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# The Role of Railway Infrastructure Development on the Regional Economic Growth

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**Abstract:** This paper aims to investigate the impact of railway infrastructure development on the Indonesia national economy. The data used in this study are Gross Regional Domestic Product (GRDP), Railway Assets, Government Budget for Railway, Employee Cost, Consumer Price Index, and Railway Income. The data collected from 10 provinces in Java and Sumatera from 2000 to 2015. Panel data was processed using E-Views 9.0 software. The results of econometric analysis indicate a positive relationship among each variable, development budget, railway assets, railway income and employee cost and Gross Regional Domestic Product which represents the regional and national economy. An increase in railway development budget and railway assets in Java will result in a bigger GRDP compared to Sumatera because there are relatively more railway assets, thereby increasing passenger and freight transportation services. From these analyses can be suggested policy implementation by prioritizing the development of railway infrastructure to increase GRDP. The development of railway infrastructure in the island of Sumatera is expected to further increase GRDP.

**Keywords**: Asset, Economic Growth, Government Budget, Gross Regional Domestic Product, Income

## 1. Introduction

Transportation is a basic need for people to mobilize people and goods, with a scale that are regional, national, or international. Transport modes include road, rail, river and lake, sea and air transportation. Indonesia as an archipelagic country, the role of transportation is very important to connect all regions of the country. Indonesia is a country in a cross position between two continents and two oceans, transportation has a strategic position in providing support for political, economic, social and cultural aspects.

In the political aspect, transportation is directed to become a unifying vehicle of the nation within the Republic of Indonesia as well as supporting the activities of central and local government. In the field of Economy, transportation serves as the main supporter of goods and services distribution activities in order to realize economic stability, minimize disparity among regions and increase competitiveness, especially for industrial activities, trade and investment. In the social aspect, transportation can play a role to provide mobility support and community accessibility in social interaction activities, strengthening relationships and facilitating the community especially in remote and rural areas. In a cultural perspective, transportation is directed to provide accessibility support in the tourism sector, cultural and religious activities. In the economic system, transportation is referred to as derived demand, meaning transportation is necessary because of

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other activities. Transportation needs will increase with increasing economic activity and decrease in case of economic downturn.

The economic benefits of transport infrastructure investment are long-term competitiveness, productivity, innovation, lower production prices, and higher revenues. Investment in transport infrastructure also creates thousands of jobs in the near future. A well performing transport network opens up employment, enabling businesses to grow and lower down the price of home appliances. This will make the entrepreneurs to manage the stock of goods well and efficiently. Transportation makes it easy for suppliers to market their products, making it more cost-effective for industry to keep their production going.

Based on the World Bank survey, in 2016, Indonesia's national logistics costs amounted to 25% of Gross Domestic Product (GDP). This level is practically high compared to other countries. For example South Korea has a figure of 16.3%, Malaysia 15%, Japan 10.6% and the United States has 9.9%. In the 2015 - 2019 National Medium-Term Development Plan (RPJMN), it is targeted that logistics costs of Indonesia will decrease to 16% level in 2019. To be able to reach the 16% level , the first thing to do is to know what happened to the Indonesian logistics system.

One of the way to find the problems in the Indonesian logistics system is to compare Indonesia's logistics performance with the logistics performance of other countries. According to The World Bank report on the 2018 Global Logistic Performance Index (LPI), shows that Indonesia's LPI is ranked 46 in the world from 160 countries. Among ASEAN countries, Singapore (ranked 7), Thailand (32), Vietnam (39), Malaysia (41), Philippines (60), Laos (82), Cambodia (98), and Myanmar (137). In addition, it also shows that the performance of transportation infrastructure in Indonesia is still low, which results in high logistics costs. For this reason, efforts are needed to reduce logistics costs which are expected to increase Indonesia's competitiveness in the global economy as a result of a market that will be increasingly open. Low logistics costs will provide added value for national products in terms of cost or quality. One effort to reduce logistics costs can be done through increasing the efficiency of the national transportation system.

Transportation in Indonesia includes road, rail, ferry, sea and air transportation serving passenger and goods transportation, both between islands, regional and urban transportation. Most of the railway networks in Indonesia are currently relics of the era of the Dutch Government, and desperately need special and intensive handling as a result of technological and other changes. One of the real consequences of the lagging of Indonesian railway technology is that the advantages of railway modes have not been optimized. This can be seen from the still low share of rail transport, as in Table 1 below.

