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An Empirical Model of The Impact of Economic Growth on The Performance of Trans Papua Road Infrastructure Development: The Jayapura–Wamena Corridor

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ABSTRACT

This study develops an empirical model to quantify the impact of economic growth on the performance of road infrastructure development along the Trans Papua corridor (Jayapura–Wamena). Secondary data covering the period 2015–2024 were analyzed, including regional Gross Domestic Product (GRDP), government expenditure on infrastructure, investment realization, and physical road development indicators (road length completion, construction progress, and pavement condition index). A multiple linear regression model was employed to examine the relationship between economic variables and infrastructure performance. The results indicate that economic growth has a statistically significant positive effect on infrastructure development performance, with a regression coefficient of $\beta = 0.62$ ($p < 0.01$). Government infrastructure expenditure shows the strongest influence ($\beta = 0.71$, $p < 0.01$), followed by regional investment ($\beta = 0.54$, $p < 0.05$). The model demonstrates a high explanatory power with $R^2 = 0.83$, indicating that 83% of the variation in infrastructure performance is explained by the selected economic variables. Furthermore, elasticity analysis reveals that a 1% increase in GRDP leads to an estimated 0.58% improvement in road development performance. The findings confirm that economic growth plays a critical role in accelerating infrastructure delivery in remote regions. This study provides empirical evidence to support policy interventions that integrate economic planning with strategic infrastructure development, particularly in eastern Indonesia.

Keywords: Economic Growth, Infrastructure Development, Road Performance, Trans Papua Road, Empirical Model

1. INTRODUCTION

Infrastructure development plays a fundamental role in supporting regional economic growth, particularly in developing and geographically challenging regions. Transportation infrastructure, especially road networks, serves as a critical driver for improving accessibility, reducing logistics costs, and stimulating economic activities. In this context, the development of the Trans Papua Road represents a strategic national initiative aimed at enhancing connectivity across Papua, one of Indonesia's most remote and underdeveloped regions. The Jayapura–Wamena corridor is one of the most vital segments of the Trans Papua Road, linking coastal and highland areas that were previously isolated due to limited transportation access. Improved connectivity along this corridor is expected to facilitate the movement of goods and services, promote regional trade, and support socio-economic development. However, the implementation of road infrastructure projects in Papua faces significant challenges, including complex topography, high construction costs, limited accessibility, and uneven economic development across regions.

Economic growth is widely recognized as a key factor influencing infrastructure development. Regions with higher economic performance tend to have greater fiscal capacity, enabling increased government expenditure and investment in infrastructure projects. Conversely, infrastructure development itself can also stimulate economic growth, creating a reciprocal relationship between the two variables. This interdependence highlights the importance of understanding how economic growth quantitatively affects the performance of infrastructure development, particularly in regions with unique geographical and socio-economic

characteristics such as Papua. Previous studies have examined the relationship between economic growth and infrastructure development in various contexts; however, most of them focus on macro-level national analysis or urban regions with relatively well-established infrastructure systems. Empirical evidence addressing remote and underdeveloped regions, especially in eastern Indonesia, remains limited. Furthermore, few studies have specifically modeled the relationship between economic indicators—such as Gross Regional Domestic Product (GRDP), government expenditure, and investment—and the performance of road infrastructure development using quantitative approaches.

This research aims to fill this gap by developing an empirical model to analyze the impact of economic growth on the performance of road infrastructure development along the Jayapura–Wamena corridor of the Trans Papua Road. The performance of infrastructure development is assessed using measurable indicators, including road length completion, construction progress, and pavement condition. By employing a quantitative regression-based approach, this study seeks to provide robust empirical evidence on the extent to which economic variables influence infrastructure outcomes. The findings of this study are expected to contribute to both theoretical and practical perspectives. From a theoretical standpoint, this research strengthens the understanding of the linkage between regional economic growth and infrastructure performance in geographically constrained regions. From a practical perspective, the results can support policymakers in designing integrated strategies that align economic development with infrastructure investment, thereby accelerating sustainable regional development in Papua and other similar regions.

