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Study of The Relationship Between Telecommunication Infrastructure and Gross Domestic Product In Indonesia

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Abstract. Telecommunication infrastructure has a crucial role in driving the growth of a country's Gross Domestic Product (GDP). Telecommunications infrastructure can improve operational efficiency in various sectors of the economy, such as trade and services, which utilize information and communication technologies. This study aims to analyze the relationship between telecommunications infrastructure and GDP in Indonesia. The data used in this study are annual secondary data derived from the World Development Indicators for the period 2000 to 2023. The analysis tool used is multiple linear regression to analyze the relationship between telecommunications infrastructure and GDP in Indonesia. The results of the study show that the simultaneous influence of internet and telephone telecommunications infrastructure on GDP is positive and significant. The test results also show that internet telecommunications infrastructure has a positive and significant effect on GDP, while telephone telecommunications infrastructure has a negative and significant effect. This research provides important insights for policymakers in formulating telecommunications infrastructure development strategies to increase GDP in Indonesia.

Keywords: telecommunications infrastructure, internet, telephone, GDP, multiple linear regression

INTRODUCTION

Gross Domestic Product is the total value of all goods and services produced in a country over a given period, usually one year. It serves as a key indicator to measure the economic health of a nation. GDP consists of several main components: consumption (household spending on goods and services), investment (expenditure on capital goods used for future production), government expenditure (government spending on goods and services), and net exports (the difference between exports and imports) (Agu et al., 2022; Fernando, 2022; Finley, 2022; Konchitchki & Patatoukas, 2014). The condition of Gross Domestic Product in Indonesia shows a positive growth trend; for example, the value of GDP in 2023 reached IDR 20,892.4 trillion, compared to IDR 9,588.4 trillion in 2022.

Indonesia's economic growth reached 5.05 percent at the end of 2023 and 5.11 percent in the first quarter of 2024. The main sectors contributing to GDP growth include agriculture, manufacturing, trade, and transportation. Household consumption remains the main driving force of the economy. In addition, government consumption and investment play essential roles in increasing production capacity. Indonesia's GDP growth is projected to average 5.1% per year from 2024 to 2026, although challenges such as fluctuations in commodity prices and geopolitical uncertainty remain. Government policies supporting investment and infrastructure development are expected to continue encouraging economic growth in the future (Amelia, et al. 2023).

Good telecommunications infrastructure can increase productivity and efficiency in various sectors, encourage innovation, and expand markets for products and services (Wang & Wang, 2024). Thus, the development of telecommunication infrastructure—including a reliable internet network—is essential to create an ecosystem that supports inclusive and sustainable economic growth, as well as improving the overall quality of life of the community (Setiaji & Stuart, 2022).

In 2023, internet penetration in Indonesia reached 78.19%, with the number of internet

users at 221 million people. The penetration rate in urban areas reached 76.30%, while in rural areas it reached 59.33%. This data shows a significant increase in internet access throughout Indonesia.

Table 1. Internet Usage in 2023

Information	Data
Number of Internet Users	221 million people
Total Population	276.4 million people
Internet Penetration Rate	78.19%
Urban Penetration	76.30%,
Penetration in the Countryside	59.33%
User Growth (YoY)	5.44%
Average Usage Time	7 hours 42 minutes per day
Percentage of Mobile Users	98.3%
Residents Not Connected	63.51 million people

Source: Central Statistics Agency

Telecommunications infrastructure includes systems and facilities that enable communication and data exchange through various media, such as the internet, telephone networks, and communication systems. Telecommunication infrastructure plays a crucial role in increasing the Gross Domestic Product in Indonesia, especially by providing the connectivity needed to reduce inequality and improve access to information. This infrastructure consists of various parts, such as cable networks, satellite systems, and transmitting stations (Sekar Asmoro Gati, 2023b).Base Transceiver Stations / BTS), which allow people and companies to communicate effectively and support economic and social activities throughout the region, including in remote areas(Sekar Asmoro Gati, 2023a).