**Table 1 - Contribution of transportation sector in the total output in 2015**

| No. | Transport Modes | GDP (Rp. Billion) | % GDP | Share of modes Transportation (%) |
|---|---|---|---|---|
| 1. | Road transport | 193,257 | 2.22 | 55.41 |
| 2. | Rail transport | 2,950 | 0.03 | 0.84 |
| 3. | River, Lake and Ferries | 10,222 | 0.12 | 2.93 |
| 4. | Sea transport | 30,173 | 0.35 | 8.65 |
| 5. | Air transport | 57,185 | 0.66 | 16.40 |
| 6. | Warehouse and support | 54,983 | 0.63 | 15.77 |
| 7. | Transportation | 348,770 | 4.01 | 100.00 |
| 8. | Gross Domestic Product (GDP) | 8,695,000 | 100.00 | |

As shown in Table 1 above, the contribution of the transportation sector in the formation of Gross Domestic Product (GDP) is 4.01%, while the railway transportation 0.03%. For the share of transportation mode, road transport dominated by 55.41%, while rail transport was by 0.84%. Despite the fact the value of the contribution of railway transportation sector is low enough, the development of railway in Indonesia shows a significant growth as in fig.1.

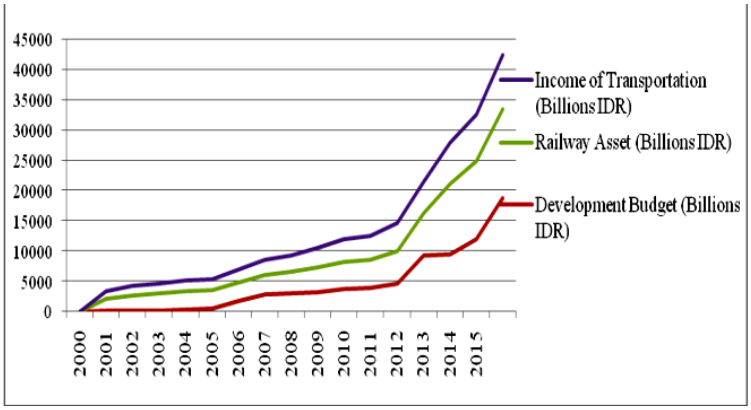


**Fig. 1** : **Graphics of the increment of development budget, railway asset, and income**

Railway transport has certain characteristics and advantages, especially in its ability to transport both passengers and goods in bulk, energy saving, space-saving, high safety, low pollution (more environmentally friendly) and more efficient than road transport. The railway system is a mass transportation that can be used for the transportation of passengers and goods in large quantities so that it's more efficient than the road transport. For urban transport, transportation costs have a significant contribution to economic activity, for example in Jabodetabek area, rail transportation gives a very real role. The number of Jabodetabek commuter train passengers in November 2017, averaging 1.1 million passengers a day (PT. KAI, 2017).

In the period of 2006 to 2016, the average annual growth of passenger transportation is 9%, while the average annual growth of freight transport is 8% (PT. KAI, 2016). In essence, the focus of government policy in the field of freight and passenger transportation is to optimize the role of each mode of transportation in an effort to minimize costs and externalities. The policy is carried out through the integration of a number of modes of transportation in accordance with their respective comparative advantages.

Rail transportation has certain characteristics and advantages, especially in its ability to transport both passengers and goods in bulk, saving energy, saving space use, having high safety factors, low pollution levels or being more environmentally friendly and more efficient than road transportation. The advantages and characteristics of the railway need to be utilized in an effort to develop an integrated transportation system. Therefore, the implementation which starts from planning, construction, business, maintenance, inspection and testing, and its operation needs to be managed as well as possible to be able to improve the provision of rail transportation services for the mobility of people and goods safely, comfortably, quickly, precisely, regularly at a cost affordable to the community. By using railroad transportation that has a large carrying capacity will be able to reduce road density so that it can reduce congestion, accidents, road damage and air pollution due to motor vehicle exhaust gases.

