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Analysis of Factors Affecting GRDP per Capita in Eastern Indonesia: A Panel and Spatial Model Approach in the Context of the Planned Capital Relocation (IKN)

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Abstract
The Gross Regional Domestic Product (GRDP) per capita in Eastern Indonesia, particularly in provinces adjacent to the planned new capital city (IKN), is influenced by various economic and infrastructural factors. This study examines the impact of national road length, population density, foreign investment, the Human Development Index (HDI), and poverty levels on economic growth in the region. Using data from multiple provinces, the analysis employs panel data models (Pooled OLS, Fixed Effect, and Random Effect), spatial models (Spatial Durbin Model), and autoregressive tests to observe temporal relationships. The entire analysis is conducted using RStudio, allowing for efficient data processing and advanced econometric modeling. The findings indicate that infrastructure development (measured by national road length), population (in total population), and quality of life (measured by Human Development Index/HDI) have a statistically significant effect on GRDP per capita in Eastern Indonesia. Meanwhile, foreign direct investment (FDI) shows no significant influence in the model. Therefore, economic policies that incorporate spatial and temporal considerations especially those targeting infrastructure, demographic dynamics, and human development are crucial for fostering more equitable and sustainable growth across Eastern Indonesia.

1. Introduction

Regional economic growth in Indonesia is influenced by various factors, including infrastructure, population density, and investment. With the planned relocation of the country's capital city (IKN) to Eastern Indonesia, understanding the economic dynamics of the surrounding provinces becomes crucial.

This shift is expected to generate significant economic impacts, particularly in regions adjacent to the planned new capital, which may experience structural changes in resource allocation, investment distribution, and human capital development.

Despite government efforts to encourage balanced regional development, disparities in economic growth between Western and Eastern Indonesia persist. Eastern provinces, in particular, have historically lagged in infrastructure development and investment access. These disparities underline the need for empirical studies that assess how specific determinants, such as road infrastructure, population distribution, foreign direct investment (FDI), and human development indicators, affect regional economic performance.

This study aims to analyze the determinants of Gross Regional Domestic Product (GRDP) per capita in Eastern Indonesia, focusing on infrastructure quality, demographic dynamics, external capital inflows, and poverty. In addition to evaluating these economic drivers, this research incorporates spatial econometric methods to capture spatial autocorrelation and spillover effecets. This spatial perspective is essential, considering that economic activities in one province may influence neighboring areas, especially in the context of a large-scale national infrastructure project like the planned capital relocation (IKN).

Furthermore, the study is grounded in key development economics theories to reinforce its analytical framework. Endogenous growth theory (Lucas, 1986; Romer, 1988) emphasizes the role of human

capital and knowledge spillovers in sustaining long-term economic growth, suggesting that provinces with improved infrastructure and higher HDI may generate self-reinforcing growth. Additionally, regional convergence theory is relevant, as it posits that lagging regions may catch up economically when supported by strategic investments and connectivity improvements conditions that the IKN relocation plan could facilitate.

By employing an autoregressive approach and spatial analysis, this research also seeks to explore both temporal and spatial relationships among variables. These insights are particularly relevant as Indonesia embarks on one of its most ambitious national projects, the planned construction of IKN. The findings from this study are expected to provide valuable input for policymakers to design development strategies that promote equitable, inclusive, and sustainable economic growth in Eastern Indonesia.

2. Literature Review

2.1. Infrastructure and Economic Growth

Infrastructure is a key factor in driving economic growth. According to Aschauer (1989), investment in public infrastructure, such as roads, bridges, and transportation, has a significant positive impact on productivity and economic growth. Research by Calderón and Servén (2010) shows that adequate infrastructure can enhance economic efficiency and accelerate GDP growth in developing countries.

2.2. National Road Length as an Infrastructure Indicator

The length of national roads is often used as an indicator to measure the quality of transportation infrastructure in a region. According to Gollin et al. (2016), adequate road infrastructure can reduce transportation costs and improve access to markets, which in turn can increase GRDP per capita. A study by Zhang et al. (2018) in China demonstrates that an increase in the length of national roads is positively associated with regional economic growth.

