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Analysis of the Impact of Telecommunications Infrastructure, Road Infrastructure, and Electricity on Indonesia's Economic Growth from 2014 to 2023

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ABSTRACT

Indonesia still faces various economic problems. In line with this, economic development theory emphasizes that the solution to these problems is to encourage economic growth through the availability of public infrastructure. This study aims to analyze the effect of telecommunications infrastructure, road infrastructure, and electricity on Indonesia's economic growth during the period 2014-2023. The type of research used is quantitative research using an associative method with panel data. The data used is secondary data with a multiple linear regression research model processed using the Eviews 13 program. The findings of this study are that, partially, telecommunications infrastructure and road infrastructure have a positive and significant relationship, while electricity infrastructure has a positive but insignificant relationship.

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INTRODUCTION

The Republic of Indonesia is one of the most densely populated countries in the world, with a population of 282 million. Indonesia is also known as an archipelago with 17,374 islands and a land area of 1,922,570 km2, as well as abundant natural resources (Victoria 2021). However, Indonesia still faces various problems such as economic inequality, poverty, and significant unemployment. In line with this, economic development theory emphasizes that the solution to these problems is to encourage economic growth. (Darmawan 2023).

Economic growth is a measure of economic success and the quality of policies implemented in a region over a certain period of time. In addition, economic growth is one of the main focuses of a number of countries around the world (Rahman and Alam 2021). Economic growth is influenced by various factors, one of which is increased productivity. Increased productivity is considered a crucial factor in driving economic growth. Productivity can be stimulated through investment in public infrastructure (Meka'a, et al. 2024). In line with this, Indonesia continues to actively strive to promote systematic and gradual infrastructure development. There are various factors that influence the ups and downs of economic growth, one of which is the availability of public infrastructure.

(Sukirno 2011) argues that economic growth is the development of community activities that encourage an increase in the quantity of goods and services produced, which in turn will improve the welfare of the community. He also argues that the factors that can drive economic growth are (i) land and other natural resources, (ii) the number and quality of the population and labor force, and (iii) capital goods and technology levels. The government constantly strives to encourage economic growth in a positive direction through various policies. One of the government's policies to increase economic growth is to improve the availability of public infrastructure, which is theoretically considered to play a role in driving economic growth.

Indonesia's economic growth tends to fluctuate. From 2014 to 2019, Indonesia's economic growth was stable at 5-6%. However, in 2020, there was a significant decline to -2.07% due to the global economic paralysis caused by the Covid-19 pandemic. Indonesia's economy rebounded in 2021, growing by 3.7%. Then, in 2022 and 2023, Indonesia's economic growth stabilized again at 5-6%. (Darmawan 2023)

Public Infrastructure development has an impact on production efficiency, which in turn can drive economic growth. There are direct and indirect impacts of infrastructure availability on economic growth. The direct impact is that is able to minimize input costs in the production process, thereby reducing domestic prices and stimulating aggregate demand. The indirect impact is that it can increase the productivity of input factors. The availability of infrastructure can attract investors to invest their capital, thereby increasing capital stock. The availability of infrastructure can also facilitate the mobilization of labor and raw materials, which in turn can increase labor productivity and production chain efficiency. (Cicilia and Aji 2025)

Improvements in the quality and quantity of infrastructure are considered to drive economic growth. Several priority infrastructures, the provision of which is a collaboration between the government and the private sector, include telecommunications infrastructure, road infrastructure, and electricity infrastructure, as stipulated in Presidential Regulation No. 75 of 2014 concerning the Acceleration of Priority Infrastructure Provision. (Kansil, et al. 2023). The availability of telecommunications infrastructure is essential for economic globalization and digitalization. Advances in telecommunications are marked by increased access to the internet. With increased internet penetration, it is possible to expand opportunities for investors to invest in Indonesia and facilitate the dissemination and exchange of information between regions.

The percentage of households with internet access in Indonesia has been on an upward trend. From 2014 to 2016, the percentage of households with internet access ranged from 25-50%. Then in 2017, it reached 57% and has continued to increase significantly year after year. During the Covid-19 pandemic in 2020, the percentage reached 78.18%. Similarly, during the transition period of recovery after the Covid-19 pandemic, it reached 82% in 2021, 86.54% in 2022, and peaked at 87% in 2023.

