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Road Infrastructure, Mining Production, and Economic Growth in Muara Enim Regency: Evidence from 2010–2025

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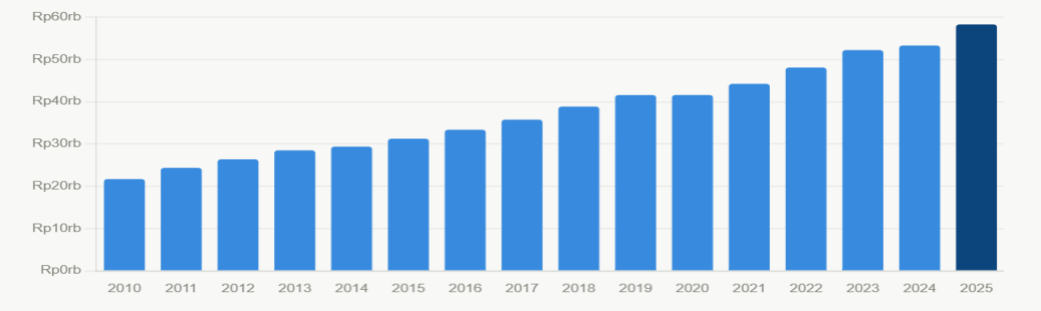
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ABSTRACT

The research focuses on examining the associations of road infrastructure, population growth, mining production, and economic growth in Muara Enim Regency, Indonesia from 2010 to 2025. With the use of secondary data in years, OLS regression analysis was used with 15 observations in total after considering the one-year lag of road length. The dependent variable includes road length lagged, population growth rate, mining production, and a dummy variable for the year 2020. Mining production was found to be positively and significantly associated with economic growth. The road length lagged has a negative relationship that is significant at 10% but not at 5%. No significant associations were found in population growth with economic growth. The dummy variable in 2020 had a negative and significant effect on economic growth. Approximately 80.70% of the variation in economic growth can be explained by the model. This finding emphasizes the strong link between mining output and economic performance in the region; however, the link between road networks and economic growth is statistically inconclusive. The study offers regionally relevant evidence to inform development strategies in the mining-dependent region. It must be noted that due to the limited sample size, the results can only be seen as statistical associations.

Introduction

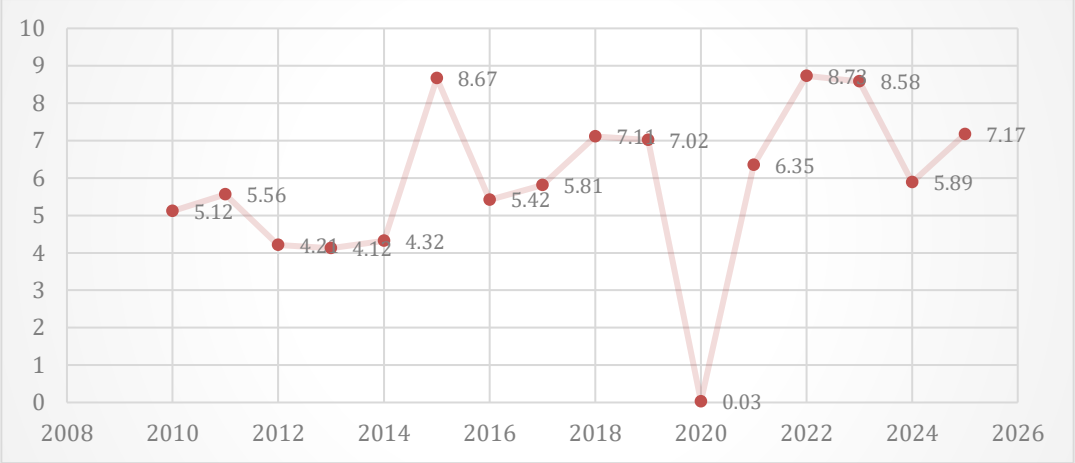
Economic growth is one of the main indicators of a region's development success, reflecting its ability to increase output and improve people's welfare sustainably. According to (Sukirno, 2011), economic growth is defined as the development of activities in the economy that leads to an increase in the goods and services produced in society. At the regional level, economic growth is measured through the growth rate of Gross Regional Domestic Product (GRDP) based on constant prices, which reflects real changes in the region's production capacity (Todaro, M. P. & Smith, 2011).



Source : Statistics Indonesia, (2026)

Figure 1. GRDP at Constant 2010 Prices of Muara Enim Regency (Million Rupiahs)

The GRDP of Muara Enim Regency based on 2010 constant prices shows a consistent upward trend throughout the period 2010–2025, from IDR 21,696 billion in 2010 to IDR 58,300 billion in 2025. This increase reflects the region's continually growing production capacity, even though it slowed down in 2020 due to the COVID-19 pandemic, where the GRDP barely moved from 2019 (IDR 41,582 billion) to 2020 (IDR 41,595 billion).



Source : Statistics Indonesia (2026)

Figure 2. Economic Growth Rate Chart of Muara Enim Regency for 2010-2025 (%)

The economic growth rate shows a very fluctuating pattern. The highest growth rate occurred in 2011 at 12.27%, while the lowest was in 2020 at 0.03%, which was a direct impact of the COVID-19 pandemic. Before 2020, the growth rate was relatively stable between 3–9%. After 2020, it recovered and reached 8.73 % in 2025. The red dashed line shows the economic growth performance during the observation period, with an average annual growth rate of 6.43%. Significant physical infrastructure development is indicated by the increase in road length in Muara Enim Regency; however, this increase did not always come with consistent economic growth. The economic growth rate of Muara Enim Regency kept developing, even dropping sharply in 2020, raising the question of whether the road infrastructure improvements really drive local economic growth.