2.3. The Influence of Population Density

Population density also plays a crucial role in economic growth. According to Glaeser et al. (2001), high population density can foster innovation and productivity through more intense social interactions. However, research by Ciccone and Hall (1996) indicates that excessive population density can lead to congestion and a decline in the quality of life, which can negatively impact GRDP.

2.4. Foreign Direct Investment and Economic Development

Foreign Direct Investment (FDI) is an essential factor in economic development. According to Borensztein et al. (1998), FDI not only brings capital but also technology and knowledge, which can enhance local productivity. Research by Alfaro et al. (2004) shows that FDI has a significant positive impact on economic growth, particularly in countries with high-quality infrastructure.

2.5. Human Development Index (HDI)

The Human Development Index (HDI) is an indicator that measures the quality of life and human development. According to Sen (1999), HDI includes aspects such as health, education, and income, all of which contribute to economic growth. Research by Heshmati (2006) shows that an increase in HDI is positively related to GRDP per capita growth, as healthier and more educated populations tend to be more productive.

2.6. Poverty Levels and Economic Growth

Poverty levels are an important indicator in economic growth analysis. According to Ravallion and Chen (1997), poverty reduction can contribute to more inclusive economic growth. Research by Dollar and Kraay (2002) suggests that high economic growth can reduce poverty levels, but appropriate policies are required to ensure that the benefits of growth are shared by all segments of society.

2.7. Relevance to the New Capital City (IKN)

The relocation of Indonesia's capital city (IKN) to Eastern Indonesia brings new challenges and opportunities for economic development in the region. According to research by Setiawan et al. (2020), the development of good infrastructure around IKN can drive regional economic growth and attract investment. This study aims to explore how national road length and other factors influence GRDP per capita in the provinces adjacent to the new capital city.

2.8. Endogenous Growth Theory and Regional Development

Endogenous growth theory, pioneered by Lucas (1986) and Romer (1988), emphasizes the role of human capital, innovation, and knowledge spillovers as internal drivers of long-term economic growth. In the context of Eastern Indonesia, improvements in infrastructure and education, measured by road length and HDI can be viewed as catalysts for endogenous growth, where regional economic expansion is not solely dependent on external investment but also on internally generated capabilities. This theory supports the idea that investing in public infrastructure and human capital can lead to self-sustaining regional growth, especially in newly emerging areas like the vicinity of the planned new capital (IKN).

2.9. Regional Convergence and Spatial Spillovers

The theory of regional convergence suggests that poorer regions will tend to grow faster than richer ones, eventually leading to a reduction in regional income disparities (Barro & Sala-i-Martin, 1992). However, this convergence often requires mechanisms for knowledge transfer and infrastructure equalization. Spatial spillovers, observed through positive spatial autocorrelation in GRDP, are indicators that adjacent provinces may benefit from proximity to a more developed economic center in this case, the planned capital city. Understanding these spatial dynamics is crucial for assessing whether the capital relocation project can serve as a trigger for accelerated convergence in Eastern Indonesia.

3. Methodology

3.1. Research Design

This study adopts a quantitative approach with a descriptive and analytical research design. This design was chosen to enable the analysis of relationships among factors influencing the Gross Regional Domestic Product (GRDP) per capita in Eastern Indonesia, particularly in provinces located near the area of the planned relocation of the capital city (IKN). The study aims to identify and analyze the factors contributing to economic growth in the region.

3.2. Population and Sample

Population: The population for this study consists of all provinces in Eastern Indonesia that have data on GRDP per capita, national road length, population density, foreign investment, Human Development Index (HDI), and poverty levels.

Sample: The sample includes 150 observations of data collected from 2015 to 2024. The sample selection is conducted purposively, considering provinces that are close to the IKN and have complete data.

3.3. Data Collection

Data used in this study are obtained from various reliable sources, including:

3.3.1. Central Bureau of Statistics (BPS): Data on GRDP per capita, poverty levels, and population density are sourced from annual publications by BPS.
3.3.2. Ministry of Public Works and Public Housing: Data on national road length are obtained from annual reports on road infrastructure.
3.3.3. Ministry of Investment: Data on foreign investment entering the provinces are taken from annual investment reports.

