



## Unraveling the spatial dynamics of regional economic disparities in East Java

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### Abstract

The objective of this research was to analyze the determinants of regional disparities in East Java Province. This study utilized panel data, incorporating research locations across 38 regencies in East Java, with a data series spanning from 2016 to 2020. Spatial panel data models were employed to address the research objective, specifically examining the impact of spatial and non-spatial factors on disparities in East Java. The study's findings indicated that the Spatial Autoregressive (SAR) model was the most effective for estimating disparities in the region. The effects of each variable are as follows: the average duration of schooling and investment had positive and significant effects on disparities, while the variable of open unemployment rate did not exhibit any significant effect. Additionally, there is a spatial effect in the form of an endogenous interaction effect, signifying that the extent of disparities is influenced by the disparities in neighboring areas.

*Keywords: regional disparities; average duration of school; unemployment; investment, spatial panel data model.*

### Introduction

Economic growth occurs geographically unevenly and remains localized (Proost and Thisse, 2019), indicating that location plays a crucial role in regional economic development. The process of economic growth in a region is closely related to its geographic position relative to other regions (Ernawati et al., 2014). Additionally, the diverse resources a region possesses and its ability to manage them affect the success of its economic growth. Therefore, the success of economic growth varies across regions. A region that efficiently and effectively utilizes its resources will exhibit different outcomes compared to one that does not (Miranti, 2022).

Empirically, economic growth increases unevenly across regions. Myrdal (1957) suggested that economic growth is a special cumulative process, implying that spatial accumulation creates developmental disparities between regions. Contrarily, Kuznets (1955) explained that economic development disparities tend to increase in the early stages of economic development but eventually decline at a certain point.

Disparities in economic development are common issues in many regions, often caused by the resources available to a region. Variations in resources lead to uneven economic activities, concentrated in specific areas (Santoso et al., 2019). Consequently, concentration and unevenness become the most striking characteristics of economic activities geographically (Kuncoro, 2012). Regions with higher economic activities grow faster than those with lower activities, triggering disparities in economic development between regions.

Regional disparities on a macro scale may inhibit development processes and reduce the scope of national growth (Majumder, 2021; Ohlan, 2013), affecting economic factors and policymakers (Novkovska, 2017). East Java Province, with its substantial economic resources and strategic location connecting western and eastern Indonesia, plays a vital role in the national economy due to the high flow of goods and trade. Figure 1 shows the gross regional domestic product (GRDP) across regencies and municipalities in East Java Province. The unequal GRDP distribution indicates varying intensities of economic activities, which in turn signal economic development disparities between regions in East Java.

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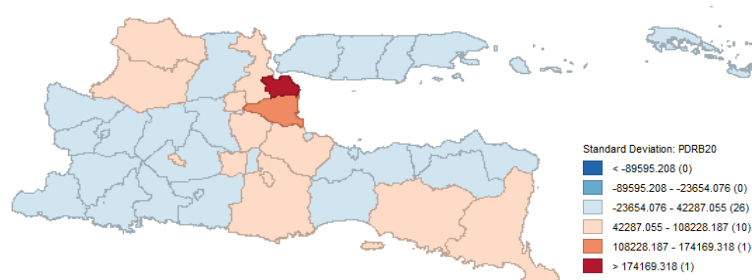


Figure 1. Distribution of GRDP in East Java Province in accordance with regency/municipality

Several factors, such as human resources, capital resources, and unemployment, may affect economic development disparities between regions. The quality of human resources, influenced by educational background, plays a significant role. Todaro (2000) described education as a primary goal of economic development, affecting income and, consequently, long-term economic growth and disparities. In this study, the education variable is proxied by the Average Duration of Schooling in East Java to examine its effect on economic development disparities.

The amount of capital in a region, often measured through investment, accelerates economic development. Harrod (1939) and Domar (1946) theorized a positive correlation between investment and economic growth, implying that lack of investment leads to lower economic growth and income, exacerbating development disparities. This study uses foreign direct investment as a proxy for investment.

Unemployment also impacts regional disparities. Unemployment refers to individuals within the labor force who are jobless, becoming a burden on economic development and increasing disparities. Keynes suggested that unemployment results from insufficient labor demand, hindering economic development and creating disparities.