The availability of road infrastructure is considered one of the components that contributes to regional economic growth. Road infrastructure is very important for speeding up the distribution of goods and services, increasing market accessibility, reducing transportation costs, and improving connectivity between regions. Ultimately, road infrastructure boosts the productivity and competitiveness of an area (Kuncoro, 2010).

Table 1. Road Conditions in Muara Enim Regency (in KM)

Year	Good (km)	Medium (km)	Damage (km)	Heavy Damage (km)	Total Length Road (km)
2021	1,227.70	96.20	14.66	12.12	1,400.68
2022	1,305.70	76.20	14.13	11.12	1,407.15
2023	1,317.41	72.34	14.41	11.23	1,415.40
2024	1,347.50	55.44	10.30	9.40	1,422.64

2025	1,269.48	92.65	53.75	11.94	1,427.82

Source : Statistics Indonesia, (2026)

The road condition data of Muara Enim Regency for 2021–2025 shows that roads were consistently in good condition. In 2024, 1,347.50 km out of 1,442.64 km, or 93.4 percent of the total, were in good condition. The success of the road maintenance program is shown by the decrease in moderate and severely damaged roads from 2021 to 2024. However, there was a significant increase in damaged roads in 2025, from 10.30 km to 53.75 km, and an increase in moderately damaged roads to 92.65 km. This indicates that the maintenance program needs to be evaluated and improved up to 2025.

(Prasetyo & Firdaus, 2022) found that infrastructure helps the economic growth of regions in Indonesia, but its impact is not direct and depends on mediating factors such as the productivity level of the real sector. (Amalia, 2017), who conducted research in 33 provinces of Indonesia during 2008-2017, road infrastructure has a significant influence on economic growth. In addition, (Kartiasih, 2019) found that transportation infrastructure has a positive and significant impact on Indonesia's economic growth using panel data regression methods. On the other hand, according to (Darma, 2021) who observed in his study in Tebo Regency, economic growth is influenced by population size. (Anas et al., 2017) found that investment in road infrastructure significantly affects the processing industry sector.

According to (Munandar, A. I. et al., 2018), the infrastructure sector makes a significant contribution to Indonesia's Gross Domestic Product (GDP), exports, government revenue, employment, and the development of remote areas in Indonesia. Adequate road infrastructure is very important for Muara Enim Regency because it will enable the distribution of goods, labor mobility, and connections between production areas and markets. However, investment, mining production, and commodity prices are some other factors that influence the economic growth of regions dependent on natural resources. Therefore, it’s important to analyze how much road infrastructure is related to local economic growth.

Table 2. Contribution of The Mining Sector to Muara Enim's GRDP

Industry	**2020**	**2021**	**2022**	**2023***	**2024****
Agriculture, Forestry and Fishing	10.09	8.74	5.66	5.72	6.26
Mining and Quarrying	51.66	58.00	72.76	72.43	69.59
Manufacturing	16.21	14.11	9.01	8.84	9.78
Electricity and Gas	0.17	0.15	0.10	0.10	0.11
Water Supply, Sewerage, Waste Management and Remediation Activities	0.03	0.02	0.01	0.01	0.02
Construction	5.67	4.80	3.06	3.07	3.31
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	8.44	7.48	4.96	5.30	5.87
Transportation and Storage	1.47	1.27	0.93	1.01	1.14
Accommodation and Food Service Activities	0.59	0.52	0.34	0.35	0.39
Information and Communication	0.80	0.71	0.45	0.45	0.50
Financial and Insurance Activities	0.57	0.49	0.30	0.30	0.33
Real Estate Activities	1.17	1.00	0.65	0.66	0.73
Business Activities	0.02	0.01	0.01	0.01	0.01
Public Administration and Defence; Compulsory Social Security	1.18	1.04	0.66	0.66	0.72
Education	1.20	1.04	0.67	0.67	0.78
Human Health and Social Work Activities	0.45	0.38	0.25	0.25	0.29
Other Services Activities	0.30	0.24	0.15	0.16	0.17
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Source : Muara Enim Regency (2025)

Mining and excavation are the main economic sources of Muara Enim Regency. The contribution of the mining sector to the overall GRDP shows an increasing trend from 2020 to 2024, according to GRDP structure data by business field. The contribution of the mining industry was 51.66% in 2020, increased to 58.00% in 2021, and peaked at 72.76% in 2022. Mining's contribution is still higher than others, although it slightly decreased in 2023 to 72.43% and in 2024 to 69.59%.

Most research on economic growth and infrastructure is done at the provincial or national level, or through inter-regional panels. Not much research specifically looks into how economic growth and road infrastructure correlate with each other at the district level, especially in areas like Muara Enim Regency that heavily rely on natural resources. Besides that, there isn't a lot of research studying the relationship between economic growth in mining areas and road length. Based on this background and research gap, this study aims to analyze the impact of road infrastructure, population growth rate, mining production, and the COVID-19 pandemic dummy on the economic growth rate of Muara Enim Regency from 2010 to 2025.

Literature Review

Economic Growth Theory

The increase in national income is shown as economic growth, which is the process of increasing the economy's production capacity (Sukirno, 2011). (Todaro, M. P. & Smith, 2011) define economic growth as the long-term increase in a country or region's capacity to provide various economic goods to its population. This growth is determined by technological, institutional, and ideological advancements or adjustments to meet the demands of existing conditions. For the local economy, the GRDP growth rate is calculated based on constant prices. (Kuncoro, 2010) states that internal factors like natural resources, infrastructure, and the quality of human resources, as well as external factors like commodity prices and investment flows, influence the economic growth of a region. According to (Mankiw, 2006) human capital and physical capital are the main components of long-term economic growth. According to the endogenous growth theory developed by Romer (Prasetyo & Firdaus, 2022), investment in infrastructure and knowledge is key to sustainable economic growth.