Previous studies have explored the relationship between telecommunication infrastructure and economic performance. For instance, Yunianto (2021) found that telecommunication infrastructure, including BTS deployment, mobile phone usage, and internet connectivity, positively influences GDP per capita growth in Indonesia. Similarly, Khaira (2020) emphasized the significant role of telecommunication infrastructure in economic development, while Parhusip (2023) highlighted increased household expenditure on telecommunication services as a contributor to economic growth. However, research on the impact of telecommunication infrastructure still requires a more in-depth study related to the measurement of telecommunication infrastructure using the latest data (Dwi Yunianto, 2021).

Therefore, this study focuses on analyzing the relationship between telecommunication infrastructure and Gross Domestic Product in Indonesia, utilizing measurements of telecommunication infrastructure following international standards and the latest available data. This research is essential to improve access to information in remote areas and provide broader and inclusive public policy recommendations to support Gross Domestic Product. The results of this research are expected to help create wider and more inclusive public policies.

MATERIALS AND METHOD

To analyze the relationship between internet telecommunication infrastructure, telephone, and Gross Domestic Product (GDP) in Indonesia, the research employed a quantitative method. Multiple linear regression analysis was used to test and illustrate the research hypothesis through descriptive and statistical approaches.

This study used annual secondary data on Indonesia's internet telecommunications infrastructure, telephone, and GDP from 2000 to 2023. This data was obtained from the World Development Indicators of the World Bank, a reliable source of information on various aspects of economic and social development around the world.

The research variables used to address the research objectives consisted of a dependent

variable—namely, Gross Domestic Product—and independent variables, namely telecommunication infrastructure, internet, and telephone. To ensure that the research variables could be understood and measured consistently, operational definitions of the variables were provided.

The following is the operational definition of the variables of this study:(Sadri, 2024)

1. Gross Domestic Product

   Gross Domestic Product (GDP) is the total value of all goods and services produced within a country over a given period, usually measured in one year. GDP reflects the size of a country's economy and is a key indicator for assessing the health of the economy. GDP can be calculated by summing up all expenditures on goods and services produced, including household consumption, investment, government spending, and net exports. In this study, Gross Domestic Product is based on constant prices in 2015, expressed in natural logarithms.

2. Internet Telecommunication Infrastructure

   The internet telecommunications infrastructure is the main tool for measuring the technological progress of a region in each period. The internet refers to high-speed internet access services that use a fixed connection, such as a cable, DSL, or fibre optic modem. In this study, data on internet telecommunication infrastructure uses Fixed Broadband Subscriptions data sourced from World Development Indicators. In this study, the internet telecommunication infrastructure is expressed in natural logarithms.

3. Telecommunications Infrastructure

   Telephone telecommunications infrastructure is a telephone service that uses a fixed network to enable voice communication. This includes landlines and office phones that are connected via cables, such as copper or fibre optics. The telecommunication infrastructure data in this study uses Fixed Telephone Subscriptions data sourced from World Development Indicators. In this study, telecommunications infrastructure is expressed in natural logarithms.

Table 2. Operational Variables and Data Sources

No	Variable	Description	Unit	Data Source
1	LNPDB	Gross Domestic Product from the value of GDP on a constant price basis (2015=100). In this study, GDP data is expressed in natural logarithms (ln).	Percent	World Development Indicators
2	LNINTERNET	Internet telecommunication infrastructure provides high-speed internet access services via fixed connections, such as cable modems, DSL, or fibre optics. In this study, internet data are expressed in natural logarithms (ln).	Percent	World Development Indicators
3	LNTELEPON	Telephony telecommunications infrastructure encompasses the number of services/subscriptions for analogue fixed telephone lines, voice-over-IP (VoIP) subscriptions, fixed wireless local loops (WLL), ISDN voice lines, and active fixed pay telephones. In this study, telephone data is expressed in natural logarithms (ln).	Percent	World Development Indicators

Source: World Development Indicators, World Bank (2023)

This study employed multiple linear time series regression analysis to examine the relationship between telecommunication infrastructure and Gross Domestic Product (GDP) in Indonesia from 2000 to 2023. The time series method allowed for the identification of trends

and patterns in sequentially collected data, facilitating predictive modeling based on historical values (Lestari, 2022). To ensure the validity and reliability of the regression model, a series of classical assumption tests were conducted, including tests for normality, multicollinearity, heteroscedasticity, autocorrelation, and linearity. Furthermore, hypothesis testing was performed using the F-test (for simultaneous significance), t-test (for partial significance), and the coefficient of determination (R^2) to evaluate the model's explanatory power.

