The Role of Information Technology in Increasing Labor Productivity in North Sumatra

Yunita Fitriana, Annisa Ilmi Faried

Abstract

The development of information technology is one of the important factors in encouraging regional economic dynamics in the digital era. This study aims to analyze the role of Information Technology Users, Labor Force Participation Rates, and Investment in explaining changes in Gross Regional Domestic Product (GDP) in North Sumatra Province. This study uses a quantitative approach with time series data during the period 2010–2024. The analysis method used is multiple linear regression. The results of the study show that simultaneously Information Technology Users, Labor Force Participation Rate, and Investment are significant to GDP. Partially, Information Technology Users were positively and significantly related to GDP, while Labor Force Participation and Investment Levels did not show a significant relationship. The Adjusted R Square value of 0.341 indicates that 34.1 percent of the variation in GDP can be explained by variables in the model, while the rest is influenced by other factors outside the study. These findings affirm the importance of the role of information technology as the main driver of regional economic activities, as well as the need to improve the quality of labor and investment effectiveness to encourage sustainable economic growth.

Keywords: Information Technology, TPAK, Investment, GDP, Regional Economic Growth

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2nd International Conference on Islamic Community Studies (ICICS)
Theme: History of Malay Civilisation and Islamic Human Capacity and Halal Hub in the Globalization Era
https://proceeding.pancabudi.ac.id/index.php/ICIE/index

Introduction

The growth of information and communication technology has had a significant impact on the world of employment in various countries, including Indonesia. Increasing labor productivity through technological integration is one of the main focuses for governments and industry players to face global challenges and increase national competitiveness. This article will explore the influence of technology on labor productivity in Indonesia, paying attention to key aspects related to technology adoption, workforce training, and impacts on various sectors of the economy (Ningsih, 2024). This makes IT one of the key factors in driving increased workforce productivity. In the context of the modern economy, mastery of information technology has become the main requirement for the workforce to be able to compete and adapt to changes in the dynamic work environment.

North Sumatra Province is one of the provinces in Indonesia located in the western part of Indonesia, located at the line of 10 - 4 0 North Latitude and 980 - 1000 East Longitude. It is bordered by waters and sea as well as two other provinces: to the north it is bordered by Aceh Province, to the east by Malaysia in the Strait of Malacca, to the south by Riau and West Sumatra provinces, and to the west by the Indian Ocean (Nasution et al., 2020). North Sumatra Province as one of the economic centers in the western region of Indonesia has great potential in the development of information technology. The rapid growth in the number of internet users, the improvement of telecommunication infrastructure, and the development of various digital platforms are strategic opportunities to boost labor productivity. However, on the other hand, there are still challenges in the form of digital skills gaps, disparities in access to technology between regions, and the unpreparedness of some of the workforce in adopting technology-based changes. This condition raises questions about the extent to which the role of information technology can make a real contribution to increasing labor productivity in North Sumatra. Research on this issue is important considering that high productivity is one of the determining factors for regional competitiveness in facing national and global economic competition. In addition, a better understanding of the relationship between information technology, labor productivity, as well as other factors such as labor force participation, investment, quality of human resources, and economic growth, will provide a solid basis in the formulation of regional development policies.

Technology is a means that provides human needs to provide comfort and ease of activity. Generally, technology is used by humans to make it easier for them to do a job. Technology is developing very rapidly to help human work, The role of technology has become very dominant for the development of companies, from increasing sales, transactions, and company performance (Adiastri, 2024). Technology is indeed very important in the lives of today's people. With the presence of technology today, it has helped to improve the economy, computers, and food. And technology is one of the supports of human progress, this can be proven by the many innovations that have been carried out in this world. These innovations have developed in all sectors of the employment sector (Son, 2024).

Technological developments have brought major changes in various aspects of life, including the world of work. In Indonesia, technology has been used in various sectors, such as the service manufacturing industry, and agriculture. However, the influence of technology on the Indonesian workforce still needs to be further analyzed. Technological developments have brought significant changes in various aspects of life, including the world of work In Indonesia, technology has been used in various sectors, such as the manufacturing, service, and agriculture industries. However, the influence of technology on the Indonesian workforce still needs to be

further analyzed. This research aims to analyze the influence of technology on the Indonesian workforce, focusing on positive and negative aspects (Technique & Kurniawan, 2025).

