also used in this research.

Variables (variables) to be used in the study refers to research Arbues et.al (2016) and Hikmah (2012). Variables in this study consists of two parts, namely response variables (Y) and explanatory variables (X). The variables are presented in Table 3.1 as follows:

Table 2.1 Research Variables

No	Variabels	Definition	Type of Variabels	Source
1	GDRP	Gross Domestic Regional Bruto	Response	BPS
2	INF	Infrastructure road (Km)	Explanatory	BPS
3	HC	*Human Capital* (person)	Explanatory	BPS
4	TK	Employment (person)	Explanatory	BPS

2.2 Procedures

The analysis used in this research consisted of GRDP mapping, then Spatial Lag X (SLX) modeling was done to find out the factors influencing GRDP. Here is the analysis phase,
a. Map the districts and municipalities from the distribution of employment by sector.
b. Specifies a spatial weighted matrix
c. Modeling SLX

3. Results

3.1 Distribution Pattern of Gross Regional Domestic Product of Central Java

Figure 4.1 shows the distribution of district and municipal GRDP in Central Java Province by 2015. Based on Figure 4.1 can be interpreted if the color of each region gets more concentrated, the higher the GRDP value of the region. It is seen that the districts and cities with GRDP level in the first cluster are cluster with the highest GRDP value with the GRDP value range ranging from 38798789 million to 134268634 million. The second cluster has a range of GDP values from 29117331 million to 38798789 million. Meanwhile, as many as 10 districts were identified in the third cluster with GRDP value range of 20182089 million up to 29117331.

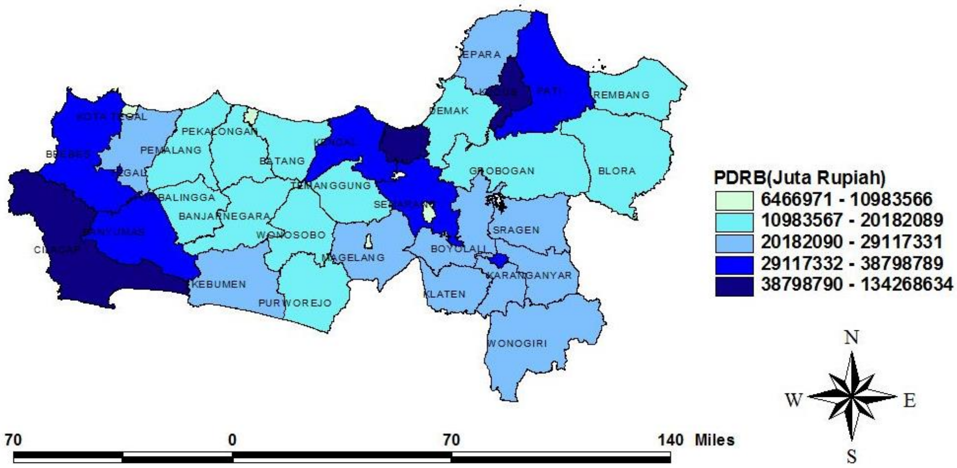

Figure 2.1 Distribution of Regency and Municipal GRDP in Central Java Province
Source: Processed from Central Java publication in Central Java Central BPS figure 2016

In the fourth cluster has a GRDP value of 10983566 million to 20182089 million, and the fifth cluster that has a range of GRDP value of 6466971 million to 9748306 million defines 3 cities that are categorized into clusters namely, Kota Salatiga (9748306 million), Pekalongan City (7778272 million), and City of Magelang (6466971 million). Definition of each district into the cluster Value of GRDP is:

Table 2.2 Definition of cluster value GRDP district and city of Central Java Province

Cluster	Region
Cluster 1	Kota Semarang, Kab.Cilacap, Kab.Kudus
Cluster 2	Kab.Banyumas, Kab.Semarang, Kota Surakarta, Kab.Brebes, Kab.Pati, Kab.Kendal, Kab.kendal
Cluster 3	Kab.Sragen, Kab.Karanganyar, Kab.Sukoharjo, Kab.Tegal, Kab.Magelang, Kab.Boyolali, Kab.Jepara, Kab.Wonogiri, Kab.Kebumen, Kab.Grobogan.
Cluster 4	Kab.Demak, Kab.Pemalang, Kab.Purbalingga, Kab.Pekalongan, Kab.Blora, Kab.Temanggung, Kab.Batang, Kab.Banjarnegara, Kab.Wonosobo, Kab.Purworejo, Kab.Rembang, Kota Tegal
Cluster 5	Kota Salatiga, Kota Pekalongan, Kota Magelang

2.2 Spatial Autokorelasi

The spsaial dependency test is performed using Moran's I test statistic. The purpose is to identify the relationships between the locations in each variable, both response and explanatory variables. Hypotheses on Morans'I test statistics are:

H0: IM = 0 (there are no dependencies)
H1: IM = 0 (there are dependencies between locations)
The test results of spatial dependencies on each variable are presented in table 4.5 as follows:

Table 2.3 Morans'I Test Results

Variabels	Morans'I	P-value	Results
GRDP	0.058	0.163	Terima H_0
INF	0.022	0.307	Terima H_0
HC	0.221	0.007*	Tolak H_0
TK	0.101	0.101	Terima H_0

* Sig α = 5%

Based on the result of Morans'I test, it was found that the GDRR response variable and the explanatory variables INF and TK statistically do not have significant spatial dependencies on α = 5%, whereas HC variable has spatial dependency. Then it can be concluded that human capital variables have regional interrelations, thus the right spatial model is a model with only spatial effects on explanatory or spatial lag X (SLX) variables.

2.3. Estimation Spatial lag X (SLX)

Estimation of ordinary least squares (OLS) and SLX model resulted in parameters affecting GRDP value in Central Java province with a significance level of 5%. The result of parameter estimation shown in table 2.4 as follows,

Table 2.4 Parameter Estimation Results OLS and SLX models

Parameter	**OLS (*P-value*)**	**SLX (*P-value*)**
Intercept	8.005e-05	0.404
	(0.999)	(0.257)
INF	-0.261	-0.158
	(0.137)	(0.372)
TK	0.181	-0.013
	(0.445)	(0.959)
HC	0.676	0.934
	(0.002*)	(0.000*)
WINF	-	-0.169
	-	(0.116)
WTK	-	0.24
	-	(0.022*)
WHC	-	-0.159
	-	(0.183)
R^2	0.49	0.64

***** Sig α = 5%

Based on the output table 2.1 it can be concluded that only significant HC parameters give effect in OLS and SLX models. While in the SLX model there is addition of parameters that are weighted by spatial matrix, where only significant WTK. Furthermore, the best model is shown with the highest R2 value. The SLX model produces R2 of 0.64, so the best model is SLX. Thus, it can be concluded that the GRDP value in a region in Central Java is influenced by the value of the human capital of the region as well as the labor of the nearest region. If you can, the value of GRDP in Semarang City is influenced by human capital Semarang City and Working Plants in the nearest area of Semarang City.

4. Discussion

In this research the best model is SLX model, SLX develop OLS model which not only consider the direct effect but also indirect effect on explanatory variables. Further research can be done by involving spatial lag on explanatory variables, response variables and residual components.

5. Conclusions

Based on the above study, it can be concluded that the human capital parameters give significant influence in OLS and SLX model. While in the SLX model only the weighted variable of labor has significant effect. Furthermore, the best model is shown with the highest R2 value. The SLX model produces R2 of 0.64, so the best model is SLX. Thus, it can be concluded that the GRDP value in a region in Central Java is influenced by the value of the human capital of the region as well as the labor of the nearest region.

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