The multiple linear regression model is expressed as $Y = a + b_1X_1 + b_2X_2 + \varepsilon$, where Y represents GDP, X_1 and X_2 denote internet and telephone infrastructure, respectively, and ε is the error term. The regression assumptions are verified through diagnostic tests such as the Jarque-Bera normality test, Variance Inflation Factor (VIF) for multicollinearity, Glejser test for heteroscedasticity, and Breusch-Godfrey test for autocorrelation. Subsequently, the F-test assesses the joint significance of the independent variables, while the t-test evaluates their individual impacts. The coefficient of determination (R^2) indicates the proportion of variance in GDP explained by the model, ensuring a robust and interpretable analysis (Sholihah et al., 2023; Sianturi, 2022).

RESULTS AND DISCUSSION

Descriptive Data

The explanation begins with an overview of the research variables, followed by the results of the analysis, interpretation of the findings and discussion of the implications of the research.

Development of Gross Domestic Product in Indonesia

The data used in this study is secondary data taken from the World Development Indicators database, which covers the period 2000-2023. The following is presented the development of Gross Domestic Product in 2000-2023.

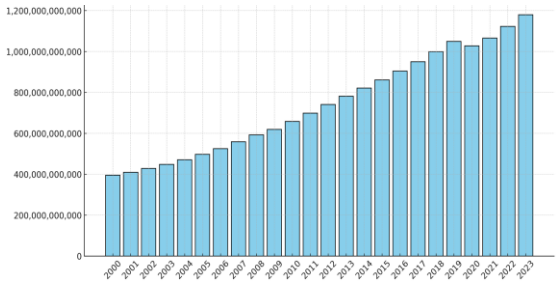

Figure 1. Development of Indonesia's Gross Domestic Product, 2000-2023
Source: Processed from World Development Indicators (2023)

Indonesia's constant Gross Domestic Product (GDP), calculated based on 2015 fixed prices (US$), shows a stable and significant growth trend over the period 2000 to 2023. In 2000, Indonesia's GDP was recorded at US$395 billion. Over the next eight years, Indonesia's economy grew consistently at an average annual growth rate of around 5–6%, reaching US$591 billion in 2008. This growth was driven by post-reform political stability, increasing foreign direct investment (FDI), and the strong role of domestic consumption as the main driver of the national economy. In addition, rising global commodity prices such as coal and palm oil have also boosted Indonesia's export performance(Basri & Hill, 2011).

Development of Internet Telecommunication Infrastructure

The development of internet telecommunications infrastructure in Indonesia from 2000 to 2023 exhibited a significant surge, reflecting the gradual yet consistent national digital transformation.

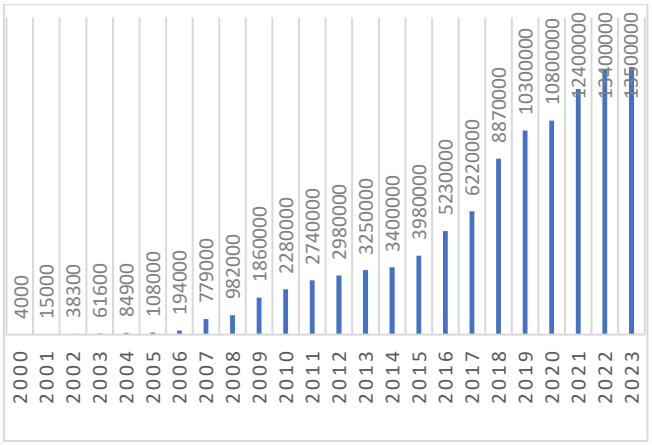

Figure 2. Development of Internet Telecommunication Infrastructure, Year 2000-2023 (Unit)

Source: Processed from World Development Indicators (2023)

In 2000, the number of internet users was recorded at only around 4,000 units, reflecting limited access due to the lack of network infrastructure, high device prices, and low digital literacy of the community. However, by the middle of the first decade (2005), users increased to 108,000 units, triggered by the presence of local internet service providers and the growth of internet cafes. From 2006 to 2010, the number of users accelerated, reaching 2.28 million, driven by the expansion of broadband networks, the early adoption of 3G technology, and the widespread use of personal computers among urban communities (Widiyastuti et al.,2001).