Figure 1. Information Technology User Level
Source: Central Statistics Agency

The graph shows that the level of information technology users in North Sumatra has experienced a consistent increase from 2010 to 2024. At the beginning of the period, IT users were still relatively low, around twenty percent, but increased slowly until 2014. Entering 2015 to 2018, growth began to increase faster in line with the ease of internet access and the use of smartphones in the community. The most significant upward trend occurred in the period 2018 to 2022, when the number of IT users jumped from around fifty percent to exceeding eighty percent, influenced by the development of digitalization in various sectors and the need for technology during the pandemic. In 2023 to 2024, growth is still continuing although not as fast as before, and the rate of IT users is almost ninety percent. Overall, this graph illustrates that digitalization in North Sumatra is developing very rapidly and the readiness of the community to utilize technology is getting higher from year to year.

With the advancement of technology, it makes relationships between people, between organizations, between companies, and even between countries very easy. Technology is considered very useful to solve all problems quickly, make work easier, save time and budget, and be more accessible to those in need so as to increase the effectiveness and productivity of its users (Prajna, 2024). On the one hand, digitalization drives the growth of job opportunities, while on the other hand it demands the workforce to upskill to stay relevant in an increasingly technology-based world of work. With the right policies and investments in education and training, the digital economy has the potential to be a major driver of employment growth in Indonesia (Faried, 2025).

In an organization or company, productivity is needed to achieve the goals that have been set. Productivity is an important aspect of a company in determining the sustainability of its business in the future. Productivity is the effective and efficient use of resources (inputs) to produce or increase the output of goods and services. In an effort to increase employee work productivity, every company must pay attention to the factors that affect work productivity. Employees are said to be productive if they are able to produce goods and services in accordance with the specified targets within a short and appropriate period of time. Productivity increases, so efficiency (time, materials, labor), work systems, production techniques, and labor skills will also increase (Adiastri, 2024). In the production process, additional investment doubles output that requires additional labor. This additional need for labor will expand job opportunities and have an impact on increasing people's income so that people's welfare increases. In fact, the

success of an investment in an area will be proposed with additional other investments in the region, both as a supporting investment and as a competitor so that there is a multiplier effect of investment that will have a chain impact on improving people's welfare (Son, 2024).

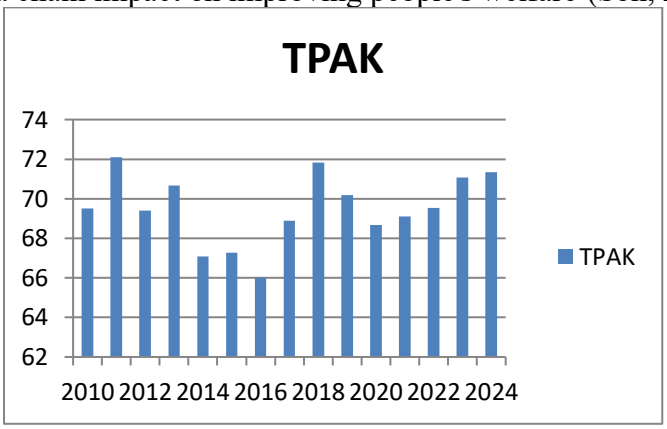


Figure 2. Labour Force Participation Rate
Source: Central Statistics Agency

The graph shows the development of the Labor Force Participation Rate (TPAK) in North Sumatra from 2010 to 2024. In general, TPAK values fluctuate, but tend to be in a relatively stable range between sixty-five to seventy-two percent. At the beginning of the period, TPAK was around sixty-eight percent, then increased in 2012, before falling again in 2014 to 2016. After that, TPAK began to increase again in 2018 and reached one of its highest points in 2020. Although it had experienced a slight decline the following year, the trend is moving upwards again until 2024 and is in the range of around seventy-one percent. This pattern illustrates that the dynamics of the labor market in North Sumatra are influenced by various factors such as economic conditions, job availability, and changes in demographic structure, but still show good recovery ability over time.