Efforts to develop railway infrastructure networks are issue that oftenly raised by local governments. Islands that have not been developed with a railroad network feel the need for the existence of a railway mode especially for transporting goods to the nearest sea port. In urban areas there is also a desire to revitalize railway transportation modes, given the increasingly congested roads due to the increasing use of private cars. Plans for connecting and developing a broken railway network on the island of Sumatera, the construction of the Trans Sulawesi, Trans Kalimantan and Trans Papua railroad networks, are also big hopes for the local government. These thoughts and plans need to be continued to the implementation stage by more carefully formulating the role of the central government, regional government and development entities in dividing the risk of returning investment during the period of construction and operation. To increase the role of the railway in the future, there are still many things that need to be addressed, including related to the integration of modes, regulatory principles, ease of investment and institutions, technology selection, etc. All of which can encourage the creation of multi-operator railways in accordance with Law Number 23 of 2007 concerning Railways.

This journal aims to investigate the role of rail transportation and four other transportation sectors in Indonesian economy for period 2000 – 2015 using econometric analysis to provide policymakers with a basic picture of the role of rail transportation sector compared with other sectors.

## 2. Literature Review

A study finds empirical evidence of the importance of developing transport infrastructure in accelerating productivity and economic development, particularly for African countries (Seetanah Boopen, 2009). In line with that (Akanbi Bosede, et al, 2013) found that transportation infrastructure has a statistically significant and positive relationship with economic growth in Nigeria. This means that improving the transport infrastructure will boost economic growth.

Rong-Her Chu and Yu-Chang Lin, (2012) concluded that the relationship of the transport industry in Taiwan is stronger in absorbing related industrial products than the products used as inputs in other industries. Road, rail and air transport have a strong ability to attract other industries. The effects of the transport sector triggered production high enough and increased from 2.80% in 1991 to 19.41% in 2006. The highest effect was road transport whereas the lowest was water transport, but water transport had the highest effect on job creation, followed by the air transport and warehousing sectors.

Transport infrastructure investment in economic development is important as a means to facilitate the mobility of goods and services that facilitate the relationship between remote and growth centers. Smooth flow of goods and services will stimulate economic activity resulting in an increase in household income (Glen Weisbrod, 2009). Increased production activities in the transportation sector affect the activities in other sectors, so as to provide an increase in the economy of the community. The effectiveness of investment in transport infrastructure to improve the economy and provide benefits to the community depends on the utilization of transportation facilities by producers and consumers as well as the leading sectors.

Jin Wang, Michael B, and Charles, (2006) studied that the rail and water transport sectors resulted in a significant change in sectoral prices in the energy resources sector. This reflects the high dependence of these sectors on the rail and water transport sectors.

Hideo Fukushi (2010) studied in Thailand resulted that there is a growing phenomenon of transportation costs of road transport. This phenomenon leads to shifting modes of transportation from road to other modes. The mode of rail transport is considered as one of the solutions to the problem. The development of rail transport modes and water transport has great potential to boost Thailand's economy through reduced logistics costs.

Ina Drejer (2002) has conducted a research of the characteristics of different attempts to operate the Hirschman original concept in relations with forward and backward with an inception of Rasmussen Dispersion Index and shift into

what is called the interrelated measurement of Hirschman-Rasmussen. Empirical analysis employed with input-output Denmark data of the periods of 1966 to 1992 demonstrates a high stability rate from time to time from the individual interrelatedness, yet the key to the industry “power” becomes weak.

Ramirez and Esfahani (2002) conducted a study on the relationship between infrastructure and economic growth in some developing countries of which Latin America, East Asia, South Asia, and more. In this study developed a model that shows the economic production opportunities represented by the aggregate output, with several factors such as labor, infrastructure assets, non-infrastructure capital, and other factors that influence.

Atack et. al (2009) conducted a study of the impact of railways on economic growth in the Midwest of America from 1850 to 1860. At that study Atack made the percentage of urbanization and population growth rate as an indicator of economic growth. In this study, the data used is divided into two groups namely "treatment group" and "control group". Testing of data was first performed by looking at changes in urbanization and logarithmic percentage of the growth rate of 1850 that railways services have not been available to the year 1860 where railway services have begun to be used. In addition, there is also a search for linear probability regression with both factors and given the addition of factors resulting from agricultural activities. Furthermore, there is also a regression of linear probability with one of the controlled variables. The last step is to do a first phase regression cross section to predict the treatment and regression phase two to determine the value of treatment. The result of this research is that railway services have a significant impact on the growth of urbanization but less influence on the rate of population growth. The existence of these rail services increases the fraction of the urban population from 3 to 4 percent.