Development of Telecommunications Infrastructure

The development of telephone telecommunication infrastructure in Indonesia from 2000 to 2023 exhibits a dynamic trend, reflecting changes in public communication structures due to the advancement of digital technology, particularly the shift from fixed lines to mobile.

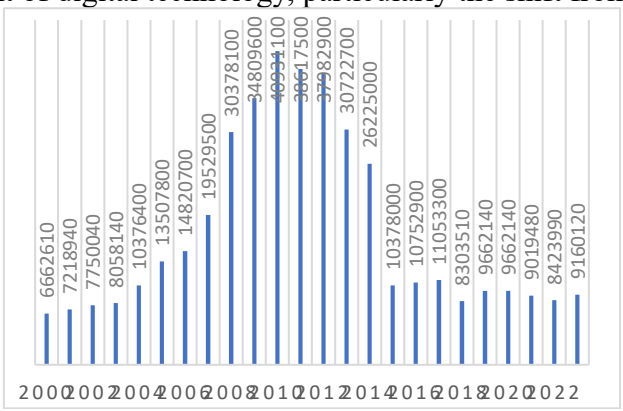

Figure 3. Development of Telephone Telecommunication Infrastructure, Year 2000-2023 (Unit)

Source: Processed from World Development Indicators (2023)

In 2000, the number of telephone connections reached about 6.66 million units, and continued to increase steadily until reaching a peak in 2010, which was 40.9 million connection units. The rapid growth in the first decade was influenced by the massive expansion of fixed and mobile telephone networks by operators such as Telkom and Indosat, as well as the increasing communication needs of the public and businesses during the early digital economy transition (Laughter et al. 2020).

Data Test Results

Descriptive Statistical Data

Descriptive statistics are methods used to describe and summarise the characteristics of data collected in a study. The primary purpose of this analysis is to provide a clear and concise picture of the data, making it easier to understand and interpret. These descriptive statistics include information about mean values, standard deviations. maximum, minimum, and total data.(Nasution 2017)

Table 3. Descriptive Statistics of Research Variables

	LNGDP	LNINTERNET	LNTELEPHONE
Mean	27.27433	13.94260	16.46520
Median	27.30137	14.86545	16.17294
Maximum	27.79562	16.41820	17.52740
Minimum	26.70218	8.294050	15.71202
Std. Dev.	0.352763	2.375540	0.620645
Skewness	-0.146560	-0.898727	0.610058
Kurtosis	1.675449	2.640585	1.777501
Jarque-Bera	1.840355	3.360023	2.983189
Probability	0.398448	0.186372	0.225014
Sum	654.5838	334.6225	395.1647
Sum Sq. Dev.	2.862155	129.7934	8.859592
Observations	24	24	24

Source: Data processed with Eviews version 12

Based on the results of descriptive statistical analysis, an overview of the data characteristics of three main variables was obtained, namely Gross Domestic Product (GDP), internet, and telephone. The average GDP value was 27.27433% with a standard deviation of 0.352763%, which indicates economic fluctuations between observations within moderate limits. The minimum GDP value was recorded at 26.70218% and the maximum was 27.79562%, indicating that there is a difference between regions or times in the achievement of economic growth.

Meanwhile, the internet variable has an average value of 13.94260% with a standard deviation of 2.375540%. This indicates that the internet penetration rate remains highly variable between regions or times during the observation period. The minimum value was recorded at 8.294050% and the maximum value was 16.41820%, indicating a sharp disparity in broadband access between regions. The telephone variable had an average value of 16.46520% with a relatively low standard deviation of 0.620645%, indicating that the use of telephone services remained stable during the observation period.

In terms of distribution, the GDP and internet variables exhibit left-skewed data distributions, with skewness values of -0.146560% and -0.898727%, respectively. In contrast, the telephone variable has a positive skewness value of 0.610058%, resulting in a right-skewed distribution. The kurtosis values of all three variables are below 3, which means that the distribution is flatter than the normal distribution (platykurtic), indicating the absence of extreme outliers.