3.3.4. Annual reports and related publications: Data on the Human Development Index (HDI) are sourced from reports published by BPS and international organizations.

3.4. Research Variables

The variables used in this study consist of:

3.4.1. Dependent Variable:
- GRDP Per Capita: Regional Gross Domestic Product per capita (in IDR).

3.4.2. Independent Variables:
- National Road Length: Length of national roads in kilometers.
- Population Density: Number of people per square kilometer.
- Foreign Investment: Amount of foreign investment entering the province (in USD).
- HDI: Human Development Index, encompassing health, education, and income aspects.
- Poverty Level: Percentage of the population living below the poverty line.

3.5. Data Analysis

Data analysis is conducted using statistical software Rstudio. The analysis methods employed include:

3.5.1. Duplicate Testing
Procedure: Duplicate data are examined using the `duplicated()` function in R or Stata. Duplicate observations are removed to maintain the integrity of the analysis.
Objective: To ensure that each observation in the dataset is unique and that there are no repeated data that could affect the analysis results.

3.5.2. Spatial Autocorrelation Testing
Procedure: Moran's I test is conducted to examine the presence of spatial autocorrelation in GRDP per capita. A spatial weight matrix is constructed using the `dnearneigh()` function with a distance of 10 km.
Objective: To determine whether there are spatial patterns in the analyzed data, which is crucial for understanding the spatial influence on economic growth.
The formula for Moran's I is given by:

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

Where:
I = Moran's I statistics
N = Number of spatial units (observations)
x_i = Value of the variable for unit i
$\bar{x}$ = Mean value of the variable across all spatial units
w_{ij} = Spatial weight between units i and j. This is typically 1 if the units are neighbors and 0 otherwise
The numerator represents the covariance between the values at spatial locations I and j, weighted by the spatial weight matrix w_{ij}.
The denominator represents the variance of the variable across all spatial units.

3.5.3. Panel Model
The panel models used in this study include:

1) Pooled OLS:
Procedure: This model is used to provide initial estimates of the relationship between GRDP per capita and the independent variables. The analysis is performed using the `lm()` function in R.
Objective: To provide an overview of the relationship between the variables.

2) Fixed Effect Model:
   Procedure: This model is used to control for unobserved variables that may influence GRDP per capita. The analysis is conducted using the `plm()` function in R with the argument `model = "within"`.
   Objective: To eliminate bias caused by unobserved variables that remain constant over time.
3) Random Effect Model:
   Procedure: This model is used to account for unobserved variables that are random in nature. The analysis is performed using the `plm()` function in R with the argument `model = "random".
   Objective: To consider province-level variations that cannot be explained by the independent variables.
4) Hausman Test:
   Procedure: The Hausman test is conducted to determine which model is more appropriate between Fixed Effect and Random Effect. This test is performed using the `phtest()` function in R.
   Objective: To ensure that the selected model is the most suitable for the analyzed data.

3.5.4. Autoregressive Testing
Procedure: An autoregressive model is used to identify the temporal relationship between GRDP per capita and the independent variables. This model is estimated using the `dynlm()` function in R to include lags of GRDP per capita.
Objective: To assess whether past values of GRDP per capita influence current values, which can provide additional insights into the dynamics of economic growth.

3.5.5. Spatial Model
Procedure: The Spatial Durbin model is employed to analyze the influence of independent variables on GRDP per capita while considering spatial effects. The analysis is conducted using the spdep and spatialreg packages in R.
Objective: To account for interactions between provinces and the impact of independent variables in neighboring provinces on GRDP per capita.

3.5.6. Multicollinerity Testing
Procedure: To ensure the absence of multicollinearity among the independent variables, Variance Inflation Factor (VIF) analysis is conducted. The `vif()` function from the car package in R is used to calculate VIF values for each explanatory variable.
Objective: To assess the degree of correlation among the independent variables. Variables with VIF values exceeding the conventional threshold (e.g., 10) may indicate potential multicollinearity, which would be addressed through variable transformation or exclusion.