Herranz - Loncan (2011) has examined the contribution of rail transport to economic growth in Latin America covering the countries of Argentina, Brazil, Mexico and Uruguay. The influence of railway transportation on the economic growth of each country is different, for example in Uruguay the influence is very small compared to other countries including European countries namely England and Spain. The low influence of railways in Uruguay is due to the geographic factors and economic structure of the country.

Bogart and Chaudhary (2013) conducted research on the contribution of rail transport to the Indian economy. From the results of his research, rail transport with a wide network in India is very instrumental for passenger and goods transportation including raw material transportation and the production of factories in India.

Apanisile and Akinlo (2013) conducted research on the relationship between railway construction and economic growth in Nigeria in 1911 - 2011. From the results of his research there appears to be a positive relationship between investment in the rail sector with economic growth in Nigeria. Other research results show that in Nigeria there is a strong relationship between GDP, Capital, State Investment, rail transport production and inflation. Furthermore, to obtain a mathematical equation derived from the Solow growth model:

$$Y_t = A_t K_t^{\alpha} H_t^{\beta} L_t^{1-\alpha-\beta} \quad \text{..... (1)}$$

in intensive model :

$$y_t = A K_t^{\alpha} h_t^{\beta} \quad \text{..... (2)}$$

$$\ln y_t = \ln A_t + \propto \ln k_t + \beta \ln h_t \quad \text{..... (3)}$$

In order to introduce the infrastructure components, Ijaiya and Akanbi (2009) and Esfahani and Ramirez (2003) stated that human capital capital is decomposed as follows:

$$\ln h_t = \ln GE_t + \ln RA_t + \ln INF_t \quad \text{..... (4)}$$

with substitute equation 3 to equation 4 :

$$\ln y_t = \gamma_1 + \gamma_2 \ln k_t + \gamma_3 \ln GE_t + \gamma_4 \ln RA_t + \gamma_5 \ln INF_t + \varepsilon_t \quad \text{..... (5)}$$

Economic change is stated in :

$$\Delta y_t = f(\Delta k_t, \Delta h_t) \quad \text{..... (6)}$$

$$\Delta \ln y_t = \gamma_1 + \gamma_2 \Delta \ln k_t + \gamma_3 \Delta \ln GE_t + \gamma_4 \Delta \ln RA_t + \gamma_5 \Delta \ln INF_t + \varepsilon_t \quad \text{..... (7)}$$

where :

$y_t$ = GDP

$INF_t$= Inflation

$k_t$ = Capital

$RA_t$= Rail Output

$GE_t$ = Government Budget on Railway

$\varepsilon_t$ = Error.

Banerjee, Duflo and Qian (2010) examined the effect of transportation network access to the local economy in China during the years 1986-2003. The results showed a positive relationship between the transport network with a growth rate of GDP per capita. The results of William E. James and Natsuki Fujita (2000) suggest that manufacturing exports have responded positively to trade reforms in Indonesia during the study period (1985-1995). Manufacturing exports, in turn, have generated additional employment both directly and indirectly through inter-industry linkages. Furthermore, it is estimated that the employment effects of manufacturing exports in two sub-periods, 1985-90 and 1990-95, using an input-output table (I-O) in 1995.

Abhijit Banerjee, Esther Duflo and Nancy Qian (2010) in their study estimated the effect of access to transport networks on regional economic outcomes in China over twenty periods of rapid revenue growth. The research also addresses the problem of endogenous network placement by utilizing the fact that this network tends to connect historic cities. The results show that proximity to transport networks has moderate positive causal effects on per capita GDP levels across sectors, but has no effect on per capita GDP growth.