The results of the Jarque-Bera test for the three variables showed a probability value above 0.05, which was 0.398448% for GDP, 0.186372% for internet, and 0.225014% for telephone. Thus, the three variables can be declared to be normally distributed. This strengthens the validity of the use of these three variables in regression analysis or other econometric models, since the assumption of normality as one of the statistical prerequisites is well met.

Classical Assumptions

Normality Test

Normality test is a statistical method used to determine whether or not residual is

normally distributed.

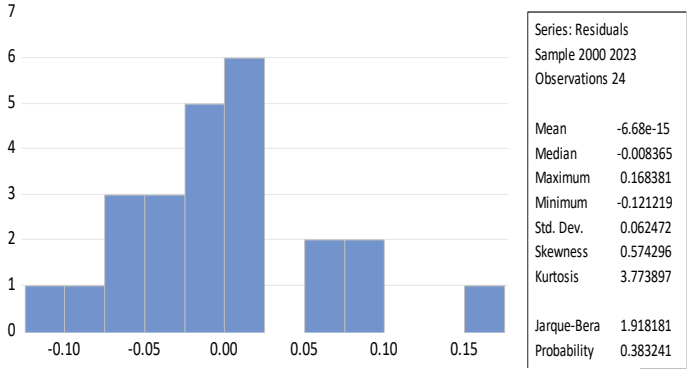

Figure 4. Normality Test Results

Source: Processed with Eviews version 12

The results obtained from the normality test with a Jarque-Bera value of 1.918181 and a probability value of 0.383241 > 0.05. With demikan, it can be stated that the residual is distributed normally.

Multicollinearity Test

Multicollinearity is a condition in which there is a strong linear relationship between two or more independent variables in multiple regression analysis, which can make it difficult to determine the influence of each independent variable on the dependent variable.

Table 4. Multicollinearity Test Results (VIF)

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	0.131098	736.0806	NA
LNINTERNET	3.51E-05	39.42463	1.067098
LNTELEPHONE	0.000515	784.7413	1.067098

Source: Processed with Eviews version 12

Heteroscedasticity Test

The heteroscedasticity test is a classical assumption test that must be fulfilled in regression analysis, aiming to find out whether there is a bias in the regression analysis model used, to find out whether there is a residual variance in a heteroscedasticity model.

Tabel 5.

Heteroskedasticity Test: Glejser

Null hypothesis: Homoskedasticity			
F-statistic	2.498875	Prob. F (2.21)	0.1063
Obs*R-squared	4.613706	Prob. Chi-Square (2)	0.0996
Scaled explained SS	4.893992	Prob. Chi-Square (2)	0.0866

Source: Processed with Eviews version 12

Autocorrelation Test

The autocorrelation test is a statistical method used to identify the correlation between values in a time series at different lags. This test is essential to check whether the residual of a time series model is random or still contains a pattern of dependencies that the model did not capture.

Table 6. Autocorrelation Test Results (Breusch-Godfrey Test)

Breusch-Godfrey Serial Correlation LM Test:			
Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	1.436068	Prob. F (2.19)	0.2625
Obs*R-squared	3.151556	Prob. Chi-Square (2)	0.2068

Source: Processed with Eviews version 12

Linearity Test

A linearity test is a statistical method used to determine whether there is a linear relationship between two variables. In the context of regression analysis, this test aims to verify whether the regression model used can describe the relationship between dependent and independent variables well. If the relationship is not linear, then the linear regression model may not be accurate and may result in inaccurate predictions.

Table 7. Linearity Test Results

	Value	df	Probability
t-statistic	0.803384	20	0.4352
F-statistic	0.645427	(1, 20)	0.4352
Likelihood ratio	1.081699	1	0.2983

Source: Processed with Eviews version 12

Multiple Linear Regression Model

The Multiple Linear Regression Model is a statistical technique used to analyse the influence of one dependent variable and two or more independent variables, to predict the value of the dependent variable based on the value of the independent variables, as well as to understand how much influence each independent variable has on the dependent variable.