Technological advances minimize the impact of job changes. Therefore, this transition is expected to change the way education systems in ASEAN countries prepare human resources to deal with technological disruptions and many job changes. Meanwhile, the need for information technology (IT) personnel or *Information and Communication Technology* (ICT) is expected to continue to increase until 2025. According to a report by the Ministry of Manpower (Kemnaker), the number of people working in the country's ICT sector was only around 1 million in 2021. Since then, its need has increased year by year, and is expected to reach 1.97 million by 2025. The Department of Labor estimates that the most in-demand IT staff in the coming years will be network operations access, the backbone of network operations, and software engineers. In this context, the role of technology in employment transformation is important to drive economic development and provide job opportunities to job seekers and the unemployed. The use of technology in the digital era is expected to make it easier for people, especially micro and small businesses, to open new businesses and create wider jobs.(Wacika, 2023). While the digital economy offers many opportunities, especially when it comes to workforce readiness, there are some major issues that need to be addressed. The limited skills of the workforce to meet the needs of the digital industry is one of the important issues that have arisen. To serve digital transformation, employees are needed who not only have specialized technical skills, such as abilities in information technology, big data, artificial intelligence (AI), and data analysis, but also have basic skills such as creativity, problem-solving, and adaptability. Unfortunately, there

are still many Indonesian workers who are not ready to switch to this type of work, leading to a huge reduction in skills (Faried & Nasution, Lia Nazliana, 2025).

The success of economic growth cannot be separated from increased investment. There are investment activities, the wheels of the economy in a region will move. Economists state that investment and exports are the engine of economic growth. Investment is the key word that determines the rate of economic growth, because in addition to encouraging a significant increase in output, it will also automatically increase the absorption of labor and community welfare as a consequence of the increase in income received by the community. Investment activities allow a society to continuously increase economic activities and employment opportunities, increasing national income and the level of prosperity of the community. The existence of new investments allows the creation of new capital goods so that they will absorb new production factors, namely creating new jobs or job opportunities that will absorb labor which in turn will reduce unemployment. With new investments, there will be additional output and new income in these production factors so that in the end it increases economic growth (Indrani, 2024). However, the increase in the use of information technology has not been fully followed by an increase in labor productivity evenly. There are still challenges in the form of digital skills gaps, differences in technology access between regions, and fluctuations in the level of labor force participation. The Labor Force Participation Rate (TPAK), which reflects the involvement of the working-age population in economic activities, shows dynamics influenced by labor market conditions, economic structure, and the ability of the workforce to adapt to technological changes. In addition to labor and technology factors, investment also plays an important role in the regional economic development process. Investment, whether made by the government or the private sector, contributes to increasing production capacity, expanding employment opportunities, and driving economic output growth. The combination of the use of information technology, the availability of active labor, and increased investment is expected to strengthen labor productivity which is reflected in the increase in regional economic output.

Bibliography Review

Information Technology

Information and Communication Technology (ICT) plays a role in creating efficiency in the production process of goods and services and increasing business competitiveness. ICT eliminates the limitations of space and time that will indirectly affect economic growth. From a social and cultural point of view, technology provides more opportunities to access information related to education, health, politics, and entertainment. Indonesia's technological development has made positive progress in recent years. This can be seen through the value of the Information and Communication Technology Development Index which continues to increase. IP-ICT is a standard measure used to measure the growth of information and communication technology development, measure the digital gap between regions, and measure the potential for information technology development between regions (Nuryartono & Pasaribu, 2023).

Economic Growth

The neo-classical economic growth theory initiated by Adam Smith states that economic growth depends on the development of factors of production, namely; capital, labor, and technology. One of the factors that affect the absorption of Labor is Capital stock or investment, which is one of the important factors in determining the level of National income. Increased investment will open or expand job opportunities, so that it will absorb more human resources. Economic development is the provision of sufficient employment to pursue the growth of the

labor force, whose growth is faster than the growth of employment opportunities. Expanding labour absorption is needed to keep pace with the growth rate of the young population entering the labour market (Devi, 2024).

Classical Economic Growth Theory emphasizes that investment is an important factor as a driving force in driving economic growth. believes that capital accumulation from investment activities is the key to increasing labor productivity. "This view was later developed by Robert Solow, who emphasized that in the long run, economic growth is greatly influenced by an increase in the amount of physical capital, labor growth, and technological advancement" (Solow, 1956). Increased investment is believed to be able to expand production capacity, opening up more job opportunities, which in turn has an impact on increasing people's income (Adrianto et al., 2025).

Labor Productivity

The high or low productivity of the workforce is largely determined by education, health, government investment and private investment.