Economic activities are not solely determined by local characteristics but also by interactions with surrounding regions. Santoso et al. (2019) describe these interactions as spatial relations, resulting in spatial effects. Spatial interaction involves various flows between places related to human and material movement, creating a demand and supply relationship expressed through geographic space (Wang, 2017). Ullman (1957, 1980) introduced the concept of spatial interaction, defining it with three interdependent conditions: complementarity, transferability, and opportunities for intervention.

As noted by McCulloch and Sjahrir (2008) and Akira et al. (2011), regional development analysis must consider spatial effects at the sub-national level. Traditionally, economies have been viewed as independent units, ignoring potential spatial interactions between regions (Rey and Montouri, 1999). The application of spatial approaches to study regional economic development disparities has been limited, as seen in the scarce previous research. Analyzing disparities in East Java by considering both non-spatial and spatial variables presents a novel approach. This paper aims to contribute theoretical insights and empirical observations on spatial disparities in Indonesia, utilizing a spatial approach to explicitly account for spatial dependence among regional units in analyzing geographical inequality.

The rest of this study is organized as follows: the second section discusses the literature review. The third section outlines the data and methodologies applied, analyzing the main expected results. Finally, the last section provides the study's conclusions.

## Literature Review

Economic growth across regions is inherently uneven, manifesting in a dichotomy between highly developed regions with intense economic activities and underdeveloped regions with limited economic activities. This unevenness can have both positive and negative implications. Positively, it can incentivize underdeveloped regions to enhance their economic welfare by emulating successful regions. However, the negative effects of extreme unevenness include economic inefficiency, social instability, weakened solidarity, and a general perception of injustice (Todaro, 2003; Simbolon, 2017). Myrdal (1957) argued that such regional disparities arise due to the dominance of the backwash effect over the spread effect, particularly in developing countries. The backwash effect refers to the negative impacts on underdeveloped regions due to the outflow of resources towards more developed areas. Jhingan (2010) further explained that capital movement towards developed regions increases demand, stimulates investment, and raises income in those areas, while creating capital scarcity in underdeveloped regions.

Local resources, especially human resources, are a critical determinant of regional economic development. The quality and quantity of human resources significantly influence economic outcomes. Becker (1993) posited that human resources act as capital, providing returns on investment through enhanced productivity. Formal education plays a pivotal role in this process, as it increases the skill levels of the labor force, leading to higher productivity (Tomul, 2009). Higher education levels are often correlated with greater economic output and growth, as well-educated individuals are typically more innovative and efficient.

Investment levels in a region also play a crucial role in determining economic growth and disparities. The Harrod-Domar model (Harrod, 1939; Domar, 1946) emphasizes the importance of capital accumulation in fostering economic growth. This model combines classical economic theories with Keynesian principles, highlighting that investment is essential for maintaining economic stability and growth. According to Harrod and Domar, a lack of investment leads to lower economic growth and income, exacerbating regional disparities.

Unemployment is another critical factor affecting regional disparities. Unemployment represents the portion of the labor force that is jobless, which poses a burden on regional economic development and exacerbates disparities. Keynes (1936) suggested that unemployment results from insufficient demand for labor, preventing the labor market from fully absorbing available workers. High unemployment rates hinder economic development and contribute to widening regional disparities.

The significance of spatial effects in regional economic development cannot be overlooked. Traditionally, regional economies have been viewed as independent units, disregarding potential spatial interactions (Rey and Montouri, 1999). However, spatial dependence—where an observation in one location is influenced by observations in other locations (Paas, 2007)—is critical in understanding regional economic disparities. Spatial dependence can arise from various factors, including technology spillovers, labor and non-labor migration, commodity flows, and other beneficial interactions (Rey and Janikas, 2005). These spatial interactions underscore the importance of considering geographic dimensions in economic analyses.