Road Infrastructure and Economic Growth

One component of public capital that plays a strategic role in driving economic growth is road infrastructure. Roads, as land transportation infrastructure, help improve overall economic efficiency by reducing logistics costs and connecting production centers with markets (Kuncoro, 2010)(Putra & Maryati, 2026). Using panel data regression from 2010 to 2016, (Kartiasih, 2019) showed that transportation infrastructure has a positive and significant contribution to economic growth in Indonesia. As stated by (Timilsina et al., 2024) although countries rich in natural resources tend to grow more slowly, proper infrastructure investment can be a way to break dependence on major commodities. According to (Anas et al., 2017), they also found that the growth of the processing industry sector is positively and significantly influenced by road infrastructure investment. According to (Amalia, 2017) they proved that the length of roads has a significant positive impact on economic growth in 33 provinces of Indonesia during the 2008-2017 period. While road infrastructure is generally supposed to contribute to economic growth in a region, the connection might differ according to the nature of the development of the infrastructure and the economic profile of the region. An increased road length does not always mean that the quality of roads has been enhanced as well as their effectiveness in terms of connectivity and efficient movement of transportation. In the case of resource-based regions, road infrastructure may be utilized in extraction operations only, whereas its contribution to economic development at a regional level is determined by the degree to which it enables access to markets, promotes productivity and contributes to intersectoral linkages. Besides, there is no immediate economic impact of infrastructure development.

Mining Production and Economic Growth

In this regard, the influence of mining production on regional economic growth is linked to the influence of natural resources on output generation and economic activities. An increase in mining production could have a positive impact on regional economic performance due to an increase in output from the sector and increased demand for economic activities that support mining production. However, the benefits of the extraction of natural resources on economic performance are conditional on the integration of mining with other productive sectors. (Frederick, 2011) indicates that the presence of natural resources does not automatically lead to sustainable economic development due to the fact that its consequences are determined by the quality of institutions, economic management, and the ability to use resource revenues productively. Given that the mining sector contributes significantly to the regional economic output in Muara Enim Regency, changes in the mining production level could be closely related to regional economic growth. At the same time, the reliance on extractive activities may make the regional economy vulnerable to market fluctuations and diversification challenges.

Population growth rate and Economic Growth

In the literature on regional and macroeconomics, the relationship between population growth rate and economic growth has always been a fundamental discussion. From a pessimistic perspective rooted in the expansion of the Solow growth model, excessively high population growth rate without sufficient land availability and capital expansion can trigger diminishing returns (decreased marginal productivity). Overconcentration of population risks overloading the carrying capacity of a region and spreading existing capital among too many workers, which can suppress per capita income in the long run (Mankiw, 2006). On the other hand, an optimistic perspective especially referring to the theory of economic agglomeration of Krugman argues that well-managed population growth rate can actually be a major catalyst for economic growth.

This spatial concentration creates efficiency, facilitates knowledge spillovers, expands the domestic market scale, and provides a massive labor supply for the industrial sector (Todaro, M. P. & Smith, 2011). Empirically, this spatial interaction has been shown to affect the dynamics of regional economies. A study conducted by (Mose et al., 2025) confirms that population growth rate has significant implications for a region's economic growth, where high demographic concentration can trigger escalating economic activity. However, the benefits of this spatial agglomeration do not occur automatically; they very much depend on the quality of the population itself.

As emphasized by (Sukirno, 2011), in the long term, a high population growth rate will only transform into an effective engine of economic growth if it is accompanied by strategic investment in human capital, particularly through improving the quality of education and healthcare facilities. Therefore, population growth rate should be directed to form an agglomeration of productive and innovative labor, rather than simply becoming a consumptive burden that triggers spatial congestion and increased unemployment. The Concept of the Contribution of the Mining Sector to Economic Growth According to (Arsyad, 2010) states that mining is one of the economic sectors with a strategic role in driving local economic growth, and regions must have the capability to manage and optimize the potential of this sector. Mining serves as a primary source of value-added formation in the region, especially in areas that have a lot of natural resources. Therefore, the contribution of the mining sector to the Regional Gross Domestic Product (RGDP) shows how big a role the extraction and processing of mineral resources play in driving a region's economy. According to (Koko Mukti Wibowo, Indra Kanedi, 2021) mining, according to Indonesian Law Number 4 of 2009, includes part or all stages of activities related to the exploration, management, and operation of minerals or coal, which cover general surveys, exploration, feasibility studies, construction, mining, processing and refining, transportation and sales, as well as post-mining activities.

(Lestari, 2016) showed in their research that investment in mining and excavation has a positive and significant impact on Indonesia's economic growth. This finding shows that mining not only boosts economic value but also drives economic growth through its positive effects on other sectors like transportation, trade, and processing. (Hidayati, 2021) carried out research in South Kalimantan and found that local investment in mining has a significant and positive impact on

economic growth in the region. This study found that the increase in GRDP in areas dependent on natural resources is influenced by mining, using panel data methods with a Fixed Effects Model. Besides playing an important role in the formation of GRDP and total regional output, the link between mining sector with another sectors is still below average. As part of the primary sector, mining could have a bigger impact on the local economy if it manages to build strong connections with construction and building sectors, as well as other fields (Hidayat et al., 2014). As shown by the dominance of the mining sector in Muara Enim Regency's total GRDP, which reached 51.66% to 72.76% during the 2020–2024 period, it indicates a very high dependence on a single sector. This is also reflected in the increase of LPE to 8.73% in 2022, along with the rise in global coal prices after the COVID-19 pandemic (BPS Kabupaten Muara Enim, 2025). This situation makes the local economic growth rate very sensitive to changes in coal prices on the international market.