- Education, education and training are seen as an investment in the field of human resources that aims to increase labor productivity. Therefore, education and training are one of the important factors in a company's organization.
- Health, which affects productivity is human capital which includes education and health. Education and health are fundamental development goals; Apart from other things, those two things are important. Health is at the heart of well-being, and education is essential to achieving a fulfilling and valuable life; Both are fundamental to form a broader human capability that is at the core of the meaning of development.
- Government investment plays a key role in its role in the economic development process, especially regarding the dual role of investment. First, investment has a dual role in generating income, and second, investment increases the production capacity of the economy by increasing capital stocks.
- Private Investment Private investment in Indonesia has been guaranteed its existence since the issuance of Law No. 1 of 1967 on foreign investment and Law No. 6 of 1968 on domestic investment, which later, was supplemented and perfected by Law No. 11 of 1970 on foreign investment and Law No. 12 of 1970 on domestic investment (Ramayani, 2022).

Method

This study uses a quantitative approach with time series data. The analysis method used is multiple linear regression to analyze the role of information technology, labor force participation rate, and investment in regional economic formation in North Sumatra Province. Multiple linear regression was chosen because it is able to explain the functional relationship between one dependent variable and more than one independent variable, and is suitable for measuring the contribution of each explanatory variable to the economic performance of the region proxied by the Gross Regional Domestic Product (GDP).

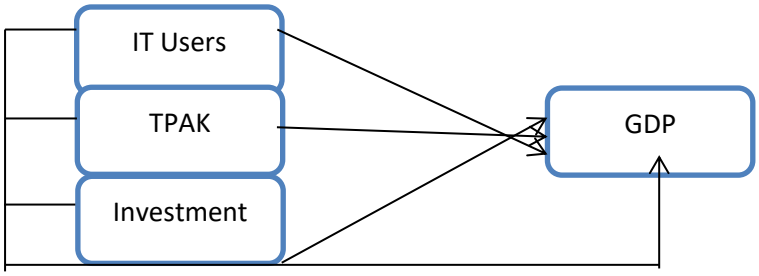


Figure 3. Conceptual Framework

$PDRB_t=\beta0+\beta1PTI_t+\beta2TPAK_t+\beta3INV_t+\varepsilon t$

Where:

GDP = Regional Economic Growth (millions)
INV = Investment (millions)
TPAK = Labor Force Participation Rate (Percent)
PTI = Information Technology Users (Percent)
β0 = Constant
εt\varepsilon_t εt = Error term

Results and Discussion

Table 1. Correlation

Correlations					
		GDP	PTI	TPAK	INV
Pearson Correlation	GDP	1.000	.676	.162	.061
	PTI	.676	1.000	.092	.231
	TPAK	.162	.092	1.000	.222
	INV	.061	.231	.222	1.000
Sig. (1-tailed)	GDP	.	.003	.282	.415
	PTI	.003	.	.372	.204
	TPAK	.282	.372	.	.213
	INV	.415	.204	.213	.
N	GDP	15	15	15	15
	PTI	15	15	15	15
	TPAK	15	15	15	15
	INV	15	15	15	15

Source: SPSS Output 2025

The results of the Pearson correlation showed that TPAK and investment had a low and insignificant relationship with GDP, with correlation values of 0.162 (sig. 0.282) and 0.061 (sig. 0.415), respectively. Meanwhile, information technology users showed a fairly strong and significant relationship with GDP with a correlation value of 0.676 in sig. 0.003 < 0.05.

Table 2. Model Summary

Model Summary[b]						
Mod	R	R	Adjust	Std.	Change Statistics	Durbin-

els		Square	ed R Square	Error of the Estimate	R Square Change	F Change	df 1	df 2	Sig. F Change	Watson
1	.695a	.483	.341	7535.71710	.483	3.419	3	11	.056	1.178
a. Predictors: (Constant), INV, TPAK, PTI										
b. Dependent Variable: GDP										

Source: SPSS Output 2025

The result of the R value of 0.695 as a multiple correlation value shows that Information Technology Users, Labor Force Participation Rate, and Investment have a fairly strong relationship with GDP. The value of R Square and Adjusted R Square is a coefficient of determination, but in multiple linear regression it is more appropriate to use the Adjusted R Square value of 0.341 or 34.1 percent. This means that the variation in GDP can be explained by 34.1 percent by Information Technology Users, Labor Force Participation Rates, and Investment, while the remaining 65.9 percent is influenced by other variables outside the model or not researched.

