



Impact of Land Transport, Infrastructure, and Population on GRDP (2016–2020) in 31 Indonesian Provinces

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Abstract:

Gross Regional Domestic Product (GRDP) is widely recognized as a key indicator for measuring the economic performance of each province. It serves as a benchmark to describe and evaluate the level of economic growth and the general welfare of the population within a given region. Various factors are believed to influence GRDP, among which transportation systems, infrastructure development, and population size are considered critical. This research aims to analyze the extent to which these three variables—land transportation, infrastructure, and population—affect the GRDP of 33 provinces in Indonesia over the period from 2016 to 2020. The study employs a multiple linear regression analysis using panel data to test the relationships among the variables. The results of the analysis reveal that: (1) land transportation has a positive but statistically insignificant influence on GRDP, (2) infrastructure also exhibits a positive yet insignificant effect on GRDP, and (3) population size demonstrates a positive and statistically significant effect on GRDP. These findings suggest that while transportation and infrastructure contribute positively, their effects are not strong enough to be deemed statistically significant within the scope of this study, unlike population, which plays a more impactful role in regional economic performance.

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1. Introduction

Basically, economic development in a country has the aim of achieving people's welfare with good economic growth. Among this economic development there is a close relationship between national and regional economic development, thus creating a strong, equitable and sturdy economy. Economic growth is explained through an increase in GRDP without looking at whether this increase is higher or vice versa compared to the level of population growth, as well as whether there is a change in the economic structure. GRDP is considered the best measuring tool for assessing the functioning of the regional economy of each province in a country. Gross Regional Domestic Product can summarize economic activity in a single amount of money in a certain period (Atmojo, 2018). Economic development is an important topic for developed and developing countries seeking growth in production and consumption.

There are several benefits for countries wishing to improve economic development through investment in human development. The main benefit is improving the welfare of citizens. (Partanto, & Zulkarnaen, 2020).

A number of problems will arise if economic growth or GRDP grows slowly. The value of growth is a standard of prosperity and progress for a country. The problem with slow economic growth is that productivity growth slows down. If productivity is slower, it will be increasingly difficult for people's living standards to increase. Less even economic growth occurs in all regions due to unfavorable factors, only large cities provide maximum distribution of the country's economic growth. One of the factors in achieving increased social welfare is high economic growth. People's prosperity from an economic perspective can be seen through the country's national income level, one of which is looking at GDP growth or through the GRDP of each region in each province. Increasing GRDP is a very important goal that must be achieved through the process of economic growth (Nuritasari, 2013; Hapsari, 2011; Todaro & Smith, 2004; Mankiw, 2003; Jhingan, 2000; Todaro, 2000). Transportation has a relationship with economic productivity. Progress in transportation that follows developments will help increase the movement of production factors, human mobility, and the mobility of distributed production results. This assistance requires a number of factors, including public transportation, the availability of roads, as well as assistance from the government which can take the form of public facilities or government expenditure (Junaidi et al., 2020). The transportation sector has a big role in increasing economic growth because the transportation sector is a driver for various kinds of economic activities from different factors in the formation of national income, from production to distribution. Transportation has an important role not only in facilitating the passage of goods and the movement or mobility of people, but also as a means of transportation that helps realize maximum allocation of economic resources, so that production activities can be carried out efficiently and effectively, so that the economic gap between each region can be reduced to as low as possible (Setyowati, 2015). The growth of the transportation sector reflects direct economic improvement, meaning that transportation has a strategic and important role (Amin et al., 2017; Resmi, 2009; Rhardja & Manurung, 2002; Rompis & Wangkar, 2015; Rororong et al., 2010; Sabijono & Tungka, 2015).

In the era of globalization, the improvement of a region can be seen from the improvement of infrastructure as an important aspect in the pace of the regional or national development process. Infrastructure has an important role in driving economic growth. The increase in infrastructure and improvements carried out by the government hope to trigger greater economic growth. (Sumadiasa et al., 2016). There is infrastructure development that is growing slowly. The theory explained by Solow and Haspari reveals that roads have a good influence on economic growth. However, in the growth of infrastructure, there is an imbalance between the large amount of land transportation and the amount of long road infrastructure, which as transportation facilities and infrastructure experiences an imbalance which can slow down the accessibility and mobility of people in carrying out economic activities between regions, which makes economic growth only in large cities where the influence is maximal. From a macroeconomic perspective, regional potential is an important factor in improving the quality of national economic growth. The availability of infrastructure, especially roads, also influences the growth of a region's Gross Regional Domestic Product (GRDP), because the availability of road infrastructure can accelerate and facilitate economic mobility (Nasir & Sari, 2015; Atmadja, 2007; Iek, 2013; Rother, 2004; Samuelson & Nordhaus, 2004; Wijono, 2005).