The link between population growth rate and economic growth in a region can be analyzed using the concepts of agglomeration economies. (Duranton & Puga, 2004) mention the sharing, matching, and learning as key mechanisms by which spatial concentration can lead to economic efficiency. The presence of high population growth rate can help in firm interaction, input specialization, and knowledge exchange. Nevertheless, the positive effects of high population growth rate can depend on the ability of the infrastructure, labor markets, and industries in the region to cope with it. In a region where economic activities are dominated by extractive industries, the presence of higher population growth rate does not have to be associated with economic growth in terms of increased production. Therefore, the connection between population growth rate and economic growth can differ in different regions depending on their specific economic conditions.

COVID-19 Pandemic and Regional Economic Growth

In particular, the coronavirus pandemic can be viewed as an external shock occurring in the period of economic activity disruptions in various regions. Mobility restrictions, changes in production processes, disturbances in the supply chain, as well as variations in market demand, might affect regional economic performance via various channels of impact. For those regions where extractive activities are dominant, the shifts in commodity demand and their delivery might be especially important for economic growth dynamics. However, the intensity and nature of such connections might vary depending on the regional economic structure and features of the sector under consideration. In this paper, a dummy variable is used to separate the year 2020 from other observation years. This variable is aimed at capturing the difference of this year in terms of economic growth, rather than the causal effect of the coronavirus pandemic itself.

Drawing upon the theoretical and empirical literature, regional economic growth can be said to be linked with the interrelationship of infrastructure provision, demography, sectoral productivity, and economic shock. The presence of road infrastructure can potentially aid economic activities via increased accessibility and reduced constraints related to transportation, while its relationship with economic growth could be contingent on the quality of infrastructure and its usage. Population growth rate can potentially confer on regions certain agglomeration benefits, while those benefits can be determined by productive capacity and labor market conditions in the region. Mining activities might positively affect regional economic growth through their contribution to sectoral output. Finally, the unprecedented economic conditions in the wake of the pandemic can be used for the analysis of changes in the regional growth experience. Therefore, the current study analyzes conditional relationship between lagged road length, population growth rate, mining output per year, and a dummy for 2020 and the growth rate of Muara Enim Regency during 2010-2025.

Method

For the purpose of this study, 16 observations are used annually during the period from 2010 to 2025. The sample size used is relatively small, and estimating a regression equation with several independent variables and a lagged dependent variable can greatly reduce the degrees of freedom of the residual and increase parameter uncertainty. Hence, great care should be taken when specifying

a model and selecting variables based on an economic rationale. The estimation results are treated as preliminary evidence for possible statistical associations, and not as firm causal estimates. This will be evaluated using the diagnostics and sensitivity analysis of the model to alternative specifications. The data comes from official publications of the Muara Enim Regency Central Statistics Agency (BPS) in Muara Enim in Figures editions 2010 to 2025 as well as Muara Enim in Figures 2024 (BPS Kabupaten Muara Enim, 2025). The data used includes Economic Growth Rate (LPE), total road length (National Roads, Provincial Roads, and Regency Roads), Population growth rate (LPP) of Muara Enim Regency, as well as the Annual Mining Production Rate of Muara Enim Regency. This study consists of three variables, namely:

1. Dependent variable (Y): Economic Growth Rate (LPE) of Muara Enim Regency, measured based on the percentage change of GRDP at constant 2010 prices, expressed in percent (%).
2. First independent variable (X1): road infrastructure, proxied by the total length of roads (national roads + provincial roads + regency roads) in Muara Enim Regency, expressed in kilometers (KM) and transformed into natural logarithms (Ln). A time lag effect (t-1) is used because public infrastructure like roads usually does not have an instant impact on the Economic Growth Rate (LPE) in the same year. Roads built or repaired in the base year may only facilitate logistics distribution and boost the economy in the following year.
3. Second independent variable (X2): Population growth rate (LPP) of Muara Enim Regency.
4. Third Independent Variable (X3): Annual Mining Production in Muara Enim Regency, transformed into natural logarithm (Ln).

The regression model used in this study is a multiple linear regression model with the following equation:

$$LPEt = \beta0 + \beta1\ln(ROADt\text{-}1) + \beta2(LPPt) + \beta3\ln(MINEt) + \beta4D2020t + \varepsilon t$$

Description:

LPEt = Economic Growth Rate in year t
β0 = Constant
β1 = Regression coefficient for Total Road Length
ROAD = Total Road Length in year t (Ln)
β2 = Regression coefficient for Population growth rate
LPPt = Population growth rate in year t
β3 = Regression coefficient for Total Mining Production
MINE = Mining Production in year t (Ln)
D2020 = Covid dummy, 0 = Non-Covid, 1 = Covid-19
E = Error term (residual)

Descriptive statistical analysis is used to describe the characteristics of the research data through the mean, minimum value, maximum value, and standard deviation of each research variable (Gujarati, 2012).The estimation method used is Ordinary Least Squares (OLS). (Gujarati, 2012) show that the OLS method minimizes the sum of squared differences between actual and predicted values, making the estimator that meets the Gauss-Markov assumptions considered the Best Linear Unbiased Estimator (BLUE). The EViews statistical program is used to process the data. Before interpreting the regression results, classical assumption tests are conducted, which include:

- Normality test using the Jarque-Bera test. H0 is accepted if the JB probability > 0.05, which means the residuals are normally distributed (Gujarati, 2012).
- Multicollinearity test using the correlation matrix. If the absolute correlation value is below 0.80, it is considered that there is no serious multicollinearity problem (Gujarati, 2012).
- Heteroskedasticity test using the White test. H0 is accepted if the probability > 0.05, which means there is no heteroskedasticity.

- Autocorrelation test using the Breusch-Godfrey Serial Correlation LM Test. There is no autocorrelation if the Chi-Square probability value > 0.05 at $\alpha = 5\%$.

t-Test (Partial) was used to test the influence of each independent variable partially on the dependent variable at $\alpha = 5\%$. H_0 is rejected if the probability value (p-value) < 0.05, which means the independent variable has a significant partial effect on the dependent variable. Besides, F-Test (Simultaneous) to test the influence of all independent variables together on the dependent variable at $\alpha = 5\%$. H_0 is rejected if the calculated F > F-table (3.8056) or the probability < 0.05. Meanwhile, coefficient of determination (R^2) to measure how much of the variation in the dependent variable can be explained by the independent variables in the model (Gujarati, 2012).