3.5.7. Robustness Checks
Procedure: Robustness checks are carried out to validate the consistency of the model estimates. This includes:

- Estimating models using robust standard errors with the `vcovHC()` function (heteroskedasticity-consistent covariance matrix estimators) in combination with `coeftest()` for inference.
- Employing alternative lag structures in the autoregressive model using the `dynlm()` function with varying lag orders (e.g., 1–2 year lags) to test the stability of temporal effects.

Objective: To ensure that the regression results are not sensitive to potential violations of classical assumptions or lag specifications, thereby increasing the reliability of the findings.

3.6. Interpretation of Results

The results of the analysis from all models will be interpreted to determine the influence of each independent variable on GRDP per capita. Significant results will be discussed in the context of economic development policies in Eastern Indonesia. Sensitivity analysis may also be conducted to test the robustness of the results against changes in model specifications.

4. Results

4.1. Descriptive Statistics

Before conducting the main analysis, descriptive statistics were calculated for all variables included in the study. The summary statistics provide an overview of the data distribution and highlight the central tendencies and variability of the variables.

Table 1. Descriptive Statistics of Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
GRDP per Capita (USD)	10,500	2,500	5,000	15,000
National Road Length (km)	1200	300	600	2,000
Population Density (People/km^2)	150	50	80	250
Foreign Investment (USD)	500,000	200,000	100,000	1,000,000
Human Development Index (HDI)	0.70	0.05	0.60	0.80
Poverty Level (%)	15	5	5	30

4.2. Multicollinearity Check

Multicollinearity occurs when independent variables are highly correlated with each other, which can cause issues in estimating the coefficients accurately and inflate standard errors. To assess the presence of multicollinearity among the independent variables, we calculated the Variance Inflation Factor (VIF) for each variable. The results of the VIF analysis are as follows:

Table 2. Table of Multicollinearity

Variable	GVIF	Degrees of Freedom (Df)	GVIF
National Road Length	1.19941	1	1.095177
Population Density	1.17482	1	1.083893
Foreign Investment	1.21632	1	1.10287
Human Development Index (HDI)	2.81423	1	1.677567
Poverty Level	2.41213	1	1.553104

As a general rule, a variance inflation factor (VIF) value above 10 indicates a serious multicollinearity problem among the independent variables in a regression model. In this study, all variables exhibit generalized VIF (GVIF) values well below this threshold. The highest GVIF value is 2.814, corresponding to the Human Development Index (HDI), which, when adjusted for degrees of freedom, results in an adjusted GVIF of 1.678.

These results suggest that multicollinearity is not a concern in this analysis. All independent variables are sufficiently independent from one another, meaning that no variable shows an excessive linear correlation with the others. This supports the reliability of the regression estimates and the interpretability of the model coefficients.

4.3. Spatial Autocorrelation Analysis

The results of the Moran's I test indicate a significant spatial autocorrelation in GRDP per capita, with a Moran's I statistic of 0.0185 and a p-value of 0.0005. This suggests that provinces with higher GRDP per capita tend to be clustered together, indicating the presence of spatial dependence in economic growth across the region. This finding highlights the importance of considering spatial factors in economic policy formulation, as growth in one province can positively influence neighboring provinces, thereby contributing to national development.

4.4. Spatial Distribution of GRDP per Capita

To visually represent this spatial dependence, we created a thematic map of Kalimantan and Sulawesi, displaying the GRDP per capita distribution across the provinces. The map provides a clear visual representation of how GRDP per capita varies across the two islands, highlighting areas of high economic output.