Population growth is said to be able to encourage the pace of economic growth. Seeing the role of society in advancing economic growth. Firstly, from a demand perspective, people act as consumers. Second, from a supply perspective, society acts as a producer. A population that has a large population and the quality of human resources that are generally unproductive is at risk of slowing down the development process, which can be seen from the problem of the risk of the central government and local governments to provide various public services such as employment, environment, housing, education and health (Handayani et al., 2016). Indonesia's population always experiences a large increase. Effective human resources are the beginning of economic growth. This can happen if the

population in question is of productive age and has an income. The problem is that our population of productive age has no economic activity, low productivity and does not have a steady income. The increase in population is caused by cultural factors, not following government programs, namely family planning, and many of the population supports birth and it is not spread evenly. There are also other studies that discuss population numbers by (Afifah Ariyani, Fitri Yetti, 2018).

From the description above, the author created an idea that could help with this as the background for the research with the title "The Influence of Land Transportation, Road Infrastructure and Population on Gross Regional Domestic Product 2016-2020".

2. Literature Review

Robert Solow's Grand Theory in his theory of neo-classical economic growth concerns the influence of savings as capital, population as labor, and technology on output levels and economic growth. The higher the level of savings and infrastructure technology, the higher the capital and output produced. The view of this theory is that the role of technological advances in economic growth is very high. It could be said that the extent to which the economy will develop depends on population growth, capital accumulation and technological progress. Gross Domestic Product (GDP) There are a number of theories about economic growth, the first is Rostow's theory which reveals the stages a country takes to increase economic growth. A way to rapidly grow the economy by strengthening the country's national savings. This theory is strengthened by a theory by Harrod Domar which explains that the greater the amount of GDP saved will increase the capital stock which will increase economic growth. However, various studies show different results in each country. This means that there are various other factors that influence economic growth, for example the quality of human resources and other driving infrastructure (Akbar, 2018).

Transportation. The Solow-Swan theory considers the importance of capital as a major source of growth, capital is defined as applied knowledge and technology. The technology in question will trigger innovation, increase productivity and encourage stable economic growth. Economic activities and transportation are closely related where they influence each other (Mulya & Rizki, 2016). Infrastructure The Big Push Theory explains the need to build infrastructure, various factors that need and are helped by infrastructure will be able to develop (trickle down effect). There are a minimum number of resources that must be available if a development plan is to be successful. This theory explains that if work steps are carried out minimally or only a few, they cannot drive the economy through successful development, but the value of large infrastructure investments is the main way to advance the economy. It requires the achievement of external economies, originating from the joint establishment of technically interconnected industries (NSS et al., 2015).

Total population. Smith said population growth could increase economic growth. Increasing population will widen the market, widening the market will increase various types in the economy. As the economy improves, new amounts of physical capital are needed to keep the economy growing. This means that effective human resources are a necessary condition for economic growth (Adipuryanti & Sudibia, 2015).

The Relationship between Land Transportation and Gross Regional Domestic Product. Transportation has a very important role not only in facilitating the passage of goods and human movement, but also as a transportation service that helps realize the maximum allocation of economic resources, meaning that production activities are carried out effectively and efficiently so that economic disparities between regions can be reduced to a low level. Increasing per capita income and development growth are the targets of development, so the benefits of transportation for economic development and growth in development are very positive, so the benefits of transportation are considered as a sector supporting development as well as a sector providing transportation services

(Setyowait, 2015). The Relationship of Road Length to Gross Regional Domestic Product as one of the transport infrastructures, road infrastructure has a role in growing the economy because the availability of roads will reduce complementary capital so that production and distribution will be more effective. Poor and damaged road facilities can slow down the development of industry, delivery of production factors, allocation of resources, goods and services, which will affect income. In rural economic and agricultural development in general, road infrastructure is very necessary for the smooth running of production or marketing of produce (Nuritasari, 2013).

The Relationship between Population and Gross Regional Domestic Product. Population growth is considered to encourage economic growth. Solow-Swan estimates that countries with high population growth will have low levels of GDP per capita. The increase in population will enlarge the market and the size of the market will increase in the types of fields in the economy. Maximum allocation of human resources as capital for economic growth. After the economy improves, the accumulation of physical capital is needed to keep the economy continuing to grow. In this way, maximum allocation of human resources is a necessary condition for economic growth. The increasing population can trigger production activities, the consumption required from the population can create aggregate demand. There will come a time when increasing aggregate consumption levels will increase productive business opportunities, as will the economy as a whole (Dedek Hasanur, 2017).