One of the limitations of this study is the small number of yearly observations used. Even though some initial information regarding the relationships among roads, demographics, mining output, and economic development of the regions has been obtained, due to small sample size, statistical significance cannot be achieved in the coefficients estimation process. Thus, the lack of significant estimates does not indicate the lack of economic relationship. These results are applicable only for specific circumstances, and need to be tested for robustness through other researches with longer time periods or other regions' data.

The specified model employs a linear-log approach whereby the dependent variable (growth rate of the economy) is specified in percentage points while some of the independent variables have been specified in logarithmic terms. The interpretation of the coefficients for these variables will then be a semi-elasticity such that a unit percentage increase in the independent variable increases the dependent variable by roughly $\beta/100$ percentage points. The interpretation of coefficients for variables specified in level or binary form shall follow their corresponding scales.

Results and Discussion

Table 3. Descriptive Statistics

Descriptive Statistics	X1 (Total length of Road Km)	X2 (Population Growth Rate %)	X3 (Mining Production/Ton)
Mean	1588.364375	1.62125	28815259.63
Standard Error	54.29965134	0.106606265	2658135.256
Median	1565.485	1.6	27004240
Mode	1647.75	1.03	27004240
Standard Deviation	217.1986054	0.426425062	10632541.03
Minimum	1321.34	1.03	11948767
Maximum	1975.45	2.6	47253844
Sum	25413.83	25.94	461044154
Count	16	16	16

The Total Road Length variable (X1) has an average value of 1,588.36 km, with a minimum value of 1,321.34 km and a maximum value of 1,975.45 km, and a standard deviation of 217.20 km. Based on the relatively large standard deviation, road infrastructure development in Muara Enim Regency showed quite a lot of variation during the observation period. The average population growth rate variable (X2) has a mean of 1.6213%, with a minimum value of 1.03% and a maximum of 2.60%. A standard deviation of 0.4264 percentage points indicates that the LPP experienced variation between 2010 and 2025.

With a minimum value of 11,948,767 tons and a maximum value of 47,253,844 tons, the Annual Mine Production variable (X3) has an average value of 28,815,259.63 tons and a standard deviation of 10,632,541.03 tons. This very large standard deviation shows that during the observation period, there were many changes in mine production, significantly influenced by mining company

production policies and global market demand. With a standard deviation of 2.18%, the average value of the Economic Growth Rate variable (Y) is 5.88%, with a minimum value of 0.03% and a maximum value of 8.73%. The maximum value of 8.73% indicates a strong economic recovery in 2022 due to the rise in coal prices in the global market, while the very low minimum value shows a sharp economic contraction in 2020 due to the COVID-19 pandemic.

Table 4. Estimation Output

Dependent Variable: Y
Method: Least Squares
Date: 06/12/26 Time: 10:58
Sample (adjusted): 2011 2025
Included observations: 15 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.348815	30.30935	0.110488	0.9142
DUMMY	-6.564143	1.215777	-5.399132	0.0003
LnROAD(-1)	-4.878988	2.344657	-2.080897	0.0641
LnMINE	2.912187	0.928804	3.135417	0.0106
LPP	-2.497686	4.577293	-0.545669	0.5973

R-squared	0.806963	Mean dependent var	5.932667
Adjusted R-squared	0.729748	S.D. dependent var	2.247444
S.E. of regression	1.168350	Akaike info criterion	3.410264
Sum squared resid	13.65043	Schwarz criterion	3.646281
Log likelihood	-20.57698	Hannan-Quinn criter.	3.407750
F-statistic	10.45089	Durbin-Watson stat	3.166696
Prob(F-statistic)	0.001350		

Y = 3.349 – 4.879Jalan – 2.498LPP + 2,912Tambang – 6,564D2020

Simultaneous Test (F Test)

The estimation results show an F-statistic value of 10.451 with a probability of 0.001, which is below $\alpha = 0.05$. This means H_0 is rejected, so it can be concluded that simultaneously all the independent variables, namely total road length, population growth rate, mining production, and the D2020 dummy, have a significant simultaneous effect on the Economic Growth Rate.

Partial Test (t Test)

Partially, the t-test results show that:

- The road length variable (X1) has a coefficient of -4.879 with a probability of 0.10 > 0.064 > 0.05, so it does not have a significant effect on the Economic Growth Rate at a 5% significance level but has a significant effect if using a 10% significance level.
- The Population growth rate variable (X2) has a coefficient of -2.498 with a probability of 0.597 > 0.05, so it does not have a significant effect on the Economic Growth Rate.
- The Annual Mine Production variable (X3) has a coefficient of 2.912 with a probability of 0.016 < 0.05, so it has a positive and significant effect on GDP per capita (LPE). An increase in mine production of 1% is associated with an increase in LPE of about 0.291%, assuming other variables are constant.
- The dummy variable D2020 has a coefficient of -6.546 with a probability of 0.003 < 0.05, so it has a negative and significant effect on LPE. This reflects that the year 2020 had a significant impact on slowing economic growth, which can be linked to the COVID-19 pandemic that caused a drastic economic contraction.

Coefficient of Determination (R^2)

An R-squared value of 0.807 indicates that 80.7% of the variation in Economic Growth Rate changes can be explained by the variables of total roads, population growth rate, annual mining production, and the D2020 dummy, while the remaining 19.3% is explained by other variables outside the model. Meanwhile, the Adjusted R-squared value of 0.729 confirms that the model has a pretty good explanatory power after considering the number of variables and observations used.