Table 3. Anova

NEW ERA						
Models		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	582422718.369	3	194140906.123	3.419	.046b
	Residual	624657354.031	11	56787032.185		
	Total	1207080072.400	14			
a. Dependent Variable: GDP						
b. Predictors: (Constant), INV, TPAK, PTI						

Source: SPSS Output 2025

Based on the results of the ANOVA test, an F value of 3.419 was obtained with a significance level of 0.046 < 0.05. This shows that Information Technology Users, Labor Force Participation Rates, and Investment together have a significant relationship with GDP. Thus, the multiple linear regression model used was declared feasible to explain the variation in GDP in North Sumatra Province.

Table 4. Clerks

Coefficient											
Models		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Share	Tolerance	VIVID
1	(Constant)	-7317.776	80470.984		-.091	.929					

	PTI	2.215	.712	.694	3.112	.010	.676	.684	.675	.945	1.058
	TPAK	6.641	11.639	.127	.571	.580	.162	.170	.124	.949	1.054
	INV	-.055	.099	-.128	-.560	.587	.061	-.166	-.121	.906	1.104
a. Dependent Variable: GDP											

Source: SPSS Output 2025

Based on the results of the SPSS output in the Coefficients table, the multiple linear regression equations in this study are:

$$\mathbf{Y = 7317.7 + 2.215X1 + 6.641X2 – 0.55X3 + e}$$

Interpretation of Regression Equations

- If all independent variables are considered constant, then the value of the Gross Regional Domestic Product (GDP) is −7317.776.
- If the Information Technology Users (PTI) increase by 1 unit, then the GDP will increase by 2.215 units, assuming other variables are constant. This shows that the increase in the use of information technology contributes positively to the increase in GDP.
- If the Labor Force Participation Rate (TPAK) increases by 1 unit, then GDP will increase by 6,641 units, assuming other variables are constant. Nevertheless, this increase is not statistically significant.
- If Investment increases by 1 unit, then GDP will decrease by -0.055 units (indicated by a negative sign), assuming other variables are constant. This decline indicates that investment in the study period has not had a direct impact on the increase in GDP.

Table 5. Coefficients

Coefficient											
Models		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Share	Tolerance	VIVID
1	(Constant)	-7317.776	80470.984		-.091	.929					
	PTI	2.215	.712	.694	3.112	.010	.676	.684	.675	.945	1.058
	TPAK	6.641	11.639	.127	.571	.580	.162	.170	.124	.949	1.054
	INV	-.055	.099	-.128	-.560	.587	.061	-.166	-.121	.906	1.104
a. Dependent Variable: GDP											

Source: SPSS Output 2025

The results of the t-test are partially known as follows:

- The t-value of Information Technology Users (PTI) is 3.112 > table t is 2.201 (n − k − 1 = 15 − 3 − 1 = 11, α 5%), then the significance value is 0.010 < 0.05, so that H_0 is rejected and H_a is accepted, meaning that Information Technology Users are partially significant to GDP.
- The value of t-calculated the Labor Force Participation Rate (TPAK) is 0.571 < t table is 2.201 (n − k − 1 = 15 − 3 − 1 = 11, α 5%), then the significance value is 0.580 > 0.05, so that H_0 is accepted and H_a is rejected, meaning that TPAK is partially insignificant to GDP.

- The value of t calculated Investment is −0.560 < t table is 2.201 (n − k − 1 = 15 − 3 − 1 = 11, α 5%), then the significance value is 0.587 > 0.05, so that H_0 is accepted and H_a rejected, meaning that investment is partially insignificant to GDP.