Gohar Badalyan, Thomas Herzfeld and Miroslava Rajcaniova (2014), stated that providing efficient, reliable, and affordable infrastructure is critical to economic growth, transport infrastructure in particular, vital to regional prosperity. To know the relationship and causality direction between transportation infrastructure, investment in infrastructure and economic growth, cointegration panel analysis and panel causality analysis for three countries of Armenia, Turkey and Georgia were used. Data used in the annual data of Armenia, Turkey and Georgia for the period 1982-2010. From the analysis results proved the existence of more than one vector cointegration which indicates that the system under study is in more than one direction. The results show that the formation of gross capital and transported goods has a statistically significant and statistically significant impact on economic growth in the short term. Overall, there is a two-way causality between economic growth and infrastructure investment, and between road and rail passengers brought in and infrastructure investments shown both in the short and long term.

## 3. Research Methodology

This journal used econometrics to analyze panel data. Econometrics is the application of statistical methods to economic data in order to give empirical content to economic relationships. A basic tool for econometrics is the multiple liniar regression model. Econometrics theory uses statistical theory and mathematical statistics to evaluate and develop econometric methods.

The model used to see the effect of the independent variable with the dependent variable is the regression model. The regression model made will adopts existing models in previous studies. For the analysis of growth model (econometric analysis) the panel data of each variable from 2000 to 2015 is processed using Eviews 9. One of the journals that discuss about the research of the influence of rail transport to the national economic development is a journal written by Apanisile Olumuyiwa Tolulope and Akinlo Taiwo which entitled "Rail Transport and Economic Growth in Nigeria (1970-2011)".

Based on the above research, further adjustments were made to enable the model to describe the situation in Indonesia in a good way. The independent variables affecting the model developed by Akinlo are capital, government spending on rail lines, rail transport output and inflation. The modification made to the growth model is using asset variables, development budget, employee costs and income PT. Kereta Api Indonesia (Indonesia Railway Company).

In the modified growth model, the capital variable is represented by railway assets obtained from the Ministry of Transportation and PT. Kereta Api Indonesia, while the variable of government expenditure is represented by the railway development budget which is also obtained from the Ministry of Transportation and PT. Kereta Api Indonesia. In addition, production (output) is represented by the income of the dependent variable represented by the Gross Regional Domestic Product of the transport sector for provinces in Java and the provinces of North Sumatra, West Sumatra, South Sumatera and Lampung obtained from the Central Bureau of Statistics.

Data processing for growth uses data from 2000 to 2015 and is concentrated in the islands of Java and Sumatera, since railway lines are only available on the islands of Java and Sumatera. For Sumatera, only North Sumatera, West Sumatera, South Sumatera and Lampung provinces are panel data per province. Panel data is used because it is a combination of time series and cross section data.

The growth model as follows :

$$\ln GRDP_{ti} = C_1 + C_2 \ln Asset_{ti} + C_3 \ln Budget_{ti} + C_4 \ln CPI_{ti} + C_5 \ln EC_{ti} + C_6 \ln Income_{ti} + \varepsilon_t \quad \text{..... (8)}$$

where :

$GRDP_{ti}$ = Gross Regional Domestic Product
$Asset_{ti}$ = Railway Asset
$Budget_{ti}$ = Railway Government Budget
$CPI_{ti}$ = Province Consumer Price Index
$EC_{ti}$ = Employee Cost of PT. KAI
$Income_{ti}$ = Passenger and Cargo Income
$\varepsilon_t$ = Error
t = time(year)
I = Province (1,2, ..., n).

## 3.1. Estimated Panel Data Regression Model

Panel data equation model which is a combination of cross section data and time series data is as follows:

$Y_{it} = \alpha + \beta_1 X_{1it} + \beta_2 X_{2it} + \ldots + \beta_n X_{nit} + e_{it}$ .....(9)

where:

$Y_{it}$ = dependent variable
$X_{it}$ = independent variables
$i$ = entity -$i$
$t$ = period -$t$

The above equation is a multiple linear regression model of several independent variables and one dependent variable. The estimation of multiple linear regression models aims to predict the parameters of the regression model, namely the value of the constant (α) and the regression coefficient (βi). Constants commonly referred to as intercepts and regression coefficients are commonly called slopes. Panel data regression has the same goal with multiple linear regression, which predicts the value of intercept and slope.