Table 8. Multiple Linear Regression Estimation Results

Dependent Variable: LNGDP				
Method: Least Squares				
Sample: 2000 2023				
Included observations: 24				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	27.62308	0.362075	76.29103	0.0000
LNINTERNET	0.150970	0.005928	25.46677	0.0000
LNTELEPHONE	-0.149022	0.022690	-6.567692	0.0000
R-squared	0.968638	Mean dependent var		27.27433
Adjusted R-squared	0.965651	S.D. dependent var		0.352763
S.E. of regression	0.065379	Akaike info criterion		-2.500748
Sum squared resid	0.089764	Schwarz criterion		-2.353491
Log likelihood	33.00897	Hannan-Quinn criter.		-2.461680
F-statistic	324.2959	Durbin-Watson stat		0.961723
Prob(F-statistic)	0.000000			

Source: Processed with Eviews version 12

The regression equation can be written as follows:

LNGDP= 27.62308 + 0.15095 LNINTERNET - 0.14902 LNTELEPON + ε

Where:

LNGDP =Gross Domestic Product (ln)

LNINTERNET= Internet telecommunication infrastructure (ln)

LNTELEPHONE= Telecommunications infrastructure (ln)

ε = Error term

a. The constant of 27.62308 shows that if there is no internet and telephone telecommunication infrastructure, then the GDP value is 27.62308 percent.
b. The internet telecommunication infrastructure coefficient of 0.15095 shows that the internet has a positive and significant effect on Gross Domestic Product. If the internet telecommunication infrastructure increases by 1 percent, GDP increases by 0.15095 percent, assuming the variable of the telecommunication infrastructure is constant.
c. The telephone telecommunication infrastructure coefficient of -0.14902 indicates that the telephone telecommunication infrastructure has a negative and significant effect on the Gross Domestic Product. If the telecommunications infrastructure of the telephone decreases by 1 percent, the GDP increases by 0.149022 percent, assuming that the internet variable remains constant

Overall, this regression equation shows that internet telecommunication infrastructure has a positive effect on Gross Domestic Product, while telephone telecommunication infrastructure has a negative effect. These findings provide important insights for policymakers in formulating Telecommunication Infrastructure development strategies to drive Gross Domestic Product growth**.**

Hypothesis Test

Hypothesis testing is a statistical procedure used to test assumptions or claims about population parameters based on sample data. This process begins by formulating two hypotheses: the null hypothesis (H0), which states no effect or influence, and the alternative hypothesis (H1), which states the existence of an effect or influence. Next, the collected data is analysed to determine if there is enough evidence to reject the null hypothesis at a certain level of significance.

F Test

The F test is a statistical procedure used to test a null hypothesis that states whether independent (free) variables together (simultaneously) have a significant effect on the dependent (bound) variables in a regression model. Suppose the calculated F-value is greater than the F-value of the table at a certain level of significance. In that case, the null hypothesis is rejected, indicating that there is at least one significantly different group(Sianturi 2022). Statistical test F in this study used a significance level of 0.05. If the significance level in this study is less than 0.05 or if the F calculation exceeds the F table, then all independent variables simultaneously have a significant effect on the dependent variables.

Based on the F test results, the F value is 324.2969, and the probability value of 0.000000 is smaller than the significance level of 0.05 (0.000000 < 0.05). This indicates that the Internet and Telephone Telecommunication Infrastructure simultaneously impact Indonesia's Gross Domestic Product.

T Test

The results of the variable t-test of internet telecommunication infrastructure showed that the calculated t-value of 25.4668, which was greater than the t-value of table 2.0796 and the sig value of 0.0000 < 0.05, then Ho was rejected and Ha was accepted, meaning that the internet telecommunication infrastructure had a positive and significant effect on Gross Domestic Product.

From the results of the variable t-test of telecommunications infrastructure, a calculated t-value of -6.5677 < t table -2.0796 and a sig value of 0.0000 < 0.05, then Ho was rejected and Ha was accepted, meaning that the telecommunications infrastructure of the telephone had a negative and significant effect on Gross Domestic Product.