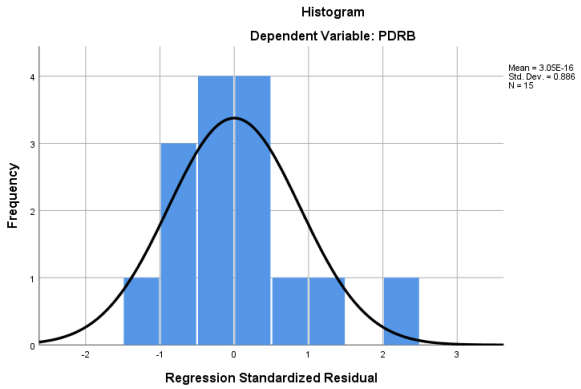


Figure 3. Histogram Dependent Variable: PDRB
Source: SPPS Output 2025

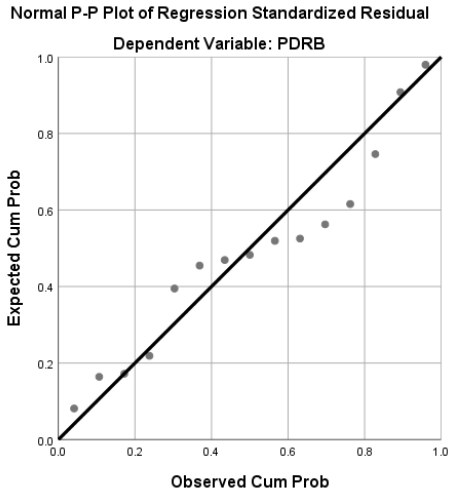


Figure 4. Normal P-P Plot of Regression Standardized Residual
Source: SPPS Output 2025

Based on the results of the normality test using Histogram graphs and Normal P–P Plots, it can be seen that the distribution of residual data is distributed normally. This can be seen in the residual histogram graph which forms a bell-shaped pattern and does not show extreme deviations. In addition, on the Normal P–P Plot of Regression Standardized Residual graph, data points are seen to be spread around the diagonal line and follow the direction of the line. This condition indicates that the residual is normally distributed. Thus, it can be concluded that the assumption of normality in multiple linear regression models has been met, so that the regression model is feasible to use for further analysis.

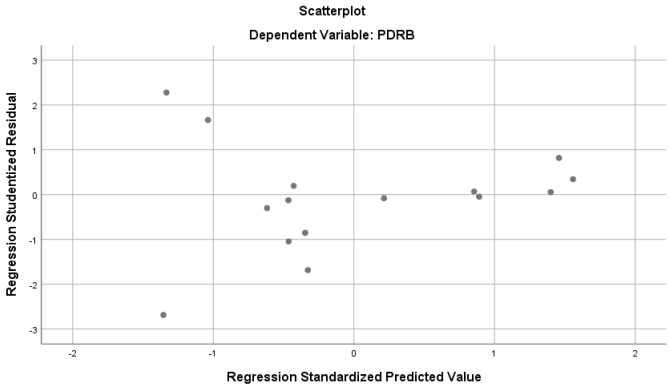
Table 6. Coefficients

Coefficient	
Correlations	Collinearity Statistics

Zero-order	Partial	Share	Tolerance	VIF
.676	.684	.675	.945	1.058
.162	.170	.124	.949	1.054
.061	-.166	-.121	.906	1.104
a. Dependent Variable: GDP				

Source: SPSS Output 2025

Based on the results of the SPSS output in the Collinearity Statistics table, it is known that all independent variables have a Tolerance value greater than 0.10 and a Variance Inflation Factor (VIF) value of less than 10. The Tolerance value of each variable is 0.945; 0,949; and 0.906, while the VIF value was 1.058 each; 1,054; and 1,104. Thus, it can be concluded that there are no symptoms of multicollinearity between independent variables in the multiple linear regression model, so the regression model is suitable for further analysis.



Source: SPSS Output 2025

Figure 5. Scatter Plot

Based on the results of the heteroscedasticity test using the Scatterplot graph, it can be seen that the residual points are randomly spread above and below the zero axis and do not form a specific pattern, either constricted, widened, or corrugated patterns. This indicates that the residual variance is constant or homogeneous. Thus, it can be concluded that the multiple linear regression model does not experience symptoms of heteroscedasticity, so the classical assumption of heteroscedasticity has been fulfilled.

Conclusion

1. Simultaneously, Information Technology Users, Labor Force Participation Rates, and Investment are proven to be significant in explaining the variation in Gross Regional Domestic Product (GDP) in North Sumatra Province. This shows that these three variables together are related to the performance of the regional economy.
2. Partially, Information Technology Users have a positive and significant relationship with GDP. These findings indicate that increased use of information technology plays an important role in increasing productivity and regional economic activity.

3. The Labor Force Participation Rate is partially insignificant to GDP, although it has a positive relationship direction. This condition shows that the increase in the number of workers has not been followed by an increase in optimal productivity.
4. Partial investment also has no significant effect on GDP and has a negative relationship direction. This indicates that the impact of investment on GDP has not been felt directly in the study period, possibly due to time lag or suboptimal investment allocation.
5. The Adjusted R Square value of 0.341 shows that 34.1 percent of the variation in GDP can be explained by the variables of Information Technology Users, Labor Force Participation Rate, and Investment, while the rest is influenced by other factors outside the research model.

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