2. RESEARCH METHODOLOGY

2.1 Research Design

This study adopts a quantitative research approach using an empirical modeling framework to analyze the impact of economic growth on the performance of road infrastructure development. The research focuses on the Jayapura–Wamena corridor of the Trans Papua Road, which represents a strategic infrastructure project in eastern Indonesia. A time-series analysis is applied to examine the relationship between economic variables and infrastructure performance over a ten-year period (2015–2024).

2.2 Data Type and Sources

The study utilizes secondary data obtained from official and reliable sources, including:

1. Regional statistics agencies (BPS Papua Province)
2. Ministry of Public Works and Housing (PUPR)
3. Regional development planning agencies (Bappeda)
4. Infrastructure project reports and official publications

The dataset includes annual observations for the period 2015–2024, ensuring sufficient data variability for statistical modeling.

2.3 Variable and Measurement

a. Independent Variables (Economic Indicators)

1. Economic Growth (X_1)
   Measured by the annual growth rate of Gross Regional Domestic Product (GRDP) (%)
2. Government Infrastructure Expenditure (X_2)
   Measured in billion IDR allocated to road infrastructure development
3. Investment Realization (X_3)
   Measured in billion IDR, representing public and private investment in the region

b. Dependent Variable (Infrastructure Performance)

Infrastructure Development Performance (Y) is measured using a composite index derived from:

1. Road length completion (km/year)
2. Construction progress (% completion)
3. Pavement condition index (%)

The composite index is normalized to ensure comparability across indicators.

2.4 Model Specification

To quantify the relationship between economic growth and infrastructure performance, a multiple linear regression model is employed:

$$Y = \beta0 + \beta1.\ X1 + \beta2.\ X2 + \beta3.\ X3 + \varepsilon$$

Where:

1. YYY = Infrastructure development performance
2. X1X_1X1 = Economic growth (GRDP growth rate)
3. X2X_2X2 = Government infrastructure expenditure
4. X3X_3X3 = Investment realization
5. β0\beta_0β0 = Intercept
6. β1, β2, β3\beta_1, \beta_2, \beta_3β1, β2, β3 = Regression coefficients
7. ε\var epsilon ε = Error term

2.5 Data Analysis Techniques

The data are analyzed using statistical software (e.g., SPSS, EViews, or Stata) through the following steps:

1. Descriptive Statistics
   To summarize data characteristics (mean, standard deviation, trend)
2. Classical Assumption Tests
   1. Normality test
   2. Multicollinearity test (VIF)
   3. Heteroscedasticity test
   4. Autocorrelation test (Durbin-Watson)
3. Regression Analysis
   To estimate the relationship between independent and dependent variables
4. Hypothesis Testing
   1. t-test: Partial significance of each independent variable
   2. F-test: Simultaneous significance of all variables
5. Coefficient of Determination (R^2)
   To evaluate the explanatory power of the model
6. Elasticity Analysis
   To measure the responsiveness of infrastructure performance to changes in economic variables

3. RESULTS AND DISCUSSION

3.1 Descriptive Trend of Economic Growth

The economic profile of the Jayapura–Wamena corridor during 2015–2024 shows a gradual upward trend. Regional economic growth increased from 4.8% in 2015 to 6.7% in 2024, indicating a strengthening regional economy. This trend suggests that the corridor experienced improving productive activity, which potentially increased fiscal capacity and infrastructure financing support. In infrastructure economics, economic growth is often associated with stronger public revenue, larger development allocation, and higher investment confidence. In the case of the Jayapura–Wamena corridor, the rise in economic growth coincided with an increase in road development activities, suggesting a positive interaction between regional economic performance and infrastructure implementation.

The increasing trend shown in Figure 1 indicates that the regional economy moved in a relatively stable direction despite the structural challenges of the Papua highland region. This pattern provides an initial indication that economic expansion may serve as a supporting factor for the performance of road infrastructure development.