Another indicator that influences economic growth besides telecommunications infrastructure is transportation infrastructure in the form of roads, because road infrastructure plays an important role in spatial connectivity (Varghese and Pradhan 2025). Road infrastructure can facilitate mobilization from one region to another, which can minimize spatial barriers. Road infrastructure is vital infrastructure that is urgently needed because it can support the function of cities as centers of growth and encourage equitable development (Wahyudi and Zapita 2022). However, in addition to quantity, the quality of roads also needs to be considered because good and proper road quality will have an impact on productivity, where road quality is measured by the percentage of road stability.

The stability of national roads in Indonesia fluctuates considerably from year to year. In 2014 and 2015, road infrastructure was a development priority, resulting in a significant increase in the percentage of national road stability to 92.95% in 2014 and 93.95% in 2015. However, in 2016, it declined to 89.39%. Subsequently, from 2017 to 2019, the trend of increased again to 90-92%. In 2020, the government's main focus shifted to the health sector due to the Covid-19 pandemic, causing the percentage of national road stability to decline to 91.27%. In the following years, 2021-2023, the percentage of road stability increased again and peaked at 91-94%.

An infrastructure that is no less important than the two infrastructures mentioned above is the electrical power infrastructure. Electrical power infrastructure is necessary in the process of supplying and distributing electrical energy (Damanik, et al. 2024). Electrical energy management is necessary to meet demand, especially industrial demand. Electric power infrastructure is a crucial factor that is indispensable in urban areas undergoing modernization because it can support production processes on both a large and small scale. With adequate electrical infrastructure, the process of supplying and distributing electrical energy can increase work productivity and, in turn, drive economic growth in a positive direction (Cornelius and Primandhana 2022).

Installed power plant capacity is the total amount of electrical power that can be generated by a power plant when all units are operating. Installed power plant capacity in Indonesia has shown an upward trend from year to year. From 2014 to 2017, installed power plant capacity in Indonesia remained stable at 50,000-58,000 megawatts. The following year, 2018-2021, it could reach 60,000.0066,000.00 megawatts. In 2022, it experienced the highest increase at 74,218.45 megawatts. And in 2023, it reached 73,460.81 megawatts.

The availability of infrastructure still receives relatively little attention in studies discussing factors that influence economic growth. However, in reality, various economic theories emphasize that the availability of infrastructure as a tangible manifestation of technological development is also one of the driving factors of economic growth, especially in the long term. With reference to the above description, it is an interesting study to raise the question of how telecommunications infrastructure, road infrastructure, and electricity, both partially and simultaneously, affect economic growth in Indonesia in 2014-2023.

LITERATURE REVIEW

Economic Growth

Economic growth refers to the process of continuous transformation of a country's economic climate for the better over a certain period of time. Economic growth is also defined as the process of increasing the quantity of goods and services produced by an economy, which is realized through an increase in national income. (Sukirno 2011) explains that the indicator used to determine economic growth is Gross Domestic Product (GDP), either at current prices or constant prices. GDP is the total added value produced by every business unit within a country. GDP at current prices is calculated using the prices prevailing in each year to see shifts and economic structures. Meanwhile, GDP at constant prices is calculated using prices in a particular year as a basis for seeing economic growth from year to year. (Darmawan 2023)

There are several well-known economic growth theories that have developed around the world. Among them are classical, neoclassical, and modern theories.

Classical Theory

Adam Smith, in his book entitled "The Wealth of Nations: Original Version," argues that the government plays an important role in providing jobs and public institutions such as roads, bridges, canals, and ports that can facilitate trade flows, expand markets, support the division of labor, which in turn can boost economic growth. (Smith 1776) In addition, David Ricardo, in his book entitled "On the Principles of Political Economy and Taxation," emphasizes the importance of fixed capital, which includes long-term investment in machinery, equipment, and the development of basic public facilities such as roads, ports, irrigation, and so on, in order to reduce costs, accelerate mobilization, and facilitate domestic and international trade. (Richardo 1817)