3. Data and Methodology

Population

The population chosen for this research is Gross Regional Domestic Product, Land Transportation, Road Infrastructure, and Population in 31 Provinces in Indonesia.

Sample

In the sample research using panel data in 2016-2020 in 31 provinces in Indonesia, in other words the number of observations was 155.

Data Collection

Data collection techniques used *purposive sampling*. Research is carried out by conducting literature studies by collecting various information which is used as a reference or research guide through library studies, books, literature, websites and various research related to the problem being researched or other sources.

Data Analysis Techniques

The Multiple Linear Regression Model uses more than one independent variable. The analysis chosen is multiple regression because it has more than one variable. Multiple linear regression functions to find out how far the variables (X1, X2, and X3) are related and influenced by the variable (Y). So, in order to get clearer results, the researcher will use the Microsoft Excel 2010 application and the Eviews 10 software application. The equation method in this research uses double logarithms. The regression results will be converted into double logarithm using the natural logarithm (LN). The equation is converted into natural logarithm form so that it becomes:

$$\text{Log}Y_{it} = \beta_0 + \beta_1 \text{Log}X1_{it} + \beta_2 \text{Log}X2_{it} + \beta_3 \text{Log}X3_{it} + \varepsilon_{it} \quad (1)$$

In the equation, the dependent variable $\text{Log}Y_{it}$ represents Gross Regional Domestic Product (GRDP) in the form of natural logarithm, which is measured based on regional and time units (panel data). β_0 is a constant, while β_1 , β_2 , and β_3 are regression coefficients that measure the effect of each independent variable on GRDP. The variable $\text{Log}X1_{it}$ represents the natural logarithm of the transportation sector, $\text{Log}X2_{it}$ represents the logarithm of the length of road infrastructure, and $\text{Log}X3_{it}$ represents the logarithm of total population. Meanwhile, it is an error term that reflects the influence of other factors outside the model that cannot be explained explicitly.

4. Result and Discussion

Multiple Linear Regression Model

Table 1. Multiple Linear Regression Result
Source: Analysis, 2022

Variable	Coefficient	Std. Error	T-Statistic
C	-8,18657	2,350079	-3,48353***
LOGX1	-0,02284	0,019709	-1,15834
LOGX2	-0,05005	0,133545	-0,37477
LOGX3	2,470432	0,213036	11,59671***
R Square	0.998859		
Observation	155		

Notes: Significant at ***1%, **5%, *10%

Based on the table 1 above, the following conclusions are obtained:

- The constant value is -8.186569 which shows that if variable x is considered to have not experienced any changes or has a constant value, then the value of variable y has a value of -8.186569.
- The regression coefficient for Variable X1 is -0.022834, which means that every increase in
- The regression coefficient for Variable X2 is -0.050448, which means that every increase in
- The regression coefficient for Variable X3 is 2.470832, which means that every increase in

Classic Assumption Test Results

Normality Test

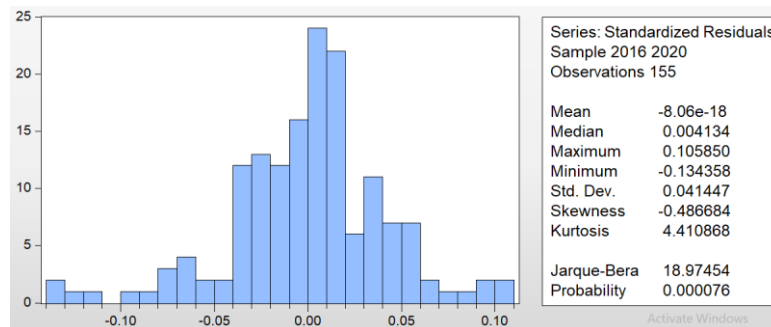


Figure 1. Normality Test Result

Source: Analysis, 2022

From figure 1 above, we can see that the residuals are not normally distributed, which means that the classical assumption of normality is not fulfilled because the Jarque-Bera value is greater than 2 and the probability is below 0.05.