Classical Assumption Test

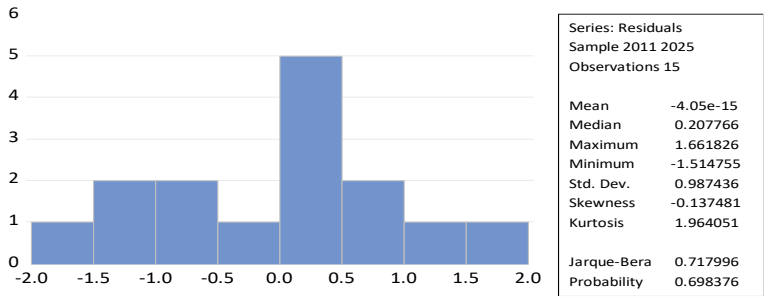


Figure 3. Normality Test

Based on the normality test results with 15 observations for the 2011–2025 period, a Jarque-Bera statistic of 0.7179 was obtained with a probability value of 0.6983. Since the probability value of 0.6983 > 0.05, H_0 is accepted, which means the regression model residuals are normally distributed. This is also supported by a skewness value of -0.1374, which is close to zero, and a kurtosis value of 1.964, which is close to 2, so statistically, the residual distribution of the model meets the normality assumption.

Table 5. Multikolinearitas Test

	DUMMY	ROAD	MINE	LPP
DUMMY	1	0.0138	0.0886	-0.0435
ROAD	0.0138	1	0.1135	-0.1861
MINE	0.0886	0.1135	1	0.3521
LPP	-0.0435	-0.1861	0.3521	1

Based on the estimation results of the variable matrix, the highest correlation between independent variables is only 0.3521 (well below the danger limit of 0.80), so it can be concluded that there is no multicollinearity problem in the regression model.

Table 6. Heteroscedasticity Test

Heteroskedasticity Test: White
Null hypothesis: Homoskedasticity

F-statistic	0.784084	Prob. F(10,4)	0.6576
Obs*R-squared	9.932792	Prob. Chi-Square(10)	0.4464
Scaled explained SS	2.127937	Prob. Chi-Square(10)	0.9953

Based on the results of the White test for the 2011–2025 sample period with 15 observations, an F-statistic value of 0.7841 with an F probability of 0.6576 was obtained, an Obs*R-squared value of 9.9328 with a Chi-Square probability of 0.4464, and a Scaled Explained SS value of 2.1279 with a Chi-Square probability of 0.9953. All of these probability values are above $\alpha = 0.05$, so H_0 is accepted. Therefore, it can be concluded that there are no heteroskedasticity issues in the regression model, meaning the residual variance is homoscedastic and constant across all observations. These

results indicate that the model meets the classical heteroskedasticity assumption, so the regression coefficient estimates remain the Best Linear Unbiased Estimators (BLUE).

Table 7. Autocorrelation Test

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	3.600361	Prob. F(2,8)	0.0767
Obs*R-squared	7.105638	Prob. Chi-Square(2)	0.0286

Based on the Breusch-Godfrey test results for the 2011–2025 sample period with 15 observations, an F-statistic value of 3.600 was obtained with an F probability of 0.0767, and an Obs*R-squared value of 7.1056 with a Chi-Square probability of 0.0286. Since one of these probabilities is below $\alpha = 0.05$, H_0 is rejected. Therefore, it can be concluded that there is an autocorrelation problem in the regression model up to the 2nd lag. The variable resid(-1) has a probability value of 0.0378 or < 0.05, which indicates that the autocorrelation issue is strongly caused by disturbances from the previous period.

The coefficients of the regression equation have been estimated through ordinary least squares (OLS). As there is a possibility of heteroskedasticity and autocorrelation in the disturbance terms of the regression equation, heteroskedasticity and autocorrelation consistent standard errors have been used based on the Newey-West method (Newey & West, 1987). The Newey-West correction does not form a separate regression model or a diagnostic test. It is merely a correction applied to the estimated variance covariance matrix of the OLS coefficients without changing their estimates. It must be noted that given the limited number of 16 annual data points, HAC-based inferences have to be drawn cautiously as the HAC method relies on asymptotics.

Table 8. Newey-West Test

Dependent Variable: Y
Method: Least Squares
Date: 06/12/26 Time: 11:19
Sample (adjusted): 2011 2025
Included observations: 15 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed
bandwidth = 3.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.348815	20.65472	0.162133	0.8744
DUMMY	-6.564143	0.218617	-30.02577	0.0000
LnROAD (-1)	-4.878988	1.435039	-3.399899	0.0068
LnMINE	2.912187	0.592837	4.912291	0.0006
LPP	-2.497686	2.011168	-1.241908	0.2426

R-squared	0.806963	Mean dependent var	5.932667
Adjusted R-squared	0.729748	S.D. dependent var	2.247444
S.E. of regression	1.168350	Akaike info criterion	3.410264
Sum squared resid	13.65043	Schwarz criterion	3.646281
Log likelihood	-20.57698	Hannan-Quinn criter.	3.407750
F-statistic	10.45089	Durbin-Watson stat	3.166696
Prob(F-statistic)	0.001350	Wald F-statistic	332.1425

Prob(Wald F-statistic)	0.000000

The Newey-West test results show that the coefficient values of the variables remain the same as in the previous model, but the standard errors are smaller and robust against autocorrelation. With standard errors that are already robust, it can be concluded as follows:

- The coefficient of road length has been calculated to be -4.879. Because the dependent variable is the economic growth rate in percentage, while the road length has been taken in the natural log form, the calculation can be considered as a linear-log model. In other words, a 1 percent rise in the road length would lead to an approximate fall of the economic growth rate by 0.0488 percent points. It should be noted that this calculation does not prove any causal relation but only provides a statistical correlation.
- The DUMMY condition decreases Y by 6.5641 units.
- The mining variable increases Y by 2.9121%.
- The population growth rate variable still does not have a significant effect on the Y variable.

