Patterns of Spatial Modeling of The Economy; Human Capital and Poverty in 60 Regions in Southern Sumatera

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Abstract. This study tests spatial concepts which is calculated in each region of the 60 regions of South Area of Sumatra by analyzing the observed spatial patterns and spatial autocorrelation. The Spatial Analytical Regression (SAR) model was chosen to analyze the cases of spatial linkage and determine how the variables meet the requirements of the model. The analysis tool uses Expletory Spatial Data Analysis with Geographic Information Systems (GIS) and Geodes to analyze the status of the proportion of poor people using Moran I, LISA, and LISA cluster map statistics in 2015. The GRDP of Sumatra's 60 regions suggests a spatial relationship. That is, there should be a clustered pattern of regions with the same characteristics. The results of the Moran I scatter plot show the division of the Moran I quadrant. Eventually, this study shows how population proportions have a significant impact on GRDP and (HDI).

Keywords: GRDP, Moran I, Spatial Autoregressive Model.

1 Introduction

The focus of this study is to see if the development patterns in each region are based on the distribution of GDP in the economy. Currently, spatial units are a very hot topic, when the economy works according to the space of each region, each space works well, has a positive influence on each other, and has a positive spillover effect on neighboring areas. , The regions are positive interrelationships [1]. And mutually beneficial. Therefore, this survey uses the approach and may be one of the surveys with the latest updates. Spatial and economic methods provided in dialogue and dialogue episodes.

This study focuses on looking at the description of the economic pattern in 60 Regions in South Sumatra in 2015-2019 how the spatial pattern of the economy through GRDP. The results of the distribution of GRDP in each region whether it has an economy with the same characteristics or different in each region [2]. The evaluation of the model used in the spatial regression takes elements of the Human Development Index and the Percentage of the Poor, taking these two variables to see a little picture of the influence of human capital and poverty on GRDP. In summary, the main purpose of this study is to analyze the spatial patterns and spatial autocorrelation of regional economic variables. In particular, the five states of South Sumatra are being discussed from an economic perspective.This at the same time serves as a contribution in the field of science with two points of view; spatial and economic.

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2 Literature Review

Economic Growth Theory

This study is b Economic Growth Theory ased on a literature study which shows that the economy has dimensions of space and time in the process. Regional development with regard to the spatial dimension of development activities is based on the idea that economic activities are distributed in an in homogeneous space. Because the location has potential and relative value to other locations, activities with economic and social objectives will be spread according to the potential and relative value of the locations that support it. In the spatial concept, several explanations explain that neighboring relationships have positive and negative spillover effects, where the economy of a region can be said to have the same or different characteristics [3].

In mainstream economics, economic growth theory provides several factors that may be responsible for promoting regional performance [4]. Discussions on the determinants of long-term economic growth originated in the Thoreau growth model (1956) and may include human capital [5], migration (Barro and Salai Martin 2003), and externalities of growth [6]. Enlarged by many others. Elhorst (2010) used spatial economic methods to focus on spatiotemporal models, but they studied only the process of economic growth at the spatial level [7].

Spatial Linkage

Spatial linkage is a relationship that occurs because the interaction depends on adjacent observations, that is, region j. Here is i; j. Interactions can occur between regions in the form of economic relationships. For example, the flow of goods and services, the movement of labor, the inflow of income, remittances, remittances, etc. [8]. Interaction can also occur in the field of technology, namely, the diffusion of technology from areas with higher technology to areas with lower technology. In addition, the political situation in a region will affect policies in that region which will have an impact on neighboring regions [9].

Gross Regional Domestic Product

One of the important indicators to determine the economic conditions in a region/province in a certain period is shown by data on Gross Regional Domestic Product (GRDP), either on the basis of prevailing prices or on the basis of constant prices. The definition of GRDP by National Planning Beureu is the amount of value added generated for all business units in a region, or the total value of final products and services generated by all economic agents in a region. GRDP calculations can be performed using two methods: direct and indirect (attribution) [10].

The State of Art

The growing interest in spatial perspectives is driven by significant changes in theoretical focus. It provides a new theoretical perspective for analyzing phenomena such as peer effects, environmental effects, spatial spillover effects, and network effects [11]. In addition, many other similar studies have emerged on the relationship between spatial and economic variables. Spatically, the role of Geographic Information Systems (GIS) can better explain the link between these two factors. As stated in [12], GIS does more than just display a map. But beyond that, the process of economic development at the local, regional and state levels. Most existing systems use GIS analytics to find suitable locations for different types of development. At a minimum, research on economic impact analysis, space policy design, identification of potential cluster areas, identification of important social relationships, and web-based GIS [13]. Indeed, the examples of economic impacts in the realm presented by GIS show a close link between meeting human needs and degrading the quality of the environment. GIS provides this functionality. Ultimately, this can also explain the restrictions on access to available economic resources and their changes [14].