In general, using panel data can produce intercepts and different coefficient slopes for each time period. To estimate the parameters of the model with the data panel there are several techniques:

## 4. Result of the Study

## 4.1. Estimated Panel Data Model

The estimation of panel data model is carried out in 3 types of models, namely Common Effect Model, Fixed Effect Model and Random Effect Model. For the selection of the best model among the three models, Chow Test and Hausman Test were carried out. Chow test is taken to choose the best model between the Common Effect models and the Fixed Effect models, with the hypothesis :

$H_0$: Common Effect (CE) model is better than Fixed Effect (FE) model
$H_1$: Fixed Effect (FE) model is better than Common effect (CE) model

If the probability value is greater than 5% then $H_0$ is accepted and $H_1$ is rejected, meaning the Common Effect model is better than Fixed Effect. But if the probability value is less than 5% then $H_0$ is rejected and $H_1$ is accepted, meaning the Fixed Effect model is better than the Common Effect model. From the results of the Chow test, it was found that the probability of a small value of 5% which is 0.00 means that the Fixed Effect model is better than the Common Effect model, or $H_0$ is rejected. Then the Hausman test is done, to choose between the Random Effect and Fixed Effect models. The hypothesis:

$H_0$: Random Effect (RE) model is better than Fixed Effect (FE) model
$H_1$: Fixed Effect (FE) model is better than Random Effect (RE) model

If the probability value is greater than 5% then $H_0$ is accepted and $H_1$ is rejected, meaning the Random Effect model is better than Fixed Effect. But if the probability value is less than 5% then $H_0$ is rejected and $H_1$ is accepted, it means that the Fixed Effect model is better than the Random Effect model. From the results of the Chow test, it was found that the probability of a small value of 5% which is 0.00 means that the Fixed Effect model is better than the Random Effect model, or $H_0$ is rejected and $H_1$ is accepted.

**1. Multicollinearity test**

Multicollinearity test was conducted to test whether there was inter correlation or collaborationism between independent variables. It can be seen that there is a strong correlation with the variables Ln (Assets) and Ln (Income), while the other variables are not strong correlations.

**2. Normality test**

Normality test aims to test whether in the regression model, residuals are normally distributed. A good regression model is a model that has a normally distributed residual. The method of testing is to look at the probability value of Jarque-Bera (JB). If the value is greater than 5%, the residual is normally distributed. The results of the normality test are found and can be seen that the JB value is greater than 5% so it is concluded that the regression model is feasible to predict GDP.

**3. Autocorrelation test**

Autocorrelation test is used to test whether or not there is a correlation between residuals in an observation with other observations in the regression model. The autocorrelation test used in this study is the Breusch-Godfrey Serial Correlation Langrange Multiplier test with the hypothesis:

$H_0$: there are no autocorrelation problems (probability> 5%)

$H_1$: there are autocorrelation problems (probability <5%)

From regression result with fixed effect model still has autocorrelation problem because Durbin-Watson value is 0,379413. One way to overcome the problem of autocorrelation problems can be done with the method EGLS (Estimated Generalized Least Square).

There is an increase in the Durbin Watson coefficient value to 1.508077. Although the DW value has increased, but still in the region of doubt, for that need to use another model for the problem of autocorrelation can be overcome. In this research, Error Correction Model (ECM) has been done. However, the regression obtained through ECM gives a low significance value and there are variables whose coefficient value is minus, although the DW value is obtained above 2. So the authors conclude the best model of this research is by EGLS method, DW value is in hesitant region because the data in this study is a combination of cross section and times series data so that autocorrelation test should not be done.

**Table 2 - EGLS Regression Output**

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 9.589601 | 0.147000 | 65.23548 | 0.0000 |
| Ln(Budget) | 0.002783 | 0.004116 | 0.676090 | 0.5007 |
| Ln(Asset) | 0.036560 | 0.013481 | 2.712008 | 0.0080 |
| Ln(Employee Cost) | 0.006241 | 0.016827 | 0.370894 | 0.7116 |
| Ln(CPI) | 0.671517 | 0.042541 | 15.78507 | 0.0000 |
| Ln(Income) | 0.016635 | 0.011106 | 1.497859 | 0.1376 |
| AR(1) | 0.709645 | 0.052505 | 13.51586 | 0.0000 |
| *Fixed Effects* (Cross) | | | | |
| West Jawa—C | 0.580363 | | | |
| Jaka-Ban—C | 0.887859 | | | |
| Central Jawa—C | 0.233628 | | | |
| East Jawa—C | 0.620266 | | | |
| South Sumatera—C | -0.472092 | | | |
| West Sumatera—C | -1.468972 | | | |
| North Sumatera—C | -0.381051 | | | |