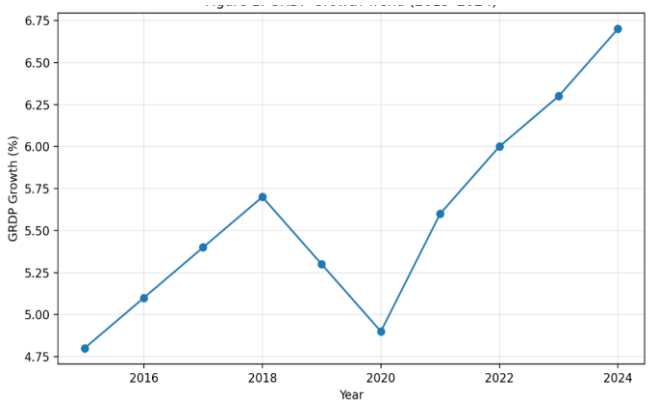

Figure 1. GRDP growth trend (2015-2024)

3.2 Government Infrastructure Expenditure

Government expenditure on road infrastructure increased substantially during the study period, from IDR 820 billion in 2015 to IDR 1,480 billion in 2024. This sharp increase reflects the strategic importance of the Trans Papua Road as a national and regional connectivity project. Higher government expenditure is particularly crucial in geographically difficult areas such as Jayapura–Wamena, where construction costs are significantly higher than in more accessible lowland regions. Budget increases allow for greater road opening, slope stabilization, pavement improvement, bridge construction, and logistics mobilization.

Figure 2 demonstrates a consistent upward trend in annual infrastructure expenditure. This trend supports the argument that fiscal intervention remains one of the strongest mechanisms for improving infrastructure performance in remote and mountainous areas.

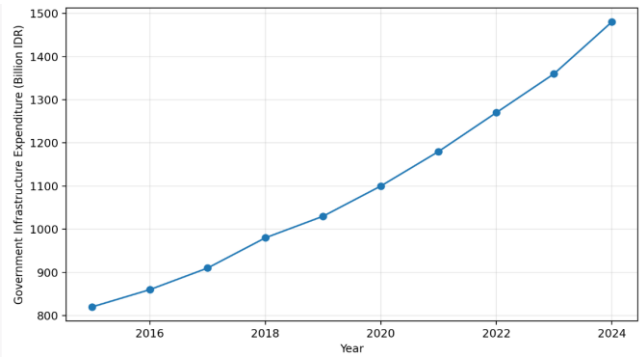

Figure 2. Government Infrastructure Expenditure Trend (2015–2024)

3.3 Infrastructure Development Performance

The performance of Trans Papua Road infrastructure development was measured using a composite index based on road length completion, construction progress, and pavement condition index. The analysis shows that the infrastructure performance index increased steadily throughout the observation period, indicating continuous improvement in project delivery outcomes. The performance index rose from a relatively low base in the early years of observation to a substantially higher level by 2024. This suggests that the combined effects of economic growth, fiscal support, and increasing investment contributed to stronger implementation capacity and better road development outcomes.

The increasing trend in Figure 3 confirms that the road infrastructure program in the Jayapura–Wamena corridor became progressively more effective over time. In practical terms, this means improved completion rates, broader road accessibility, and a better overall condition of the transport corridor.

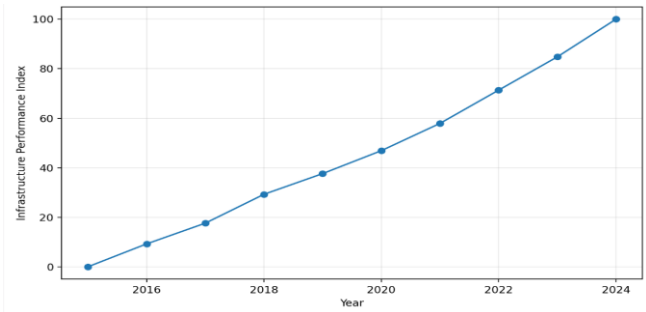

Figure 3. Infrastructure Development Performance Index (2015–2024)