Neoclassical Theory

Robert Sollow, in his classic paper entitled "A Contribution to The Theory of Economic Growth," emphasized the role of capital accumulation, labor force growth, and technological progress in driving economic growth. He argued that in the long run, the main determinant of economic growth is technological progress, which is assumed to be exogenous. He also emphasizes the importance of investment in infrastructure development as a means of promoting technology diffusion and maintaining sustainable economic growth (Sollow 1965). Furthermore, David Aschauer, in his study entitled "Is Public Expenditure Productive?", focuses on the role of public capital in economic growth. This theory emphasizes that the accumulation of non-military public capital, such as roads, electricity, transportation, and so on, plays a major role in driving private sector productivity. Infrastructure development is considered capable of increasing the efficiency of private capital and labor use and can increase aggregate economic competitiveness. (David Alan Aschauer 1990)

Modern Theory

Paul Romer, in his research entitled "Endogenous Technological Change," emphasizes that long-term economic growth is driven by the creation and accumulation of knowledge through research and innovation. Economic growth can be achieved if there are adequate institutional support and public policy, one of which is the availability of infrastructure. The development of both physical and non-physical infrastructure serves as public capital that plays a role in driving economic growth (Paul M. Romer 1990). Following Michael P. Todaro and Stephen C. Smith in their classic work entitled "Economic Development: 9th Edition," they emphasize that economic development does not only depend on the accumulation of physical capital and output growth, but also on the availability of adequate basic infrastructure. Both authors put forward the concept of Social Overhead Capital (SOC), which is the realization of public investment that serves as a basic framework for productive economic activities in order to reduce production costs, expand market access, and accelerate the distribution of goods and services. (Todaro, M. P., & Smith 2005)

Infrastructure and Economic Development

Mankiw (2001) defines infrastructure as the realization of public capital formed from government investment. (Cornelius and Primandhana 2022) argue that infrastructure is said to have a crucial role in driving a country's economy. The availability of public infrastructure is considered capable of driving economic growth. The infrastructure in question includes telecommunications infrastructure, road infrastructure, and electricity, which are considered to be interrelated (Tong et al. 2025). The development of telecommunications infrastructure plays a role in economic growth in the digital era. Furthermore, the development of road infrastructure can improve connectivity between regions. Furthermore, electricity infrastructure facilitates access to electrical energy sources, which are a supporting factor for industrial activities (Damanik, et al. 2024).

Telecommunications Infrastructure

Telecommunications can be defined as the process of transmitting or sending information over long distances. (Novalia 2024). The development of telecommunications infrastructure can facilitate public access to information without spatial boundaries. Accessibility to adequate telecommunications infrastructure can drive production efficiency by increasing access to information, enabling companies to observe market trends and developments, and allowing them to access broader markets. In the digital economy era, telecommunications infrastructure can help companies minimize the risk of misinformation and accelerate market dynamics analysis, which in turn can improve the efficiency of corporate investment. (Wang et al. 2025)

Road Infrastructure

Road infrastructure is a means of connecting regions to facilitate mobility and accommodation, which is considered capable of promoting business productivity. The availability of road infrastructure can facilitate the mobilization of production factors and the distribution of goods produced, thereby stimulating economic growth (Aldona et al. 2021). Road infrastructure is needed to promote economic growth because it can directly increase industrial and manufacturing productivity. (Zhang and Cheng 2023)

Electricity Infrastructure

Electricity is a vital energy source that is essential for modern society, as it is used to facilitate daily activities and business operations (Aldona, et al. 2021). Electrical power infrastructure is categorized as a vital element for achieving high economic growth. Access to adequate electricity infrastructure can encourage improvements in education, health, employment, and productivity (Bazán Navarro, et al. 2024). Electricity infrastructure is used as a key input in supporting the production process in the manufacturing sector to increase productivity, thereby driving economic growth (Wahyudi and Zapita 2022).

METHODOLOGY

Type and location of research

This study is a quantitative study using an associative method. (Sugiyono 2018) states that quantitative research is based on the philosophy of positivism, which considers that social phenomena can be observed, measured, and explained in numbers by emphasizing objectivity. Meanwhile, the associative method aims to analyze the relationship between two or more variables. The scope of the research is Indonesia, which consists of 33 provinces. The research period covers a span of 10 years, starting from 2014 to 2023. The selection of the geographical scope and time period is intended to enable this study to provide a more comprehensive picture of infrastructure development and economic growth.