| Weighted Statistics | | | |
|---|---|---|---|
| R-squared | 0.999332 | Mean dependent var | 13.44472 |
| Adjusted R-squared | 0.999245 | S.D.dependent var | 2.385599 |
| S.E. of regression | 0.022599 | Sum squared resid | 0.046988 |
| F-statistic | 11464.66 | Durbin-Watson stat | 1.508077 |
| Prob(F-statistic) | 0.000000 | | |

| Unweighted Statistics | | | |
|---|---|---|---|
| R-squared | 0.999378 | Mean dependent var | 13.04435 |
| Sum squared resid | 0.047420 | Durbin-Watson stat | 1.485408 |

Furthermore, the feasibility test of the model can be summarized as follows:

1. In F test,prob score F count <5%, it means the model is feasible to use.
2. In t test, the value of prob t arithmetic each variable is <5% means free variable significantly influence on the dependent variable. Only variable cost of employees whose value is above 5% means that the effect is not so significant to the GRDP.
3) On Determination test, seen from adjusted value R2 = 99,99% means that the four variables give influence of 99.99% to the dependent variable.

From the econometric analysis, it is found that the biggest influence on GRDP in the railway sector is CPI and Asset. CPI, of course, gives effect to GRDP in any sector. The influence of the number of railway assets is very influential to the increase of GRDP, because Asset is a supporting activity of a sector. By increasing the number of sets in the railway sector it gives a significant increase to the increase in the national economy which is marked by the increasing value of GRDP. Increased Assets are carried out through the construction of railway infrastructure (railways, stations and operating facilities) and the provision of railway facilities (locomotives, passenger coaches and freight wagon).

For provincial constants stated that for the provinces in Java with constant positive constants means the addition of development budget and railway assets resulted in larger increases in GRDP. For the provinces of Sumatra Island with negative constant constants, the addition of development budget and railway assets resulted in a smaller increase of GRDP.

## 5 Conclusions

On a regional scale, it is simulated that if carried out the development in the railway sub-sector will have the following effects:

(1) There is a positive correlation between development budget, railway assets, income, employee cost and CPI to GRDP.

(2) An increase in the development budget and train assets in Java will result in a bigger GRDP compared to Sumatera because there are relatively more train assets, thereby increasing passenger and freight transportation services

From these analyses can be suggested policy implementation by prioritizing the development of railway infrastructure to increase GRDP. The development of railway infrastructure in the islands of Sumatera is expected to further increase GRDP.

## Appendix

**1. Fixed coefficients between time and individuals (Common Effect)**

Common Effect model is the simplest panel data approach, this model does not pay attention to individual dimensions or time so it is assumed that behavior between individuals is the same in various time periods. This model combines time series data and cross section in the form of a pool, estimating it using the least squares approach, Ordinary Least Square (OLS).

**2. Fixed effects model (fixed effects)**

The Fixed Effects model assumes that there are different effects between individuals. This difference can be accommodated through differences in the intercepts. In this model each parameter is unknown and will be estimated using the dummy variable technique.

**3. Random effect model (random effect)**

In the Random Effect Model it is assumed that differences between individuals are accommodated through random errors and do not correlate with observed variables.

**4. Selection of panel regression model**

For estimating panel data regression steps are needed for testing as follows :

**a. Chow test**

The Chow test is done to choose whether the Common Effect or Fixed Effect approaches are better used for panel data regression. The hypothesis in the Chow test is as follows:

$H_0$: Common Effect model

$H_1$: Fixed Effect model

If in the Chow test the F-statistic value > F table or probability <significance level, then Ho is rejected and the Fixed Effect model is good to use, but if the Chow test results show F-statistics > F table or probability> significance level, Ho is accepted and The common effect model is the one that should be used.

**b. Langrange multiplier test**

The Langrange multiplier test is used to find out whether the Random Effect model or Common Effect model is the most appropriate to use in the analysis. The Langrange Multiplier (LM) test is based on the distribution of chi-squares with a degree of freedom equal to the number of independent variables. If the statistical LM value is greater than the critical value of chi-squares, we reject the null hypothesis, which means that the right estimate for the panel data regression model is the Random Effect method rather than the Common Effect method. Conversely, if the statistical LM value is smaller than the value of the chi-squares statistic as a critical value, then the null hypothesis can be accepted which means that the estimation used in panel data regression is the Common Effect method.