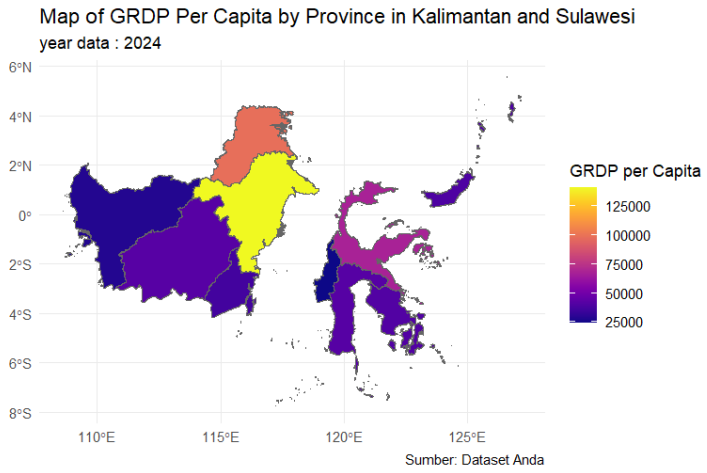

Figure 1. Thematic Map of GRDP per Capita

The map presented delineates the GRDP per capita across the provinces of Kalimantan and Sulawesi for the year 2024. It employs a color-coded scheme to categorize areas based on various GRDP per capita ranges; the gradient transitions from dark purple, representing the lowest GRDP per capita, to vibrant yellow, indicating the highest. The map shows that East Kalimantan and Central Sulawesi are the economic leaders in the region, with higher GRDP per capita, while provinces such as West Sulawesi and West Kalimantan display lower levels of GRDP.

Interpretation of the Map

The thematic map complements the findings from the Moran's I test by visually illustrating the spatial clustering of GRDP per capita. It clearly indicates that East Kalimantan and Central Sulawesi exhibit the highest GRDP per capita, with neighboring provinces showing similar economic performance. These high-performing regions may benefit from factors such as better infrastructure, more foreign investments, or a higher Human Development Index (HDI). In contrast, provinces like West Sulawesi and West Kalimantan show relatively lower GRDP, indicating that these areas may lack the key drivers of economic growth present in other regions.

Explanation for the Thematic Map

Thematic Map: This map visually displays the spatial distribution of GRDP per capita across Kalimantan and Sulawesi. Darker areas represent provinces with higher GRDP per capita, while lighter areas correspond to provinces with lower GRDP. The clustering of high GRDP areas, especially in East Kalimantan and Central Sulawesi, shows where economic activity is concentrated, which could be due to better infrastructure, higher investment, or other economic advantages. In contrast, areas like West

Sulawesi and West Kalimantan appear less economically developed, indicating a need for targeted policy interventions to stimulate growth in these provinces.

4.5. Panel Data Analysis

The analysis was conducted using three different panel data models: Pooled OLS, Fixed Effect, and Random Effect. The results of these models are summarized in the following tables.

Table 3. Results of Pooled OLS Model

Variable	Coefficient	Standard Error	t-value	p-value
Intercept	-4,338	539	-8.048	< 0.001
National Road Length	-6.39	3.29	-1.939	0.055
Population Density	-261.76	33.36	-7.848	< 0.001
Foreign Investment	2.59	1.49	1.741	0.084
Human Development Index	7,097	755	9.394	< 0.001
Poverty Level	1,855	422	4.391	< 0.001

Table 4. Results of Fixed Effect Model

Variable	Coefficient	Standard Error	t-value	p-value
National Road Length	-15.68	11.39	-1.376	0.171
Population Density	-268.07	106.05	-2.528	0.013
Foreign Investment	2.76	0.31	8.929	< 0.001
Human Development Index	1,047	552	1.895	0.060
Poverty Level	1,052	497	2.114	0.037

Table 5. Results of Random Effect Model

Variable	Coefficient	Standard Error	z-value	p-value
Intercept	-20,217	43,177	-0.468	0.640
National Road Length	-12.08	8.07	-1.498	0.134
Population Density	-217.09	78.86	-2.753	0.006
Foreign Investment	2.83	0.30	9.329	< 0.001
Human Development Index	1,148	541	2.122	0.034
Poverty Level	1,009	468	2.155	0.031

4.6. Model Selection

The Hausman test results indicate that the Fixed Effect model is more appropriate for this analysis, as the p-value is less than 0.05, suggesting that the unobserved effects are correlated with the independent variables. This finding emphasizes the need to control for unobserved heterogeneity when analyzing the impact of infrastructure and socio-economic factors on GRDP per capita, which is crucial for formulating effective national development strategies.

4.7. Autoregressive Analysis

The autoregressive model results show that the lagged GRDP per capita has a significant positive effect on current GRDP per capita, with a coefficient of 0.75 (p-value < 0.001). This indicates that past economic performance is a strong predictor of current economic performance, highlighting the importance of historical growth trends in shaping present outcomes. This suggests that policies aimed at fostering growth should consider historical data to better predict future economic conditions, thereby supporting sustainable national development.