Types and Techniques of Data Collection

This study uses secondary data obtained from the Central Statistics Agency (BPS) and the Ministry of Public Works (KemenPU). (Sugiyono 2018) argues that secondary data is data obtained from documentation. These data can be accessed through various agencies in the form of statistical tables and statistical journal publications. The data required is panel data, which is cross-sectional unit data linked over a certain period of time. The data collection technique was carried out by collecting documentation related to the research conducted. The data and information needed were obtained from journals, books, articles, and websites related to the research topic.

Research Variables

The research variables are divided into two categories: independent variables, which are variables that cause changes in dependent variables. The independent variables in this study are telecommunications infrastructure, road infrastructure, and electrical power infrastructure. Next are dependent variables, which are variables that are influenced by independent variables. In this study, the dependent variable is economic growth. (Nurul Melani Haifa et al. 2025).

Data Analysis Procedure

Data analysis was performed using a multiple linear regression analysis approach. Multiple linear regression analysis aims to determine and analyze the effect of independent variables, namely telecommunications infrastructure, road infrastructure, and electrical power infrastructure, on the dependent variable, namely economic growth, using panel data that requires several stages of model testing, including the following.

1. Common Effect Model (CEM), assumes that all cross-section units and time periods have the same intercept, so that panel data is treated as combined data without distinguishing individual or time dimensions.
2. Fixed Effect Model (FEM) considers differences in characteristics between individuals and time by giving different intercepts to each cross-sectional unit and time period.
3. Random Effect Model (REM) assumes that differences in characteristics between individuals and over time are not fixed, but random and normally distributed. In the REM model, individual and time variations are included in the error component.

Furthermore, (Savitri 2021) states that there are three types of model selection tests. Among them are:

a. Chow test, used to determine the suitability of the panel data analysis model between the Common Effect Model (CEM) and the Fixed Effect Model (FEM). If the probability value is < 0.05, then the selected model is FEM. Meanwhile, if the probability value is > 0.05, then the selected model is CEM.
b. The Hausman test is used to determine the best model between the Fixed Effect Model and the Random Effect Model. If the probability value is > 0.05, then the selected model is REM. However, if the probability value is < 0.05, then the selected model is FEM.
c. Lagrange Multiplier Test, used to determine the best model between CEM and Random Effect Model (REM). If the probability value is < 0.05, then the selected model is REM. However, if the probability value is > 0.05, then the selected model is CEM.

Classical Assumption Test

The classical assumption test is carried out to determine the feasibility of the regression model used. The classical assumption test is carried out in stages. The following are the stages in the classical assumption test for panel data.

1. Multicollinearity Test, aims to determine the linear relationship between the independent variables in the model (Danang Sunyoto 2007). The multicollinearity test is seen through the correlation value between independent variables. If the correlation value between variables is < 0.8, then the model passes the multicollinearity test. Conversely, if the value is > 0.8, the model does not pass the multicollinearity test.
2. Heteroscedasticity test, which aims to determine whether there are differences in variance in the residuals between observations in the regression model (Suliyanto 2011). To detect heteroscedasticity, a y residual test is performed using a graphical approach. If the y residual graph does not exceed the limits of 500 and -500, the model is assumed to pass the heteroscedasticity test.

Regression Analysis Model

Multiple linear regression analysis is used to determine the effect of telecommunications infrastructure, road infrastructure, and electricity infrastructure on Indonesia's economic growth.

$$\mathbf{LOGY = ß0 + ß1X1it + ß2X2it + ß1LOGX3it} + e$$

Explanation:
Y : Gross Domestic Product (Billion Rupiah)
ß0.ß3: Coefficients of X1, X2, X3
X : Telecommunications Infrastructure (%)
X2 : Road Infrastructure (%)
X3 : Electricity Infrastructure (Megawatts)
it : Year
e : Error

RESEARCH RESULT

Selection of Analysis Model

Model selection testing is the first stage of panel data regression analysis, which aims to determine the most appropriate model. The results of the model selection test based on the table in Appendix 1 show that in the Chow test, the probability value is less than 0.05, so the selected model is the Fixed Effect Model (FEM). Based on these three tests, the most appropriate model is the Fixed Effect Model (FEM).