The application of spatial econometric models in analyzing regional economic development disparities is relatively limited but offers significant advantages. These models capture spatial effects or relationships within an economy, providing a more comprehensive understanding of regional disparities. Tobler's first law of geography—"Everything is related to everything else, but near things are more related than distant things" (Tobler, 1970, 2004)—highlights the relevance of spatial dependence in economic studies. Ignoring spatial problems can result in biased and inconsistent estimators when using traditional methods like Ordinary Least Squares (OLS) (Anselin, 1988). Spillover effects, which describe how economic activities in one region influence neighboring regions, are essential for explaining the distribution of economic activities. Hence, the geographic dimension must be considered in regional economic analyses.

Recent studies have increasingly acknowledged the importance of spatial effects in regional economic development. For instance, Akita et al. (2011) and McCulloch and Sjahrir (2008) emphasized the need to consider spatial dependence in sub-national economic analyses. Spatial econometric models allow researchers to account for the interactions between regions, providing a more accurate depiction of economic dynamics. These models also help identify the factors driving regional disparities and offer insights into potential policy interventions to mitigate these disparities.

Despite the growing recognition of spatial effects, research on the determinants of regional economic disparities using spatial econometric models remains limited. Existing studies have predominantly focused on non-spatial variables, neglecting the spatial interactions that significantly influence economic outcomes. This gap in the literature highlights the need for further research that incorporates spatial econometric models to better understand regional economic disparities.

In conclusion, regional economic disparities are influenced by various factors, including local resources, human capital, investment levels, and unemployment. The consideration of spatial effects is crucial for a comprehensive analysis of these disparities. Spatial econometric models offer valuable insights into the interactions between regions and the factors driving regional economic development. This study aims to contribute to the literature by utilizing spatial econometric models to analyze regional economic disparities in East Java Province, considering both non-spatial and spatial variables. The findings will provide theoretical insights and empirical evidence on the determinants of regional economic disparities and offer policy recommendations to promote balanced regional development.

## **Research Method**

### Method of Analysis

A spatial econometric approach is utilized to examine the influence of both spatial and non-spatial aspects on economic development disparities among regions in East Java Province. This approach is particularly suitable for data that includes geographic coordinates, as spatial effects frequently occur between neighboring regions. In spatial data, observations at one location often depend on observations at nearby locations. Consequently, using the Ordinary Least Squares (OLS) method can result in spatially autocorrelated residuals, leading to biased and inconsistent estimates. This, in turn, can make the overall conclusions based on the model incorrect (Anselin, 1988; LeSage and Pace, 2009; Arbia, 2005).

Spatial econometric analysis addresses spatial dependence within an econometric model. It is a collection of techniques that tackle spatial issues, such as spatial autocorrelation and heterogeneity, within regression models that utilize spatial data points (Anselin, 1988). Elhorst (2016) identified two main challenges when incorporating panel data into spatial analysis: 1) spatial correlation may occur between objects of observation in each period, and 2) parameters may vary across different locations, indicating non-homogeneity. Traditional panel regression methods fail to capture these spatial effects. Although traditional panel regression can show different intercepts, these intercepts do not reflect differences between spatial units, potentially omitting relevant variables from the model or capturing them within the error term.

### Specification of the Research Models

The determinants of disparities (DISP) in economic development among regions in East Java Province analyzed in this study include Average Duration of School (SCHOOL), Investment (INVEST), and Open Unemployment Rate (UNEMP) for each regency or municipality. Additionally, the study considers the endogenous interaction effect ( $\rho$ ), exogenous interaction effect ( $\theta$ ), and interaction among error components ( $\lambda$ ). The functional model design is formulated as follows equation (1).

$$DISP = f(SCHOOL, INVEST, UNEMP, \rho, \theta, \lambda) \quad (1)$$

This study analyzes the influence of each independent variable on the dependent variable using various spatial econometric models. Four spatial panel data models are employed: the Spatial Autoregressive Model (SAR), the Spatial Error Model (SEM), and the Spatial Durbin Model (SDM). The SAR model assumes spatial autoregression in the response variable, the SEM model assumes that the error term follows a spatial autoregressive process, and the SDM model assumes spatial autoregression through both predictor and response variables.

### Data

The research uses panel data from East Java Province, comprising 38 municipalities/regencies. The data sources are officially published by the Central Bureau of Statistics and related institutions. This study utilizes secondary data, including Gross Regional Domestic Product (GRDP), Average Duration of School (SCHOOL), Investment (INVEST), and Open Unemployment Rate (UNEMP). The data series covers the observation period from 2016 to 2020.