Discussion

The regression model estimates that the coefficient on road length is −4.879, implying a negative correlation between road infrastructure and economic growth during the period of the analysis. Within the linear-log regression, a 1 percent increase in road length corresponds to a 0.0488 percent decrease in the economic growth rate, all else being equal. Nevertheless, one cannot construe this negative coefficient as implying that road infrastructure development impedes economic growth. This estimate might be influenced by other variables such as how road infrastructure is used and the economic situation, among others, which may not have been considered in the model.

Since the model is purely observational, in addition to the few annual observations, it should be viewed as a statistical association conditional on the variables in the model rather than a causal effect. In addition, it has to be substantively interpreted taking into account the statistical significance of the estimate. First, the Total Road Length variable (X1) has a significant negative effect on LPE with a coefficient of -4.879 and a probability of 0.0068 < 0.05. This result is not in line with the research by (Prasetyo & Firdaus, 2022) who found that road length has a positive and significant effect on economic growth in , as well as (Kartiasih, 2019) who showed similar results at the national level. The model estimation results indicate that the road length in the previous year (lag-1) has a negative effect of 4.878 on economic growth. This finding aligns with the research of (Devarajan et al., 2004) and the recent (Timilsina et al., 2024) (Putra & Maryati, 2026) which show that physical infrastructure investment in the short term can suppress growth rates. This shows that a long gestation period is needed, where the costs of land acquisition, construction, and the fiscal burden of road maintenance have to be borne by local governments in the previous year (t-1), while the economic benefits will only be felt in the medium to long term. This also aligns with other findings by (Lestari, 2016), the increase in road length in mining areas raises the risk of faster damage from heavy vehicles, which disrupts the economic mobility of the general public.

Second, the estimated relationship between the population-related variable and the economic growth will need to be interpreted in light of the economic structure of Muara Enim Regency. From the report by BPS Kabupaten Muara Enim (2025), mining and quarrying constituted roughly 64.69% of the gross regional domestic product of the regency in 2024. Mining and quarrying added to 4.32 percentage points of the 5.89% economic growth recorded in the regency that year. These statistics highlight the significance of mining operations in the regional economy. Despite the importance of the mining industry, it cannot necessarily be said that it is the capital intensity of the industry that explains the estimated relationship between the population characteristics and economic growth. For such an assertion to be valid, there would be need for further data on the employment pattern, capital

investment and productivity of labor in the industry. Thus, the estimated relationship can only be interpreted as a statistical correlation while the economic structure remains a relevant context. This result differs from (Darma, 2021) study, which found that population numbers significantly affect economic growth in Tebo Regency. The insignificance of population growth rate aligns with (Mankiw, 2006) view that population growth rate does not automatically drive economic growth if it is not accompanied by an improvement in human resource quality. In the context of Muara Enim Regency, the mining sector, which dominates the GRDP, is capital-intensive and does not absorb much local labor directly, so population growth rate has not yet been able to have a real impact on the region's economic growth (Sukirno, 2019).

Third, the variable Annual Mine Production (X3) has a positive and significant effect on LPE with a coefficient of 2.9122 and a probability of 0.0006 < 0.05. This means that a 1% increase in mine production is associated with an increase in LPE of around 2.9122%, assuming other variables remain constant. This result aligns with the studies by (Lestari, 2016) and (Hidayati, 2021), which showed that the mining sector has a positive and significant impact on economic growth. The contribution of the mining sector in Muara Enim Regency, ranging from 51.66% to 72.76% of the total GRDP during the 2020–2024 period, makes it the main driver of regional economic growth. However, (Munandar, A. I. et al., 2018) warn that the mining sector generally has weak inter-sectoral linkages, so its multiplier effects on other sectors are still limited and need to be monitored to avoid excessive dependence.

Fourth, the dummy variable D2020 has a negative and significant effect on LPE with a coefficient of -6.5641 and a probability of 0.0000 < 0.05. This reflects that the COVID-19 pandemic in 2020 caused a sharp decline in LPE to only 0.03%, far below the average of 5.88% during the observation period. This decline was triggered by the halt of some mining production activities, disruptions in the commodity distribution chain, and weakened coal demand in the international market. This situation emphasizes that an economy that relies too heavily on a single sector makes Muara Enim Regency vulnerable to external shocks, so economic diversification into non-mining sectors needs to become a long-term development priority (Tambunan, 2011).

The findings must be seen in light of the conditional nature of the statistical relationships rather than any causative effects. While the regression coefficients reflect the nature and strength of the relationship between the road infrastructure, population attributes, mining production, and economic growth, the empirical design cannot provide any insight into the direction of causation. Reverse causation, omitted variable issues, and structural breaks might affect the relationships as well. What is more, the rather small sample size, which only amounts to 16 years of data, constrains the robustness of the regression results. Therefore, the results can be taken as suggestive evidence of economic interrelationships in the region but cannot be seen as conclusive proof of causality.

Conclusion

This paper investigates the linkages among road infrastructure, population growth, mining production, and economic growth in Muara Enim Regency from 2010 to 2025. The results indicate that there is a significant positive relationship between mining production and regional economic growth, which points out the significance of mining industry in the regional economy. On the other hand, lagged road length indicates a negative relationship that is significantly important at the 10 percent significance level, while there is no significant relationship between population growth and economic growth. The negative and significant coefficient of the dummy COVID pandemic variable in 2020 can be attributed to unique economic situation in this year. This global shock caused a regional economic contraction that reached a low point of 0.03% in 2020, where supply chain disruptions and a drop in commodity demand had negative impacts. Muara Enim Regency's economy is very sensitive to the performance of the mining sector and external shocks like the pandemic overall. Equitable and sustainable regional economic growth must be supported by long-term development policies that position processing industries, modern agriculture, and progressive

services as main pillars, reducing the absolute dominance of a single sector. The study offers an empirical analysis of the impact of infrastructure development, demographic trends, and economic growth in a region that heavily relies on mining activities. From the policy perspective, the study indicates the significance of economic diversification as well as paying attention to the quality, connectivity, and usage of roads, instead of the length of roads only. However, in view of the relatively small number of observations (only 15 years), the estimated relations can only be regarded as statistical associations, not causal relationships. Future research could include longer data panels with other structural variables. The mining and quarrying sector consistently acts as the main driver determining the movement direction of the region's Gross Regional Domestic Product (GRDP) throughout the research period.