Multicollinearity Test

Table 2. Multicollinearity Test Result
Source: Analysis, 2022

	LOGX1	LOGX2	LOGX3
LOGX1	1.000000	0.439954	0.861894
LOGX2	0.439954	1.000000	0.628881
LOGX3	0.861894	0.628881	1.000000

The table 2 above shows that in the regression model there is a multicollinearity problem because the VIF value is more than 0.8.

Autocorrelation Test

Table 3. Autocorrelation Test Result
Source: Analysis, 2022

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.186569	2.350078	-3.483530	0.0007
LOGX1	-0.022834	0.019709	-1.158541	0.2489
LOGX2	-0.050448	0.133554	-0.377736	0.7063
LOGX3	2.470832	0.213063	11.59671	0.0000
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.998659	Mean dependent var	12.03539	
Adjusted R-squared	0.998294	S.D. dependent var	1.131998	
S.E. of regression	0.046759	Akaike info criterion	-3.096546	
Sum squared resid	0.264555	Schwarz criterion	-2.428956	
Log likelihood	273.9823	Hannan-Quinn criter.	-2.825386	
F-statistic	2731.403	Durbin-Watson stat	1.017396	
Prob(F-statistic)	0.000000			

Because the Durbin-Watson stat value is in the Positive Autocorrelation area in table 3 above, namely $D-W < dL < dU < 4-dU$, namely $1.017396 < 1.2292 < 1.6500 < 2.3500$, it can be stated that there is autocorrelation interference in the regression.

Heteroscedasticity Test

Table 4. Heteroscedasticity Test Result
Source: Analysis, 2022

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-653198.2	588916.3	-1.109153	0.2696
LOGX1	3595.465	4939.074	0.727963	0.4680
LOGX2	25105.93	33468.00	0.750147	0.4546
LOGX3	43621.38	53392.44	0.816995	0.4155
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.701350	Mean dependent var	10392.79	
Adjusted R-squared	0.619900	S.D. dependent var	19005.86	
S.E. of regression	11717.53	Akaike info criterion	21.76664	
Sum squared resid	1.66E+10	Schwarz criterion	22.43423	
Log likelihood	-1652.914	Hannan-Quinn criter.	22.03780	
F-statistic	8.610820	Durbin-Watson stat	2.545998	
Prob(F-statistic)	0.000000			

Based on the table 4 above, the Chi-Square prob value is > 0.05 alpha level, therefore it can be concluded that there is no heteroscedasticity problem.

Linearity Test

Table 5. Linearity Test Result
Source: Analysis, 2022

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.186569	2.350078	-3.483530	0.0007
LOGX1	-0.022834	0.019709	-1.158541	0.2489
LOGX2	-0.050448	0.133554	-0.377736	0.7063
LOGX3	2.470832	0.213063	11.59671	0.0000
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.998659	Mean dependent var	12.03539	
Adjusted R-squared	0.998294	S.D. dependent var	1.131998	
S.E. of regression	0.046759	Akaike info criterion	-3.096546	
Sum squared resid	0.264555	Schwarz criterion	-2.428956	
Log likelihood	273.9823	Hannan-Quinn criter.	-2.825386	
F-statistic	2731.403	Durbin-Watson stat	1.017396	
Prob(F-statistic)	0.000000			

Based on the table 5 above, Prob F statistic < alpha level 0.05, it can be concluded that there is a problem with linearity and the regression model.

Hypothesis Testing

T-statistical test

Table 6. T-statistical Test Result

Source: Analysis, 2022

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.186569	2.350078	-3.483530	0.0007
LOGX1	-0.022834	0.019709	-1.158541	0.2489
LOGX2	-0.050448	0.133554	-0.377736	0.7063
LOGX3	2.470832	0.213063	11.59671	0.0000
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.998659	Mean dependent var	12.03539	
Adjusted R-squared	0.998294	S.D. dependent var	1.131998	
S.E. of regression	0.046759	Akaike info criterion	-3.096546	
Sum squared resid	0.264555	Schwarz criterion	-2.428956	
Log likelihood	273.9823	Hannan-Quinn criter.	-2.825386	
F-statistic	2731.403	Durbin-Watson stat	1.017396	
Prob(F-statistic)	0.000000			

Based on the table above, the following conclusions can be drawn:

- The variable Number of Land Transportation has a t-statistic probability of 0.2489. This value is > 0.05 so that the variable amount of transportation has an insignificant relationship with the GRDP variable.
- The Infrastructure variable (Road Length) has a t-statistic probability of 0.7063. This value is > 0.05 so that the infrastructure variable (road length) has an insignificant relationship with the GRDP variable.
- The Population Number variable has a t-statistical probability of 0.0000. This value is <0.05 so that the population variable has a significant relationship with the GRDP variable.