### Model Data Analysis

This section presents the results of the study on the influence of average duration of school, foreign investment, and open unemployment on the economic disparities among regencies/municipalities in East Java Province from 2016 to 2020. The study analyzed cross-sectional and time series data from 38 regencies/municipalities in East Java Province using spatial panel data analysis with spatial models such as Spatial Autoregressive Model (SAR), Spatial Error Model (SEM), and Spatial Durbin Model (SDM).

Before analyzing the influence of independent variables on the dependent variable, it is essential to measure the level of unevenness among the regencies/municipalities in East Java Province. The Williamson Index was employed to quantify the unevenness between regions by calculating the Gross Regional Domestic Product (GRDP) and population numbers. The Williamson Index ranges from 0 to 1, where values closer to zero indicate more evenly distributed regions, and values closer to one indicate higher levels of unevenness.

### Parameter Estimation Results

The parameter estimation results for each model are presented in Table 1. To select the best model for estimating development disparities between regions in East Java Province, the probability values, Log-Likelihood, R-squared ( $R^2$ ), and Akaike Information Criterion (AIC) values from the SAR, SEM, and SDM

models were compared.

Table 1. Estimation Results of Panel Data Spatial Model

	MODEL		
	SAR	SEM	SDM
MAIN			
<i>SCHOOL</i>	0.047*	0.005****	0.0026 <sup>ns</sup>
<i>INVEST</i>	-7.38e-07*	-6.57e-07*	-8.13e-07**
<i>UNEMP</i>	-0.0000429 <sup>ns</sup>	-0.000066 <sup>ns</sup>	-0.00008 <sup>ns</sup>
Cons	0.044*	0.0575*	0.0485*
Wx (Θ)			
<i>SCHOOL</i>			0.002 <sup>ns</sup>
<i>INVEST</i>			-6.34e-07 <sup>ns</sup>
<i>UNEMP</i>			0.0005*
Spatial			
<i>rho</i>	0.2059598*		0.158 <sup>ns</sup>
<i>lamda</i>		0.163 <sup>ns</sup>	
R-sq	0.0667	0.0590	0.0811
Log-likelihood	649.5681	647.8421	6538.950
AIC	-1287.136	-1283.684	-1674.124

Sig.codes: \*\*\*\* ( $p \leq 0.0001$ ), \*\*\* ( $p \leq 0.001$ ), \*\* ( $p \leq 0.01$ ), \* ( $p \leq 0.05$ ), ( $p \leq 0.10$ ), <sup>ns</sup> ( $p > 0,10$ )

### Selection of the Best Model

Several indicators, including R<sup>2</sup>, Log-Likelihood, and AIC, were used to determine the best model. Among these indicators, the SAR model was found to be the best for estimating regional disparities in East Java. The SAR model exhibited the highest values for AIC and Log-Likelihood and the lowest R<sup>2</sup> value. The following table compares the values of R<sup>2</sup>, Log-Likelihood, and AIC for the three models:

Table 2. Indicators of Model Determination

Indicator	R-square	Log Likelihood	AIC
SAR	0.0667	649.5681	-1287.136
SEM	0.059	647.8421D	-1283.684
SDM	0.0811	6538.950	-1674.124

Based on these indicators, the SAR model was chosen as the best model to estimate disparities in East Java Province. Although the SAR model did not have the highest AIC and Log-Likelihood values, it showed significant spatial and probability values for each variable. Thus, the SAR model was used to estimate regional disparities, formulated as follows in Equation (2).

$$DISP_{it} = 0.2059598 \sum_{j=1}^{38} W_{ij}DISP_j + 0.04402257 + 0.00472176SCHOOL_{it} - 0.000000738INVEST_{it} - 0.00004286UNEMP_{it} + \mu_{it} + \varepsilon_{it} \quad (2)$$

## Result and Discussion

### Analysis Results

The model in Equation (2) includes the effect of endogenous interactions between dependent variables or spatial lag (W<sub>y</sub>), indicating that the spatial autoregressive process passed through the dependent variables. In other words, the dependent variables in location i depend on dependent variables in neighboring regional units. The analysis results showed that rho (ρ) in the modeling is 0.2059, meaning that regional disparity of each regency/municipality is influenced by 0.2059 from each regency/municipality in neighboring regions. The p-value for the spatial lag was lower than 0.05, indicating that the spatial effect significantly affects regional disparities in East Java Province.