References

Amalia, D. (2017). *Judul : ANALISIS PENGARUH INFRASTRUKTUR TERHADAP PERTUMBUHAN EKONOMI (Studi Pada 33 Provinsi di Indonesia Tahun 2008-2017)*.

Anas, R., Tamin, O. Z., & Wibowo, S. S. (2017). Pengaruh Investasi Infrastruktur Jalan Terhadap Sektor Industri Pengolahan. *Jurnal Transportasi*, *17*(2), 145–154.

Arsyad, L. (2010). *Ekonomi Pembangunan (Edisi 5)*. UPP STIM YLPPN Yogyakarta.

BPS Kabupaten Muara Enim. (2025). *Kabupaten Muara Enim Dalam Angka 2024*. Muara Enim: Badan Pusat Statistik Kabupaten Muara Enim.

Darma, B. (2021). Pengaruh Jumlah Penduduk Terhadap Pertumbuhan Ekonomi Kabupaten Tebo Tahun 2016-2020. *Jurnal Citra Ekonomi*, *2*(1), 1–12.

Devarajan, S., Swaroop, V., & Zou, H. (2004). The composition of public expenditure and economic growth. *Journal of Monetary Economics*, *37*(2), 313–344. https://doi.org/https://doi.org/10.1016/S0304-3932(96)90039-2

Duranton, G., & Puga, D. (2004). Chapter 48 - Micro-Foundations of Urban Agglomeration Economies. *Handbook of Regional and Urban Economics*, *4*, 2063–2117. https://doi.org/https://doi.org/10.1016/S1574-0080(04)80005-1

Frederick, V. D. P. (2011). Natural Resources: Curse or Blessing? *Journal of Economic Literature*, *49*(2), 366–420.

Gujarati, D. N. (2012). *Basic Econometrics 4th ed*. Salemba Empat.

Hidayat, W., Rustiadi, E., & Kartodihardjo, H. (2014). Dampak Sektor Pertambangan Terhadap Perekonomian Wilayah Di Kabupaten Luwu Timur. *Jurnal Economia*, *10*(1), 65–80.

Hidayati, R. (2021). Investasi di Sektor Pertambangan dan Tingkat Partisipasi Angkatan Kerja Sebagai Determinan Pertumbuhan Ekonomi di Kalimantan Selatan. *Jurnal Kebijakan Pembangunan*, *16*(1), 17–27. https://doi.org/10.47441/jLPP.v16i1.149

Kartiasih, F. (2019). *Dampak infrastruktur transportasi terhdap ekonomi*. *16*(1), 67–77.

Koko Mukti Wibowo, Indra Kanedi, J. J. (2021). Sistem Informasi Geografis (Sig) Menentukan Lokasi Pertambangan Batu Bara Di Provinsi Bengkulu Berbasis Website. *Jurnal Media Infotama*, *11*(1), 223–260.

Kuncoro, M. (2010). *Masalah, Kebijakan, dan Politik Ekonomika Pembangunan*. Erlangga.

Lestari, D. (2016). DAMPAK INVESTASI SEKTOR PERTAMBANGAN TERHADAP PERTUMBUHAN EKONOMI DAN TENAGA KERJA Diana Lestari Fakultas Ekonomi dan Bisnis Universitas Mulawarman, Indonesia. *Forum Ekonomi*, *18*(2), 176–186.

Mankiw, N. G. (2006). *Principles of Economics: Pengantar Ekonomi Makro (Edisi 3)*. Salemba Empat.

Mose, N., Kinuthia, J., & Kipchirchir, E. (2025). Relationship between Population and Economic Growth in Kenyan Counties. *South Asian Journal of Social Studies and Economics*, *22*(4), 56–67. https://doi.org/10.9734/sajsse/2025/v22i4985

Munandar, A. I., Zeffa Aprilasani, S. T., Samputra, P. L., & S Pi, M. M. (2018). *Industri Pertambangan di Indonesia*. Bypass.

Prasetyo, indang B., & Firdaus, M. (2022). Pengaruh Infrastruktur Pada Pertumbuhan Ekonomi di Wilayah Sulawesi Tengah. *Jurnal Ekonomi Dan Kebijakan Pembangunan*, *2*(2), 239.

Putra, V. V., & Maryati, S. (2026). The Impact of Infrastructure on Economic Growth in West Sumatra: A Dynamic Panel Analysis. *Jurnal Informatika Ekonomi Bisnis*, *8*, 2–3. https://doi.org/10.37034/infeb.v8i1.1372

Sukirno, S. (2011). *Makroekonomi: Teori Pengantar (Edisi Ketiga)*. PT RajaGrafindo Persada.

Sukirno, S. (2019). *Mikroekonomi Teori Pengantar (Edisi ke 3)*. Rajawali.

Tambunan, T. (2011). *Perekonomian Indonesia: Kajian Teoritis dan Analisis Empiris*. Ghalia Indonesia.

Timilsina, G., Stern, D. I., & Das, D. K. (2024). Physical infrastructure and economic growth. *Applied Economics*, *56*(18), 2142–2157.https://doi.org/10.1080/00036846.2023.2184461

Todaro, M. P., & Smith, S. C. (2011). *Economic Development (11th ed.)*. Pearson Education.