3 Methodology and Data Analysis

A. Influence Model Using Spatial Concept

1. Spatial Autoregressive Model (SAR)

There are two types of spatial modeling based on the type of spatial data. Spatial modeling based on points and spatial modeling based on area 13. Spatial autoregressive model (SAR) is one of the area-based spatial models. The spatial regression model can describe the relationship between the independent variable (X) and the dependent variable (Y) by incorporating the positional effect of the data, then the equation becomes:

$y = \rho Wy + \beta X + \varepsilon$ (3)

Where:

Y: Dependent variable vector

ρ: Parameters of spatial autocorrelation coefficient on dependent variable

W: Weight Matrix

β-regression parameter coefficient vector

X: Independent variable matrix

ε: Error vector

The hypothesis used for Auto Replay Aggregate Regression is:

H0: = 0 = 0 (parameter is considerably)

Ha: $\rho \neq 0$ (parameter is not important)

2. Spatial Error Model

Describe the equation for (SEM) as followed:

If $\rho = 0$ dan $\lambda \neq 0$, then, the equation:

$y = X\beta + u$ (4)

$u: \lambda Wu + \varepsilon, \varepsilon \sim N(0, o2\ I)$

Where:

y: Dependent variable vector

X: Measure-independent variables

β: Parameter regression Parameter coefficient vector

λ: Spatial autocorrelation coefficient of parameter

ε: Error vector

W: Weight criterions

2. Spatial Error Model (SEM)

Matrix needs grouping Area with intersections. Between the sides of the area and the angle, Where the region's Wij = 1, side by side (common side) , Angle (common vertices . In problem areas Wij = 0 in other areas

$$u\ i = \sum_{j=1\ i \neq j}^{n} w\ ij + \varepsilon\ i$$

If = 0 and 0, then the equation becomes:

H0 : λ = 0 (Parameter is significant)

Ha: $\lambda \neq 0$ (Parameter is not significant)
Lagrange Multiplier (LM) Test
Spatial effects, or spatial dependencies, are caused by the correlation between regions. The effects of spatial dependence, namely lag dependence and spatial residuals, can be tested using the LM test. The results of the LM test are used as the basis for building a spatial regression model. The hypothesis used in the LM test is: The Lagrange multiplier (LM) test implements two hypotheses:

1. For SAR

H0: $\lambda = 0$ (There is no spatial dependency between dependent variables)
Ha: $\lambda \neq 0$ (There is a spatial dependency between the dependent variables)

2. For SEM

H0: $\rho = 0$ (There is no spatial dependency between dependent variables)
Ha: $\rho \neq 0$ (There is a spatial dependency between the dependent variables)

Determination of the Best Model
How to choose the best model based on the value of
Log Likelihood (LL), Akaike's Information Criterion (AIC), and Coefficient of Determination (R2) [11]. However, observing data must be traced back to the theory of fundamental problem to determine which model to describe more accurately. [15].

Log-Likelihood
In statistics, the likelihood ratio test is a statistical test used to compare the correctness of two models. When using the likelihood ratio log, this statistic is called the log-likelihood ratio statistic, and the higher the value of the log-likelihood (LL), the better the model, and the probability of this test statistic. You will get a distribution.

Akaike Info Criterion
The Akaike Information Criterion is a measure of the relative goodness of the statistical model developed by Hirotugu Akaike as the Akaike Information Criterion (AIC) and first published by Akaike in 1974. Akaike Information Criterion (AIC), a general format:
$AIC = -2\ln(L)+2K$
Where K: the number of parameters in the statistical model. L: Maximum value of the probability function of model estimation.

4 Research Result and Discussion

1. Research Result

Evaluation of Spatial Regression Modeling
The spatial model is selected using the Lagrange multiplier (LM) as the initial identification. The Lagrange multiplier (LM) is used to detect spatial effects more accurately using lag, error, or both (lag and error). The spatial linkage test was performed with queen adjacency weighting. The results of the Lagrange multiplier (LM) test in Table 5 are as follows:

Table 1. Result of Lagrange Multiplier (LM)

Spatial Dependence Test	Score	P-Score
Moran'I (*error*)	4,0497	0,00005
LM (lag)	10,4709	0,00012
LM (*error*)	12,6766	0,00037
LM (SARMA)	16,5847	0,00025

Source: Result Estimation of Geoda Regresi spasial data calculated, 2021.

In the LM test, the p-value (0.00012) & lt; concluded that the SAR modelling H0 was correct. was denied. = 0.05, LM Robust value is 0.04805. In order for the model to be spatially dependent, it must configure the spatial model used. This is a spatial autoregressive model (SAR).