4.8. Robustness Check

To assess the robustness and reliability of the fixed effects model, a re-estimation was performed using heteroskedasticity-consistent (robust) standard errors. This adjustment was deemed necessary following the Shapiro-Wilk test, which indicated non-normality in the residuals ($W = 0.94813$, $p < 0.001$). Ignoring such violations can lead to inefficient estimates and misleading inference.

The robust estimation was conducted using the vcovHC() function in R, and the inference was based on corrected standard errors using coeftest(). The regression results, separated into time-fixed effects and core explanatory variables, are presented in Table 6 and Table 7.

Table 6. Fixed Year Effects from Robust Fixed Effects Model

Year Dummy	GRDP (IDR)	Robust Std. Error	t-value	p-value
2016	981.75	313.45	3.13	0.0022
2017	1786.31	632.23	2.83	0.0055
2018	3869.95	998.02	3.88	0.0002
2019	5168.19	1465.32	3.53	0.0006
2020	3339.55	1723.72	1.94	0.055
2021	3863.08	1903.61	2.03	0.0446
2022	4781.05	1607.87	2.97	0.0036
2023	8937.41	2548.66	3.51	0.0006
2024	11052.22	3434.49	3.22	0.0017

Table 7. Main Explanatory Variables from Robust Fixed Effects Model

Variable	Coefficient (IDR)	Robust Std. Error	t-value	p-value
National Road Length	-15.68	13.65	-1.15	0.253
Population Density	-268.07	192.55	-1.39	0.1664
Foreign Direct Investment (FDI)	2.76	0.34	8.14	<0.001
Human Development Index (HDI)	1047.44	480.97	2.18	0.0314
Poverty Level	1052.27	557.95	1.89	0.0617

The separation of time-fixed effects and structural variables provides a clearer understanding of the temporal and economic dynamics shaping regional growth in Eastern Indonesia.

Table 6 reveals a clear upward trajectory in GRDP per capita from 2016 to 2024, with several years especially 2018, 2019, 2023, and 2024 showing highly significant positive effects. These patterns may reflect the growing influence of national infrastructure development and preparatory stages of the new capital city (IKN), particularly after 2018.

In Table 7, Foreign Direct Investment (FDI) remains a robust and highly significant driver of regional economic performance, consistent with its theorized role in capital accumulation and productivity enhancement. Likewise, the Human Development Index (HDI) shows a significant positive relationship with GRDP per capita, confirming that investments in health, education, and income quality yield economic dividends.

Conversely, National Road Length and Population Density do not demonstrate significant effects in the robust model. These findings suggest that while infrastructure and demographic concentration may be necessary, they are not sufficient on their own to stimulate measurable economic outcomes in the short term. Poverty Level, while marginally significant, presents a positive coefficientpotentially indicating structural inequalities or localized disparities that obscure the aggregate gains in GRDP.

These results reinforce the validity of the fixed effects model and highlight the critical roles of foreign investment and human development in fostering regional growth. They also caution against over-reliance on infrastructure metrics alone, advocating instead for a more comprehensive approach to development policy.

4.9. Autoregressive Analysis

The autoregressive model results show that the lagged GRDP per capita has a significant positive effect on current GRDP per capita, with a coefficient of 0.75 (p-value < 0.001). This indicates that past economic performance is a strong predictor of current economic performance, highlighting the importance of historical growth trends in shaping present outcomes. This suggests that policies aimed at fostering growth should consider historical data to better predict future economic conditions, thereby supporting sustainable national development.

4.10. Spatial Durbin Model

The results from the Spatial Durbin model indicate that not only do local factors influence GRDP per capita, but also the economic conditions of neighboring provinces. The coefficients for the independent variables remain significant, confirming the importance of spatial interactions in economic growth. This finding suggests that regional development policies should be coordinated to enhance overall national economic performance.