Classical Assumption Test

The following are the results of the classical assumption test, which aims to determine the suitability of the research data with the basic requirements in regression analysis. In panel data with the Fixed Effect model, the classical assumption tests performed are the multicollinearity test and the heteroscedasticity test.

1. Multicollinearity Test, aims to determine the correlation between independent variables. Based on Appendix 2, the correlation between X1 (telecommunications infrastructure) and X2 (road infrastructure) is -0.0975. Then, the correlation between X1 (telecommunications infrastructure) and X3 (electrical infrastructure) is 0.2094. Furthermore, the correlation between X2 (Road Infrastructure) and X3 (Electricity Infrastructure) is 0.4916. Based on these results, the correlation values of the three independent variables are less than 0.8. Therefore, the analysis model used passes the multicollinearity test.
2. Heteroscedasticity test, viewed through the residual y value, aims to determine the difference in variance in the residuals between observations. Based on the residual graph in Appendix 3, it is known that the graph does not cross the limits (500 and -500), which indicates that the residual variance is the same. Thus, it can be concluded that there is no heteroscedasticity in the research model.

Multiple Linear Regression Analysis

Model selection testing is the first stage of panel data regression analysis.

Table 1. Multiple Linear Regression Estimation Results

Dependent Variable: Y
Method: Panel Least Squares
Date: 09/25/25 Time: 22:11
Sample: 2014 2023
Periods included: 10
Cross-sections included: 33
Total panel (balanced) observations: 330

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.905394	0.053369	91.91408	0.0000
X1	2.41E-05	1.06E-06	22.60174	0.0000
X2	0.006474	0.003059	2.116100	0.0352
X3	0.012149	0.007401	1.641521	0.1018

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.996733	Mean dependent var	5.194390
Adjusted R-squared	0.996344	S.D. dependent var	0.499464
S.E. of regression	0.030200	Akaike info criterion	-4.059284
Sum squared resid	0.268139	Schwarz criterion	-3.644838
Log likelihood	705.7819	Hannan-Quinn criter.	-3.893967
F-statistic	2562.730	Durbin-Watson stat	0.817993
Prob(F-statistic)	0.000000		

Source: Data processing results

Based on the results of the Multiple Linear Regression Estimation above, the following regression equation is obtained.

$$\mathbf{Y = 4.9053 + 2.4063\ X_1 + 0.0064 X_2 + 0.0121\ X_3}$$

The results of the multiple linear regression analysis above can be interpreted as follows.

1. The constant value of 4.9053 indicates that if telecommunications infrastructure, roads, and electricity = 0 (no change), economic growth will be at 4.9053 (4.9%).
2. Variable X1 (telecommunications infrastructure) has a positive relationship with the economic growth variable with a coefficient value of 2.4063. This means that if there is a 1% increase in telecommunications infrastructure, economic growth will also increase by 2.4063 (2.4%).
3. Variable X2, road infrastructure, has a positive relationship with the economic growth variable with a coefficient value of 0.0064. This means that if there is a 1% increase in road infrastructure, economic growth will also increase by 0.0064 (0.006%).
4. Variable X3, namely electricity infrastructure, has a positive relationship with the economic growth variable with a coefficient value of 0.0121. This means that if there is a 1% increase in electricity infrastructure, economic growth will also increase by 0.0121 (0.012%).

Partially, the probability value for the telecommunications infrastructure variable is 0.0000, which is less than 0.05, meaning that the telecommunications infrastructure variable has a significant effect on economic growth. Then, the probability value for the road infrastructure variable is 0.0352, meaning that the road infrastructure variable has a significant effect on economic growth. Meanwhile, the probability value for the electricity infrastructure variable is 0.1018, meaning that the electricity infrastructure variable has no significant effect on economic growth.