Table 2. Comparison of classical regression model and spatial regression model

Coefficient	OLS	SAR	SEM
R^2	0,096195	0,184754	0,167744
AIC	156,642	185,531	182,809
Log Likelihood	-75,3208	95,765740	95,4047

Source : Result Estimation of Geoda Regresi spasial data calculated,2021.

Based on Table 6. It shows the AIC at SAR185.531 with log likelihood 95.765740 and R20.184754. This value indicates that the SAR spatial model is superior to other spatial models. The SAR model was chosen to analyze the case of spatial correlation. From the model, we can conclude that the model is a good model if it has the lowest AIC value and the highest log-likelihood and R2 value. Based on the table, you can get the information that SAR is the best model.

Table 3. SAR Estimation Results

Variable	Coefficient	Std.Error	Z-Value	P-value
CONSTANT	3,73651	0,689875	5,41622	0,00000
ρ	0,0667877	0,163682	0,408033	0,68325
PPM	-0,0308992	0,013854	-2,23035	0,02572
IPM	0,0180394	0,00725482	2,48653	0,01290
R^2 = 0,184754				
Likelihood of Log:= 95,765740				
Criterion of Akaike =185,531				
Error Term $\alpha = 0{,}05\%$				

Source: Result Estimation of Geoda Spatial Regression data calculated

***SAR which will be* calculated is:**

$$\widehat{y_i} = 0{,}0667877 \sum_{i=1, i\neq j}^{n} w_{ij} y_i + -0{,}0308992_{PPM_i} + 0{,}0180394_{IPM_i} + \varepsilon_i$$

The SAR model of the spatial lag coefficient value (ρ) is significant, meaning that there is a dependency on the lag between regions. The value of obtained is 0.0667877, which means that the magnitude of the spatial interaction between 60 regions in South Sumatra which have similar characteristics is 0.0667877.

$PDRB_i$: Constanta PDRB ADHK in 60 regions in South Area of Sumatra

PPM_i: Percentage of low income people in 60 regencies/cities in South Area of Sumatra.

IPM: Human Development Index in 60 regencies/cities in South Area of Sumatra

W_{ij}: Weighting criterions

ε_i: Residual of 60 regencies/cities in South Area of Sumatra.

2. Discussion of Research Results

From the results of the survey conducted, the results obtained by the model are as follows.

a) The defect rate coefficient value of PPM: 0.0308992 has a negative and significant effect on GRDP. If the regency / city defect rate increases by 1% and is independent, GRDP decreases by 0.0308992% for every 1% increase in the variable. Variables, spatial weight matrices (w), and residuals (\ /) are considered constant, so the defect rate can be reduced by 0.0308992 percent.

b) HDI: The Human Development Index coefficient value of 0.0180394 has a positive and significant impact on GRDP. If the Human Development Index value is in the regency, then for every 1% increase in the variable, the GRDP will increase by 0.0180394%. The rupiah and independent variables, the spatial weight matrix (w) and the residuals (\ /) are assumed to be constant, so the proportion of poor people can increase by 0.01039 34 percent.

5 Implication and Suggestion for Future Research

Implication

a) GRDP ADHK is known to have a positive Moran's I statistic among the 60 provinces / cities in the five states of South Sumatra. This shows that there is a spatial relationship in the form of positive autocorrelation. This means that the state GRDP's 2015-2019 ADHK Regency / Cities show a clustered pattern.

b) The Moran scatter plot shows that there are 2 regions in quadrant I, HH (HighHigh), 28 regions in quadrant II LH (Low-High), 5 regions in quadrant III, and 25 regions in quadrant IV. The LISA cluster map describes a grouping of GRDPs showing 11 regions covering high-high, 16 regions covering low-low, and one region covering high-low. The LISA significance map consists of 10 regions with a significance level of 0.05, 11 regions with a significance level of 0.01, and 7 regions with a significance level of 0.001.

c) SAR model was selected to analyze cases of spatial linkage where P-Score, AIC, R2, and log-likelihood meet the requirements for using the model.

d) SAR model of the spatial delay factor (ρ) value is important and means that there is a delay dependency between the regions. The proportion of the poor has a significant negative impact on GRDP, the Human Development Index, and a positive impact on GRDP.

Suggestion

a) 60 provinces / cities really need all governments to continue their essentially regional policies, depending on the characteristics of each region of the population. Appropriate and accurate poverty hacking policies in one region are examples in other regions. Neighbors are all other areas.

b) Human capital remains an important part of economic development, with five states with 60 provinces / cities in South Sumatra certainly having human capital, and some research and policy on human capital. Providing guidelines for continuous growth, policy coherence, and regional oversight, education in the middle of continuous HDI is becoming an important factor in South Sumatra's economy.

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