**c. Hausman test**

The Hausman test is used to choose between the Fixed Effect model or the Random Effect model. The Hausman test compares the Hausman statistical value with the Chi-squares distribution table value with the degree of freedom of a number of independent variables. If Hausman statistic value > Chi-squares and probability value <(critical value), then $H_0$ is rejected and Fixed Effect Model approach is chosen, whereas if Hausman statistical value < Chi-squares probability value > (critical value), then $H_0$ is accepted and approach Random Effect Model selected. The Hausman test statistic follows the Chi-squares statistical distribution with the degree of freedom as many variables.

**d. Classic assumption test**

Before analyzing the data, a classic assumption test is needed on available data. If there is a classic assumption deviation, it can use non parametric statistical testing. Parametric statistics are used to test data if variable data is free from multicollinearity, autocorrelation, and heteroscedasticity and data must be normally distributed.

**e. Normality test**

The normality test has the purpose of testing whether the regression model has a normal distribution or not. In addition, the normality test can be able to use the results of testing t and F statistics, because it assumes the residual value follows a normal distribution. There are several methods to determine the normal or not residual distribution, including Jarque-Bera (J-B) test and graph method.

**f. Multicollinearity test**

Multicollinearity test aims to test whether the regression model found a relationship between independent variables. A good regression model should not have a correlation between the independent variables. If there is multicollinearity in the

model, the estimator is still the Best Linear Unbiased Estimator (BLUE), but the estimator has a large variance and covariance so that the exact estimation is difficult.

**g. Heteroscedasticity Test**

Heteroscedasticity test aims to test whether the regression model has a variable that is not constant or heteroscedasticity. Symptoms of heteroscedasticity are more common in cross-section data. Variant variables that are not constant or occur heteroscedasticity problems arise due to the residuals on the independent variables in the model. In testing heteroscedasticity can use the Park test to determine the presence or absence of symptoms of heteroscedasticity in the regression model and in the form of natural logarithms. The Park Test in principle regresses residuals that are squared with independent variables on the model. If the t-statistic < t table or probability t statistic > significance level there is no symptom of heteroscedasticity and if on the contrary it contains the problem of heteroscedasticity.

**h. Autocorrelation Test**

Autocorrelation test is used to find out whether in a linear regression model there is a correlation between one observation variable and another observation or known as autocorrelation. Autocorrelation arises because sequential observations are interrelated. This problem arises because residuals are not free from one observation to another. This is often found in time-series data which shows the similarity of up and down movements. Testing using Durbin Watson is a test to see the symptoms of autocorrelation.

## 5. Feasibility test panel data regression model

**a. Test the hypothesis**

Hypothesis testing is useful to test the significance of the regression coefficient obtained, meaning that the regression coefficient obtained statistically is not equal to zero, because if it is equal to zero, it can be said that there is not enough evidence to declare the independent variable has an influence on the dependent variable. For these purposes, all regression coefficients must be tested. Hypothesis testing of regression coefficients that can be done, namely:

**(1) F-test**

The F-test is intended to test the regression hypothesis coefficient (slope) simultaneously, in other words it is used to ensure that the chosen model is feasible or not to interpret the influence of the independent variable on the dependent variable.

**(2) t-test**

The t-test is used to test the regression coefficients individually. Tests carried out on the population regression coefficient, is equal to zero, which means that the independent variable does not have a significant influence on the dependent variable, or not equal to zero, which means that the independent variable has a significant influence on the dependent variable.

**b. Coefficient of Determination**

The Coefficient of Determination is denoted by R-squares which is an important measure in regression, because it can inform whether or not the estimated regression model is good or not. The value of the coefficient of determination reflects how much variation in the dependent variable can be explained by the independent variable. If the value of the coefficient of determination is equal to 0, it means that the variation of the dependent variable cannot be explained by the independent variables at all. If the value of the coefficient of determination is equal to 1, it means that the variation of the dependent variable as a whole can be explained by the independent variables. Thus the good or bad of a regression equation is determined by its R-squares which have a value between zero and one.

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