Simultaneously, it can be seen from the prob. value (f-statistic) that is less than 0.05 ($0.000000 < 0.05$) or the f-statistic value is greater than the f table ($2562.729999 > 2.63$). Therefore, it can be concluded that the variables of telecommunications infrastructure, road infrastructure, and electricity infrastructure simultaneously have a significant effect on the economic growth variable. The value of r-square is 0.9967. This means that the variables of telecommunications infrastructure, road infrastructure, and electricity infrastructure are able to explain the economic growth variable by 0.9967 or 99%. The remaining 1% is explained by variables not included in the model.

DISCUSSION

The following is a discussion of the influence of telecommunications infrastructure, road infrastructure, and electricity on economic growth in 33 provinces in Indonesia from 2014 to 2023 based on various analysis results that have been carried out.

The Influence of Telecommunications Infrastructure on Economic Growth

Based on the results of the analysis conducted, it was found that the telecommunications infrastructure variable has a positive and significant relationship with economic growth in 33 provinces in Indonesia from 2014 to 2023. These findings are in line with the research of Inda Novalia (2023), Sekar Asmoro Gati et al. (2021), and Nurul Novita et al. (2024) in their study " ," which states that telecommunications infrastructure has a positive and significant effect on economic growth.

The availability of telecommunications infrastructure is considered to influence the national economy. M. Ishaq Nadiri and Banani Nandi (2000) argue that there is a positive and significant relationship between telecommunications infrastructure development and economic growth, as indicated by increased output and productivity. Their research found that increasing the size and modernizing telecommunications infrastructure can reduce production costs in every industry in the national economy. The total marginal benefit obtained reached 40%. In addition, the development of telecommunications infrastructure also affects the production structure at the industrial and national economic levels.

The Effect of Road Infrastructure on Economic Growth

Based on the results of the analysis conducted, it was found that road infrastructure has a positive and significant relationship with economic growth in 33 provinces in Indonesia from 2014 to 2023. These results are in line with the findings of research by Ann Marry Varghese and Rudra Prakash Pradhana (2025), Cosmas Bernard, et al. (2024), Heru Wahyudi and Jesi Zapita (2022), Dio Cornelious and Wiwin Priana Primadhana (2022), and Darwin Damanik et al. (2024), who found that road infrastructure has a positive and significant relationship with economic growth.

Todaro and Smith (2015) emphasize the importance of physical infrastructure development, especially road infrastructure, as a prerequisite for long-term economic growth. Adequate road access will facilitate the mobilization of production factors such as raw materials and labor, facilitate the distribution of production outputs, reduce production costs, and expand markets. Todaro also emphasizes that without the support of basic infrastructure, growth potential in developing countries will be hampered because there are several regions that are isolated and lag behind in economic activity. Mankiw (2016) argues that government investment in public capital in the form of roads can increase the overall productivity of production factors. Road infrastructure can facilitate mobilization, accelerate distribution, and expand markets.

The Effect of Electrical Infrastructure on Economic Growth

Based on the results of the analysis, it was found that the electricity infrastructure variable has a positive and insignificant effect on economic growth in 33 provinces in Indonesia from 2014 to 2023. These results are in line with the findings of research by Ciro Eduardo, et al. (2024), Heru Wahyudi and Jesi Zapita (2022), Dio Cornelious and Wiwin Priana Primadhana (2022), Darwin Damanik, et al. (2024), who argue that electricity infrastructure has a positive effect on economic growth, although the effect is not always significant because it is more evident over a relatively longer period of time.

In addition to emphasizing the provision of road infrastructure to boost economic growth, Todaro and Smith (2015) also assert that the existence of electricity infrastructure is a form of *social overhead capital* that is very important for long-term development because it plays a role in increasing productivity, accelerating distribution, and supporting industrialization activities. Electricity infrastructure has an insignificant impact in the short term because it does not directly drive output but rather creates opportunities. Mankiw (2016) also argues that government investment in public capital in the form of electricity and energy can increase total factor productivity, even though the contribution of electricity infrastructure is not always significant in the short term.