F Test (Simultaneous)

Based on the table above, you can see that the probability (f-statistic) is 0.00000. This value is <0.05 so it can be concluded that together the variables Number of Land Transportation, Infrastructure and Number of Population have a significant influence on the GRDP variable.

Coefficient of Determination R Squared

Based on the table above, it can be seen that the independent variable x continuously influences 99.86% while the remaining 0.14% is explained by other variables not included in this research.

The Influence of the Number of Transportation on Gross Regional Domestic Product in Indonesia

The variable amount of transportation obtained a t-statistical significance value of $0.2489 > 0.05$, meaning that the amount of transportation had a positive insignificant result. Transportation is needed to help activities in various other sectors to transport or carry people and goods in activities in each sector. Demand for transportation continues to increase because it is needed to meet various economic and development activities that continue to increase. The increasing demand for transportation originates from increasing economic activity from various sectors. So GRDP will increase, for example in agricultural or rural areas that produce agriculture where people can harvest their products through transportation which can distribute their results to be sent to various areas which increases their income. This is in accordance with Robert Solow's theory, this theory explains the relationship between GDP capital savings and technology, where the higher the level of capital, the technology needed to support the operation of that capital which will make the output produced greater. The results of this research are in accordance with research that has been conducted (Junaidi et al., 2020) explaining that the amount of transportation has a positive influence on economic growth. The increasing number of vehicles continues to increase every year, indicating the increasing need of society for transportation that meets the increasing movement of the population. The higher the mobility of the population, the greater the productivity, which can help people carry out economic activities that can increase their income, thereby increasing Gross Regional Domestic Product.

The Effect of Road Length on Gross Domestic Product in Indonesia

The Road Length variable obtained a t-statistical significance value of $0.7063 > 0.05$, which means that road length infrastructure has results that are not significantly positive. So if the length of the road increases, GRDP will increase but not significantly. This is in accordance with the Big Push Theory, this theory states that it is necessary to build infrastructure on a large scale, not half-heartedly, in order to get greater income later and improve other sectors in the surrounding area as well. To increase the value of Gross Regional Domestic Product (GRDP), the length of roads must be focused on being built in every region in Indonesia evenly, not just in big cities, so that they are interconnected and intertwined with the economy, thereby increasing the even growth of Gross Regional Domestic Product in Indonesia. For example, the completion of the construction of the Trans Java toll road can facilitate access to distribution of production from one region to another quickly. The results of this research are in accordance with research that has been conducted (Sumadisa et al., 2016) explaining that road length has a positive influence on economic growth. Road infrastructure is increasing every year as a sign of the increasing need for public demand for road infrastructure that connects regions so that regions can be connected to each other and can distribute each region's output to other places. The higher the regional output, the greater the community's income, which can help the community improve their welfare to meet their needs, which increases their income and welfare, thereby increasing GDP.

The Influence of Population on Gross Domestic Product in Indonesia

The Population Number variable obtained a t-statistic significance value of $0.000 < 0.05$, meaning that the population number had a significant positive result. So if the population increases, GRDP will increase significantly. So if the population increases, GRDP will increase, more population can trigger consumption, production from society can create aggregate demand. So there is demand, increasing aggregate consumption so that the possibility for productive businesses to grow, and also the economy as a whole. The influence of a large population on the economy depends on the society itself. If a large population of productive age is accompanied by high productivity, it will trigger an increase in the income received by the population and increased economic growth, however, if a large population is not balanced with productive economic activity, it can cause slow economic growth. The results of this research are in accordance with research by (Rukmana, 2012) explaining that population has a positive influence on economic growth. This means that increasing the population can accelerate economic growth provided that the people must have a steady income and carry out productive activities. The

higher the community's income and productivity in economic activities, the greater the community's income, which can increase Gross Regional Domestic Product.

5. Conclusion

- a. Partially, the variable that has an influence is the Population, while the Number of Land Transportation and Road Length Infrastructure have no effect.
- b. Simultaneously, all independent variables simultaneously influence the dependent variable in this research.

Suggestion

1. The government should create a policy that can help make it easier for people to optimize economic activities or productivity so that the output produced can be distributed evenly in national and international markets, thereby increasing gross domestic product growth.
2. The government should carry out development in sectors that help community activities in carrying out economic activities, such as transportation, infrastructure and increasing human resources by improving public facilities used by the community and conducting outreach that can improve community capabilities.

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