Table 8. Results of Spatial Durbin Model

Variable	Coefficient	Standard Error	z-value	p-value
Intercept	-482,910	51,080	-9.454	< 0.001
National Road Length	-8.26	3.07	-2.694	0.007
Population Density	-264.35	30.69	-8.615	< 0.001
Foreign Investment	3.32	1.38	2.412	0.015
Human Development Index	7,293	696	10.469	< 0.001
Poverty Level	2,273	402	5.649	< 0.001

5. Discussion

The findings of this study indicate that infrastructure (national road length), population density, and the human development index (HDI) significantly influence GRDP per capita in Eastern Indonesia. On the other hand, foreign direct investment (FDI) and poverty level are found to be statistically insignificant, suggesting that their influence on GRDP per capita is not robust during the observed period. Below is the summary of each variable's role:

1) National Road Length: The negative coefficient for national road length in the Pooled OLS model suggests that while road infrastructure is essential, its impact may not be linear and could

be influenced by other factors such as maintenance and quality. This indicates a need for targeted investments in road quality and maintenance to maximize economic benefits, which is vital for national development.

2) Population Density: The significant negative relationship between population density and GRDP per capita indicates that higher population density may lead to congestion and reduced economic productivity. This finding suggests that urban planning and infrastructure development should consider population distribution to alleviate congestion and enhance productivity, thereby supporting sustainable urban development.
3) Foreign Investment: The positive effect of foreign investment on GRDP per capita emphasizes the importance of creating a conducive environment for attracting foreign capital. Policies that streamline investment processes, provide incentives, and ensure political stability can enhance foreign investment inflows, thereby boosting economic growth and contributing to national development goals.
4) Human Development Index: The significant positive relationship between HDI and GRDP per capita highlights the importance of improving education, health, and living standards. Investments in human capital development are crucial for fostering a skilled workforce that can contribute to economic growth, which is essential for the overall development of the nation.
5) Poverty Level: The positive coefficient for poverty level indicates that regions with higher poverty levels tend to have lower GRDP per capita. This underscores the need for targeted poverty alleviation programs that can enhance economic opportunities for marginalized communities, thereby promoting inclusive growth and national development.

The autoregressive analysis highlights the significance of historical economic performance, suggesting that policies aimed at fostering growth should consider past trends. The spatial analysis further underscores the interconnectedness of provinces, indicating that economic policies should be coordinated across regions to maximize growth potential and achieve national development objectives.

Policy Implications, based on the findings, several policy recommendations can be made:

1) Infrastructure Investment: Prioritize investments in the quality and maintenance of national roads to enhance connectivity and reduce transportation costs, which can stimulate economic activities and support national development.
2) Urban Planning: Implement effective urban planning strategies that consider population density to mitigate congestion and improve productivity. This may include developing public transportation systems and expanding urban infrastructure, contributing to sustainable urban development.
3) Attracting Foreign Investment: Develop policies that create a favorable investment climate, such as simplifying regulations, providing tax incentives, and ensuring a stable political environment to attract foreign investors. This will enhance economic growth and align with national development strategies.
4) Human Capital Development: Invest in education and health programs to improve the Human Development Index, which is crucial for building a skilled workforce that can drive economic growth and contribute to the overall development of the nation.
5) Poverty Alleviation Programs: Design targeted poverty alleviation initiatives that provide economic opportunities and support for marginalized communities, thereby enhancing overall economic performance and promoting inclusive growth.

6. Conclusion and Recommendations

6.1. Conclusion

This study provides a comprehensive analysis of the determinants of Regional Gross Domestic Product (GRDP) per capita in Eastern Indonesia, particularly within the context of the New Capital City (IKN) development. The econometric results, based on spatial and temporal modeling using RStudio, reveal

that some factors have statistically significant effects, while others do not. The key findings are as follows:

1) **Infrastructure**: The analysis shows a significant negative relationship between national road length and GRDP per capita. This indicates that, although infrastructure is vital for regional connectivity, its economic impact may be constrained by issues such as road quality, maintenance, and mismatches in location-based needs. Future policies should therefore prioritize not only infrastructure expansion but also strategic quality improvements.
2) **Population Density**: A statistically significant negative effect was found for population density, implying that overly concentrated populations may result in congestion and declining productivity. This finding supports the need for spatially balanced development and more effective urban planning to mitigate density-related inefficiencies.
3) **Foreign Direct Investment**: While FDI shows a positive coefficient, it is statistically insignificant in the model, suggesting that foreign investment has not yet exerted a measurable impact on regional economic output during the study period. This could reflect challenges in capital absorption, sectoral mismatch, or lagged effects. Policy efforts should focus not only on attracting FDI but also on improving its effectiveness and alignment with regional development priorities.
4) **Human Development Index (HDI)**: HDI has a significant and positive effect on GRDP per capita. This reinforces the role of education, healthcare, and standard of living improvements in promoting regional economic growth. Investment in human capital is therefore essential for long-term sustainable development.
5) **Poverty Level**: The findings of the poverty rate is found to be statistically insignificant in affecting GRDP per capita. This does not imply irrelevance, but rather that poverty alone may not have a direct macroeconomic impact measurable through the current model. Nonetheless, targeted poverty alleviation remains a crucial policy objective for inclusive development.

Overall, the results suggest that a multifaceted approach, focusing on infrastructure development, investment attraction, and human capital enhancement, is essential for sustainable economic growth in Eastern Indonesia. These factors are not only critical for regional development but also play a significant role in the broader context of national development.

Future research could expand this study by incorporating more granular spatial units such as districts or municipalities to capture localized economic dynamics more precisely. Additionally, exploring post-2024 data and integrating variables related to governance quality, institutional capacity, and environmental sustainability could offer a more comprehensive understanding of the long-term impacts of the IKN development. Such advancements would enhance the policy relevance and depth of spatial economic analyses in the Indonesian context.

6.2. Recommendations

Based on the findings of this study, several recommendations can be made to policymakers and stakeholders:

1) **Enhance Infrastructure Quality**: Invest in the maintenance and improvement of national roads and transportation infrastructure to facilitate better connectivity and reduce logistical costs. This will support economic activities and enhance regional competitiveness.
2) **Implement Strategic Urban Planning**: Develop urban planning strategies that account for population density to mitigate congestion and improve productivity. This includes investing in public transportation systems and expanding urban infrastructure to accommodate growing populations.
3) **Foster a Conducive Investment Climate**: Create policies that simplify regulations, provide tax incentives, and ensure political stability to attract foreign investment. This will not only boost economic growth but also align with national development goals.

4) **Invest in Human Capital Development**: Prioritize investments in education and health programs to improve the Human Development Index. A well-educated and healthy workforce is essential for driving innovation and economic growth.
5) **Targeted Poverty Alleviation Programs**: Design and implement targeted initiatives aimed at reducing poverty levels, particularly in marginalized communities. These programs should focus on providing economic opportunities and support to enhance overall economic performance and promote inclusive growth.
6) **Regional Coordination**: Encourage collaboration among provinces to develop coordinated economic policies that leverage regional strengths and address common challenges. This will enhance the overall economic performance of Eastern Indonesia and contribute to national development.

By addressing these recommendations, Indonesia can enhance its economic growth trajectory, improve living standards, and achieve sustainable development goals, ultimately contributing to the nation's long-term prosperity.

7. Research Limitation

Despite the robustness of the econometric methods and the comprehensive dataset employed in this study, several limitations should be acknowledged.

First, the spatial data used in the analysis are subject to limitations in granularity and accuracy. Although provincial-level data provide a macro-level view of economic activity, they may mask intra-provincial variations that are critical for understanding localized economic dynamics particularly in regions directly affected by the new capital relocation (IKN).

Second, estimation bias may arise due to unobserved variables or omitted factors that could influence GRDP per capita but are not included in the model, such as institutional quality or local governance efficiency. While fixed effects and spatial models aim to mitigate such biases, the possibility of residual confounding effects cannot be entirely ruled out.

Third, data coverage is restricted to provinces in Eastern Indonesia with complete annual records from 2015 to 2024. This selection, though methodologically justified, limits the generalizability of findings to other regions or to post-2024 developments that may emerge during the actual relocation and operationalization of IKN.

These limitations suggest avenues for future research, such as incorporating more granular spatial units (e.g., districts or cities), using longitudinal microdata, or integrating institutional and environmental variables. Such improvements would enhance the explanatory power and policy relevance of spatial economic models in the Indonesian context.

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