The coefficient value for the SCHOOL variable has a positive effect on disparities in economic development between regions in East Java. The coefficient value of the SCHOOL variable is 0.00472176, indicating that if the average duration of school increases by 1%, the average value for disparities in economic development will increase by 0.00472176. The p-value is 0.000, which is lower than 0.05,

showing a significant effect.

The coefficient value for the INVEST variable has a negative effect on regional unevenness in East Java. The coefficient value of the INVEST variable is  $-7.377e-07$ , indicating that if investment (foreign investment) increases by 1%, the average disparities in economic development will reduce regional unevenness by  $7.377e-07$ .

The coefficient value for the UNEMP variable has a negative effect on regional unevenness in East Java. The coefficient value of the UNEMP variable is 0.00004286, indicating that if unemployment increases by 1%, the average value of disparities in economic development will reduce regional unevenness by 0.00004286.

The analysis showed that the coefficient value of variables in this study is 0.04402257, meaning that if the independent variables for average duration of school, investment, and unemployment are constant, the disparities will increase by 0.04402257 on average. The analysis also showed a significant spatial autoregressive process through the endogenous interaction effect on the estimation model of regional disparities in East Java, with a value of 0.2059.

### **The Influence of Average Duration of School**

The analysis using the SAR model reveals that the Average Duration of School (SCHOOL) has a positive effect on disparities in economic development between regions in East Java Province. This finding contradicts the initial hypothesis, which posited that a higher average duration of schooling would reduce disparities in economic development. According to Becker's theory, formal education should enhance productivity, leading to economic growth and reduced disparities. However, our results do not support this theory, suggesting that increased schooling may not necessarily decrease regional disparities in East Java.

This outcome aligns with previous research by Istikharoh et al. (2020), which found a positive relationship between the average duration of schooling and regional unevenness in DI Yogyakarta. Similarly, Umar et al. (2014) found that educational variables contributed to income unevenness in Nigeria. These findings challenge the traditional view that education uniformly promotes economic equity and development.

### **The Influence of Investment**

The research results show that foreign investment (INVEST) significantly reduces disparities in economic development between regions in East Java Province, which is consistent with the hypothesis. This supports Harrod-Domar's investment theory, which suggests that investments increase economic production capacity and local income, thereby reducing regional disparities. Previous studies by Nurhayani et al. (2015) and Yanthi & Sutrisna (2021) also confirmed that investment has a negative effect on disparity, reinforcing the idea that foreign investment can promote more balanced economic development.

### **The Influence of Unemployment**

The analysis indicates that the unemployment variable (UNEMP) has a negative effect on regional disparities in East Java, contrary to the initial hypothesis. This result challenges Keynesian theory, which argues that higher unemployment inhibits economic growth and increases disparities. However, our findings are consistent with Fatsabit & Yusran (2019), who observed a negative relationship between unemployment and disparities in East Java. One possible explanation for this anomaly could be the introduction of assistance programs like the Kartu Pra-Kerja (Pre-Employment Card) in 2020, which provided skill development and financial support to unemployed individuals. This intervention may have mitigated the expected negative impact of unemployment on regional disparities.

### **The Influence of Spatial Aspects**

The analysis of spatial aspects reveals that disparities in economic development tend to cluster, with regions exhibiting high disparities often located adjacent to other high-disparity regions. This clustering suggests that regional disparities are influenced by neighboring areas, supporting the notion of spatial interaction. According to Das & Paul (2020) and Kumar & Prakash (2019), spatial interaction involves various flows between places, including human and material movements, which can affect regional economic conditions.

Spatial analysis highlights that regions interact and influence each other, leading to spatial effects or spillovers (Elhorst, 2016; Vega & Elhorst, 2016). Unlike standard econometric models that assume no spatial spillovers, spatial econometric models account for these interactions, allowing for a more accurate assessment of spatial effects (Anselin, 2019).