Determination Coefficient Test (R^2)

The coefficient of determination (R^2) is a statistical measure that shows the proportion of variance in a dependent variable that can be explained by an independent variable in a regression model. The R^2 value ranges between 0 and 1, where a higher value indicates that the regression model is better at explaining the variance of the data. In contrast, a low value indicates that the model cannot explain the variance of the data well. R^2 is used to evaluate how effective the proposed regression model is in predicting the value of dependent variables based on independent variables, thus providing an idea of the quality and fit of the model. (Sianturi 2022)

Based on the test results obtained, the Adjusted R-squared value of 0.965651 or 96.5651% shows that the independent variable, namely telecommunication infrastructure, internet and telephone together can explain the variation in the dependent variable, Gross Domestic Product (GDP) of 96.5651%, meaning that around 3.43% of the variation in GDP is explained by factors other than this regression model.

The Influence of Internet and Telephone Telecommunication Infrastructure on Gross Domestic Product

The results of the hypothesis test show that telecommunication infrastructure, internet and telephone have a simultaneous effect on Gross Domestic Product. The results of the F test showed that the significance of 0.000000 was smaller than the significance level of 0.05, so that it could be concluded that H_0 was rejected and accepted. H_a

In other words, these results show that the simultaneous use of the internet and telephone telecommunication infrastructure has a significant effect on Gross Domestic Product. In this context, the use of the internet and telephone telecommunication infrastructure is considered an essential factor driving the Gross Domestic Product. With the increase in access and use of the internet, as well as more efficient communication via telephone, it is expected to increase productivity, efficiency and innovation in various sectors of the economy.

The results of this study support the research (Khaira, 2020; Parhusip, 2023). Khaira's research (2020) highlights the influence of telecommunication infrastructure on economic development, and complements the results with evidence of a direct impact on GDP. In addition, Parhusip's (2023) research supports these findings through data on increased household spending on telecommunication services, which reflects increased consumption and contribution to economic growth.

Influence of Internet Telecommunication Infrastructure on Gross Domestic Product

The results of the multiple linear regression T test show that the internet telecommunication infrastructure has a positive effect on the Gross Domestic Product. This can be seen from the probability value of the internet telecommunication infrastructure of 0.0000, which is smaller than the significance level of 0.05 with a coefficient of 0.150970. A coefficient is a value that shows the magnitude of the influence or contribution of independent variables to dependent variables. By increasing access to and use of internet telecommunication infrastructure, it is hoped that it can improve productivity, efficiency and innovation in various sectors of the economy.

The internet telecommunications infrastructure enables faster and wider access to information, ultimately leading to improved decision-making and better outcomes for businesses and governments. This is in line with economic theory, which states that information and communication technology (ICT) plays an essential role in increasing competitiveness and economic growth. The results of this study align with those of Khaira (2020) and Parhusip (2023), indicating that internet telecommunications infrastructure can contribute to increasing GDP.

Influence of Telephone Telecommunications Infrastructure on Gross Domestic Product

The results of multiple linear regression show that the telecommunications infrastructure of the telephone has a negative and significant influence on the Gross Domestic Product. This can be seen from the significance value of telecommunications infrastructure of 0.0000, which is smaller than the significance level of 0.05 with a coefficient of -0.149022. The negative coefficient value indicates that the reduced use of the telephone telecommunications infrastructure can increase GDP. These findings can be interpreted as the function of telephones in supporting productive economic activities has declined, as the role of conventional telecommunications has been replaced by more efficient digital technologies, such as the internet. The results of this study align with those of Khaira (2020), Parhusip (2023), and Wahyuni (2020), indicating that the role of the telephone is being replaced by more efficient technologies, such as the internet.

CONCLUSION

Data analysis using multiple linear regression for the period 2000–2023 revealed that internet and telephone telecommunication infrastructures had divergent effects on Indonesia's Gross Domestic Product (GDP). Internet infrastructure exerted a positive and significant influence, whereby enhanced access and usage drove higher economic output and greater GDP potential through improved infrastructure. In contrast, telephone infrastructure showed a negative and significant effect, reflecting a decline in conventional services amid economic growth and a shift toward modern, efficient digital alternatives like internet-based platforms offering superior speed, flexibility, and cost efficiency amid sectoral digitalization. For future research, longitudinal studies could explore the moderating role of digital literacy or 5G rollout in amplifying these effects post-2023.

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