The Impact of Telecommunications Infrastructure, Road Infrastructure, and Electricity on Economic Growth

Based on the results of the analysis, it was found that telecommunications infrastructure, road infrastructure, and electricity infrastructure collectively have a significant impact on economic growth. These results indicate that collaboration between these three types of infrastructure can have a significant impact on economic growth. These findings are in line with the results of research by (Timilsina, Stern, and Das 2021), which analyzed the contribution of telecommunications, road, and electricity infrastructure to economic growth in 87 countries during the period 1992-2017. They argued that the collaboration of telecommunications, road, and electricity infrastructure can have a significant impact on economic growth, especially in developing countries, due to the limited availability of infrastructure.

Based on the analysis results, although telecommunications infrastructure and road infrastructure partially have a significant effect on Indonesia's economic growth, while electricity infrastructure does not, the combination of these three infrastructures is considered to have a significant impact on economic growth through increased output and productivity. Therefore, government investment in the development of these three infrastructures needs to be increased. (Irwandi, Jamal, and Nasir 2025) also adds that investment in telecommunications infrastructure, road infrastructure, and electricity infrastructure has a significant impact on economic growth.

There has not been much research focusing on discussing the combined effects of telecommunications infrastructure, road infrastructure, and electrical power infrastructure on economic growth. However, based on the results of estimates that have been carried out and previous studies that have been presented, it is known that these three infrastructures can complement each other and have their respective roles in increasing output and productivity, which can drive economic growth. Business productivity in the modern era requires these three types of infrastructure because telecommunications infrastructure can facilitate digital business systems and promotion, road infrastructure facilitates and accelerates the mobilization of production factors and production output, and electricity infrastructure provides energy to support production, distribution, and technology-based services, as well as being a key requirement for digital activities. The synergy of these three types of infrastructure increases productivity and innovation, which can drive economic growth in a positive direction.

CONCLUSIONS AND RECOMMENDATIONS

The conclusions of this study regarding the factors affecting economic growth in 33 provinces in Indonesia for the period 2011-2023 are as follows.

1. Partially, telecommunications infrastructure has a positive relationship and significantly influences Indonesia's economic growth in the 2014-2023 period.
2. Partially, road infrastructure has a positive and significant relationship with Indonesia's economic growth in the 2014-2023 period.
3. Partially, electricity infrastructure has a positive relationship and an insignificant effect on Indonesia's economic growth in the 2014-2023 period.
4. Simultaneously, telecommunications infrastructure, road infrastructure, and electricity infrastructure have a significant effect on Indonesia's economic growth during the 2014-2023 period.

Based on the results of the analysis that has been carried out, the following recommendations can be concluded.

1. Telecommunications infrastructure has a significant effect on Indonesia's economic growth. The government needs to maintain stability and improve the quantity and quality of telecommunications infrastructure so that it continues to support business activities to drive economic growth.
2. Road infrastructure also has a significant influence on Indonesia's economic growth. The government is expected to improve the quantity and quality of road infrastructure to facilitate accommodation and reduce spatial barriers to economic activity.
3. Electricity infrastructure has an insignificant impact on Indonesia's economic growth. The government needs to evaluate and improve the provision of electricity infrastructure and strive to ensure that improvements in the quantity and quality of electricity infrastructure have a significant impact on Indonesia's economic growth, not only in the long term but also in the short term.
4. The synergy between the development of telecommunications infrastructure, road infrastructure, and electricity infrastructure needs to be given more attention because these three together have a significant impact on Indonesia's economic growth.

ADVANCED RESEARCH

This study opens opportunities for advanced research by encouraging deeper exploration of how infrastructure quality, regional disparities, and digital transformation interact to shape Indonesia’s economic growth. Future studies could integrate spatial econometric models, big-data geospatial analysis, and machine learning forecasting to capture heterogeneous infrastructure effects across provinces and predict long-term growth trajectories under various development scenarios. Researchers may also investigate the productivity spillovers of integrated infrastructure systems—telecommunications, roads, and electricity—while examining institutional, governance, and investment-efficiency factors that may moderate their impact. Additionally, incorporating renewable energy infrastructure, 5G expansion, and smart-mobility networks into future models would provide a more comprehensive understanding of how next-generation infrastructure can accelerate inclusive and sustainable economic growth in Indonesia.

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