The SAR model, selected based on indicators such as AIC and Log-Likelihood, includes spatial

interaction effects through endogenous variables. The model estimation results demonstrate that disparities in each regency or municipality are influenced by the disparities in neighboring regions. For instance, Sidoarjo Regency and Gresik Regency, which exhibit high disparities, are influenced by regional disparities in Surabaya (Das & Paul, 2020).

The spatial interaction between regions can either promote even distribution of economic activities or exacerbate disparities. Strong interactions between neighboring regions can lead to a more balanced distribution of economic benefits, while weak interactions may result in increased disparities (LeSage, 2014).

Myrdal's theory of development inequality, which emphasizes the backwash effect versus the spread effect, is relevant here. The backwash effect describes the negative consequences of economic expansion in one region on surrounding areas, while the spread effect refers to the positive dissemination of development from a central region to others (Myrdal, 1957). Our findings suggest that the backwash effect may be more pronounced, leading to increased regional disparities, although the spread effect could still have a positive influence in some cases.

In conclusion, while our study provides valuable insights into the factors influencing economic disparities in East Java Province, the results highlight the complex interplay between education, investment, unemployment, and spatial dynamics. Further research may be needed to fully understand these relationships and their implications for regional development policies.

### **Conclusions, suggestions and limitations**

The research has provided several key insights into the disparities in economic development between regions in East Java Province. Firstly, the study has found that the average duration of schooling does not effectively reduce these disparities. Contrary to expectations, increasing the average duration of schooling has not led to a significant decrease in economic inequalities between regions. This finding challenges the hypothesis that higher education levels would contribute to more balanced economic development. It also contrasts with Becker's theory, which posits that better education should enhance productivity, thus promoting economic growth and reducing regional disparities. Supporting this, previous research in other regions, such as DI Yogyakarta and Nigeria, has also indicated a positive effect of education on regional disparities.

On the other hand, the study has confirmed that investment plays a crucial role in reducing economic disparities between regions. The findings align with the Investment Theory by Harrod-Domar, which suggests that increased investment enhances a region's economic capacity, thereby improving local incomes and promoting more equitable economic growth. This conclusion is consistent with previous studies, which have observed a negative relationship between investment levels and economic disparity.

However, the research found no evidence that unemployment affects regional disparities in a meaningful way. Contrary to the Keynesian theory, which suggests that higher unemployment exacerbates economic inequalities, the study observed no significant effect of unemployment on regional disparities. This result may be influenced by recent policies, such as the Pre-Employment Card (Kartu Pra-Kerja), which aims to enhance skills and provide financial assistance to the unemployed, thereby mitigating the expected negative impact on regional economic balance.

An important finding of the research is the significant endogenous interaction effect on regional disparities. The study shows that disparities in economic development within a regency or municipality are influenced by the disparities present in neighboring regions. This spatial interaction suggests that economic inequalities are not isolated but are affected by regional disparities in adjacent areas. For instance, high disparities in one regency tend to coincide with high disparities in neighboring regions, indicating a spatial spillover effect.

The study has also provided several recommendations based on these findings. Regions with low average durations of schooling should implement policies that mandate compulsory education and establish minimum educational thresholds. These measures should be complemented by improvements in educational facilities and infrastructure. Additionally, increasing investment in regions with low investment rates is crucial. Enhancing the attractiveness of these regions to investors can help reduce economic disparities. Furthermore, creating job opportunities is essential for reducing unemployment and, by extension, regional disparities.

However, the research is not without its limitations. The analysis model used is suited for assessing short-term effects, and thus, the impact of variables on regional disparities is observed over a relatively

brief period. This limitation means that the study may not fully capture long-term trends and effects. Additionally, the study's scope is restricted to a specific set of variables and does not account for all factors influencing regional disparities. Future research should consider incorporating additional relevant variables, particularly those related to spatial dynamics. Understanding how economic relationships with neighboring regions affect regional disparities will provide a more comprehensive view of the factors driving economic inequality.

### Competing Interests

The author(s) declare that there are no competing interests relevant to the content of this article.

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