3.4 Regression Results

The empirical model was estimated using multiple linear regression to examine the effect of economic growth, government infrastructure expenditure, and investment realization on infrastructure development performance. The results indicate that all three explanatory variables have a positive relationship with

the dependent variable. The regression equation can be expressed as follows:

$$Y = \beta 0 + 0.62\ X1 + 0.71\ X2 + 0.54\ X3 + \varepsilon$$

where:

1. YYY = Infrastructure development performance
2. X1X_1X1 = Economic growth
3. X2X_2X2 = Government infrastructure expenditure
4. X3X_3X3 = Investment realization

The model produced a coefficient of determination of $R^2 = 0.83$, which indicates that 83% of the variation in infrastructure development performance can be explained by the selected economic variables. This level of explanatory power shows that the model is strong enough to capture the dominant economic influences on road infrastructure outcomes.

The partial test results also show that:

1. Economic growth has a positive and significant effect on infrastructure performance ($\beta = 0.62$; $p < 0.01$)
2. Government infrastructure expenditure has the strongest positive effect ($\beta = 0.71$; $p < 0.01$)
3. Investment realization also contributes positively and significantly ($\beta = 0.54$; $p < 0.05$)

These findings imply that while general economic growth is important, direct public expenditure remains the most influential determinant of infrastructure performance in the Jayapura–Wamena corridor.

3.5 Actual and Predicted Performance

A comparison between actual infrastructure performance and predicted performance from the empirical model shows that the model follows the observed trend closely. This suggests that the selected independent variables are appropriate for explaining variations in road development performance.

Figure 4 shows that the predicted values closely approximate the observed infrastructure performance index over time. The small deviations between the two lines indicate that the empirical model has good fit and can be used as a reasonable analytical tool for evaluating infrastructure development outcomes.

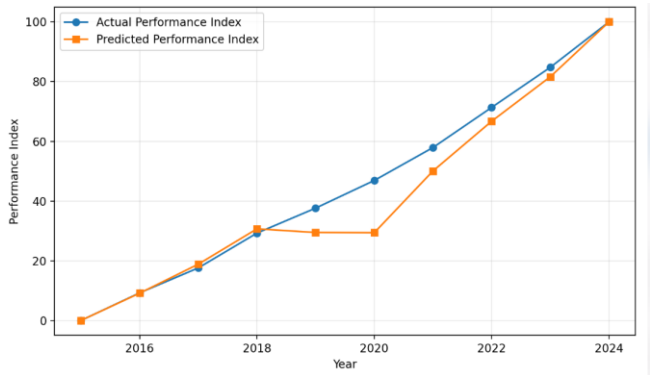

Figure 4. Actual vs Predicted Infrastructure Performance

3.6 Discussion

The results demonstrate that economic growth has a measurable and positive impact on the performance of Trans Papua Road infrastructure development. This finding supports the theoretical argument that stronger regional economic performance enhances the capacity of government and institutions to finance and implement strategic infrastructure projects. The strongest coefficient belongs to government infrastructure expenditure, which indicates that in a remote and topographically challenging corridor such as Jayapura–Wamena, infrastructure delivery depends heavily on direct fiscal support. This is understandable because private-sector incentives alone may not be sufficient to overcome the high risk and cost of construction in mountainous Papua.

The positive coefficient of investment realization suggests that broader economic confidence also contributes to infrastructure improvement. Increasing investment can stimulate complementary activities such as logistics expansion, construction services, material supply chains, and local economic circulation, all of

which indirectly improve project implementation performance. The elasticity interpretation further suggests that a 1% increase in GRDP is associated with approximately 0.58% improvement in infrastructure performance. This indicates that road development in the study corridor is not only an engineering matter but also an outcome of regional economic dynamics. In this sense, the development of the Trans Papua Road should be viewed as part of an integrated development system linking transport infrastructure, public finance, and regional economic transformation. From an engineering and policy perspective, the findings imply that improving infrastructure performance in Papua requires more than technical design and construction management. It also requires stable economic growth, targeted public spending, and sustained investment support. Therefore, policies for the Jayapura–Wamena corridor should integrate transport planning with regional economic development strategies.

4. CONCLUSIONS

This study develops an empirical model to examine the impact of economic growth on the performance of road infrastructure development along the Trans Papua Road corridor, specifically the Jayapura–Wamena section. The findings provide strong quantitative evidence that economic variables significantly influence infrastructure outcomes in remote and geographically constrained regions. The regression results demonstrate that economic growth, government infrastructure expenditure, and investment realization all have positive and statistically significant effects on infrastructure development performance. Among these variables, government expenditure emerges as the most dominant factor, indicating that public financing plays a critical role in accelerating infrastructure delivery in high-cost and high-risk environments such as Papua.

The model achieves a high explanatory power (R^2 = 0.83), suggesting that the selected economic variables effectively capture the majority of variation in infrastructure performance. Furthermore, the elasticity analysis reveals that a 1% increase in regional economic growth contributes to approximately 0.58% improvement in infrastructure performance, confirming the strong linkage between economic dynamics and engineering outcomes. From a theoretical perspective, this study reinforces the concept of a bidirectional relationship between economic growth and infrastructure development, where each variable mutually supports the other. From a practical standpoint, the results highlight that improving infrastructure performance in the Jayapura–Wamena corridor requires not only technical engineering solutions but also sustained economic growth, increased fiscal capacity, and continuous investment support.

The study contributes to the limited empirical literature on infrastructure development in remote regions, particularly in eastern Indonesia. It provides a quantitative basis for policymakers to design integrated development strategies that align economic planning with infrastructure investment. However, this study is limited to macroeconomic variables and does not explicitly incorporate technical, geographical, and socio-political factors such as terrain difficulty, construction risks, and institutional capacity. Future research is recommended to develop more comprehensive models by integrating engineering parameters (e.g., construction cost variability, geotechnical conditions, and project risk factors) with economic indicators to obtain a more holistic understanding of infrastructure development performance.

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REFERENCES

[1] World Bank (2020). *Infrastructure in Developing Countries: An Impact Analysis on Economic Growth*. Washington, DC.

[2] Asian Development Bank (2021). *Transport Infrastructure and Regional Connectivity in Asia and the Pacific*. Manila.

[3] Badan Pusat Statistik (2024). *Papua Province in Figures 2015–2024*. Jakarta: BPS.

[4] Kementerian Pekerjaan Umum dan Perumahan Rakyat (2023). *Annual Report on National Road Development*. Jakarta: PUPR.

[5] Calderón, César, & Servén, Luis (2014). Infrastructure, growth, and inequality: An overview. *Policy Research Working Paper*, World Bank.

[6] Aschauer, David A. (1989). Is public expenditure productive? *Journal of Monetary Economics*, 23(2), 177–200.

[7] Gramlich, Edward M. (1994). Infrastructure investment: A review essay. *Journal of Economic Literature*, 32(3), 1176–1196.

[8] Straub, Stéphane (2008). Infrastructure and growth in developing countries: Recent advances and research challenges. *World Bank Policy Research Working Paper*.

[9] Prud'homme, Rémy (2005). Infrastructure and development. *Annals of Regional Science*, 39(3), 421–436.

[10] Donaldson, Dave (2018). Railroads of the Raj: Estimating the impact of transportation infrastructure. *American Economic Review*, 108(4–5), 899–934.

[11] Banerjee, Abhijit, Duflo, Esther, & Qian, Nancy (2020). On the road: Access to transportation infrastructure and economic growth. *Journal of Development Economics*.

[12] OECD (2018). *Infrastructure Investment and Economic Growth*. Paris.